Coth

Notations

Traditional name

Hyperbolic cotangent

Traditional notation

$\coth(z)$

Mathematica StandardForm notation

`Coth[z]`

Primary definition

01.22.02.0001.01

$$\coth(z) = \frac{\cosh(z)}{\sinh(z)} = \frac{e^z + e^{-z}}{e^z - e^{-z}}$$

Specific values

Specialized values

01.22.03.0001.01

$$\coth(\pi\, i\, m) = \tilde{\infty} \;/;\; m \in \mathbb{Z}$$

01.22.03.0002.01

$$\coth\left(\pi\, i\left(\frac{1}{2} + m\right)\right) = 0 \;/;\; m \in \mathbb{Z}$$

Values at fixed points

01.22.03.0003.01

$$\coth(0) = \tilde{\infty}$$

01.22.03.0004.01

$$\coth\left(\frac{\pi\, i}{12}\right) = -i\left(2 + \sqrt{3}\right)$$

01.22.03.0005.01

$$\coth\left(\frac{\pi\, i}{12}\right) = \left(z;\, z^4 + 14\, z^2 + 1\right)_1^{-1}$$

01.22.03.0006.01

$$\coth\left(\frac{\pi i}{10}\right) == -i\sqrt{5+2\sqrt{5}}$$

01.22.03.0007.01

$$\coth\left(\frac{\pi i}{10}\right) == \left(z;\, z^4+10\,z^2+5\right)_1^{-1}$$

01.22.03.0008.01

$$\coth\left(\frac{\pi i}{9}\right) == -\frac{\left(-1-i\sqrt{3}\right)^{4/3}+\left(-1+i\sqrt{3}\right)^{4/3}}{-\left(-1-i\sqrt{3}\right)^{4/3}+\left(-1+i\sqrt{3}\right)^{4/3}}$$

01.22.03.0009.01

$$\coth\left(\frac{\pi i}{9}\right) == \left(z;\, 3\,z^6+27\,z^4+33\,z^2+1\right)_3^{-1}$$

01.22.03.0010.01

$$\coth\left(\frac{\pi i}{9}\right) == \frac{1+(-1)^{2/9}}{-1+(-1)^{2/9}}$$

01.22.03.0011.01

$$\coth\left(\frac{\pi i}{8}\right) == -i\left(1+\sqrt{2}\right)$$

01.22.03.0012.01

$$\coth\left(\frac{\pi i}{8}\right) == \left(z;\, z^4+6\,z^2+1\right)_3^{-1}$$

01.22.03.0013.01

$$\coth\left(\frac{\pi i}{8}\right) == \frac{1+\sqrt[4]{-1}}{-1+\sqrt[4]{-1}}$$

01.22.03.0014.01

$$\coth\left(\frac{\pi i}{7}\right) = \left(2\, i\, 2^{2/3} \sqrt[3]{7 - 21\, i \sqrt{3}} + 2 \sqrt[3]{7 - \frac{i\sqrt{7}}{2} - \frac{3\sqrt{21}}{2}} \left(\sqrt{7} + i\sqrt{21}\right) - 2\sqrt{7} \sqrt[3]{7 + \frac{i\sqrt{7}}{2} + \frac{3\sqrt{21}}{2}} + 2\, i \sqrt{21} \sqrt[3]{7 + \frac{i\sqrt{7}}{2} + \frac{3\sqrt{21}}{2}} + i\left(14 - i\sqrt{7} - 3\sqrt{21}\right)^{2/3} \sqrt[3]{14 + i\sqrt{7} + 3\sqrt{21}} - \sqrt{3}\left(14 - i\sqrt{7} - 3\sqrt{21}\right)^{2/3} \sqrt[3]{14 + i\sqrt{7} + 3\sqrt{21}} + i\sqrt[3]{14 - i\sqrt{7} - 3\sqrt{21}} \left(14 + i\sqrt{7} + 3\sqrt{21}\right)^{2/3} + \sqrt{3}\sqrt[3]{14 - i\sqrt{7} - 3\sqrt{21}} \left(14 + i\sqrt{7} + 3\sqrt{21}\right)^{2/3}\right) \Big/ \left(2\, 2^{2/3}\, 7^{5/6} \sqrt[3]{1 - 3\, i\sqrt{3}} - 2\, i\sqrt{7}\left(-i + \sqrt{3}\right) \sqrt[3]{7 - \frac{i\sqrt{7}}{2} - \frac{3\sqrt{21}}{2}} + i\left(2\sqrt{7}\left(i + \sqrt{3}\right)\sqrt[3]{7 + \frac{i\sqrt{7}}{2} + \frac{3\sqrt{21}}{2}} + \sqrt[3]{14 - 42\, i\sqrt{3}} \left(\left(1 + i\sqrt{3}\right)\sqrt[3]{14 - i\sqrt{7} - 3\sqrt{21}} + i\left(i + \sqrt{3}\right)\sqrt[3]{14 + i\sqrt{7} + 3\sqrt{21}}\right)\right)\right)$$

01.22.03.0015.01

$$\coth\left(\frac{\pi i}{7}\right) = \left(z;\, 7 z^6 + 35 z^4 + 21 z^2 + 1\right)_5^{-1}$$

01.22.03.0016.01

$$\coth\left(\frac{\pi i}{7}\right) = \frac{1 + (-1)^{2/7}}{-1 + (-1)^{2/7}}$$

01.22.03.0017.01

$$\coth\left(\frac{\pi i}{6}\right) = -\sqrt{3}\, i$$

01.22.03.0018.01

$$\coth\left(\frac{\pi i}{5}\right) = -i \sqrt{1 + \frac{2}{\sqrt{5}}}$$

01.22.03.0019.01

$$\coth\left(\frac{\pi i}{5}\right) = \left(z;\, 5 z^4 + 10 z^2 + 1\right)_1^{-1}$$

01.22.03.0020.01

$$\coth\left(\frac{2\pi i}{9}\right) = \frac{\sqrt[3]{-1 - i\sqrt{3}} + \sqrt[3]{-1 + i\sqrt{3}}}{-\sqrt[3]{-1 - i\sqrt{3}} + \sqrt[3]{-1 + i\sqrt{3}}}$$

01.22.03.0021.01

$$\coth\left(\frac{2\pi i}{9}\right) = \left(z;\, 3 z^6 + 27 z^4 + 33 z^2 + 1\right)_1^{-1}$$

01.22.03.0022.01

$$\coth\left(\frac{2\pi i}{9}\right) = \frac{1+(-1)^{4/9}}{-1+(-1)^{4/9}}$$

01.22.03.0023.01

$$\coth\left(\frac{\pi i}{4}\right) = -i$$

01.22.03.0024.01

$$\coth\left(\frac{2\pi i}{7}\right) = -\left(2\, i\left(7-21\, i\sqrt{3}+7\, 2^{2/3}\sqrt[3]{7-21\, i\sqrt{3}}-\sqrt[3]{2}\left(7-21\, i\sqrt{3}\right)^{2/3}\right)\right)\Big/ \left(\sqrt[3]{\frac{7}{2}\left(1-3\, i\sqrt{3}\right)}\left(2\, 2^{2/3}\, 7^{5/6}\sqrt[3]{1-3\, i\sqrt{3}}+4\sqrt{7}\sqrt[3]{7-\frac{i\sqrt{7}}{2}-\frac{3\sqrt{21}}{2}}-2\sqrt{7}\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}}-2\, i\sqrt{21}\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}}+i\left(14-i\sqrt{7}-3\sqrt{21}\right)^{2/3}\sqrt[3]{14+i\sqrt{7}+3\sqrt{21}}+\sqrt{3}\left(14-i\sqrt{7}-3\sqrt{21}\right)^{2/3}\sqrt[3]{14+i\sqrt{7}+3\sqrt{21}}+2\, i\sqrt[3]{14-i\sqrt{7}-3\sqrt{21}}\left(14+i\sqrt{7}+3\sqrt{21}\right)^{2/3}\right)\right)$$

01.22.03.0025.01

$$\coth\left(\frac{2\pi i}{7}\right) = \left(z;\, 7\, z^6+35\, z^4+21\, z^2+1\right)_3^{-1}$$

01.22.03.0026.01

$$\coth\left(\frac{2\pi i}{7}\right) = \frac{1+(-1)^{4/7}}{-1+(-1)^{4/7}}$$

01.22.03.0027.01

$$\coth\left(\frac{3\pi i}{10}\right) = -i\sqrt{5-2\sqrt{5}}$$

01.22.03.0028.01

$$\coth\left(\frac{3\pi i}{10}\right) = \left(z;\, z^4+10\, z^2+5\right)_3^{-1}$$

01.22.03.0029.01

$$\coth\left(\frac{\pi i}{3}\right) = -\frac{i}{\sqrt{3}}$$

01.22.03.0030.01

$$\coth\left(\frac{3\pi i}{8}\right) = -i\left(\sqrt{2}-1\right)$$

01.22.03.0031.01

$$\coth\left(\frac{3\pi i}{8}\right) = \left(z;\, z^4+6\, z^2+1\right)_1^{-1}$$

01.22.03.0032.01

$$\coth\left(\frac{3\pi i}{8}\right) == \frac{1+(-1)^{3/4}}{-1+(-1)^{3/4}}$$

01.22.03.0033.01

$$\coth\left(\frac{2\pi i}{5}\right) == -i\sqrt{1-\frac{2}{\sqrt{5}}}$$

01.22.03.0034.01

$$\coth\left(\frac{2\pi i}{5}\right) == \left(z;\, 5z^4+10z^2+1\right)_3^{-1}$$

01.22.03.0035.01

$$\coth\left(\frac{5\pi i}{12}\right) == -i\left(2-\sqrt{3}\right)$$

01.22.03.0036.01

$$\coth\left(\frac{5\pi i}{12}\right) == \left(z;\, z^4+14z^2+1\right)_3^{-1}$$

01.22.03.0037.01

$$\coth\left(\frac{3\pi i}{7}\right) == \left(-2^{2/3}\sqrt[3]{7-21i\sqrt{3}} + \sqrt{7}\left(i+\sqrt{3}\right)\sqrt[3]{7-\frac{i\sqrt{7}}{2}-\frac{3\sqrt{21}}{2}} + 2i\sqrt{7}\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}} + \left(14-i\sqrt{7}-3\sqrt{21}\right)^{2/3}\sqrt[3]{14+i\sqrt{7}+3\sqrt{21}} - \frac{1}{2}\sqrt[3]{14-i\sqrt{7}-3\sqrt{21}}\left(14+i\sqrt{7}+3\sqrt{21}\right)^{2/3} - \frac{1}{2}i\sqrt{3}\sqrt[3]{14-i\sqrt{7}-3\sqrt{21}}\left(14+i\sqrt{7}+3\sqrt{21}\right)^{2/3}\right) \Big/ \left(-i\,2^{2/3}\,7^{5/6}\sqrt[3]{1-3i\sqrt{3}} + \sqrt{7}\left(i+\sqrt{3}\right)\sqrt[3]{7-\frac{i\sqrt{7}}{2}-\frac{3\sqrt{21}}{2}} - \frac{1}{2}i\left(4\sqrt{7}\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}} + \sqrt[3]{14-42i\sqrt{3}}\left(-2i\sqrt[3]{14-i\sqrt{7}-3\sqrt{21}} + \left(-i+\sqrt{3}\right)\sqrt[3]{14+i\sqrt{7}+3\sqrt{21}}\right)\right)\right)$$

01.22.03.0038.01

$$\coth\left(\frac{3\pi i}{7}\right) == \left(z;\, 7z^6+35z^4+21z^2+1\right)_1^{-1}$$

01.22.03.0039.01

$$\coth\left(\frac{3\pi i}{7}\right) == \frac{1+(-1)^{6/7}}{-1+(-1)^{6/7}}$$

01.22.03.0040.01

$$\coth\left(\frac{4\pi i}{9}\right) == \frac{-\sqrt[3]{-1+i\sqrt{3}}\,\left(-i+\sqrt{3}\right)+\sqrt[3]{-1-i\sqrt{3}}\,\left(i+\sqrt{3}\right)}{\sqrt[3]{-1+i\sqrt{3}}\,\left(-i+\sqrt{3}\right)+\sqrt[3]{-1-i\sqrt{3}}\,\left(i+\sqrt{3}\right)}$$

01.22.03.0041.01

$$\coth\left(\frac{4\pi i}{9}\right) == \left(z;\, 3z^6+27z^4+33z^2+1\right)_5^{-1}$$

01.22.03.0042.01

$$\coth\left(\frac{4\pi i}{9}\right) == \frac{1+(-1)^{8/9}}{-1+(-1)^{8/9}}$$

01.22.03.0043.01

$$\coth\left(\frac{\pi i}{2}\right) == 0$$

01.22.03.0044.01

$$\coth\left(\frac{5\pi i}{9}\right) == \frac{\sqrt[3]{-1+i\sqrt{3}}\,\left(-i+\sqrt{3}\right)-\sqrt[3]{-1-i\sqrt{3}}\,\left(i+\sqrt{3}\right)}{\sqrt[3]{-1+i\sqrt{3}}\,\left(-i+\sqrt{3}\right)+\sqrt[3]{-1-i\sqrt{3}}\,\left(i+\sqrt{3}\right)}$$

01.22.03.0045.01

$$\coth\left(\frac{5\pi i}{9}\right) == \left(z;\, 3z^6+27z^4+33z^2+1\right)_6^{-1}$$

01.22.03.0046.01

$$\coth\left(\frac{5\pi i}{9}\right) == \frac{-1+\sqrt[9]{-1}}{1+\sqrt[9]{-1}}$$

01.22.03.0047.01

$$\coth\left(\frac{4\pi i}{7}\right) == \left(7+7i\sqrt{3}+\left(\frac{7}{2}\left(1-3i\sqrt{3}\right)\right)^{2/3}-i\sqrt{3}\left(\frac{7}{2}-\frac{21i\sqrt{3}}{2}\right)^{2/3}+2^{2/3}\sqrt[3]{7-21i\sqrt{3}}\right)\bigg/$$
$$\left(-i\,2^{2/3}\,7^{5/6}\sqrt[3]{1-3i\sqrt{3}}+\sqrt{7}\left(i+\sqrt{3}\right)\sqrt[3]{7-\frac{i\sqrt{7}}{2}-\frac{3\sqrt{21}}{2}}-\frac{1}{2}i\left(4\sqrt{7}\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}}+\right.\right.$$
$$\left.\left.\sqrt[3]{14-42i\sqrt{3}}\left(-2i\sqrt[3]{14-i\sqrt{7}-3\sqrt{21}}+\left(-i+\sqrt{3}\right)\sqrt[3]{14+i\sqrt{7}+3\sqrt{21}}\right)\right)\right)$$

01.22.03.0048.01

$$\coth\left(\frac{4\pi i}{7}\right) == \left(z;\, 7z^6+35z^4+21z^2+1\right)_2^{-1}$$

01.22.03.0049.01

$$\coth\left(\frac{4\pi i}{7}\right) == \frac{-1+\sqrt[7]{-1}}{1+\sqrt[7]{-1}}$$

01.22.03.0050.01

$$\coth\left(\frac{7\pi i}{12}\right) == i\left(2-\sqrt{3}\right)$$

01.22.03.0051.01

$$\coth\left(\frac{7\pi i}{12}\right) == \left(z;\, z^4+14\, z^2+1\right)_4^{-1}$$

01.22.03.0052.01

$$\coth\left(\frac{3\pi i}{5}\right) == i\sqrt{1-\frac{2}{\sqrt{5}}}$$

01.22.03.0053.01

$$\coth\left(\frac{3\pi i}{5}\right) == \left(z;\, 5\, z^4+10\, z^2+1\right)_4^{-1}$$

01.22.03.0054.01

$$\coth\left(\frac{5\pi i}{8}\right) == i\left(\sqrt{2}-1\right)$$

01.22.03.0055.01

$$\coth\left(\frac{5\pi i}{8}\right) == \left(z;\, z^4+6\, z^2+1\right)_2^{-1}$$

01.22.03.0056.01

$$\coth\left(\frac{5\pi i}{8}\right) == \frac{-1+\sqrt[4]{-1}}{1+\sqrt[4]{-1}}$$

01.22.03.0057.01

$$\coth\left(\frac{2\pi i}{3}\right) == \frac{i}{\sqrt{3}}$$

01.22.03.0058.01

$$\coth\left(\frac{7\pi i}{10}\right) == i\sqrt{5-2\sqrt{5}}$$

01.22.03.0059.01

$$\coth\left(\frac{7\pi i}{10}\right) == \left(z;\, z^4+10\, z^2+5\right)_4^{-1}$$

01.22.03.0060.01

$$\coth\left(\frac{5\pi i}{7}\right) = \left(-2\,i\,2^{2/3}\sqrt[3]{7-21\,i\sqrt{3}} + 4\sqrt{7}\sqrt[3]{7-\frac{i\sqrt{7}}{2}-\frac{3\sqrt{21}}{2}} + 2\sqrt{7}\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}} + 2\,i\sqrt{21}\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}} - i\left(14-i\sqrt{7}-3\sqrt{21}\right)^{2/3}\sqrt[3]{14+i\sqrt{7}+3\sqrt{21}} - \sqrt{3}\left(14-i\sqrt{7}-3\sqrt{21}\right)^{2/3}\sqrt[3]{14+i\sqrt{7}+3\sqrt{21}} + 2\,i\sqrt[3]{14-i\sqrt{7}-3\sqrt{21}}\left(14+i\sqrt{7}+3\sqrt{21}\right)^{2/3}\right) \Big/ \left(2\,2^{2/3}\,7^{5/6}\sqrt[3]{1-3\,i\sqrt{3}} + 4\sqrt{7}\sqrt[3]{7-\frac{i\sqrt{7}}{2}-\frac{3\sqrt{21}}{2}} - 2\sqrt{7}\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}} - 2\,i\sqrt{21}\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}} + i\left(14-i\sqrt{7}-3\sqrt{21}\right)^{2/3}\sqrt[3]{14+i\sqrt{7}+3\sqrt{21}} + \sqrt{3}\left(14-i\sqrt{7}-3\sqrt{21}\right)^{2/3}\sqrt[3]{14+i\sqrt{7}+3\sqrt{21}} + 2\,i\sqrt[3]{14-i\sqrt{7}-3\sqrt{21}}\left(14+i\sqrt{7}+3\sqrt{21}\right)^{2/3}\right)$$

01.22.03.0061.01

$$\coth\left(\frac{5\pi i}{7}\right) = \left(z;\, 7z^6+35z^4+21z^2+1\right)_4^{-1}$$

01.22.03.0062.01

$$\coth\left(\frac{5\pi i}{7}\right) = \frac{-1+(-1)^{3/7}}{1+(-1)^{3/7}}$$

01.22.03.0063.01

$$\coth\left(\frac{3\pi i}{4}\right) = i$$

01.22.03.0064.01

$$\coth\left(\frac{7\pi i}{9}\right) = \frac{\sqrt[3]{-1-i\sqrt{3}}+\sqrt[3]{-1+i\sqrt{3}}}{\sqrt[3]{-1-i\sqrt{3}}-\sqrt[3]{-1+i\sqrt{3}}}$$

01.22.03.0065.01

$$\coth\left(\frac{7\pi i}{9}\right) = \left(z;\, 3z^6+27z^4+33z^2+1\right)_2^{-1}$$

01.22.03.0066.01

$$\coth\left(\frac{7\pi i}{9}\right) = \frac{-1+(-1)^{5/9}}{1+(-1)^{5/9}}$$

01.22.03.0067.01

$$\coth\left(\frac{4\pi i}{5}\right) == i\sqrt{1+\frac{2}{\sqrt{5}}}$$

01.22.03.0068.01

$$\coth\left(\frac{4\pi i}{5}\right) == \left(z;\, 5z^4+10z^2+1\right)_2^{-1}$$

01.22.03.0069.01

$$\coth\left(\frac{5\pi i}{6}\right) == \sqrt{3}\, i$$

01.22.03.0070.01

$$\coth\left(\frac{6\pi i}{7}\right) == -\left(2\left(7-7i\sqrt{3}+\left(\frac{7}{2}\left(1-3i\sqrt{3}\right)\right)^{2/3}+i\sqrt{3}\left(\frac{7}{2}-\frac{21i\sqrt{3}}{2}\right)^{2/3}+2^{2/3}\sqrt[3]{7-21i\sqrt{3}}\right)\right)\Bigg/$$
$$\left(\sqrt[3]{\frac{7}{2}\left(1-3i\sqrt{3}\right)}\left(-4i\sqrt{7}+\frac{2\sqrt{7}\left(i+\sqrt{3}\right)}{\sqrt[3]{7-\frac{i\sqrt{7}}{2}-\frac{3\sqrt{21}}{2}}}+\left(2+2i\sqrt{3}\right)\sqrt[3]{7-\frac{i\sqrt{7}}{2}-\frac{3\sqrt{21}}{2}}-\right.\right.$$
$$\left.\left.\frac{2\sqrt{7}\left(-i+\sqrt{3}\right)}{\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}}}+2i\left(i+\sqrt{3}\right)\sqrt[3]{7+\frac{i\sqrt{7}}{2}+\frac{3\sqrt{21}}{2}}\right)\right)$$

01.22.03.0071.01

$$\coth\left(\frac{6\pi i}{7}\right) == \left(z;\, 7z^6+35z^4+21z^2+1\right)_6^{-1}$$

01.22.03.0072.01

$$\coth\left(\frac{6\pi i}{7}\right) == \frac{-1+(-1)^{5/7}}{1+(-1)^{5/7}}$$

01.22.03.0073.01

$$\coth\left(\frac{7\pi i}{8}\right) == i\left(1+\sqrt{2}\right)$$

01.22.03.0074.01

$$\coth\left(\frac{7\pi i}{8}\right) == \left(z;\, z^4+6z^2+1\right)_4^{-1}$$

01.22.03.0075.01

$$\coth\left(\frac{7\pi i}{8}\right) == \frac{-1+(-1)^{3/4}}{1+(-1)^{3/4}}$$

01.22.03.0076.01

$$\coth\left(\frac{8\pi i}{9}\right) == \frac{\left(-1-i\sqrt{3}\right)^{4/3}+\left(-1+i\sqrt{3}\right)^{4/3}}{-\left(-1-i\sqrt{3}\right)^{4/3}+\left(-1+i\sqrt{3}\right)^{4/3}}$$

01.22.03.0077.01

$$\coth\left(\frac{8\pi i}{9}\right) = \left(z;\, 3z^6 + 27z^4 + 33z^2 + 1\right)_4^{-1}$$

01.22.03.0078.01

$$\coth\left(\frac{8\pi i}{9}\right) = \frac{-1 + (-1)^{7/9}}{1 + (-1)^{7/9}}$$

01.22.03.0079.01

$$\coth\left(\frac{9\pi i}{10}\right) = i\sqrt{5 + 2\sqrt{5}}$$

01.22.03.0080.01

$$\coth\left(\frac{9\pi i}{10}\right) = \left(z;\, z^4 + 10z^2 + 5\right)_2^{-1}$$

01.22.03.0081.01

$$\coth\left(\frac{11\pi i}{12}\right) = i\left(2 + \sqrt{3}\right)$$

01.22.03.0082.01

$$\coth\left(\frac{11\pi i}{12}\right) = \left(z;\, z^4 + 14z^2 + 1\right)_2^{-1}$$

01.22.03.0083.01

$$\coth(\pi i) = \tilde{\infty}$$

01.22.03.0084.01

$$\coth\left(\frac{\pi i}{17}\right) = -i\sqrt{\left(\left(\sqrt{\left(2\left(\sqrt{34\left(17 - \sqrt{17}\right)} + 6\sqrt{17} - 8\sqrt{2\left(17 + \sqrt{17}\right)} - \sqrt{34 - 2\sqrt{17}} + 34\right)\right)} + \sqrt{17} + \sqrt{34 - 2\sqrt{17}} + 15\right) \Big/ \left(16 - 2\sqrt{\left(2\left(\sqrt{\left(2\left(-\sqrt{34\left(17 - \sqrt{17}\right)} + 6\sqrt{17} + 8\sqrt{2\left(17 + \sqrt{17}\right)} + \sqrt{34 - 2\sqrt{17}} + 34\right)\right)} + \sqrt{17} - \sqrt{34 - 2\sqrt{17}} + 15\right)\right)}\right)\right)}$$

01.22.03.0085.01

$$\coth\left(\frac{\pi i}{30}\right) = -i\sqrt{23 + 10\sqrt{5} + 2\sqrt{255 + 114\sqrt{5}}}$$

$\coth\left(\frac{n i \pi}{m}\right)$ can be expressed using only square roots if $n \in \mathbb{Z}$ and m is a product of a power of 2 and distinct Fermat primes $\{3, 5, 17, 257, \ldots\}$.

Values at infinities

01.22.03.0086.01

$$\coth(\infty) = 1$$

01.22.03.0087.01

$$\coth(-\infty) = -1$$

01.22.03.0088.01

$\coth(\tilde{\infty}) == ¿$

General characteristics

Domain and analyticity

$\coth(z)$ is an analytical function of z which is defined over the whole complex z-plane..

01.22.04.0001.01

$z \longrightarrow \coth(z) :: \mathbb{C} \longrightarrow \mathbb{C}$

Symmetries and periodicities

Parity

$\coth(z)$ is an odd function.

01.22.04.0002.01

$\coth(-z) == -\coth(z)$

Mirror symmetry

01.22.04.0003.01

$\coth(\bar{z}) == \overline{\coth(z)}$

Periodicity

$\coth(z)$ is a periodic function with period πi .

01.22.04.0009.01

$\coth(z + \pi i) == \coth(z)$

01.22.04.0004.01

$\coth(z + \pi i m) == \coth(z) /; m \in \mathbb{Z}$

Poles and essential singularities

The function $\coth(z)$ has an infinite set of singular points:

a) $z == \pi i k /; k \in \mathbb{Z}$ are the simple poles with residues 1;

b) $z == \tilde{\infty}$ is an essential singular point.

01.22.04.0005.01

$\mathcal{S}ing_z(\coth(z)) == \{\{\{\pi i k, 1\} /; k \in \mathbb{Z}\}, \{\tilde{\infty}, \infty\}\}$

01.22.04.0006.01

$\text{res}_z(\coth(z))(\pi i k) == 1 /; k \in \mathbb{Z}$

Branch points

The function $\coth(z)$ does not have branch points.

01.22.04.0007.01

$\mathcal{BP}_z(\coth(z)) == \{\}$

Branch cuts

The function $\coth(z)$ does not have branch cuts.

01.22.04.0008.01

$$\mathcal{BC}_z(\coth(z)) == \{\}$$

Series representations

Generalized power series

Expansions at $z == z_0$

For the function itself

01.22.06.0021.01

$$\coth(z) \propto \coth(z_0) - \operatorname{csch}^2(z_0)(z - z_0) + \frac{1}{2}\sinh(2 z_0)\operatorname{csch}^4(z_0)(z - z_0)^2 + \ldots /; (z \to z_0)$$

01.22.06.0022.01

$$\coth(z) \propto \coth(z_0) - \operatorname{csch}^2(z_0)(z - z_0) + \frac{1}{2}\sinh(2 z_0)\operatorname{csch}^4(z_0)(z - z_0)^2 + O\left((z - z_0)^3\right)$$

01.22.06.0023.01

$$\coth(z) == \sum_{k=0}^{\infty} \frac{1}{k!}\left(\coth(z_0)\,\delta_k - \operatorname{csch}^2(z_0)\,\delta_{k-1} - (-i)^k k \sum_{m=0}^{k-1}\sum_{j=0}^{m-1} \frac{(-1)^{j+m}}{m+1}\binom{k-1}{m}\sinh^{-2m-2}(z_0)\, 2^{k-2m}\binom{2m}{j}(m-j)^{k-1}\sinh\left(\frac{i\pi k}{2} + 2(m-j)z_0\right)\right)(z - z_0)^k$$

01.22.06.0024.01

$$\coth(z) \propto \coth(z_0)\,(1 + O(z - z_0))$$

Expansions at $z == 0$

For the function itself

01.22.06.0001.02

$$\coth(z) \propto \frac{1}{z} + \frac{z}{3} - \frac{z^3}{45} + \frac{2 z^5}{945} - \ldots /; (z \to 0)$$

01.22.06.0025.01

$$\coth(z) \propto \frac{1}{z} + \frac{z}{3} - \frac{z^3}{45} + \frac{2 z^5}{945} - O\left(z^7\right)$$

01.22.06.0002.01

$$\coth(z) == \frac{1}{z} + \sum_{k=1}^{\infty} \frac{2^{2k} B_{2k} z^{2k-1}}{(2k)!} /; |z| < \pi$$

01.22.06.0003.02

$$\coth(z) \propto \frac{1}{z} + \frac{z}{3} + O(z^3)$$

Expansions at $z == \frac{\pi i}{2}$

For the function itself

01.22.06.0004.02

$$\coth(z) \propto \left(z - \frac{\pi i}{2}\right) - \frac{1}{3}\left(z - \frac{\pi i}{2}\right)^3 + \frac{2}{15}\left(z - \frac{\pi i}{2}\right)^5 - \ldots \;/;\; \left(z \to \frac{\pi i}{2}\right)$$

01.22.06.0026.01

$$\coth(z) \propto \left(z - \frac{\pi i}{2}\right) - \frac{1}{3}\left(z - \frac{\pi i}{2}\right)^3 + \frac{2}{15}\left(z - \frac{\pi i}{2}\right)^5 - O\left(\left(z - \frac{\pi i}{2}\right)^7\right)$$

01.22.06.0005.02

$$\coth(z) == \sum_{k=1}^{\infty} \frac{2^{2k}\left(2^{2k}-1\right) B_{2k}}{(2k)!} \left(z - \frac{\pi i}{2}\right)^{2k-1} \;/;\; \left|z - \frac{\pi i}{2}\right| < \frac{\pi}{2}$$

01.22.06.0006.02

$$\coth(z) \propto \left(z - \frac{\pi i}{2}\right) + O\left(\left(z - \frac{\pi i}{2}\right)^3\right)$$

q-series

01.22.06.0007.01

$$\coth(z) == -1 - 2\sum_{k=1}^{\infty} q^{2k} \;/;\; q == e^z$$

Dirichlet series

01.22.06.0008.01

$$\coth(z) == 2\sum_{k=0}^{\infty} e^{-2z(k+1)} + 1 \;/;\; \mathrm{Re}(z) > 0$$

01.22.06.0009.01

$$\coth(z) == -2\sum_{k=0}^{\infty} e^{2z(k+1)} - 1 \;/;\; \mathrm{Re}(z) < 0$$

Asymptotic series expansions

01.22.06.0010.01

$$\coth(z) \propto 1 + 2\, e^{-2z}\, {}_1F_0\left(1;\, ;\, e^{-2z}\right) \;/;\; \mathrm{Re}(z) > 0 \land (|z| \to \infty)$$

01.22.06.0011.01

$$\coth(z) \propto 1 + 2\, e^{-2z}\left(1 + O\left(e^{-2z}\right)\right) \;/;\; \mathrm{Re}(z) > 0 \land (|z| \to \infty)$$

01.22.06.0012.01

$$\coth(z) \propto -1 - 2\, e^{2z}\, {}_1F_0\left(1;\, ;\, e^{2z}\right) \;/;\; \mathrm{Re}(z) < 0 \land (|z| \to \infty)$$

01.22.06.0013.01

$$\coth(z) \propto -1 - 2\, e^{2z} \left(1 + O\left(e^{2z}\right)\right) /;\ \mathrm{Re}(z) < 0 \land (|z| \to \infty)$$

01.22.06.0014.01

$$\coth(z) \propto \coth(z) /;\ \mathrm{Re}(z) == 0 \land (|z| \to \infty)$$

01.22.06.0015.01

$$\coth(z) \propto 1 /;\ \left(z \to e^{i\phi} \infty\right) \bigwedge -\frac{\pi}{2} < \phi < \frac{\pi}{2}$$

01.22.06.0016.01

$$\coth(z) \propto -1 /;\ \left(z \to e^{i\phi} \infty\right) \bigwedge -\pi < \phi < -\frac{\pi}{2} \bigvee \frac{\pi}{2} < \phi \leq \pi$$

01.22.06.0027.01

$$\coth(z) \propto \begin{cases} -1 & -\pi < \arg(z) < -\frac{\pi}{2} \bigvee \frac{\pi}{2} < \arg(z) \leq \pi \\ 1 & -\frac{\pi}{2} < \arg(z) < \frac{\pi}{2} \\ \coth(z) & \text{True} \end{cases} /;\ (|z| \to \infty)$$

Other series representations

01.22.06.0017.01

$$\coth(z) == 2\, z \sum_{k=1}^{\infty} \frac{1}{\pi^2 k^2 + z^2} + \frac{1}{z} /;\ \frac{i\, z}{\pi} \notin \mathbb{Z}$$

01.22.06.0018.01

$$\coth(z) == \frac{1}{z} - \frac{i\, z}{\pi} \left(\sum_{k=1}^{\infty} \frac{1}{k\, (z - i\, \pi\, k)} + \sum_{k=-\infty}^{-1} \frac{1}{k\, (z - i\, \pi\, k)} \right)$$

01.22.06.0019.01

$$\coth(z) == \sum_{k=-\infty}^{\infty} \frac{z}{\pi^2 k^2 + z^2} /;\ \frac{i\, z}{\pi} \notin \mathbb{Z}$$

01.22.06.0020.01

$$\coth(z) == \frac{1}{z} - \frac{i\, z}{\pi} \sum_{\substack{k=-\infty \\ k \neq 0}}^{\infty} \frac{1}{k\, (z - \pi\, i\, k)} /;\ \frac{i\, z}{\pi} \notin \mathbb{Z}$$

Integral representations

On the real axis

Of the direct function

01.22.07.0001.01

$$\coth(z) == -\int_{\frac{\pi i}{2}}^{z} \mathrm{csch}^2(t)\, dt$$

01.22.07.0002.01

$$\coth(z) == -\frac{2\, i}{\pi} \int_0^{\infty} \frac{t^{\frac{2 i z}{\pi}+1} - 1}{t^2 - 1}\, dt /;\ 0 < \mathrm{Im}(z) < \frac{\pi}{2}$$

Limit representations

01.22.09.0001.01

$$\coth(z) = \lim_{n\to\infty} \sum_{k=-n}^{n} \frac{1}{z + i\pi k} \;/;\; \frac{i z}{\pi} \notin \mathbb{Z}$$

Continued fraction representations

01.22.10.0003.01

$$\coth(z) = \frac{1}{z} + \cfrac{z}{3 + \cfrac{z^2}{5 + \cfrac{z^2}{7 + \cfrac{z^2}{9 + \cfrac{z^2}{11 + \ldots}}}}}$$

Andreas Lauschke (2006)

01.22.10.0004.01

$$\coth(z) = \frac{1}{z} + \frac{1}{z} \operatorname{K}_k(z^2, 2k+1)_1^\infty$$

Andreas Lauschke (2006)

01.22.10.0001.01

$$\coth(z) = \frac{1}{z} + \cfrac{4\pi^{-2} z}{1 + \cfrac{1 + 4\pi^{-2} z^2}{3 + \cfrac{4(4 + 4\pi^{-2} z^2)}{5 + \cfrac{9(9 + 4\pi^{-2} z^2)}{7 + \cfrac{16(16 + 4\pi^{-2} z^2)}{9 + \cfrac{25(25 + 4\pi^{-2} z^2)}{11 + \cfrac{36(36 + 4\pi^{-2} z^2)}{13 + \ldots}}}}}}}$$

01.22.10.0002.01

$$\coth(z) = \frac{1}{z} + \frac{4z}{\pi^2 \left(1 + \operatorname{K}_k\left(k^2 \left(k^2 + \frac{4z^2}{\pi^2}\right), 2k+1\right)_1^\infty\right)}$$

01.22.10.0005.01

$$\coth(z) = \frac{1}{z} - \cfrac{z/2}{-\frac{3}{2} + \cfrac{z^2/4}{-\frac{5}{2} + \cfrac{z^2/4}{-\frac{7}{2} + \cfrac{z^2/4}{-\frac{9}{2} + \cfrac{z^2/4}{-\frac{11}{2} + \cfrac{z^2/4}{-\frac{13}{2} + \cfrac{z^2/4}{-\frac{15}{2} + \cfrac{z^2/4}{-\frac{17}{2} + \cfrac{z^2/4}{\ldots}}}}}}}}}$$

A.Lauschke (2006)

01.22.10.0006.01

$$\coth(z) = \frac{1}{z} - \frac{z}{-3 + 2\,\mathrm{K}_k\left(\frac{z^2}{4}, -k - \frac{3}{2}\right)_1^\infty}$$

A.Lauschke (2006)

Differential equations

Ordinary nonlinear differential equations

01.22.13.0001.01

$$w'(z) + w(z)^2 - 1 = 0 \,/;\, w(z) = \coth(z) \bigwedge w\left(\frac{\pi i}{2}\right) = 0$$

01.22.13.0002.01

$$w'(z) - a\,w(z)^2 - b\,w(z) - c = 0 \,/;\, w(z) = -\frac{1}{2a}\left(b + \sqrt{b^2 - 4ac}\,\coth\left(\frac{a\sqrt{b^2 - 4ac}\,z + \sqrt{b^2 - 4ac}\,c_1}{2a}\right)\right)$$

Transformations

Transformations and argument simplifications

Argument involving basic arithmetic operations

01.22.16.0001.01

$$\coth(-z) = -\coth(z)$$

01.22.16.0002.01

$$\coth\left(a\,(b\,z^c)^m\right) = \frac{(b\,z^c)^m \coth(a\,b^m\,z^{m c})}{b^m\,z^{m c}} \,/;\, 2m \in \mathbb{Z}$$

01.22.16.0003.01

$$\coth\left(\sqrt{z^2}\right) = \frac{\sqrt{z^2}\,\coth(z)}{z}$$

Argument involving inverse trigonometric and hyperbolic functions

Involving $\sin^{-1}$

01.22.16.0064.01

$$\coth\left(\sin^{-1}(z)\right) = \frac{1}{\frac{2}{\left(i z + \sqrt{1 - z^2}\right)^{2 i} + 1} - 1}$$

01.22.16.0004.01

$$\coth\left(i \sin^{-1}(z)\right) = -\frac{i\sqrt{1 - z^2}}{z}$$

01.22.16.0016.01

$$\coth\left(\frac{i}{2}\sin^{-1}(z)\right) = -i\,\frac{1+\sqrt{1-z^2}}{z}$$

01.22.16.0065.01

$$\coth\left(a\sin^{-1}(z)\right) = \frac{1}{\frac{2}{\left(i\,z+\sqrt{1-z^2}\right)^{2\,i\,a}+1}-1}$$

Involving $\cos^{-1}$

01.22.16.0066.01

$$\coth\left(\cos^{-1}(z)\right) = 1+\frac{2}{e^{\pi}\left(i\,z+\sqrt{1-z^2}\right)^{2\,i}-1}$$

01.22.16.0005.01

$$\coth\left(i\cos^{-1}(z)\right) = -\frac{i\,z}{\sqrt{1-z^2}}$$

01.22.16.0017.01

$$\coth\left(\frac{i}{2}\cos^{-1}(z)\right) = -\frac{i\sqrt{1+z}}{\sqrt{1-z}}$$

01.22.16.0067.01

$$\coth\left(a\cos^{-1}(z)\right) = 1+\frac{2}{e^{a\,\pi}\left(i\,z+\sqrt{1-z^2}\right)^{2\,a\,i}-1}$$

Involving $\tan^{-1}$

01.22.16.0068.01

$$\coth\left(\tan^{-1}(z)\right) = \frac{1}{\frac{1}{2}-\frac{1}{2}(1-i\,z)^{-i}\,(i\,z+1)^{i}}-1$$

01.22.16.0069.01

$$\coth\left(\tan^{-1}(x,y)\right) = \frac{1}{\frac{2}{\left(\frac{x+i\,y}{\sqrt{x^2+y^2}}\right)^{2\,i}+1}-1}$$

01.22.16.0006.01

$$\coth\left(i\tan^{-1}(z)\right) = -\frac{i}{z}$$

01.22.16.0070.01

$$\coth\left(i\tan^{-1}(x,y)\right) = -\frac{i\,x}{y}$$

01.22.16.0018.01

$$\coth\left(\frac{i}{2}\tan^{-1}(z)\right) = -\frac{i}{z}\left(1+\sqrt{1+z^2}\right)$$

01.22.16.0071.01

$$\coth\left(\frac{1}{2}\, i \tan^{-1}(x, y)\right) = -\frac{i\left(x+\sqrt{x^2+y^2}\right)}{y}$$

01.22.16.0072.01

$$\coth\left(a \tan^{-1}(z)\right) = \frac{1}{\frac{1}{2} - \frac{1}{2}\,(1 - i\, z)^{-i\, a}\, (i\, z + 1)^{i\, a}} - 1$$

01.22.16.0073.01

$$\coth\left(a \tan^{-1}(x, y)\right) = \frac{1}{\frac{2}{\left(\frac{x + i\, y}{\sqrt{x^2+y^2}}\right)^{2\, i\, a} + 1} - 1}$$

Involving $\cot^{-1}$

01.22.16.0074.01

$$\coth\left(\cot^{-1}(z)\right) = \frac{1}{\frac{1}{2} - \frac{1}{2}\left(\frac{-i+z}{z}\right)^{-i}\left(\frac{i+z}{z}\right)^{i}} - 1$$

01.22.16.0007.01

$$\coth\left(i \cot^{-1}(z)\right) = -i\, z$$

01.22.16.0019.01

$$\coth\left(\frac{i}{2}\cot^{-1}(z)\right) = -i\left(1+\sqrt{1+\frac{1}{z^2}}\right) z$$

01.22.16.0075.01

$$\coth\left(a \cot^{-1}(z)\right) = \frac{1}{\frac{1}{2} - \frac{1}{2}\left(\frac{-i+z}{z}\right)^{-i\, a}\left(\frac{i+z}{z}\right)^{i\, a}} - 1$$

Involving $\csc^{-1}$

01.22.16.0076.01

$$\coth\left(\csc^{-1}(z)\right) = \frac{1}{\frac{2}{\left(\sqrt{1-\frac{1}{z^2}} + \frac{i}{z}\right)^{2\, i} + 1} - 1}$$

01.22.16.0008.01

$$\coth\left(i \csc^{-1}(z)\right) = -i\sqrt{1-\frac{1}{z^2}}\; z$$

01.22.16.0020.01

$$\coth\left(\frac{i}{2}\csc^{-1}(z)\right) = -\frac{i\sqrt{z^2}}{z}\left(\sqrt{z^2}+\sqrt{z^2-1}\right)$$

01.22.16.0077.01

$$\coth\left(a\csc^{-1}(z)\right) = \frac{1}{\frac{2}{\left(\sqrt{1-\frac{1}{z^2}}+\frac{i}{z}\right)^{2ia}+1}-1}$$

Involving $\sec^{-1}$

01.22.16.0078.01

$$\coth\left(\sec^{-1}(z)\right) = 1+\frac{2}{e^{\pi}\left(\sqrt{1-\frac{1}{z^2}}+\frac{i}{z}\right)^{2i}-1}$$

01.22.16.0009.01

$$\coth\left(i\sec^{-1}(z)\right) = -\frac{i\sqrt{z^2}}{z\sqrt{z^2-1}}$$

01.22.16.0021.01

$$\coth\left(\frac{i}{2}\sec^{-1}(z)\right) = \frac{i\sqrt{-z-1}\sqrt{-z}}{\sqrt{z-1}\sqrt{z}}$$

01.22.16.0079.01

$$\coth\left(a\sec^{-1}(z)\right) = 1+\frac{2}{e^{a\pi}\left(\sqrt{1-\frac{1}{z^2}}+\frac{i}{z}\right)^{2ai}-1}$$

Involving $\sinh^{-1}$

01.22.16.0010.01

$$\coth\left(\sinh^{-1}(z)\right) = \frac{\sqrt{1+z^2}}{z}$$

01.22.16.0022.01

$$\coth\left(\frac{1}{2}\sinh^{-1}(z)\right) = \frac{\sqrt{z^2+1}+1}{z}$$

01.22.16.0080.01

$$\coth\left(i\sinh^{-1}(z)\right) = \frac{1}{1-\frac{2}{\left(z+\sqrt{z^2+1}\right)^{2i}+1}}$$

01.22.16.0081.01

$$\coth\left(a \sinh^{-1}(z)\right) = \frac{1}{1 - \frac{2}{\left(z+\sqrt{z^2+1}\right)^{2a}+1}}$$

Involving $\cosh^{-1}$

01.22.16.0011.01

$$\coth\left(\cosh^{-1}(z)\right) = \frac{z}{\sqrt{z-1}\,\sqrt{z+1}}$$

01.22.16.0023.01

$$\coth\left(\frac{1}{2}\cosh^{-1}(z)\right) = \frac{\sqrt{z+1}}{\sqrt{z-1}}$$

01.22.16.0082.01

$$\coth\left(i \cosh^{-1}(z)\right) = \frac{1}{1 - \frac{2}{\left(z+\sqrt{z-1}\,\sqrt{z+1}\right)^{2i}+1}}$$

01.22.16.0083.01

$$\coth\left(a \cosh^{-1}(z)\right) = \frac{1}{1 - \frac{2}{\left(z+\sqrt{z-1}\,\sqrt{z+1}\right)^{2a}+1}}$$

Involving $\tanh^{-1}$

01.22.16.0012.01

$$\coth\left(\tanh^{-1}(z)\right) = \frac{1}{z}$$

01.22.16.0024.01

$$\coth\left(\frac{1}{2}\tanh^{-1}(z)\right) = \frac{\sqrt{1-z^2}+1}{z}$$

01.22.16.0084.01

$$\coth\left(i \tanh^{-1}(z)\right) = 1 + \frac{2}{(1-z)^{-i}\,(z+1)^{i}-1}$$

01.22.16.0085.01

$$\coth\left(a \tanh^{-1}(z)\right) = 1 + \frac{2}{(1-z)^{-a}\,(z+1)^{a}-1}$$

Involving $\coth^{-1}$

01.22.16.0013.01

$$\coth\left(\coth^{-1}(z)\right) = z$$

01.22.16.0025.01

$$\coth\left(\frac{1}{2}\coth^{-1}(z)\right) = z\left(\sqrt{1-\frac{1}{z^2}}+1\right)$$

01.22.16.0086.01

$$\coth\left(i\coth^{-1}(z)\right) = \frac{1}{\frac{1}{2}-\frac{1}{2}\left(1+\frac{1}{z}\right)^{-i}\left(\frac{z-1}{z}\right)^{i}}-1$$

01.22.16.0087.01

$$\coth\left(a\coth^{-1}(z)\right) = \frac{1}{\frac{1}{2}-\frac{1}{2}\left(1+\frac{1}{z}\right)^{-a}\left(1-\frac{1}{z}\right)^{a}}-1$$

01.22.16.0028.01

$$\coth\left(n\coth^{-1}(z)\right) = \frac{(z-1)^n+(z+1)^n}{(z+1)^n-(z-1)^n} \;/;\; n\in\mathbb{N}^+$$

Involving csch^{-1}

01.22.16.0014.01

$$\coth\left(\text{csch}^{-1}(z)\right) = z\sqrt{1+\frac{1}{z^2}}$$

01.22.16.0026.01

$$\coth\left(\frac{1}{2}\text{csch}^{-1}(z)\right) = z\left(\sqrt{1+\frac{1}{z^2}}+1\right)$$

01.22.16.0088.01

$$\coth\left(i\,\text{csch}^{-1}(z)\right) = \frac{1}{1-\frac{2}{\left(\sqrt{1+\frac{1}{z^2}}+\frac{1}{z}\right)^{2i}+1}}$$

01.22.16.0089.01

$$\coth\left(a\,\text{csch}^{-1}(z)\right) = \frac{1}{1-\frac{2}{\left(\sqrt{1+\frac{1}{z^2}}+\frac{1}{z}\right)^{2a}+1}}$$

Involving sech^{-1}

01.22.16.0015.01

$$\coth\left(\text{sech}^{-1}(z)\right) = \frac{1}{1-z}\sqrt{\frac{1-z}{1+z}}$$

01.22.16.0027.01

$$\coth\left(\frac{1}{2}\text{sech}^{-1}(z)\right) = \frac{z}{\sqrt{-z}}\sqrt{\frac{1}{z}}\sqrt{\frac{z+1}{z-1}}$$

01.22.16.0090.01

$$\coth\left(i \operatorname{sech}^{-1}(z)\right) = \frac{1}{1 - \frac{2}{\left(\sqrt{\frac{1}{z}-1}\,\sqrt{1+\frac{1}{z}}+\frac{1}{z}\right)^{2i}+1}}$$

01.22.16.0091.01

$$\coth\left(a \operatorname{sech}^{-1}(z)\right) = \frac{1}{1 - \frac{2}{\left(\sqrt{\frac{1}{z}-1}\,\sqrt{1+\frac{1}{z}}+\frac{1}{z}\right)^{2a}+1}}$$

Addition formulas

01.22.16.0029.01

$$\coth(a+b) = \frac{\coth(a)\coth(b)+1}{\coth(a)+\coth(b)}$$

01.22.16.0030.01

$$\coth\left(a+\frac{i\pi}{4}\right) = \frac{(1-i\coth(a))\,i}{i\coth(a)+1}$$

01.22.16.0031.01

$$\coth(a-b) = \frac{1-\coth(a)\coth(b)}{\coth(a)-\coth(b)}$$

01.22.16.0032.01

$$\coth\left(a-\frac{i\pi}{4}\right) = \frac{(i\coth(a)+1)\,i}{i\coth(a)-1}$$

01.22.16.0033.01

$$\coth(a+b\,i) = \frac{\sinh(2a)-i\sin(2b)}{\cosh(2a)-\cos(2b)}$$

01.22.16.0034.01

$$\coth(a-i\,b) = \frac{i\sin(2b)+\sinh(2a)}{\cosh(2a)-\cos(2b)}$$

01.22.16.0035.01

$$\coth(z_1+z_2+z_3) = \frac{\coth(z_2)\coth(z_3)\coth(z_1)+\coth(z_1)+\coth(z_2)+\coth(z_3)}{\coth(z_1)\coth(z_2)+\coth(z_3)\coth(z_2)+\coth(z_1)\coth(z_3)+1}$$

Half-angle formulas

01.22.16.0036.01

$$\coth\left(\frac{z}{2}\right) = \coth(z)+\operatorname{csch}(z)$$

01.22.16.0037.01

$$\coth\left(\frac{z}{2}\right) = \frac{\sinh(z)}{\cosh(z)-1}$$

01.22.16.0038.01

$$\coth\left(\frac{z}{2}\right) == z\sqrt{\frac{1}{z^2}}\sqrt{\frac{\cosh(z)+1}{\cosh(z)-1}}$$

01.22.16.0039.01

$$\coth\left(\frac{z}{2}\right) == \frac{\sqrt{-z^2}}{z}\sqrt{\frac{1+\cosh(z)}{1-\cosh(z)}} \text{ /; } 0 < |\mathrm{Im}(z)| < \pi$$

Multiple arguments

Argument involving numeric multiples of variable

01.22.16.0040.01

$$\coth(2z) == \frac{1}{2}(\coth(z)+\tanh(z))$$

01.22.16.0041.01

$$\coth(3z) == \frac{\coth^3(z)+3\coth(z)}{3\coth^2(z)+1}$$

Argument involving symbolic multiples of variable

01.22.16.0042.01

$$\coth(nz) == \frac{1}{n}\sum_{k=0}^{n-1}\coth\left(z+\frac{\pi\, i\, k}{n}\right) \text{ /; } n \in \mathbb{N}^+$$

01.22.16.0043.01

$$\coth(nz) == \frac{T_n(\cosh(z))}{\sinh(z)\, U_{n-1}(\cosh(z))}$$

01.22.16.0053.01

$$\coth(nz) == \frac{\sum_{k=0}^{\left\lfloor \frac{n}{2} \right\rfloor}\binom{n}{2k}\coth^{n-2k}(z)}{\sum_{k=0}^{\left\lfloor \frac{n-1}{2} \right\rfloor}\binom{n}{2k+1}\coth^{n-(2k+1)}(z)} \text{ /; } n \in \mathbb{N}^+$$

Roger Germundsson

Products, sums, and powers of the direct function

Products of the direct function

01.22.16.0044.01

$$\coth(a)\coth(b) == \frac{\cosh(a-b)+\cosh(a+b)}{\cosh(a+b)-\cosh(a-b)}$$

Products involving the direct function

01.22.16.0045.01

$$\coth(a)\tanh(b) == \frac{\sinh(a+b)-\sinh(a-b)}{\sinh(a-b)+\sinh(a+b)}$$

Sums of the direct function

01.22.16.0046.01

$$\coth(a) + \coth(b) = \operatorname{csch}(a)\operatorname{csch}(b)\sinh(a+b)$$

01.22.16.0047.01

$$\coth(a) - \coth(b) = -\operatorname{csch}(a)\operatorname{csch}(b)\sinh(a-b)$$

Sums involving the direct function

Involving other hyperbolic functions

Involving tanh

01.22.16.0054.01

$$\coth(z) + \tanh(z) = \cosh(2z)\operatorname{csch}(z)\operatorname{sech}(z)$$

01.22.16.0055.01

$$\coth(z) - \tanh(z) = \operatorname{csch}(z)\operatorname{sech}(z)$$

01.22.16.0048.01

$$\coth(a) + \tanh(b) = \cosh(a+b)\operatorname{csch}(a)\operatorname{sech}(b)$$

01.22.16.0049.01

$$\coth(a) - \tanh(b) = \cosh(a-b)\operatorname{csch}(a)\operatorname{sech}(b)$$

Involving trigonometric functions

Involving tan

01.22.16.0056.01

$$\coth(z) + i\tan(z) = \cosh\left(\sqrt{2}\, e^{\frac{i\pi}{4}} z\right)\operatorname{csch}(z)\sec(z)$$

01.22.16.0057.01

$$\coth(z) - i\tan(z) = \cosh\left(\sqrt{2}\, e^{-\frac{1}{4}(i\pi)} z\right)\operatorname{csch}(z)\sec(z)$$

01.22.16.0058.01

$$\coth(a) + i\tan(b) = \cosh(a + b\,i)\operatorname{csch}(a)\sec(b)$$

01.22.16.0059.01

$$\coth(a) - i\tan(b) = \cosh(a - i\,b)\operatorname{csch}(a)\sec(b)$$

Involving cot

01.22.16.0060.01

$$\coth(z) + i\cot(z) = \csc(z)\operatorname{csch}(z)\sin\left(\sqrt{2}\, e^{\frac{i\pi}{4}} z\right)$$

01.22.16.0061.01

$$\coth(z) - i\cot(z) = \csc(z)\operatorname{csch}(z)\sin\left(\sqrt{2}\, e^{-\frac{i\pi}{4}} z\right)$$

01.22.16.0062.01

$$\coth(a) + i\cot(b) = \csc(b)\operatorname{csch}(a)\sin(b + a\,i)$$

01.22.16.0063.01

$$\coth(a) - i\cot(b) = \csc(b)\operatorname{csch}(a)\sin(b - a\,i)$$

Powers of the direct function

01.22.16.0050.01

$$\coth^2(z) = \frac{\cosh(2z) + 1}{\cosh(2z) - 1}$$

01.22.16.0051.01

$$\coth^3(z) = \frac{3\cosh(z) + \cosh(3z)}{\sinh(3z) - 3\sinh(z)}$$

Powers involving the direct function

01.22.16.0052.01

$$\coth^2(a) - \coth^2(b) = -\operatorname{csch}^2(a)\operatorname{csch}^2(b)\sinh(a - b)\sinh(a + b)$$

Identities

Functional identities

01.22.17.0001.01

$$\coth(z)\coth(2z) = \frac{1}{2}\left(\coth^2(z) + 1\right)$$

Complex characteristics

Real part

01.22.19.0001.01

$$\operatorname{Re}(\coth(x + i\,y)) = -\frac{\sinh(2x)}{\cos(2y) - \cosh(2x)}$$

01.22.19.0007.01

$$\operatorname{Re}(\coth(z)) = -\frac{\sinh(2\operatorname{Re}(z))}{\cos(2\operatorname{Im}(z)) - \cosh(2\operatorname{Re}(z))}$$

Imaginary part

01.22.19.0002.01

$$\operatorname{Im}(\coth(x + i\,y)) = \frac{\sin(2y)}{\cos(2y) - \cosh(2x)}$$

01.22.19.0008.01

$$\operatorname{Im}(\coth(z)) = \frac{\sin(2\operatorname{Im}(z))}{\cos(2\operatorname{Im}(z)) - \cosh(2\operatorname{Re}(z))}$$

Absolute value

01.22.19.0003.01

$$|\coth(x + i\, y)| = \sqrt{-\frac{\cos(2\, y) + \cosh(2\, x)}{\cos(2\, y) - \cosh(2\, x)}}$$

01.22.19.0009.01

$$|\coth(z)| = \sqrt{-\frac{\cos(2\, \mathrm{Im}(z)) + \cosh(2\, \mathrm{Re}(z))}{\cos(2\, \mathrm{Im}(z)) - \cosh(2\, \mathrm{Re}(z))}}$$

Argument

01.22.19.0004.01

$$\arg(\coth(x + i\, y)) = \tan^{-1}\left(-\frac{\sinh(2\, x)}{\cos(2\, y) - \cosh(2\, x)}, \frac{\sin(2\, y)}{\cos(2\, y) - \cosh(2\, x)}\right)$$

01.22.19.0010.01

$$\arg(\coth(x + i\, y)) = \frac{1}{2}\left(\mathrm{sgn}\left(\frac{\mathrm{sgn}(\sin(2\, y))}{\mathrm{sgn}(\cos(2\, y) - \cosh(2\, x))} + \frac{1}{2}\right)\left(\pi - \frac{\pi\, \mathrm{sgn}(\sinh(2\, x))}{\mathrm{sgn}(\cosh(2\, x) - \cos(2\, y))}\right) - 2\tan^{-1}(\mathrm{csch}(2\, x) \sin(2\, y))\right)$$

01.22.19.0011.01

$$\arg(\coth(z)) = \tan^{-1}\left(-\frac{\sinh(2\, \mathrm{Re}(z))}{\cos(2\, \mathrm{Im}(z)) - \cosh(2\, \mathrm{Re}(z))}, \frac{\sin(2\, \mathrm{Im}(z))}{\cos(2\, \mathrm{Im}(z)) - \cosh(2\, \mathrm{Re}(z))}\right)$$

01.22.19.0005.01

$$\arg(\coth(z)) = \frac{1}{2}\left(\mathrm{sgn}\left(\frac{\mathrm{sgn}(\sin(2\, \mathrm{Im}(z)))}{\mathrm{sgn}(\cos(2\, \mathrm{Im}(z)) - \cosh(2\, \mathrm{Re}(z)))} + \frac{1}{2}\right)\left(\pi - \frac{\pi\, \mathrm{sgn}(\sinh(2\, \mathrm{Re}(z)))}{\mathrm{sgn}(\cosh(2\, \mathrm{Re}(z)) - \cos(2\, \mathrm{Im}(z)))}\right) - 2\tan^{-1}(\mathrm{csch}(2\, \mathrm{Re}(z)) \sin(2\, \mathrm{Im}(z)))\right)$$

Conjugate value

01.22.19.0006.01

$$\overline{\coth(x + i\, y)} = \frac{\sinh(2\, x) + i\, \sin(2\, y)}{\cosh(2\, x) - \cos(2\, y)}$$

01.22.19.0012.01

$$\overline{\coth(z)} = -\frac{i\, \sin(2\, \mathrm{Im}(z)) + \sinh(2\, \mathrm{Re}(z))}{\cos(2\, \mathrm{Im}(z)) - \cosh(2\, \mathrm{Re}(z))}$$

Signum value

01.22.19.0013.01

$$\mathrm{sgn}(\coth(x + i\, y)) = \frac{\sinh(2\, x) - i\, \sin(2\, y)}{\sqrt{\cosh^2(2\, x) - \cos^2(2\, y)}}$$

01.22.19.0014.01

$$\mathrm{sgn}(\coth(z)) = \frac{\sinh(2\, \mathrm{Re}(z)) - i\, \sin(2\, \mathrm{Im}(z))}{\sqrt{\cosh^2(2\, \mathrm{Re}(z)) - \cos^2(2\, \mathrm{Im}(z))}}$$

Differentiation

Low-order differentiation

01.22.20.0001.01

$$\frac{\partial \coth(z)}{\partial z} = -\operatorname{csch}^2(z)$$

01.22.20.0002.01

$$\frac{\partial^2 \coth(z)}{\partial z^2} = 2\coth(z)\operatorname{csch}^2(z)$$

Symbolic differentiation

01.22.20.0003.01

$$\frac{\partial^n \coth(z)}{\partial z^n} = (-1)^n n!\, z^{-n-1} + \sum_{k=1}^{\infty} \frac{2^{2k-1} B_{2k} z^{2k-n-1}}{k(2k-n-1)!} \;/;\; |z| < \pi \bigwedge n \in \mathbb{N}^+$$

01.22.20.0004.01

$$\frac{\partial^n \coth(z)}{\partial z^n} = \coth(z)\,\delta_n + \operatorname{csch}^2(z)\,\delta_{n-1} - n(-i)^n \sum_{k=0}^{n-1}\sum_{j=0}^{k-1} \frac{(-1)^{j+k}(k-j)^{n-1}\sinh^{-2k-2}(z)\,2^{n-2k}}{k+1}\binom{n-1}{k}\binom{2k}{j}\sinh\left(\frac{i\pi n}{2} + 2(k-j)z\right) \;/;\; n \in \mathbb{N}$$

01.22.20.0006.01

$$\frac{\partial^n \coth(z)}{\partial z^n} = \delta_n + 2^n(\coth(z)-1)\sum_{k=0}^{n} \frac{(-1)^k k!\, \mathcal{S}_n^{(k)}}{2^k}(\coth(z)+1)^k \;/;\; n \in \mathbb{N}$$

Victor Adamchik (2005)

Fractional integro-differentiation

01.22.20.0005.01

$$\frac{\partial^\alpha \coth(z)}{\partial z^\alpha} = \mathcal{FC}_{\exp}^{(\alpha)}(z,-1)\, z^{-\alpha-1} + \sum_{k=1}^{\infty} \frac{2^{2k-1} B_{2k} z^{2k-\alpha-1}}{\Gamma(2k-\alpha)\,k} \;/;\; |z| < \pi$$

01.22.20.0007.01

$$\coth^{(\alpha)}(c z) = i^{\alpha+1}\pi^{-\alpha-1}\left((-i c z)^\alpha (i c z)^{-\alpha}\psi^{(\alpha)}\left(-\frac{i c z}{\pi}\right) - \psi^{(\alpha)}\left(\frac{i c z}{\pi}\right)\right) + i^{\alpha+1}\lim_{\nu\to\alpha}\frac{(i c z)^{-\nu-1}}{\Gamma(-\nu)}(2\log(\pi) - \log(-i c z) + \psi(-\nu) + \gamma)$$

Integration

Indefinite integration

Involving only one direct function

01.22.21.0013.01

$$\int \coth(b + a z)\, dz = \frac{\log(\sinh(b + a z))}{a}$$

01.22.21.0014.01

$$\int \coth(a\,z)\,dz = \frac{\log(\sinh(a\,z))}{a}$$

01.22.21.0015.01

$$\int \coth(z)\,dz = \log(\sinh(z))$$

Involving one direct function and elementary functions

Involving power function

Involving power

Involving z^n and linear arguments

01.22.21.0016.01

$$\int z\coth(b+a\,z)\,dz = \frac{1}{2\,a^2}\Big(a^2\,z^2 + 2\,a\,b\,z + 2\,a\log\big(1-e^{-2\,(b+a\,z)}\big)\,z + \pi\,i\,a\,z - i\,\pi\log\big(1+e^{2\,a\,z}\big) + 2\,b\log\big(1-e^{-2\,(b+a\,z)}\big) + i\,\pi\log(\cosh(a\,z)) - 2\,b\log(i\sinh(b+a\,z)) - \text{Li}_2\big(e^{-2\,(b+a\,z)}\big)\Big)$$

01.22.21.0017.01

$$\int z^n\coth(a\,z)\,dz = -\frac{z^{n+1}}{n+1} - 2\,e^{2\,a\,z}\,n!\sum_{j=0}^{n}\frac{(-1)^j\,2^{-j-1}\,a^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\big(1,\,\ldots,\,1,\,1;\,2,\,\ldots,\,2;\,e^{2\,a\,z}\big)\;/;\;n\in\mathbb{N}$$

01.22.21.0018.01

$$\int z\coth(a\,z)\,dz = \frac{a\,z\left(a\,z+2\log\big(1-e^{-2\,a\,z}\big)\right) - \text{Li}_2\big(e^{-2\,a\,z}\big)}{2\,a^2}$$

01.22.21.0019.01

$$\int z^2\coth(a\,z)\,dz = \frac{-8\,a^3\,z^3 + 24\,a^2\log\big(1-e^{2\,a\,z}\big)\,z^2 + 24\,a\,\text{Li}_2\big(e^{2\,a\,z}\big)\,z + i\,\pi^3 - 12\,\text{Li}_3\big(e^{2\,a\,z}\big)}{24\,a^3}$$

01.22.21.0020.01

$$\int z^3\coth(a\,z)\,dz = \frac{-16\,a^4\,z^4 + 64\,a^3\log\big(1-e^{2\,a\,z}\big)\,z^3 + 96\,a^2\,\text{Li}_2\big(e^{2\,a\,z}\big)\,z^2 - 96\,a\,\text{Li}_3\big(e^{2\,a\,z}\big)\,z + \pi^4 + 48\,\text{Li}_4\big(e^{2\,a\,z}\big)}{64\,a^4}$$

01.22.21.0021.01

$$\int z^4\coth(a\,z)\,dz = -\frac{z^5}{5} + \frac{\log\big(1-e^{2\,a\,z}\big)\,z^4}{a} + \frac{2\,\text{Li}_2\big(e^{2\,a\,z}\big)\,z^3}{a^2} - \frac{3\,\text{Li}_3\big(e^{2\,a\,z}\big)\,z^2}{a^3} + \frac{3\,\text{Li}_4\big(e^{2\,a\,z}\big)\,z}{a^4} - \frac{3\,\text{Li}_5\big(e^{2\,a\,z}\big)}{2\,a^5} - \frac{i\,\pi^5}{160\,a^5}$$

Involving exponential function

Involving exp

Involving $a^{b\,z}$

01.22.21.0022.01

$$\int a^{bz}\coth(cz)\,dz = -\frac{1}{b\log(a)\,(2c+b\log(a))}\left(a^{bz}\left(b\,e^{2cz}\,{}_2F_1\!\left(\frac{b\log(a)}{2c}+1,1;\frac{b\log(a)}{2c}+2;e^{2cz}\right)\log(a)+{}_2F_1\!\left(\frac{b\log(a)}{2c},1;\frac{b\log(a)}{2c}+1;e^{2cz}\right)(2c+b\log(a))\right)\right)$$

01.22.21.0023.01

$$\int e^{bz}\coth(az)\,dz = -\frac{e^{bz}}{b\,(2a+b)}\left((2a+b)\,{}_2F_1\!\left(\frac{b}{2a},1;\frac{b}{2a}+1;e^{2az}\right)+b\,e^{2az}\,{}_2F_1\!\left(\frac{b}{2a}+1,1;\frac{b}{2a}+2;e^{2az}\right)\right)$$

01.22.21.0024.01

$$\int e^{-az}\coth(az)\,dz = \frac{\log(-1+e^{-az})+e^{-az}-\log(1+e^{-az})}{a}$$

01.22.21.0025.01

$$\int e^{az}\coth(az)\,dz = \frac{\log(-1+e^{az})+e^{az}-\log(1+e^{az})}{a}$$

Involving exponential function and a power function

Involving exp and power

Involving $z^n\, e^{bz}$

01.22.21.0026.01

$$\int z^n\,e^{bz}\coth(cz)\,dz = -n!\left(e^{bz}\sum_{j=0}^{n}\frac{(-1)^j\,b^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\!\left(\frac{b}{2c},\ldots,\frac{b}{2c},1;\frac{b}{2c}+1,\ldots,\frac{b}{2c}+1;e^{2cz}\right)+e^{(b+2c)z}\sum_{j=0}^{n}\frac{(-1)^j\,(b+2c)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\!\left(\frac{b}{2c}+1,\ldots,\frac{b}{2c}+1,1;\frac{b}{2c}+2,\ldots,\frac{b}{2c}+2;e^{2cz}\right)\right)/;\,n\in\mathbb{N}$$

Arguments involving inverse trigonometric functions

Involving $\sin^{-1}$

01.22.21.0027.01

$$\int \coth\!\left(\sin^{-1}(z)\right)dz = \frac{1}{10}\,e^{-i\sin^{-1}(z)}\left(5\,e^{2i\sin^{-1}(z)}\,i\,{}_2F_1\!\left(\frac{i}{2},1;1+\frac{i}{2};e^{2\sin^{-1}(z)}\right)-5\,i\,{}_2F_1\!\left(-\frac{i}{2},1;1-\frac{i}{2};e^{2\sin^{-1}(z)}\right)-(2-i)\,e^{(2+2i)\sin^{-1}(z)}\,{}_2F_1\!\left(1+\frac{i}{2},1;2+\frac{i}{2};e^{2\sin^{-1}(z)}\right)-(2+i)\,e^{2\sin^{-1}(z)}\,{}_2F_1\!\left(1-\frac{i}{2},1;2-\frac{i}{2};e^{2\sin^{-1}(z)}\right)\right)$$

Involving $\cos^{-1}$

01.22.21.0028.01

$$\int \coth\left(\cos^{-1}(z)\right) dz = \frac{1}{10} e^{-i\cos^{-1}(z)} \left(-5 e^{2 i \cos^{-1}(z)} {}_2F_1\left(\frac{i}{2}, 1; 1+\frac{i}{2}; e^{2\cos^{-1}(z)}\right) - 5\, {}_2F_1\left(-\frac{i}{2}, 1; 1-\frac{i}{2}; e^{2\cos^{-1}(z)}\right) - (1+2i) e^{(2+2i)\cos^{-1}(z)} {}_2F_1\left(1+\frac{i}{2}, 1; 2+\frac{i}{2}; e^{2\cos^{-1}(z)}\right) - (1-2i) e^{2\cos^{-1}(z)} {}_2F_1\left(1-\frac{i}{2}, 1; 2-\frac{i}{2}; e^{2\cos^{-1}(z)}\right)\right)$$

Arguments involving inverse hyperbolic functions

Involving $\sinh^{-1}$

01.22.21.0029.01

$$\int \coth\left(\sinh^{-1}(z)\right) dz = \log(z) - \log\left(\sqrt{z^2+1} + 1\right) + \sqrt{z^2+1}$$

01.22.21.0030.01

$$\int \coth\left(a \sinh^{-1}(z)\right) dz = -\frac{1}{8a^2-2} \left(e^{-2\sinh^{-1}(z)} \left((2a-1)\left((2a+1) e^{\sinh^{-1}(z)} \left(e^{2\sinh^{-1}(z)} {}_2F_1\left(\frac{1}{2a}, 1; 1+\frac{1}{2a}; e^{2a\sinh^{-1}(z)}\right) - {}_2F_1\left(-\frac{1}{2a}, 1; 1-\frac{1}{2a}; e^{2a\sinh^{-1}(z)}\right)\right) + e^{(2a+3)\sinh^{-1}(z)} {}_2F_1\left(1+\frac{1}{2a}, 1; 2+\frac{1}{2a}; e^{2a\sinh^{-1}(z)}\right)\right) + (2a+1) e^{2a\sinh^{-1}(z)+\sinh^{-1}(z)} {}_2F_1\left(1-\frac{1}{2a}, 1; 2-\frac{1}{2a}; e^{2a\sinh^{-1}(z)}\right)\right)\right)$$

Involving $\cosh^{-1}$

01.22.21.0031.01

$$\int \coth\left(\cosh^{-1}(z)\right) dz = \sqrt{z-1}\, \sqrt{z+1}$$

01.22.21.0032.01

$$\int \coth\left(a \cosh^{-1}(z)\right) dz = \frac{1}{8a^2-2} \left(e^{-2\cosh^{-1}(z)} \left((2a+1) e^{2a\cosh^{-1}(z)+\cosh^{-1}(z)} {}_2F_1\left(1-\frac{1}{2a}, 1; 2-\frac{1}{2a}; e^{2a\cosh^{-1}(z)}\right) - (2a-1)\left((2a+1) e^{\cosh^{-1}(z)} \left(e^{2\cosh^{-1}(z)} {}_2F_1\left(\frac{1}{2a}, 1; 1+\frac{1}{2a}; e^{2a\cosh^{-1}(z)}\right) + {}_2F_1\left(-\frac{1}{2a}, 1; 1-\frac{1}{2a}; e^{2a\cosh^{-1}(z)}\right)\right) + e^{(2a+3)\cosh^{-1}(z)} {}_2F_1\left(1+\frac{1}{2a}, 1; 2+\frac{1}{2a}; e^{2a\cosh^{-1}(z)}\right)\right)\right)\right)$$

Involving $\tanh^{-1}$

01.22.21.0033.01

$$\int \coth\left(\tanh^{-1}(z)\right) dz = \log(z)$$

Involving $\coth^{-1}$

01.22.21.0034.01

$$\int \coth\left(\coth^{-1}(z)\right) dz = \frac{z^2}{2}$$

Involving csch^{-1}

01.22.21.0035.01

$$\int \coth\left(\operatorname{csch}^{-1}(z)\right) dz = \frac{\sqrt{1+\frac{1}{z^2}}\; z\left(\sqrt{z^2+1}\; z + \sinh^{-1}(z)\right)}{2\sqrt{z^2+1}}$$

Involving sech^{-1}

01.22.21.0036.01

$$\int \coth\left(\operatorname{sech}^{-1}(z)\right) dz = \sqrt{\frac{1}{z+1}}\; \sqrt{z+1}\; \tan^{-1}\left(\frac{z}{\sqrt{1-z^2}}\right)$$

Involving trigonometric functions

Involving sin

Involving $\sin(b z)$

01.22.21.0037.01

$$\int \sin(b z) \coth(c z)\, dz = \frac{1}{2\left(b^3+4c^2 b\right)}\left(e^{-i b z}\left(\left(4c^2+b^2\right) e^{2 i b z}\, {}_2F_1\left(\frac{i b}{2c}, 1; 1+\frac{i b}{2c}; e^{2 c z}\right) + \left(4c^2+b^2\right) {}_2F_1\left(-\frac{i b}{2c}, 1; 1-\frac{i b}{2c}; e^{2 c z}\right) + b\left((b+2 i c) e^{2(c+i b) z}\, {}_2F_1\left(1+\frac{i b}{2c}, 1; 2+\frac{i b}{2c}; e^{2 c z}\right) + (b-2 i c) e^{2 c z}\, {}_2F_1\left(1-\frac{i b}{2c}, 1; 2-\frac{i b}{2c}; e^{2 c z}\right)\right)\right)\right)$$

Involving power of sin

Involving $\sin^m(b z)$

01.22.21.0038.01

$$\int \sin^m(b\,z)\coth(c\,z)\,dz = \frac{2^{-m}\,(1 - m \bmod 2)\log(\sinh(c\,z))}{c}\binom{m}{\frac{m}{2}} + 2^{-m}\,i^{1-m}\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^s\binom{m}{s}\Bigg(\Bigg(e^{i\,b\,(m-2\,s)\,z}\left((2\,c + b\,i\,(m-2\,s))\,{}_2F_1\!\left(\frac{i\,b\,(m-2\,s)}{2\,c}, 1; \frac{b\,i\,(m-2\,s)}{2\,c} + 1; e^{2\,c\,z}\right) + b\,e^{2\,c\,z}\,i\,(m-2\,s)\,{}_2F_1\!\left(\frac{b\,i\,(m-2\,s)}{2\,c} + 1, 1; \frac{b\,i\,(m-2\,s)}{2\,c} + 2; e^{2\,c\,z}\right)\right)\Bigg)\Big/(b\,(m-2\,s)\,(2\,c + b\,i\,(m-2\,s))) - \left((-1)^m\,e^{-i\,b\,(m-2\,s)\,z}\left((2\,c - i\,b\,(m-2\,s))\,{}_2F_1\!\left(-\frac{i\,b\,(m-2\,s)}{2\,c}, 1; 1 - \frac{i\,b\,(m-2\,s)}{2\,c}; e^{2\,c\,z}\right) - i\,b\,e^{2\,c\,z}\,(m-2\,s)\,{}_2F_1\!\left(1 - \frac{i\,b\,(m-2\,s)}{2\,c}, 1; 2 - \frac{i\,b\,(m-2\,s)}{2\,c}; e^{2\,c\,z}\right)\right)\right)\Big/(b\,(m-2\,s)\,(2\,c - i\,b\,(m-2\,s)))\Bigg)\; /;\; m \in \mathbb{N}^+$$

Involving cos

Involving cos($b\,z$)

01.22.21.0039.01

$$\int \cos(b\,z)\coth(c\,z)\,dz = \frac{1}{2\left(b^3 + 4\,c^2\,b\right)}\Bigg(i\,e^{-i\,b\,z}\Bigg(\left(4\,c^2 + b^2\right)e^{2\,i\,b\,z}\,{}_2F_1\!\left(\frac{i\,b}{2\,c}, 1; 1 + \frac{i\,b}{2\,c}; e^{2\,c\,z}\right) - \left(4\,c^2 + b^2\right){}_2F_1\!\left(-\frac{i\,b}{2\,c}, 1; 1 - \frac{i\,b}{2\,c}; e^{2\,c\,z}\right) + b\left((b + 2\,i\,c)\,e^{2\,(c+i\,b)\,z}\,{}_2F_1\!\left(1 + \frac{i\,b}{2\,c}, 1; 2 + \frac{i\,b}{2\,c}; e^{2\,c\,z}\right) + (2\,c + i\,b)\,e^{2\,c\,z}\,i\,{}_2F_1\!\left(1 - \frac{i\,b}{2\,c}, 1; 2 - \frac{i\,b}{2\,c}; e^{2\,c\,z}\right)\right)\Bigg)\Bigg)$$

Involving power of cos

Involving $\cos^m(b\,z)$

01.22.21.0040.01

$$\int \cos^m(b\,z)\coth(c\,z)\,dz = \frac{2^{-m}\log(\sinh(c\,z))\binom{m}{\frac{m}{2}}(1 - m \bmod 2)}{c} + 2^{-m}\,i\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{s}\Bigg(\Bigg(e^{i\,b\,(m-2\,s)\,z}\left((2\,c + b\,i\,(m-2\,s))\,{}_2F_1\!\left(\frac{i\,b\,(m-2\,s)}{2\,c}, 1; \frac{b\,i\,(m-2\,s)}{2\,c} + 1; e^{2\,c\,z}\right) + b\,e^{2\,c\,z}\,i\,(m-2\,s)\,{}_2F_1\!\left(\frac{b\,i\,(m-2\,s)}{2\,c} + 1, 1; \frac{b\,i\,(m-2\,s)}{2\,c} + 2; e^{2\,c\,z}\right)\right)\Bigg)\Big/(b\,(m-2\,s)\,(2\,c + b\,i\,(m-2\,s))) - \left(e^{-i\,b\,(m-2\,s)\,z}\left((2\,c - i\,b\,(m-2\,s))\,{}_2F_1\!\left(-\frac{i\,b\,(m-2\,s)}{2\,c}, 1; 1 - \frac{i\,b\,(m-2\,s)}{2\,c}; e^{2\,c\,z}\right) - i\,b\,e^{2\,c\,z}\,(m-2\,s)\,{}_2F_1\!\left(1 - \frac{i\,b\,(m-2\,s)}{2\,c}, 1; 2 - \frac{i\,b\,(m-2\,s)}{2\,c}; e^{2\,c\,z}\right)\right)\right)\Big/(b\,(m-2\,s)\,(2\,c - i\,b\,(m-2\,s)))\Bigg)\; /;\; m \in \mathbb{N}^+$$

Involving trigonometric and a power functions

Involving sin and power

Involving $z^n \sin(a + b z) \coth(c z)$

01.22.21.0041.01

$$\int z^n \sin(a+bz)\coth(cz)\,dz = \frac{1}{2}\,i\,n!\left(e^{-ia-ibz}\sum_{j=0}^{n}\frac{(ib)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(-\frac{ib}{2c},\ldots,-\frac{ib}{2c},1;1-\frac{ib}{2c},\ldots,1-\frac{ib}{2c};e^{2cz}\right)-\right.$$
$$e^{-ia+(2c-ib)z}\sum_{j=0}^{n}\frac{(-1)^j(2c-ib)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c-ib}{2c},\ldots,\frac{2c-ib}{2c},1;\frac{2c-ib}{2c}+1,\ldots,\frac{2c-ib}{2c}+1;e^{2cz}\right)+$$
$$e^{ia+ibz}\sum_{j=0}^{n}\frac{(-1)^j(ib)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ib}{2c},\ldots,\frac{ib}{2c},1;\frac{ib}{2c}+1,\ldots,\frac{ib}{2c}+1;e^{2cz}\right)+e^{ia+(2c+ib)z}$$
$$\left.\sum_{j=0}^{n}\frac{(-1)^j(2c+ib)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c+ib}{2c},\ldots,\frac{2c+ib}{2c},1;\frac{2c+ib}{2c}+1,\ldots,\frac{2c+ib}{2c}+1;e^{2cz}\right)\right)/;\,n\in\mathbb{N}$$

01.22.21.0042.01

$$\int z^n \sin(bz)\coth(cz)\,dz = \frac{1}{2}\,i\,n!\left(e^{-ibz}\sum_{j=0}^{n}\frac{(ib)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(-\frac{ib}{2c},\ldots,-\frac{ib}{2c},1;1-\frac{ib}{2c},\ldots,1-\frac{ib}{2c};e^{2cz}\right)-\right.$$
$$e^{(2c-ib)z}\sum_{j=0}^{n}\frac{(-1)^j(2c-ib)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c-ib}{2c},\ldots,\frac{2c-ib}{2c},1;\frac{2c-ib}{2c}+1,\ldots,\frac{2c-ib}{2c}+1;e^{2cz}\right)+$$
$$e^{ibz}\sum_{j=0}^{n}\frac{(-1)^j(ib)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ib}{2c},\ldots,\frac{ib}{2c},1;\frac{ib}{2c}+1,\ldots,\frac{ib}{2c}+1;e^{2cz}\right)+e^{(2c+ib)z}$$
$$\left.\sum_{j=0}^{n}\frac{(-1)^j(2c+ib)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c+ib}{2c},\ldots,\frac{2c+ib}{2c},1;\frac{2c+ib}{2c}+1,\ldots,\frac{2c+ib}{2c}+1;e^{2cz}\right)\right)/;\,n\in\mathbb{N}$$

Involving powers of sin and power

Involving z^n sih$^m(b z) \coth(c z)$

01.22.21.0043.01

$$\int z^n \sin^m(b z)\coth(c z)\,dz = -n!\left(\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(e^{i b (m-2k) z}\sum_{j=0}^{n}\frac{(-1)^j (i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{i b (m-2k)}{2c},\ldots,\frac{i b (m-2k)}{2c},1;\frac{i b (m-2k)}{2c}+1,\ldots,\frac{i b (m-2k)}{2c}+1;e^{2cz}\right)+(-1)^m\left(e^{-i b (m-2k) z}\sum_{j=0}^{n}\frac{(-1)^j (-i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(-\frac{i b (m-2k)}{2c},\ldots,-\frac{i b (m-2k)}{2c},1;1-\frac{i b (m-2k)}{2c},\ldots,1-\frac{i b (m-2k)}{2c};e^{2cz}\right)+e^{(2c-i b (m-2k)) z}\sum_{j=0}^{n}\frac{(-1)^j (2c-i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c-i b (m-2k)}{2c},\ldots,\frac{2c-i b (m-2k)}{2c},1;\frac{2c-i b (m-2k)}{2c}+1,\ldots,\frac{2c-i b (m-2k)}{2c}+1;e^{2cz}\right)\right)+e^{(2c+b i (m-2k)) z}\sum_{j=0}^{n}\frac{(-1)^j (2c+b i (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c+i b (m-2k)}{2c},\ldots,\frac{2c+i b (m-2k)}{2c},1;\frac{2c+i b (m-2k)}{2c}+1,\ldots,\frac{2c+i b (m-2k)}{2c}+1;e^{2cz}\right)\right)\right)(2i)^{-m} - 2^{-m}\binom{m}{\frac{m}{2}} n!\,(1-m \bmod 2)\left(\frac{z^{n+1}}{(n+1)!}+2e^{2cz}\sum_{j=0}^{n}\frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}(1,\ldots,1;2,\ldots,2;e^{2cz})\right)\,/;\, n\in\mathbb{N}\land m\in\mathbb{N}^+$$

Involving cos and power

Involving $z^n \cos(a+b z)\coth(c z)$

01.22.21.0044.01

$$\int z^n \cos(a+b\,z)\coth(c\,z)\,dz = -\frac{1}{2}\,n!\left(e^{-i\,a-i\,b\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(-\frac{i\,b}{2\,c},\,\ldots,\,-\frac{i\,b}{2\,c},\,1;\,1-\frac{i\,b}{2\,c},\,\ldots,\,1-\frac{i\,b}{2\,c};\,e^{2\,c\,z}\right)+e^{-i\,a+(2\,c-i\,b)\,z}\right.$$
$$\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c-i\,b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{-i\,b+2\,c}{2\,c},\,\ldots,\,\frac{-i\,b+2\,c}{2\,c},\,1;\,\frac{-i\,b+2\,c}{2\,c}+1,\,\ldots,\,\frac{-i\,b+2\,c}{2\,c}+1;\,e^{2\,c\,z}\right)+$$
$$e^{i\,a+i\,b\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(i\,b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{i\,b}{2\,c},\,\ldots,\,\frac{i\,b}{2\,c},\,1;\,\frac{i\,b}{2\,c}+1,\,\ldots,\,\frac{i\,b}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{i\,a+(2\,c+i\,b)\,z}$$
$$\left.\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+i\,b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{2\,c+i\,b}{2\,c},\,\ldots,\,\frac{2\,c+i\,b}{2\,c},\,1;\,\frac{2\,c+i\,b}{2\,c}+1,\,\ldots,\,\frac{2\,c+i\,b}{2\,c}+1;\,e^{2\,c\,z}\right)\right)\,/;\,n\in\mathbb{N}$$

01.22.21.0045.01

$$\int z^n \cos(b\,z)\coth(c\,z)\,dz = -\frac{1}{2}\,n!\left(e^{-i\,b\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(-\frac{i\,b}{2\,c},\,\ldots,\,-\frac{i\,b}{2\,c},\,1;\,1-\frac{i\,b}{2\,c},\,\ldots,\,1-\frac{i\,b}{2\,c};\,e^{2\,c\,z}\right)+\right.$$
$$e^{(2\,c-i\,b)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c-i\,b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{-i\,b+2\,c}{2\,c},\,\ldots,\,\frac{-i\,b+2\,c}{2\,c},\,1;\,\frac{-i\,b+2\,c}{2\,c}+1,\,\ldots,\,\frac{-i\,b+2\,c}{2\,c}+1;\,e^{2\,c\,z}\right)+$$
$$e^{i\,b\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(i\,b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{i\,b}{2\,c},\,\ldots,\,\frac{i\,b}{2\,c},\,1;\,\frac{i\,b}{2\,c}+1,\,\ldots,\,\frac{i\,b}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{(2\,c+i\,b)\,z}$$
$$\left.\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+i\,b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{2\,c+i\,b}{2\,c},\,\ldots,\,\frac{2\,c+i\,b}{2\,c},\,1;\,\frac{2\,c+i\,b}{2\,c}+1,\,\ldots,\,\frac{2\,c+i\,b}{2\,c}+1;\,e^{2\,c\,z}\right)\right)\,/;\,n\in\mathbb{N}$$

Involving powers of cos and power

Involving $z^n \cos^m(b\,z)\coth(c\,z)$

01.22.21.0046.01

$$\int z^n \cos^m(b z) \coth(c z) \, dz = -2^{-m} \binom{m}{\frac{m}{2}} n! \, (1 - m \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + 2 e^{2 c z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+3}F_{j+2}(1, \ldots, 1, 2; 2, \ldots, 2; e^{2 c z}) \right) - 2^{-m} n! \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(e^{-i b (m-2k) z} \sum_{j=0}^{n} \frac{(-1)^j (-i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(-\frac{i b (m-2k)}{2c}, \ldots, -\frac{i b (m-2k)}{2c}, 1; 1 - \frac{i b (m-2k)}{2c}, \ldots, 1 - \frac{i b (m-2k)}{2c}; e^{2 c z} \right) + e^{i b (m-2k) z} \sum_{j=0}^{n} \frac{(-1)^j (i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b (m-2k)}{2c}, \ldots, \frac{i b (m-2k)}{2c}, 1; \frac{i b (m-2k)}{2c} + 1, \ldots, \frac{i b (m-2k)}{2c} + 1; e^{2 c z} \right) + e^{(2c - i b (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c - i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c - i b (m-2k)}{2c}, \ldots, \frac{2c - i b (m-2k)}{2c}, 1; \frac{2c - i b (m-2k)}{2c} + 1, \ldots, \frac{2c - i b (m-2k)}{2c} + 1; e^{2 c z} \right) + e^{(2c + b i (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c + b i (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c + i b (m-2k)}{2c}, \ldots, \frac{2c + i b (m-2k)}{2c}, 1; \frac{2c + i b (m-2k)}{2c} + 1, \ldots, \frac{2c + i b (m-2k)}{2c} + 1; e^{2 c z} \right) \right) /; n \in \mathbb{N} \land m \in \mathbb{N}^+$$

Involving trigonometric and exponential functions

Involving sin and exp

Involving $e^{p z} \sin(b z)$

01.22.21.0047.01

$$\int e^{p z} \sin(b z) \coth(c z) \, dz = -\frac{1}{2} i \left(\frac{1}{(-i b + p)(2c - i b + p)} \left(e^{(-i b + p) z} \left((2c - i b + p) \, {}_2F_1\left(\frac{-i b + p}{2c}, 1; \frac{-i b + p}{2c} + 1; e^{2 c z} \right) + e^{2 c z} (-i b + p) \, {}_2F_1\left(\frac{-i b + p}{2c} + 1, 1; \frac{-i b + p}{2c} + 2; e^{2 c z} \right) \right) \right) - \frac{1}{(i b + p)(2c + i b + p)} \left(e^{(i b + p) z} \left((2c + i b + p) \, {}_2F_1\left(\frac{i b + p}{2c}, 1; \frac{i b + p}{2c} + 1; e^{2 c z} \right) + e^{2 c z} (i b + p) \, {}_2F_1\left(\frac{i b + p}{2c} + 1, 1; \frac{i b + p}{2c} + 2; e^{2 c z} \right) \right) \right) \right)$$

01.22.21.0048.01

$$\int e^{i b z} \sin(b z) \coth(c z)\, dz = \frac{1}{4 b c (c + i b)} \left(b c\, e^{2 (c + i b) z}\, i\, {}_2F_1\!\left(1 + \frac{i b}{c}, 1; 2 + \frac{i b}{c}; e^{2 c z}\right) + (c + i b) \left(c\, e^{2 i b z}\, {}_2F_1\!\left(\frac{i b}{c}, 1; 1 + \frac{i b}{c}; e^{2 c z}\right) + 2 b\, i \log(\sinh(c z))\right)\right)$$

01.22.21.0049.01

$$\int e^{-i b z} \sin(b z) \coth(c z)\, dz = -\frac{1}{4 b (b + i c) c} \left(i\, e^{-2 i b z} \left(b c\, e^{2 c z}\, i\, {}_2F_1\!\left(1 - \frac{i b}{c}, 1; 2 - \frac{i b}{c}; e^{2 c z}\right) + (b + i c) \left(c\, i\, {}_2F_1\!\left(-\frac{i b}{c}, 1; 1 - \frac{i b}{c}; e^{2 c z}\right) + 2 b\, e^{2 i b z} \log(\sinh(c z))\right)\right)\right)$$

01.22.21.0050.01

$$\int e^{(i b - 2 c) z} \sin(a z) \coth(c z)\, dz = \frac{1}{2} \left(\frac{e^{i (a+b) z}\, {}_2F_1\!\left(\frac{i (a+b)}{2 c}, 1; 1 + \frac{i (a+b)}{2 c}; e^{2 c z}\right)}{a + b} + \frac{e^{i (a+b+2 i c) z}\, {}_2F_1\!\left(\frac{i (a+b+2 i c)}{2 c}, 1; \frac{i (a+b)}{2 c}; e^{2 c z}\right)}{a + b + 2 i c} + \frac{e^{-i (a-b) z}\, {}_2F_1\!\left(-\frac{i (a-b)}{2 c}, 1; 1 - \frac{i (a-b)}{2 c}; e^{2 c z}\right)}{a - b} + \frac{e^{-i (a-b-2 i c) z}\, {}_2F_1\!\left(-\frac{i (a-b-2 i c)}{2 c}, 1; -\frac{i (a-b)}{2 c}; e^{2 c z}\right)}{a - b - 2 i c}\right)$$

01.22.21.0051.01

$$\int e^{-(2 c + i b) z} \sin(a z) \coth(c z)\, dz = \frac{1}{2} \left(\frac{e^{i (a-b) z}\, {}_2F_1\!\left(\frac{i (a-b)}{2 c}, 1; 1 + \frac{i (a-b)}{2 c}; e^{2 c z}\right)}{a - b} + \frac{e^{i (a-b+2 i c) z}\, {}_2F_1\!\left(\frac{i (a-b+2 i c)}{2 c}, 1; \frac{i (a-b)}{2 c}; e^{2 c z}\right)}{a - b + 2 i c} + \frac{e^{-i (a+b) z}\, {}_2F_1\!\left(-\frac{i (a+b)}{2 c}, 1; 1 - \frac{i (a+b)}{2 c}; e^{2 c z}\right)}{a + b} + \frac{e^{-i (a+b-2 i c) z}\, {}_2F_1\!\left(-\frac{i (a+b-2 i c)}{2 c}, 1; -\frac{i (a+b)}{2 c}; e^{2 c z}\right)}{a + b - 2 i c}\right)$$

Involving powers of sin and exp

Involving $e^{p z} \sin^m(b z)$

01.22.21.0052.01

$$\int e^{p z}\sin^m(b z)\coth(c z)\,dz = \frac{1}{p(2c+p)} \left(2^{-m} e^{p z}(-1)\binom{m}{\frac{m}{2}}\left((2c+p)\,{}_2F_1\left(\frac{p}{2c}, 1; \frac{p}{2c}+1; e^{2cz}\right) + e^{2cz}\, p\, {}_2F_1\left(\frac{p}{2c}+1, 1; \frac{p}{2c}+2; e^{2cz}\right)\right)(1 - m \bmod 2)\right) - 2^{-m}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(\left(\left(e^{\frac{i\pi m}{2}+(p-i b(m-2k))z}\left((2c - i b(m-2k)+p)\,{}_2F_1\left(\frac{p-i b(m-2k)}{2c}, 1; \frac{p-i b(m-2k)}{2c}+1; e^{2cz}\right) + e^{2cz}(p - i b(m-2k))\,{}_2F_1\left(\frac{p-i b(m-2k)}{2c}+1, 1; \frac{p-i b(m-2k)}{2c}+2; e^{2cz}\right)\right)\right)\Big/ ((p - i b(m-2k))(2c - i b(m-2k)+p)) + \left(e^{(b i(m-2k)+p)z - \frac{i m\pi}{2}}\left((2c + b i(m-2k)+p)\,{}_2F_1\left(\frac{b i(m-2k)+p}{2c}, 1; \frac{b i(m-2k)+p}{2c}+1; e^{2cz}\right) + e^{2cz}(b i(m-2k)+p)\,{}_2F_1\left(\frac{b i(m-2k)+p}{2c}+1, 1; \frac{b i(m-2k)+p}{2c}+2; e^{2cz}\right)\right)\right)\Big/((b i(m-2k)+p)(2c + b i(m-2k)+p))\right) /; m \in \mathbb{N}^+$$

Involving cos and exp

Involving $e^{p z}\cos(b z)$

01.22.21.0053.01

$$\int e^{p z}\cos(b z)\coth(c z)\,dz = \frac{1}{2}\left(\left(e^{(-i b+p)z}\left((b + i(2c+p))\,{}_2F_1\left(\frac{-i b+p}{2c}, 1; \frac{-i b+p}{2c}+1; e^{2cz}\right) + e^{2cz}(b + i p)\,{}_2F_1\left(\frac{-i b+p}{2c}+1, 1; \frac{-i b+p}{2c}+2; e^{2cz}\right)\right)\right)\Big/((-2c + i b - p)(b + i p)) - \frac{1}{(i b+p)(2c + i b + p)}\left(e^{(i b+p)z}\left((2c + i b + p)\,{}_2F_1\left(\frac{i b+p}{2c}, 1; \frac{i b+p}{2c}+1; e^{2cz}\right) + e^{2cz}(i b+p)\,{}_2F_1\left(\frac{i b+p}{2c}+1, 1; \frac{i b+p}{2c}+2; e^{2cz}\right)\right)\right)\right)$$

01.22.21.0054.01

$$\int e^{i b z}\cos(b z)\coth(c z)\,dz = \frac{1}{4 b c(c + i b)}\left((c + i b)\left(c\, e^{2 i b z}\, i\, {}_2F_1\left(\frac{i b}{c}, 1; 1 + \frac{i b}{c}; e^{2cz}\right) + 2b\log(\sinh(c z))\right) - b c\, e^{2(c + i b)z}\,{}_2F_1\left(1 + \frac{i b}{c}, 1; 2 + \frac{i b}{c}; e^{2cz}\right)\right)$$

01.22.21.0055.01

$$\int e^{-i b z}\cos(b z)\coth(c z)\,dz = \frac{1}{4 b c(c - i b)}\left(e^{-2 i b z}\left((c - i b)\left(2 b\, e^{2 i b z}\log(\sinh(c z)) - i c\,{}_2F_1\left(-\frac{i b}{c}, 1; 1 - \frac{i b}{c}; e^{2cz}\right)\right) - b c\, e^{2cz}\,{}_2F_1\left(1 - \frac{i b}{c}, 1; 2 - \frac{i b}{c}; e^{2cz}\right)\right)\right)$$

01.22.21.0056.01

$$\int e^{(i b-2 c) z}\cos(a z)\coth(c z)\,dz = -\frac{1}{2} i \left(-\frac{e^{i(a+b)z}\,{}_2F_1\left(\frac{i(a+b)}{2c}, 1; 1+\frac{i(a+b)}{2c}; e^{2cz}\right)}{a+b} + \frac{e^{-i(a-b)z}\,{}_2F_1\left(-\frac{i(a-b)}{2c}, 1; 1-\frac{i(a-b)}{2c}; e^{2cz}\right)}{a-b} + \frac{e^{-i(a-b-2ic)z}\,{}_2F_1\left(-\frac{i(a-b-2ic)}{2c}, 1; -\frac{i(a-b)}{2c}; e^{2cz}\right)}{a-b-2ic} - \frac{e^{i(a+b+2ic)z}\,{}_2F_1\left(\frac{i(a+b+2ic)}{2c}, 1; \frac{i(a+b)}{2c}; e^{2cz}\right)}{a+b+2ic}\right)$$

01.22.21.0057.01

$$\int e^{-(2c+ib)z}\cos(a z)\coth(c z)\,dz = \frac{1}{2} i \left(\frac{e^{i(a-b)z}\,{}_2F_1\left(\frac{i(a-b)}{2c}, 1; 1+\frac{i(a-b)}{2c}; e^{2cz}\right)}{a-b} + \frac{e^{i(a-b+2ic)z}\,{}_2F_1\left(\frac{i(a-b+2ic)}{2c}, 1; \frac{i(a-b)}{2c}; e^{2cz}\right)}{a-b+2ic} - \frac{e^{-i(a+b-2ic)z}\,{}_2F_1\left(-\frac{i(a+b-2ic)}{2c}, 1; -\frac{i(a+b)}{2c}; e^{2cz}\right)}{a+b-2ic} - \frac{e^{-i(a+b)z}\,{}_2F_1\left(-\frac{i(a+b)}{2c}, 1; 1-\frac{i(a+b)}{2c}; e^{2cz}\right)}{a+b}\right)$$

Involving powers of cos and exp

Involving $e^{pz}\cos^m(bz)$

01.22.21.0058.01

$$\int e^{pz}\cos^m(bz)\coth(cz)\,dz = \frac{1}{p(2c+p)} \left(2^{-m} e^{pz}(-1)\binom{m}{\frac{m}{2}}\left((2c+p)\,{}_2F_1\left(\frac{p}{2c}, 1; \frac{p}{2c}+1; e^{2cz}\right) + e^{2cz} p\,{}_2F_1\left(\frac{p}{2c}+1, 1; \frac{p}{2c}+2; e^{2cz}\right)\right)(1-m \bmod 2)\right) - 2^{-m}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(\left(e^{(p-ib(m-2k))z}\left((2c-ib(m-2k)+p)\,{}_2F_1\left(\frac{p-ib(m-2k)}{2c}, 1; \frac{p-ib(m-2k)}{2c}+1; e^{2cz}\right) + e^{2cz}(p-ib(m-2k))\,{}_2F_1\left(\frac{p-ib(m-2k)}{2c}+1, 1; \frac{p-ib(m-2k)}{2c}+2; e^{2cz}\right)\right)\right)\Big/ ((p-ib(m-2k))(2c-ib(m-2k)+p)) + \left(e^{(bi(m-2k)+p)z}\left((2c+bi(m-2k)+p)\,{}_2F_1\left(\frac{bi(m-2k)+p}{2c}, 1; \frac{bi(m-2k)+p}{2c}+1; e^{2cz}\right) + e^{2cz}(bi(m-2k)+p)\,{}_2F_1\left(\frac{bi(m-2k)+p}{2c}+1, 1; \frac{bi(m-2k)+p}{2c}+2; e^{2cz}\right)\right)\right)\Big/((bi(m-2k)+p)(2c+bi(m-2k)+p))\right) /; m\in\mathbb{N}^+$$

Involving trigonometric, exponential and a power functions

Involving sin, exp and power

Involving $z^n e^{pz}\sin(a+bz)\coth(cz)$

01.22.21.0059.01

$$\int z^n e^{pz}\sin(a+bz)\coth(cz)\,dz = -\frac{1}{2}\,i\,n!\left(e^{-ia+(-ib+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-ib+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-ib+p}{2c},\ldots,\frac{-ib+p}{2c},1;\frac{-ib+p}{2c}+1,\ldots,\frac{-ib+p}{2c}+1;e^{2cz}\right)+\right.$$

$$e^{-ia+(2c-ib+p)z}\sum_{j=0}^{n}\frac{(-1)^j(2c-ib+p)^{-j-1}z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{2c-ib+p}{2c},\ldots,\frac{2c-ib+p}{2c},1;\frac{2c-ib+p}{2c}+1,\ldots,\frac{2c-ib+p}{2c}+1;e^{2cz}\right)-$$

$$e^{ia+(ib+p)z}\sum_{j=0}^{n}\frac{(-1)^j(ib+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ib+p}{2c},\ldots,\frac{ib+p}{2c},1;\frac{ib+p}{2c}+1,\ldots,\frac{ib+p}{2c}+1;e^{2cz}\right)-$$

$$e^{ia+(2c+ib+p)z}\sum_{j=0}^{n}\frac{(-1)^j(2c+ib+p)^{-j-1}z^{n-j}}{(n-j)!}$$

$$\left.{}_{j+2}F_{j+1}\left(\frac{2c+ib+p}{2c},\ldots,\frac{2c+ib+p}{2c},1;\frac{2c+ib+p}{2c}+1,\ldots,\frac{2c+ib+p}{2c}+1;e^{2cz}\right)\right)\; /;\; n\in\mathbb{N}$$

01.22.21.0060.01

$$\int z^n e^{pz}\sin(bz)\coth(cz)\,dz =$$

$$-\frac{1}{2}\,i\,n!\left(e^{(-ib+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-ib+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p-ib}{2c},\ldots,\frac{p-ib}{2c},1;\frac{p-ib}{2c}+1,\ldots,\frac{p-ib}{2c}+1;e^{2cz}\right)-\right.$$

$$e^{(ib+p)z}\sum_{j=0}^{n}\frac{(-1)^j(ib+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ib+p}{2c},\ldots,\frac{ib+p}{2c},1;\frac{ib+p}{2c}+1,\ldots,\frac{ib+p}{2c}+1;e^{2cz}\right)+$$

$$e^{(2c-ib+p)z}\sum_{j=0}^{n}\frac{(-1)^j(2c-ib+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-ib+2c+p}{2c},\ldots,\frac{-ib+2c+p}{2c},1;\right.$$

$$\left.\frac{-ib+2c+p}{2c}+1,\ldots,\frac{-ib+2c+p}{2c}+1;e^{2cz}\right)-e^{(2c+ib+p)z}\sum_{j=0}^{n}\frac{(-1)^j(2c+ib+p)^{-j-1}z^{n-j}}{(n-j)!}$$

$$\left.{}_{j+2}F_{j+1}\left(\frac{ib+2c+p}{2c},\ldots,\frac{ib+2c+p}{2c},1;\frac{ib+2c+p}{2c}+1,\ldots,\frac{ib+2c+p}{2c}+1;e^{2cz}\right)\right)\; /;\; n\in\mathbb{N}$$

Involving powers of sin, exp and power

Involving $z^n e^{pz}\sin^m(bz)\coth(cz)$

01.22.21.0061.01

$$\int z^n e^{p z} \sin^m(b z) \coth(c z)\, dz = -n! \left(\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left((-1)^m \left(e^{(p-i b (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (p - i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p - i b (m-2k)}{2c}, \ldots, \frac{p - i b (m-2k)}{2c}, 1; \frac{p - i b (m-2k)}{2c} + 1, \ldots, \frac{p - i b (m-2k)}{2c} + 1; e^{2 c z} \right) + e^{(2c - i b (m-2k) + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2c - i b (m-2k) + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c - i b (m-2k) + p}{2c}, \ldots, \frac{2c - i b (m-2k) + p}{2c}, 1; \frac{2c - i b (m-2k) + p}{2c} + 1, \ldots, \frac{2c - i b (m-2k) + p}{2c} + 1; e^{2 c z} \right) \right) + e^{(b i (m-2k) + p) z} \sum_{j=0}^{n} \frac{(-1)^j (b i (m-2k) + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b (m-2k) + p}{2c}, \ldots, \frac{i b (m-2k) + p}{2c}, 1; \frac{i b (m-2k) + p}{2c} + 1, \ldots, \frac{i b (m-2k) + p}{2c} + 1; e^{2 c z} \right) + e^{(2c + b i (m-2k) + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2c + b i (m-2k) + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c + i b (m-2k) + p}{2c}, \ldots, \frac{2c + i b (m-2k) + p}{2c}, 1; \frac{2c + i b (m-2k) + p}{2c} + 1, \ldots, \frac{2c + i b (m-2k) + p}{2c} + 1; e^{2 c z} \right) \right) \right) (2 i)^{-m} - 2^{-m} \binom{m}{\frac{m}{2}} n! \, (1 - m \bmod 2) \left(e^{p z} \sum_{j=0}^{n} \frac{(-1)^j p^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p}{2c}, \ldots, \frac{p}{2c}, 1; \frac{p}{2c} + 1, \ldots, \frac{p}{2c} + 1; e^{2 c z} \right) + e^{(2c + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2c + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c + p}{2c}, \ldots, \frac{2c + p}{2c}, 1; \frac{2c + p}{2c} + 1, \ldots, \frac{2c + p}{2c} + 1; e^{2 c z} \right) \right) /; n \in \mathbb{N} \land m \in \mathbb{N}^+$$

Involving cos, exp and power

Involving $z^n e^{p z} \cos(a + b z) \coth(c z)$

01.22.21.0062.01

$$\int z^n e^{p z} \cos(a + b z) \coth(c z) \, dz = -\frac{1}{2} n! \left(e^{-i a + (-i b + p) z} \sum_{j=0}^{n} \frac{(-1)^j (-i b + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p - i b}{2 c}, \ldots, \frac{p - i b}{2 c}, 1; \frac{p - i b}{2 c} + 1, \ldots, \frac{p - i b}{2 c} + 1; e^{2 c z} \right) + e^{i a + (i b + p) z} \sum_{j=0}^{n} \frac{(-1)^j (i b + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b + p}{2 c}, \ldots, \frac{i b + p}{2 c}, 1; \frac{i b + p}{2 c} + 1, \ldots, \frac{i b + p}{2 c} + 1; e^{2 c z} \right) + e^{-i a + (2 c - i b + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c - i b + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i b + 2 c + p}{2 c}, \ldots, \frac{-i b + 2 c + p}{2 c}, 1; \frac{-i b + 2 c + p}{2 c} + 1, \ldots, \frac{-i b + 2 c + p}{2 c} + 1; e^{2 c z} \right) + e^{i a + (2 c + i b + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + i b + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b + 2 c + p}{2 c}, \ldots, \frac{i b + 2 c + p}{2 c}, 1; \frac{i b + 2 c + p}{2 c} + 1, \ldots, \frac{i b + 2 c + p}{2 c} + 1; e^{2 c z} \right) \right) /; n \in \mathbb{N}$$

01.22.21.0063.01

$$\int z^n e^{p z} \cos(b z) \coth(c z) \, dz = -\frac{1}{2} n! \left(e^{(-i b + p) z} \sum_{j=0}^{n} \frac{(-1)^j (-i b + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p - i b}{2 c}, \ldots, \frac{p - i b}{2 c}, 1; \frac{p - i b}{2 c} + 1, \ldots, \frac{p - i b}{2 c} + 1; e^{2 c z} \right) + e^{(i b + p) z} \sum_{j=0}^{n} \frac{(-1)^j (i b + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b + p}{2 c}, \ldots, \frac{i b + p}{2 c}, 1; \frac{i b + p}{2 c} + 1, \ldots, \frac{i b + p}{2 c} + 1; e^{2 c z} \right) + e^{(2 c - i b + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c - i b + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i b + 2 c + p}{2 c}, \ldots, \frac{-i b + 2 c + p}{2 c}, 1; \frac{-i b + 2 c + p}{2 c} + 1, \ldots, \frac{-i b + 2 c + p}{2 c} + 1; e^{2 c z} \right) + e^{(2 c + i b + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + i b + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b + 2 c + p}{2 c}, \ldots, \frac{i b + 2 c + p}{2 c}, 1; \frac{i b + 2 c + p}{2 c} + 1, \ldots, \frac{i b + 2 c + p}{2 c} + 1; e^{2 c z} \right) \right) /; n \in \mathbb{N}$$

Involving powers of cos, exp and power

Involving $z^n e^{p z} \cos^m(b z) \coth(c z)$

01.22.21.0064.01

$$\int z^n e^{pz}\cos^m(bz)\coth(cz)\,dz = -2^{-m}\binom{m}{\frac{m}{2}} n!\,(1-m \bmod 2)\left(e^{pz}\sum_{j=0}^{n}\frac{(-1)^j p^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p}{2c},\ldots,\frac{p}{2c},1;\frac{p}{2c}+1,\ldots,\frac{p}{2c}+1;e^{2cz}\right)+ e^{(2c+p)z}\sum_{j=0}^{n}\frac{(-1)^j (2c+p)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p}{2c}+1,\ldots,\frac{p}{2c}+1,1;\frac{p}{2c}+2,\ldots,\frac{p}{2c}+2;e^{2cz}\right)\right)- 2^{-m} n!\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{s}\left(e^{(p+2ibs-ibm)z}\sum_{j=0}^{n}\frac{(-1)^j (p+2ibs-ibm)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+2ibs-ibm}{2c},\ldots,\frac{p+2ibs-ibm}{2c},1;\frac{p+2ibs-ibm}{2c}+1,\ldots,\frac{p+2ibs-ibm}{2c}+1;e^{2cz}\right)+ e^{(p-2ibs+ibm)z}\sum_{j=0}^{n}\frac{(-1)^j (p-2ibs+ibm)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p-2ibs+ibm}{2c},\ldots,\frac{p-2ibs+ibm}{2c},1;\frac{p-2ibs+ibm}{2c}+1,\ldots,\frac{p-2ibs+ibm}{2c}+1;e^{2cz}\right)+e^{(2c+p+2ibs-ibm)z} \sum_{j=0}^{n}\frac{(-1)^j (2c+p+2ibs-ibm)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c+p+2ibs-ibm}{2c},\ldots,\frac{2c+p+2ibs-ibm}{2c},1;\frac{2c+p+2ibs-ibm}{2c}+1,\ldots,\frac{2c+p+2ibs-ibm}{2c}+1;e^{2cz}\right)+e^{(2c+p-2ibs+ibm)z} \sum_{j=0}^{n}\frac{(-1)^j (2c+p-2ibs+ibm)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c+p-2ibs+ibm}{2c},\ldots,\frac{2c+p-2ibs+ibm}{2c},1;\frac{2c+p-2ibs+ibm}{2c}+1,\ldots,\frac{2c+p-2ibs+ibm}{2c}+1;e^{2cz}\right)\right)\;/;\; n\in\mathbb{N}\land m\in\mathbb{N}^+$$

Involving hyperbolic functions

Involving sinh

Involving sinh(*b z*)

01.22.21.0065.01

$$\int \sinh(bz)\coth(cz)\,dz = \frac{1}{2\left(4c^2 b-b^3\right)}\left(e^{-(2c+b)z}\left(-\left(4c^2-b^2\right)e^{2(c+b)z}\,{}_2F_1\left(\frac{b}{2c},1;\frac{b}{2c}+1;e^{2cz}\right)-\left(4c^2-b^2\right)e^{2cz}\,{}_2F_1\left(-\frac{b}{2c},1;1-\frac{b}{2c};e^{2cz}\right)+ b\left((2c+b)e^{4cz}\,{}_2F_1\left(1-\frac{b}{2c},1;2-\frac{b}{2c};e^{2cz}\right)-(2c-b)e^{2(2c+b)z}\,{}_2F_1\left(\frac{b}{2c}+1,1;\frac{b}{2c}+2;e^{2cz}\right)\right)\right)\right)$$

01.22.21.0066.01

$$\int \sinh(c z)\coth(c z)\, dz = \frac{\sinh(c z)}{c}$$

01.22.21.0067.01

$$\int \sinh(c z)\coth(2 c z)\, dz = \frac{\sinh(c z) - \tan^{-1}\left(\tanh\left(\frac{c z}{2}\right)\right)}{c}$$

01.22.21.0068.01

$$\int \sinh(c z)\coth(3 c z)\, dz = \frac{3\sinh(c z) - \sqrt{3}\, \tan^{-1}\left(\frac{2\sinh(c z)}{\sqrt{3}}\right)}{3 c}$$

01.22.21.0069.01

$$\int \sinh(c z)\coth(4 c z)\, dz = \frac{-(1-i)\sqrt[4]{-1}\, \tan^{-1}\left(\frac{i+\tanh\left(\frac{c z}{2}\right)}{\sqrt{2}}\right) - 2\tan^{-1}\left(\tanh\left(\frac{c z}{2}\right)\right) + \sqrt{2}\, i \tanh^{-1}\left(\frac{i\tanh\left(\frac{c z}{2}\right)+1}{\sqrt{2}}\right) + 4\sinh(c z)}{4 c}$$

01.22.21.0070.01

$$\int \sinh(2 c z)\coth(c z)\, dz = z + \frac{\sinh(2 c z)}{2 c}$$

01.22.21.0071.01

$$\int \sinh(3 c z)\coth(c z)\, dz = \frac{6\sinh(c z) + \sinh(3 c z)}{3 c}$$

01.22.21.0072.01

$$\int \sinh(4 c z)\coth(c z)\, dz = \frac{4 c z + 4\sinh(2 c z) + \sinh(4 c z)}{4 c}$$

Involving power of sinh

Involving $\sinh^{\mu}(b z)$

01.22.21.0073.01

$$\int \sinh^m(b z)\coth(c z)\, dz = \frac{(1 - m \bmod 2)\log(\sinh(c z))}{c}\left(\frac{i}{2}\right)^m \binom{m}{\frac{m}{2}} - 2^{-m}\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^s\binom{m}{s}\Bigg(\Bigg(\Bigg(e^{b(m-2s)z}\left((2c + b(m-2s))\, {}_2F_1\left(\frac{b(m-2s)}{2c}, 1; \frac{b(m-2s)}{2c}+1; e^{2cz}\right) + b\, e^{2cz}(m-2s)\, {}_2F_1\left(\frac{b(m-2s)}{2c}+1, 1; \frac{b(m-2s)}{2c}+2; e^{2cz}\right)\right)\Bigg)\Bigg/(b(m-2s)(2c+b(m-2s))) - \Bigg((-1)^m e^{-b(m-2s)z}\left((2c - b(m-2s))\, {}_2F_1\left(-\frac{b(m-2s)}{2c}, 1; 1-\frac{b(m-2s)}{2c}; e^{2cz}\right) - b\, e^{2cz}(m-2s)\, {}_2F_1\left(1-\frac{b(m-2s)}{2c}, 1; 2-\frac{b(m-2s)}{2c}; e^{2cz}\right)\right)\Bigg)\Bigg/(b(m-2s)(2c-b(m-2s)))\Bigg)\Bigg) /;\ m \in \mathbb{N}^+$$

01.22.21.0074.01

$$\int \sinh^{\mu}(c\,z)\coth(c\,z)\,dz = \frac{\sinh^{\mu}(c\,z)}{c\,\mu}$$

01.22.21.0075.01

$$\int \sinh^{2}(c\,z)\coth(c\,z)\,dz = \frac{\cosh^{2}(c\,z)}{2\,c}$$

01.22.21.0076.01

$$\int \sinh^{3}(c\,z)\coth(c\,z)\,dz = \frac{\sinh^{3}(c\,z)}{3\,c}$$

01.22.21.0077.01

$$\int \sinh^{2}(c\,z)\coth(2\,c\,z)\,dz = \frac{\cosh(2\,c\,z) - 2\log(\cosh(c\,z))}{4\,c}$$

01.22.21.0078.01

$$\int \sinh^{3}(c\,z)\coth(3\,c\,z)\,dz = \frac{3\sqrt{3}\,\tan^{-1}\left(\frac{2\sinh(c\,z)}{\sqrt{3}}\right) - 9\sinh(c\,z) + \sinh(3\,c\,z)}{12\,c}$$

01.22.21.0079.01

$$\int \sinh^{3}(c\,z)\coth(4\,c\,z)\,dz = \frac{1}{24\,c}\left(\sqrt[4]{-1}\,(3 - 3\,i)\tan^{-1}\left(\frac{i + \tanh\left(\frac{c\,z}{2}\right)}{\sqrt{2}}\right) + 12\tan^{-1}\left(\tanh\left(\frac{c\,z}{2}\right)\right) + (-1)^{3/4}\,(3 - 3\,i)\tanh^{-1}\left(\frac{-i\tanh\left(\frac{c\,z}{2}\right) - 1}{\sqrt{2}}\right) - 18\sinh(c\,z) + 2\sinh(3\,c\,z)\right)$$

01.22.21.0080.01

$$\int \sinh^{\frac{1}{2}}(c\,z)\coth(c\,z)\,dz = \frac{2\sinh^{\frac{1}{2}}(c\,z)}{c}$$

01.22.21.0081.01

$$\int \frac{\coth(c\,z)}{\sinh^{\frac{1}{2}}(c\,z)}\,dz = -\frac{2}{c\sinh^{\frac{1}{2}}(c\,z)}$$

01.22.21.0082.01

$$\int \frac{\coth(c\,z)}{\sqrt{\sinh^{3}(2\,c\,z)}}\,dz = -\frac{\sinh(2\,c\,z)}{3\,c\sqrt{\sinh^{3}(2\,c\,z)}}\left(\coth(c\,z) + i\,F\left(\frac{\pi}{4} - i\,c\,z \,\middle|\, 2\right)\sqrt{i\sinh(2\,c\,z)}\right)$$

Involving rational functions of sinh

Involving $(a + b\sinh(c\,z))^{-n}$

01.22.21.0083.01

$$\int \frac{\coth(c\,z)}{a + b\sinh(c\,z)}\,dz = \frac{\log(\sinh(c\,z)) - \log(a + b\sinh(c\,z))}{a\,c}$$

01.22.21.0084.01

$$\int \frac{A+B\coth(c z)}{a+b\sinh(c z)}\,dz = \frac{1}{c}\left(\frac{2A}{\sqrt{-a^2-b^2}}\tan^{-1}\left(\frac{b-a\tanh\left(\frac{c z}{2}\right)}{\sqrt{-a^2-b^2}}\right)+\frac{B(\log(\sinh(c z))-\log(a+b\sinh(c z)))}{a}\right)$$

01.22.21.0085.01

$$\int \frac{\coth(c z)}{a+b\sinh(2 c z)}\,dz = \frac{1}{2 a c}\left(-\frac{2b}{\sqrt{-a^2-b^2}}\tan^{-1}\left(\frac{b-a\tanh(c z)}{\sqrt{-a^2-b^2}}\right)+2\log(\sinh(c z))-\log(a+b\sinh(2 c z))\right)$$

01.22.21.0086.01

$$\int \frac{(A+B\sinh(c z))\coth(c z)}{a+b\sinh(c z)}\,dz = \frac{A b\log(\sinh(c z))+(a B-A b)\log(a+b\sinh(c z))}{a b c}$$

01.22.21.0087.01

$$\int \frac{\coth(c z)}{(a+b\sinh(c z))^2}\,dz = \frac{\frac{a}{a+b\sinh(c z)}+\log(\sinh(c z))-\log(a+b\sinh(c z))}{a^2 c}$$

Involving algebraic functions of sinh

Involving $(a+b\sinh(c z))^{\beta}$

01.22.21.0088.01

$$\int (a+b\sinh(c z))^{\beta}\coth(c z)\,dz = \frac{(a+b\sinh(c z))^{\beta}}{c\beta}\left(\frac{a\operatorname{csch}(c z)}{b}+1\right)^{-\beta}{}_2F_1\left(-\beta,-\beta;1-\beta;-\frac{a\operatorname{csch}(c z)}{b}\right)$$

01.22.21.0089.01

$$\int \sqrt{a+b\sinh(c z)}\,\coth(c z)\,dz = \frac{2\sqrt{a+b\sinh(c z)}}{c}\left(1-\frac{\sqrt{a}\,\operatorname{csch}^{\frac{1}{2}}(c z)}{\sqrt{b}\sqrt{\frac{a\operatorname{csch}(c z)}{b}+1}}\sinh^{-1}\left(\frac{\sqrt{a}\,\operatorname{csch}^{\frac{1}{2}}(c z)}{\sqrt{b}}\right)\right)$$

01.22.21.0090.01

$$\int \sqrt{i\sinh(c z)\,a+a}\,\coth(c z)\,dz = \frac{1}{2c\left(\cosh\left(\frac{c z}{2}\right)+i\sinh\left(\frac{c z}{2}\right)\right)}\left(\left(2i\tan^{-1}\left(\coth\left(\frac{c z}{4}\right)\right)-2i\tan^{-1}\left(\tanh\left(\frac{c z}{4}\right)\right)+4\cosh\left(\frac{c z}{2}\right)-\log\left(\cosh^2\left(\frac{c z}{4}\right)\cosh\left(\frac{c z}{2}\right)\right)+\log\left(\cosh\left(\frac{c z}{2}\right)\sinh^2\left(\frac{c z}{4}\right)\right)+4i\sinh\left(\frac{c z}{2}\right)\right)\sqrt{i\sinh(c z)\,a+a}\right)$$

01.22.21.0091.01

$$\int \sqrt{a-i a\sinh(c z)}\,\coth(c z)\,dz = \frac{1}{2c\left(\cosh\left(\frac{c z}{2}\right)-i\sinh\left(\frac{c z}{2}\right)\right)}\left(\left(-2i\tan^{-1}\left(\coth\left(\frac{c z}{4}\right)\right)+2i\tan^{-1}\left(\tanh\left(\frac{c z}{4}\right)\right)+4\cosh\left(\frac{c z}{2}\right)-\log\left(\cosh^2\left(\frac{c z}{4}\right)\cosh\left(\frac{c z}{2}\right)\right)+\log\left(\cosh\left(\frac{c z}{2}\right)\sinh^2\left(\frac{c z}{4}\right)\right)-4i\sinh\left(\frac{c z}{2}\right)\right)\sqrt{a-i a\sinh(c z)}\right)$$

01.22.21.0092.01

$$\int \frac{\coth(c\,z)}{\sqrt{a+b\sinh(c\,z)}}\,dz = -\frac{2\sqrt{b}}{\sqrt{a}\;c\,\operatorname{csch}^{\frac{1}{2}}(c\,z)\sqrt{a+b\sinh(c\,z)}}\sinh^{-1}\left(\frac{\sqrt{a}\;\operatorname{csch}^{\frac{1}{2}}(c\,z)}{\sqrt{b}}\right)\sqrt{\frac{a\operatorname{csch}(c\,z)}{b}+1}$$

01.22.21.0093.01

$$\int \frac{\coth(c\,z)}{\sqrt{i\sinh(c\,z)\,a+a}}\,dz = \frac{1}{2\,c\sqrt{i\sinh(c\,z)\,a+a}}\left(\left(2\,i\tan^{-1}\left(\coth\left(\frac{c\,z}{4}\right)\right)-2\,i\tan^{-1}\left(\tanh\left(\frac{c\,z}{4}\right)\right)-\log\left(\cosh^2\left(\frac{c\,z}{4}\right)\cosh\left(\frac{c\,z}{2}\right)\right)+\log\left(\cosh\left(\frac{c\,z}{2}\right)\sinh^2\left(\frac{c\,z}{4}\right)\right)\right)\left(\cosh\left(\frac{c\,z}{2}\right)+i\sinh\left(\frac{c\,z}{2}\right)\right)\right)$$

01.22.21.0094.01

$$\int \frac{\coth(c\,z)}{\sqrt{a-i\,a\sinh(c\,z)}}\,dz = \frac{1}{2\,c\sqrt{a-i\,a\sinh(c\,z)}}\left(\left(-2\,i\tan^{-1}\left(\coth\left(\frac{c\,z}{4}\right)\right)+2\,i\tan^{-1}\left(\tanh\left(\frac{c\,z}{4}\right)\right)-\log\left(\cosh^2\left(\frac{c\,z}{4}\right)\cosh\left(\frac{c\,z}{2}\right)\right)+\log\left(\cosh\left(\frac{c\,z}{2}\right)\sinh^2\left(\frac{c\,z}{4}\right)\right)\right)\left(\cosh\left(\frac{c\,z}{2}\right)-i\sinh\left(\frac{c\,z}{2}\right)\right)\right)$$

Involving cosh

Involving cosh(b z)

01.22.21.0095.01

$$\int \cosh(b\,z)\coth(c\,z)\,dz = \frac{1}{2\left(4\,c^2\,b-b^3\right)}\left(e^{-(2\,c+b)\,z}\left(-\left(4\,c^2-b^2\right)e^{2\,(c+b)\,z}\,{}_2F_1\left(\frac{b}{2\,c},1;\frac{b}{2\,c}+1;e^{2\,c\,z}\right)+\left(4\,c^2-b^2\right)e^{2\,c\,z}\,{}_2F_1\left(-\frac{b}{2\,c},1;1-\frac{b}{2\,c};e^{2\,c\,z}\right)-b\left((2\,c-b)\,e^{2\,(2\,c+b)\,z}\,{}_2F_1\left(\frac{b}{2\,c}+1,1;\frac{b}{2\,c}+2;e^{2\,c\,z}\right)+(2\,c+b)\,e^{4\,c\,z}\,{}_2F_1\left(1-\frac{b}{2\,c},1;2-\frac{b}{2\,c};e^{2\,c\,z}\right)\right)\right)\right)$$

01.22.21.0096.01

$$\int \cosh(c\,z)\coth(c\,z)\,dz = \frac{\cosh(c\,z)-\log\left(\cosh\left(\frac{c\,z}{2}\right)\right)+\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)}{c}$$

01.22.21.0097.01

$$\int \cosh(c\,z)\coth(2\,c\,z)\,dz = \frac{2\cosh(c\,z)-\log\left(\cosh\left(\frac{c\,z}{2}\right)\right)+\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)}{2\,c}$$

01.22.21.0098.01

$$\int \cosh(c\,z)\coth(3\,c\,z)\,dz = \frac{6\cosh(c\,z)-2\log\left(\cosh\left(\frac{c\,z}{2}\right)\right)+\log(2\cosh(c\,z)-1)-\log(2\cosh(c\,z)+1)+2\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)}{6\,c}$$

01.22.21.0099.01

$$\int \cosh(c\,z)\coth(4\,c\,z)\,dz = \frac{1}{4\,c}\left(\sqrt[4]{-1}\,(1+i)\tan^{-1}\left(\frac{i+\tanh\left(\frac{c\,z}{2}\right)}{\sqrt{2}}\right) - \sqrt{2}\,\tanh^{-1}\left(\frac{i\tanh\left(\frac{c\,z}{2}\right)+1}{\sqrt{2}}\right) + 4\cosh(c\,z) - \log\left(\cosh\left(\frac{c\,z}{2}\right)\right) + \log\left(\sinh\left(\frac{c\,z}{2}\right)\right)\right)$$

01.22.21.0100.01

$$\int \cosh(2\,c\,z)\coth(c\,z)\,dz = \frac{\cosh(2\,c\,z) + 2\log(\sinh(c\,z))}{2\,c}$$

01.22.21.0101.01

$$\int \cosh(3\,c\,z)\coth(c\,z)\,dz = \frac{6\cosh(c\,z) + \cosh(3\,c\,z) - 3\log\left(\cosh\left(\frac{c\,z}{2}\right)\right) + 3\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)}{3\,c}$$

01.22.21.0102.01

$$\int \cosh(4\,c\,z)\coth(c\,z)\,dz = \frac{4\cosh(2\,c\,z) + \cosh(4\,c\,z) + 4\log(\sinh(c\,z))}{4\,c}$$

Involving power of cosh

Involving $\cosh^{\mu}(b\,z)$

01.22.21.0103.01

$$\int \cosh^m(b\,z)\coth(c\,z)\,dz = \frac{2^{-m}\log(\sinh(c\,z))\,(1 - m \bmod 2)}{c}\binom{m}{\frac{m}{2}} - 2^{-m}\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{s}\left(\left(e^{b\,(m-2\,s)\,z}\left((2\,c + b\,(m-2\,s))\,{}_2F_1\left(\frac{b\,(m-2\,s)}{2\,c}, 1; \frac{b\,(m-2\,s)}{2\,c} + 1; e^{2\,c\,z}\right) + b\,e^{2\,c\,z}\,(m-2\,s)\,{}_2F_1\left(\frac{b\,(m-2\,s)}{2\,c} + 1, 1; \frac{b\,(m-2\,s)}{2\,c} + 2; e^{2\,c\,z}\right)\right)\right)\Big/(b\,(m-2\,s)\,(2\,c + b\,(m-2\,s))) - \left(e^{-b\,(m-2\,s)\,z}\left((2\,c - b\,(m-2\,s))\,{}_2F_1\left(-\frac{b\,(m-2\,s)}{2\,c}, 1; 1 - \frac{b\,(m-2\,s)}{2\,c}; e^{2\,c\,z}\right) - b\,e^{2\,c\,z}\,(m-2\,s)\,{}_2F_1\left(1 - \frac{b\,(m-2\,s)}{2\,c}, 1; 2 - \frac{b\,(m-2\,s)}{2\,c}; e^{2\,c\,z}\right)\right)\right)\Big/(b\,(m-2\,s)\,(2\,c - b\,(m-2\,s)))\right) /;\ m \in \mathbb{N}^+$$

01.22.21.0104.01

$$\int \cosh^{\mu}(c\,z)\coth(c\,z)\,dz = \frac{\cosh^{\mu+2}(c\,z)\coth^2(c\,z)^{\frac{1}{2}(-\mu-2)}\operatorname{csch}^2(c\,z)}{c\,\mu}\,{}_2F_1\left(-\frac{\mu}{2}, -\frac{\mu}{2}; 1 - \frac{\mu}{2}; -\operatorname{csch}^2(c\,z)\right)$$

01.22.21.0105.01

$$\int \cosh^{\mu}(c\,z)\coth(c\,z)\,dz = \frac{\left(\left(1 + e^{-2\,c\,z}\right)^{-\mu}\cosh^{\mu}(c\,z)\right)}{c}\left(\frac{e^{-2\,c\,z}\,F_1\left(\frac{2-\mu}{2}; -\mu, 1; \frac{4-\mu}{2}; -e^{-2\,c\,z}, e^{-2\,c\,z}\right)}{\mu - 2} + \frac{F_1\left(-\frac{\mu}{2}; -\mu, 1; \frac{2-\mu}{2}; -e^{-2\,c\,z}, e^{-2\,c\,z}\right)}{\mu}\right)$$

01.22.21.0106.01

$$\int \cosh^2(c\,z)\coth(c\,z)\,dz = \frac{\cosh(2\,c\,z) + 4\log(\sinh(c\,z))}{4\,c}$$

01.22.21.0107.01

$$\int \cosh^3(c\,z)\coth(c\,z)\,dz = \frac{15\cosh(c\,z) + \cosh(3\,c\,z) + 12\left(\log\left(\sinh\left(\frac{c\,z}{2}\right)\right) - \log\left(\cosh\left(\frac{c\,z}{2}\right)\right)\right)}{12\,c}$$

01.22.21.0108.01

$$\int \sqrt{\cosh^2(c\,z)}\,\coth(c\,z)\,dz = \frac{\sqrt{\cosh^2(c\,z)}\,\left(\cosh(c\,z) - \log\left(\cosh\left(\frac{c\,z}{2}\right)\right) + \log\left(\sinh\left(\frac{c\,z}{2}\right)\right)\right)\operatorname{sech}(c\,z)}{c}$$

01.22.21.0109.01

$$\int \cosh^2(c\,z)\coth(3\,c\,z)\,dz = \frac{3\cosh(2\,c\,z) + \log(2\cosh(2\,c\,z) + 1) + 4\log(\sinh(c\,z))}{12\,c}$$

01.22.21.0110.01

$$\int \cosh^{\frac{1}{2}}(c\,z)\coth(c\,z)\,dz = \frac{2\cosh^{\frac{5}{2}}(c\,z)\operatorname{csch}^2(c\,z)}{c\coth^2(c\,z)^{5/4}}\,{}_2F_1\left(-\frac{1}{4}, -\frac{1}{4}; \frac{3}{4}; -\operatorname{csch}^2(c\,z)\right)$$

01.22.21.0111.01

$$\int \frac{\coth(c\,z)}{\cosh^{\frac{1}{2}}(c\,z)}\,dz = -\frac{2\cosh^{\frac{3}{2}}(c\,z)\operatorname{csch}^2(c\,z)}{c\coth^2(c\,z)^{3/4}}\,{}_2F_1\left(\frac{1}{4}, \frac{1}{4}; \frac{5}{4}; -\operatorname{csch}^2(c\,z)\right)$$

01.22.21.0112.01

$$\int \cosh^{\frac{1}{2}}(2\,c\,z)\coth(c\,z)\,dz = \frac{1}{c}\left(\cosh^{\frac{1}{2}}(2\,c\,z) - \coth^{-1}\left(\cosh^{\frac{1}{2}}(2\,c\,z)\right)\right)$$

01.22.21.0113.01

$$\int \frac{\coth(c\,z)}{\cosh^{\frac{1}{2}}(2\,c\,z)}\,dz = -\frac{1}{c}\tanh^{-1}\left(\cosh^{\frac{1}{2}}(2\,c\,z)\right)$$

Involving rational functions of cosh

Involving $(a + b\cosh(c\,z))^{-n}$

01.22.21.0114.01

$$\int \frac{\coth(c\,z)}{a + b\cosh(c\,z)}\,dz = \frac{(a+b)\log\left(\cosh\left(\frac{c\,z}{2}\right)\right) - a\log(a + b\cosh(c\,z)) + (a-b)\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)}{(a-b)\,(a+b)\,c}$$

01.22.21.0115.01

$$\int \frac{A+B\coth(c\,z)}{a+b\cosh(c\,z)}\,dz = \left((A+B\coth(c\,z))\left(\frac{B\left((a+b)\log\left(\cosh\left(\frac{c\,z}{2}\right)\right)-a\log(a+b\cosh(c\,z))+(a-b)\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)\right)}{(a-b)\,(a+b)}-\frac{2\,A\tan^{-1}\left(\frac{(a-b)\tanh\left(\frac{c\,z}{2}\right)}{\sqrt{b^2-a^2}}\right)}{\sqrt{b^2-a^2}}\right)\sinh(c\,z)\right)\Big/(c\,(B\cosh(c\,z)+A\sinh(c\,z)))$$

01.22.21.0116.01

$$\int \frac{A+B\coth(z)}{1-\cosh(z)}\,dz = \frac{1}{4}\left(4\,A\coth\left(\frac{z}{2}\right)+B\left(\operatorname{csch}^2\left(\frac{z}{2}\right)+2\log\left(\cosh\left(\frac{z}{2}\right)\right)-2\log\left(\sinh\left(\frac{z}{2}\right)\right)\right)\right)$$

01.22.21.0117.01

$$\int \frac{A+B\coth(z)}{\cosh(z)+1}\,dz = \frac{-B\cosh(z)\left(\log\left(\cosh\left(\frac{z}{2}\right)\right)-\log\left(\sinh\left(\frac{z}{2}\right)\right)\right)+B\left(-\log\left(\cosh\left(\frac{z}{2}\right)\right)+\log\left(\sinh\left(\frac{z}{2}\right)\right)-1\right)+2\,A\sinh(z)}{2\,(\cosh(z)+1)}$$

01.22.21.0118.01

$$\int \frac{\coth(c\,z)}{a+b\cosh(2\,c\,z)}\,dz = -\frac{\log(a+b\cosh(2\,c\,z))-2\log(\sinh(c\,z))}{2\,(a+b)\,c}$$

01.22.21.0119.01

$$\int \frac{(A+B\cosh(c\,z))\coth(c\,z)}{a+b\cosh(c\,z)}\,dz = \frac{b\,(a+b)\,(A-B)\log\left(\cosh\left(\frac{c\,z}{2}\right)\right)+a\,(a\,B-A\,b)\log(a+b\cosh(c\,z))+(a-b)\,b\,(A+B)\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)}{(a-b)\,b\,(a+b)\,c}$$

01.22.21.0120.01

$$\int \frac{(A+B\cosh(z))\coth(z)}{\cosh(z)-1}\,dz = -\frac{2\left((A-B)\log\left(\cosh\left(\frac{z}{2}\right)\right)-(A+3\,B)\log\left(\sinh\left(\frac{z}{2}\right)\right)\right)\sinh^2\left(\frac{z}{2}\right)+A+B}{2\,(\cosh(z)-1)}$$

01.22.21.0121.01

$$\int \frac{(A+B\cosh(z))\coth(z)}{\cosh(z)+1}\,dz = \frac{\left(2\,(A+B)\log\left(\sinh\left(\frac{z}{2}\right)\right)-2\,(A-3\,B)\log\left(\cosh\left(\frac{z}{2}\right)\right)\right)\cosh^2\left(\frac{z}{2}\right)-A+B}{2\,(\cosh(z)+1)}$$

01.22.21.0122.01

$$\int \frac{\coth(c\,z)}{(a+b\cosh(c\,z))^2}\,dz = \frac{1}{c}\left(\frac{a}{\left(a^2-b^2\right)(a+b\cosh(c\,z))}+\frac{\log\left(\cosh\left(\frac{c\,z}{2}\right)\right)}{(a-b)^2}+\frac{\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)}{(a+b)^2}-\frac{\left(a^2+b^2\right)\log(a+b\cosh(c\,z))}{\left(a^2-b^2\right)^2}\right)$$

Involving algebraic functions of cosh

Involving $(a+b\cosh(c\,z))^\beta$

01.22.21.0123.01

$$\int (a+b\cosh(c z))^{\beta} \coth(c z)\, dz = -\frac{(a+b\cosh(c z))^{\beta+1}}{2(a-b)(a+b)c(\beta+1)} \left((a+b)\, {}_2F_1\!\left(\beta+1, 1; \beta+2; \frac{a+b\cosh(c z)}{a-b}\right) + (a-b)\, {}_2F_1\!\left(\beta+1, 1; \beta+2; \frac{a+b\cosh(c z)}{a+b}\right)\right)$$

01.22.21.0124.01

$$\int \sqrt{a+b\cosh(c z)}\, \coth(c z)\, dz = \frac{1}{\sqrt{-a-b}\, \sqrt{b-a}\, c} \left(\sqrt{b-a}\, (a+b) \tan^{-1}\!\left(\frac{\sqrt{a+b\cosh(c z)}}{\sqrt{-a-b}}\right) + \sqrt{-a-b} \left((a-b)\tan^{-1}\!\left(\frac{\sqrt{a+b\cosh(c z)}}{\sqrt{b-a}}\right) + 2\sqrt{b-a}\, \sqrt{a+b\cosh(c z)}\right)\right)$$

01.22.21.0125.01

$$\int \sqrt{\cosh(c z)\, a + a}\, \coth(c z)\, dz = \frac{\sqrt{a(\cosh(c z)+1)}\, \left(2\cosh\!\left(\frac{c z}{2}\right) - \log\!\left(\cosh\!\left(\frac{c z}{4}\right)\right) + \log\!\left(\sinh\!\left(\frac{c z}{4}\right)\right)\right) \operatorname{sech}\!\left(\frac{c z}{2}\right)}{c}$$

01.22.21.0126.01

$$\int \sqrt{a-a\cosh(c z)}\, \coth(c z)\, dz = -\frac{2\sqrt{a-a\cosh(c z)}\, \left(\tan^{-1}\!\left(\tanh\!\left(\frac{c z}{4}\right)\right) \operatorname{csch}\!\left(\frac{c z}{2}\right) - 1\right)}{c}$$

01.22.21.0127.01

$$\int \frac{\coth(c z)}{\sqrt{a+b\cosh(c z)}}\, dz = -\frac{1}{c} \left(\frac{1}{\sqrt{a-b}} \tanh^{-1}\!\left(\frac{\sqrt{a+b\cosh(c z)}}{\sqrt{a-b}}\right) + \frac{1}{\sqrt{a+b}} \tanh^{-1}\!\left(\frac{\sqrt{a+b\cosh(c z)}}{\sqrt{a+b}}\right)\right)$$

01.22.21.0128.01

$$\int \frac{\coth(c z)}{\sqrt{\cosh(c z)\, a + a}}\, dz = \frac{\cosh\!\left(\frac{c z}{2}\right) \left(\log\!\left(\sinh\!\left(\frac{c z}{4}\right)\right) - \log\!\left(\cosh\!\left(\frac{c z}{4}\right)\right)\right) - 1}{c\sqrt{a(\cosh(c z)+1)}}$$

01.22.21.0129.01

$$\int \frac{\coth(c z)}{\sqrt{a-a\cosh(c z)}}\, dz = \frac{2\tan^{-1}\!\left(\tanh\!\left(\frac{c z}{4}\right)\right) \sinh\!\left(\frac{c z}{2}\right) - 1}{c\sqrt{a-a\cosh(c z)}}$$

Involving $(a+b\cosh(2 c z))^{\beta}$

01.22.21.0130.01

$$\int (a+b\cosh(2 c z))^{\beta} \coth(c z)\, dz = -\frac{\left(a+b\left(2\cosh^2(c z)-1\right)\right)^{\beta+1}}{2(a+b)c(\beta+1)}\, {}_2F_1\!\left(\beta+1, 1; \beta+2; \frac{2b\cosh^2(c z)+a-b}{a+b}\right)$$

01.22.21.0131.01

$$\int \sqrt{a+b\cosh(2 c z)}\, \coth(c z)\, dz = \frac{1}{c}\left(\sqrt{a+b\cosh(2 c z)} - \sqrt{a+b}\, \tanh^{-1}\!\left(\frac{\sqrt{a+b\cosh(2 c z)}}{\sqrt{a+b}}\right)\right)$$

01.22.21.0132.01

$$\int \sqrt{\cosh(2 c z)\, a + a}\, \coth(c z)\, dz = \frac{\sqrt{\cosh(2 c z)\, a + a}\, \left(\cosh(c z) - \log\!\left(\cosh\!\left(\frac{c z}{2}\right)\right) + \log\!\left(\sinh\!\left(\frac{c z}{2}\right)\right)\right) \operatorname{sech}(c z)}{c}$$

01.22.21.0133.01

$$\int \sqrt{a - a\cosh(2\,c\,z)}\,\coth(c\,z)\,dz = \frac{\sqrt{a - a\cosh(2\,c\,z)}}{c}$$

01.22.21.0134.01

$$\int \frac{\coth(c\,z)}{\sqrt{a + b\cosh(2\,c\,z)}}\,dz = -\frac{1}{\sqrt{a+b}\,c}\tanh^{-1}\left(\frac{\sqrt{a + b\cosh(2\,c\,z)}}{\sqrt{a+b}}\right)$$

01.22.21.0135.01

$$\int \frac{\coth(c\,z)}{\sqrt{\cosh(2\,c\,z)\,a + a}}\,dz = \frac{\cosh(c\,z)\left(\log\left(\sinh\left(\frac{c\,z}{2}\right)\right) - \log\left(\cosh\left(\frac{c\,z}{2}\right)\right)\right)}{c\sqrt{\cosh(2\,c\,z)\,a + a}}$$

01.22.21.0136.01

$$\int \frac{\coth(c\,z)}{\sqrt{a - a\cosh(2\,c\,z)}}\,dz = -\frac{1}{c\sqrt{a - a\cosh(2\,c\,z)}}$$

Involving $\cosh(c\,z)\,(a + b\cosh(2\,c\,z))^{\beta}$

01.22.21.0137.01

$$\int \cosh(c\,z)\,(a + b\cosh(2\,c\,z))^{\beta}\coth(c\,z)\,dz = \frac{1}{(2\,\beta\,c + c)\sqrt{\coth^2(c\,z)}}\cosh(c\,z)\,(a + b\cosh(2\,c\,z))^{\beta}$$
$$\left(\frac{(a+b)\operatorname{csch}^2(c\,z)}{2\,b} + 1\right)^{-\beta} F_1\left(-\beta - \frac{1}{2}; -\frac{1}{2}, -\beta; \frac{1}{2} - \beta; -\operatorname{csch}^2(c\,z), -\frac{(a+b)\operatorname{csch}^2(c\,z)}{2\,b}\right)$$

01.22.21.0138.01

$$\int \cosh(c\,z)\sqrt{a + b\cosh(2\,c\,z)}\,\coth(c\,z)\,dz = \frac{1}{4\sqrt{b}\sqrt{a+b}\,c}$$
$$\left(\sqrt{a+b}\left(2\sqrt{b}\sqrt{a + b\cosh(2\,c\,z)}\,\cosh(c\,z) + \sqrt{2}\,(a + 3\,b)\log\left(\sqrt{2}\sqrt{b}\,\cosh(c\,z) + \sqrt{a + b\cosh(2\,c\,z)}\right)\right) -\right.$$
$$\left. 4\sqrt{b}\,(a+b)\tanh^{-1}\left(\frac{\sqrt{a+b}\,\cosh(c\,z)}{\sqrt{a + b\cosh(2\,c\,z)}}\right)\right)$$

01.22.21.0139.01

$$\int \frac{\cosh(c\,z)\coth(c\,z)}{\sqrt{a + b\cosh(2\,c\,z)}}\,dz = \frac{1}{2\,c}\left(\frac{\sqrt{2}\,\log\left(\sqrt{2}\sqrt{b}\,\cosh(c\,z) + \sqrt{a + b\cosh(2\,c\,z)}\right)}{\sqrt{b}} - \frac{2\tanh^{-1}\left(\frac{\sqrt{a+b}\,\cosh(c\,z)}{\sqrt{a+b\cosh(2\,c\,z)}}\right)}{\sqrt{a+b}}\right)$$

01.22.21.0140.01

$$\int \frac{\cosh^2(c\,z)\coth(c\,z)}{\sqrt{a + b\cosh(2\,c\,z)}}\,dz = \frac{\frac{\sqrt{a+b\cosh(2\,c\,z)}}{b} - \frac{2\tanh^{-1}\left(\frac{\sqrt{a+b\cosh(2\,c\,z)}}{\sqrt{a+b}}\right)}{\sqrt{a+b}}}{2\,c}$$

Involving $\cosh(2\,c\,z)\,(a + b\cosh(2\,c\,z))^{\beta}$

01.22.21.0141.01

$$\int \cosh(2\,c\,z)\,(a+b\cosh(2\,c\,z))^{\beta}\coth(c\,z)\,dz = \frac{(a+b\cosh(2\,c\,z))^{\beta+1}}{2\,b\,(a+b)\,c\,(\beta+1)}\left(a+b-b\,{}_2F_1\!\left(\beta+1,\,1;\,\beta+2;\,\frac{a+b\cosh(2\,c\,z)}{a+b}\right)\right)$$

01.22.21.0142.01

$$\int \cosh(2\,c\,z)\sqrt{a+b\cosh(2\,c\,z)}\,\coth(c\,z)\,dz = \frac{\sqrt{a+b}\,\sqrt{a+b\cosh(2\,c\,z)}\,(a+3\,b+b\cosh(2\,c\,z))-3\,b\,(a+b)\tanh^{-1}\!\left(\frac{\sqrt{a+b\cosh(2\,c\,z)}}{\sqrt{a+b}}\right)}{3\,b\,\sqrt{a+b}\,c}$$

01.22.21.0143.01

$$\int \frac{\cosh(2\,c\,z)\coth(c\,z)}{\sqrt{a+b\cosh(2\,c\,z)}}\,dz = \frac{1}{c}\left(\frac{\sqrt{a+b\cosh(2\,c\,z)}}{b}-\frac{1}{\sqrt{a+b}}\tanh^{-1}\!\left(\frac{\sqrt{a+b\cosh(2\,c\,z)}}{\sqrt{a+b}}\right)\right)$$

Involving tanh

Involving tanh($c\,z$)

01.22.21.0144.01

$$\int \tanh(c\,z)\coth(c\,z)\,dz = z$$

01.22.21.0145.01

$$\int \tanh(c\,z)\coth(2\,c\,z)\,dz = z-\frac{\tanh(c\,z)}{2\,c}$$

Involving power of tanh

Involving $\tanh^{\mu}(c\,z)$

01.22.21.0146.01

$$\int \tanh^{\mu}(c\,z)\coth(c\,z)\,dz = \frac{\tanh^{\mu}(c\,z)}{c\,\mu}\,{}_2F_1\!\left(\frac{\mu}{2},\,1;\,\frac{\mu}{2}+1;\,\tanh^2(c\,z)\right)$$

01.22.21.0147.01

$$\int \tanh^2(c\,z)\coth(c\,z)\,dz = \frac{\log(\cosh(c\,z))}{c}$$

01.22.21.0148.01

$$\int \tanh^3(c\,z)\coth(c\,z)\,dz = z-\frac{\tanh(c\,z)}{c}$$

Involving sinh and cosh

Involving $\sinh(c\,z)\,(a+b\cosh(2\,c\,z))^{\beta}$

01.22.21.0149.01

$$\int \sinh(c\,z)\,(a+b\cosh(2\,c\,z))^{\beta}\coth(c\,z)\,dz = \frac{(a+b\cosh(2\,c\,z))^{\beta+1}\operatorname{csch}(c\,z)}{2\sqrt{2}\,b\,c\,(\beta+1)}\sqrt{-\frac{b\sinh^2(c\,z)}{a+b}}\;{}_2F_1\!\left(\beta+1,\frac{1}{2};\beta+2;\frac{a+b\cosh(2\,c\,z)}{a+b}\right)$$

01.22.21.0150.01

$$\int \sinh(c\,z)\sqrt{a+b\cosh(2\,c\,z)}\,\coth(c\,z)\,dz = \frac{\sqrt{2}\,(a+b)\tanh^{-1}\!\left(\frac{\sqrt{2}\sqrt{b}\,\sinh(c\,z)}{\sqrt{a+b\cosh(2\,c\,z)}}\right)+2\sqrt{b}\sqrt{a+b\cosh(2\,c\,z)}\,\sinh(c\,z)}{4\sqrt{b}\,c}$$

01.22.21.0151.01

$$\int \frac{\sinh(c\,z)\coth(c\,z)}{\sqrt{a+b\cosh(2\,c\,z)}}\,dz = \frac{\tanh^{-1}\!\left(\frac{\sqrt{2}\sqrt{b}\,\sinh(c\,z)}{\sqrt{a+b\cosh(2\,c\,z)}}\right)}{\sqrt{2}\sqrt{b}\,c}$$

Other integrals

01.22.21.0152.01

$$\int \frac{(A+B\cosh(c\,z))\coth(c\,z)}{a+b\sinh(c\,z)}\,dz = \frac{1}{a\,b\sqrt{-a^2-b^2}\,c}\left(\sqrt{-a^2-b^2}\left(a\,B\,c\,z+b\,(A-B)\log\!\left(\cosh\!\left(\frac{c\,z}{2}\right)\right)+b\,(A+B)\log\!\left(\sinh\!\left(\frac{c\,z}{2}\right)\right)-A\,b\log(a+b\sinh(c\,z))\right)-2\left(a^2+b^2\right)B\tan^{-1}\!\left(\frac{b-a\tanh\left(\frac{c\,z}{2}\right)}{\sqrt{-a^2-b^2}}\right)\right)$$

01.22.21.0153.01

$$\int \frac{(A+B\sinh(c\,z))\coth(c\,z)}{a+b\cosh(c\,z)}\,dz = \frac{B\,z}{b}+\frac{2\,a\,B\tan^{-1}\!\left(\frac{(a-b)\tanh\left(\frac{c\,z}{2}\right)}{\sqrt{b^2-a^2}}\right)}{b\sqrt{b^2-a^2}\,c}+\frac{A\log\!\left(\cosh\left(\frac{c\,z}{2}\right)\right)}{a\,c-b\,c}+\frac{a\,A\log(a+b\cosh(c\,z))}{b^2\,c-a^2\,c}+\frac{A\log\!\left(\sinh\left(\frac{c\,z}{2}\right)\right)}{(a+b)\,c}$$

01.22.21.0154.01

$$\int \sqrt{\cosh(c\,z)\sinh(c\,z)}\,\coth(c\,z)\,dz = -\frac{2\coth(c\,z)\,(\cosh(c\,z)\sinh(c\,z))^{3/2}}{5\,c\sqrt[4]{-\sinh^2(c\,z)}}\;{}_2F_1\!\left(\frac{5}{4},\frac{3}{4};\frac{9}{4};\cosh^2(c\,z)\right)$$

01.22.21.0155.01

$$\int \frac{\coth(e z)}{\sqrt{a \cosh^2(e z) + b \sinh(e z) \cosh(e z) + c \sinh^2(e z)}} \, dz = \Bigg(\left(b - 2c - \sqrt{b^2 - 4ac}\right) \Bigg(F\left(\sin^{-1}\left(\sqrt{\frac{\left(-b - 2c + \sqrt{b^2 - 4ac}\right)(\tanh(e z) + 1)}{\left(-b + 2c + \sqrt{b^2 - 4ac}\right)(\tanh(e z) - 1)}} \right) \Bigg| -\frac{-a + c + \sqrt{b^2 - 4ac}}{a - c + \sqrt{b^2 - 4ac}} \right) - 2 \Pi\left(\frac{-b + 2c + \sqrt{b^2 - 4ac}}{b + 2c - \sqrt{b^2 - 4ac}}; \sin^{-1}\left(\sqrt{\frac{\left(-b - 2c + \sqrt{b^2 - 4ac}\right)(\tanh(e z) + 1)}{\left(-b + 2c + \sqrt{b^2 - 4ac}\right)(\tanh(e z) - 1)}} \right) \Bigg| -\frac{-a + c + \sqrt{b^2 - 4ac}}{a - c + \sqrt{b^2 - 4ac}} \right) \Bigg) (\tanh(e z) - 1) \sqrt{\frac{\left(-b - 2c + \sqrt{b^2 - 4ac}\right)(\tanh(e z) + 1)}{\left(-b + 2c + \sqrt{b^2 - 4ac}\right)(\tanh(e z) - 1)}} \sqrt{-\frac{2a - b + \left(b - 2c + \sqrt{b^2 - 4ac}\right)\tanh(e z) + \sqrt{b^2 - 4ac}}{(a - b + c)(\tanh(e z) - 1)}} \sqrt{\frac{-2a + b + \left(-b + 2c + \sqrt{b^2 - 4ac}\right)\tanh(e z) + \sqrt{b^2 - 4ac}}{(a - b + c)(\tanh(e z) - 1)}} \Bigg) \Big/ \left(\left(b + 2c - \sqrt{b^2 - 4ac}\right) e \,(\tanh(e z) + 1) \sqrt{a \cosh^2(e z) + b \sinh(e z) \cosh(e z) + c \sinh^2(e z)} \right)$$

Involving sinh and tanh

01.22.21.0156.01

$$\int \frac{A + C \coth(z) + B \tanh(z)}{a + b \sinh(z)} \, dz = \Bigg(2 \cosh(z) \Bigg(2 a A \left(a^2 + b^2\right) \tan^{-1}\left(\frac{b - a \tanh\left(\frac{z}{2}\right)}{\sqrt{-a^2 - b^2}} \right) + 2 a b \sqrt{-a^2 - b^2} \, B \tan^{-1}\left(\tanh\left(\frac{z}{2} \right) \right) + \sqrt{-a^2 - b^2} \left(B \log(\cosh(z)) a^2 + \left(a^2 + b^2\right) C \log(\sinh(z)) - \left((B + C) a^2 + b^2 C\right) \log(a + b \sinh(z)) \right) \Bigg) \sinh(z) (A + C \coth(z) + B \tanh(z)) \Bigg) \Big/ \left(a (a - i b)(a + i b) \sqrt{-a^2 - b^2} \, (-B + C + (B + C) \cosh(2z) + A \sinh(2z)) \right)$$

Involving cosh and tanh

01.22.21.0157.01

$$\int \frac{A + B\tanh(z) + C\coth(z)}{a + b\cosh(z)}\, dz = \left(2\cosh(z)\left(-\frac{2A}{\sqrt{b^2-a^2}}\tan^{-1}\left(\frac{(a-b)\tanh\left(\frac{z}{2}\right)}{\sqrt{b^2-a^2}}\right) + \frac{C\log\left(\cosh\left(\frac{z}{2}\right)\right)}{a-b} + \frac{B\log(\cosh(z))}{a} + \frac{C\log\left(\sinh\left(\frac{z}{2}\right)\right)}{a+b} - \frac{\left(a^2(B+C) - b^2 B\right)\log(a + b\cosh(z))}{a^3 - a b^2}\right)\sinh(z)\,(A + C\coth(z) + B\tanh(z))\right) \Big/ (-B + C + (B+C)\cosh(2z) + A\sinh(2z))$$

Involving hyperbolic and a power functions

Involving sinh and power

Involving $z^n \sinh(a + b z) \coth(c z)$

01.22.21.0158.01

$$\int z^n \sinh(a + b z)\coth(c z)\, dz = -\frac{1}{2} n! \left(e^{-a-bz}\sum_{j=0}^{n}\frac{b^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(-\frac{b}{2c}, \ldots, -\frac{b}{2c}, 1; 1-\frac{b}{2c}, \ldots, 1-\frac{b}{2c}; e^{2cz}\right) + e^{a+bz}\sum_{j=0}^{n}\frac{(-1)^j b^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{b}{2c}, \ldots, \frac{b}{2c}, 1; \frac{b}{2c}+1, \ldots, \frac{b}{2c}+1; e^{2cz}\right) - e^{(2c-b)z-a}\sum_{j=0}^{n}\frac{(-1)^j (2c-b)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{2c-b}{2c}, \ldots, \frac{2c-b}{2c}, 1; \frac{2c-b}{2c}+1, \ldots, \frac{2c-b}{2c}+1; e^{2cz}\right) + e^{a+(b+2c)z}\sum_{j=0}^{n}\frac{(-1)^j (b+2c)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{b+2c}{2c}, \ldots, \frac{b+2c}{2c}, 1; \frac{b+2c}{2c}+1, \ldots, \frac{b+2c}{2c}+1; e^{2cz}\right)\right) /; n \in \mathbb{N}$$

01.22.21.0159.01

$$\int z^n \sinh(b z)\coth(c z)\, dz = -\frac{1}{2} n! \left(e^{-bz}\sum_{j=0}^{n}\frac{b^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(-\frac{b}{2c}, \ldots, -\frac{b}{2c}, 1; 1-\frac{b}{2c}, \ldots, 1-\frac{b}{2c}; e^{2cz}\right) + e^{bz}\sum_{j=0}^{n}\frac{(-1)^j b^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{b}{2c}, \ldots, \frac{b}{2c}, 1; \frac{b}{2c}+1, \ldots, \frac{b}{2c}+1; e^{2cz}\right) - e^{(2c-b)z}\sum_{j=0}^{n}\frac{(-1)^j (2c-b)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{2c-b}{2c}, \ldots, \frac{2c-b}{2c}, 1; \frac{2c-b}{2c}+1, \ldots, \frac{2c-b}{2c}+1; e^{2cz}\right) + e^{(b+2c)z}\sum_{j=0}^{n}\frac{(-1)^j (b+2c)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{b+2c}{2c}, \ldots, \frac{b+2c}{2c}, 1; \frac{b+2c}{2c}+1, \ldots, \frac{b+2c}{2c}+1; e^{2cz}\right)\right) /; n \in \mathbb{N}$$

Involving powers of sinh and power

Involving $z^n \sinh^u(b z) \coth(c z)$

01.22.21.0160.01

$$\int z^n \sinh^u(b z) \coth(c z) \, dz = 2^{-u} n! \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^{k+1} \binom{u}{k} \Bigg(e^{b(u-2k)z} \sum_{j=0}^{n} \frac{(-1)^j (b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Big(\frac{b(u-2k)}{2c}, \ldots, \frac{b(u-2k)}{2c}, 1; \frac{b(u-2k)}{2c}+1, \ldots, \frac{b(u-2k)}{2c}+1; e^{2cz}\Big) + e^{(2c+b(u-2k))z} \sum_{j=0}^{n} \frac{(-1)^j (2c+b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Big(\frac{b(-2k+u)+2c}{2c}, \ldots, \frac{b(-2k+u)+2c}{2c}, 1; \frac{b(-2k+u)+2c}{2c}+1, \ldots, \frac{b(-2k+u)+2c}{2c}+1; e^{2cz}\Big) + (-1)^u \Big(e^{-b(u-2k)z} \sum_{j=0}^{n} \frac{(-1)^j (-b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Big(\frac{-b(-2k+u)}{2c}, \ldots, \frac{-b(-2k+u)}{2c}, 1; \frac{-b(-2k+u)}{2c}+1, \ldots, \frac{-b(-2k+u)}{2c}+1; e^{2cz}\Big) + e^{(2c-b(u-2k))z} \sum_{j=0}^{n} \frac{(-1)^j (2c-b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Big(\frac{-b(-2k+u)+2c}{2c}, \ldots, \frac{-b(-2k+u)+2c}{2c}, 1; \frac{-b(-2k+u)+2c}{2c}+1, \ldots, \frac{-b(-2k+u)+2c}{2c}+1; e^{2cz}\Big)\Big)\Bigg) - \left(\frac{i}{2}\right)^u \binom{u}{\frac{u}{2}} n! \, (1 - u \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + 2 e^{2cz} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(1, \ldots, 1, 1; 2, \ldots, 2; e^{2cz}) \right) /; n \in \mathbb{N} \land u \in \mathbb{N}^+$$

Involving cosh and power

Involving $z^n \cosh(a + b z) \coth(c z)$

01.22.21.0161.01

$$\int z^n \cosh(a + b z) \coth(c z) \, dz = -\frac{1}{2} n! \Bigg(-e^{-a-bz} \sum_{j=0}^{n} \frac{b^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Big(-\frac{b}{2c}, \ldots, -\frac{b}{2c}, 1; 1-\frac{b}{2c}, \ldots, 1-\frac{b}{2c}; e^{2cz}\Big) + e^{a+bz} \sum_{j=0}^{n} \frac{(-1)^j b^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Big(\frac{b}{2c}, \ldots, \frac{b}{2c}, 1; \frac{b}{2c}+1, \ldots, \frac{b}{2c}+1; e^{2cz}\Big) + e^{(2c-b)z-a} \sum_{j=0}^{n} \frac{(-1)^j (2c-b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Big(\frac{2c-b}{2c}, \ldots, \frac{2c-b}{2c}, 1; \frac{2c-b}{2c}+1, \ldots, \frac{2c-b}{2c}+1; e^{2cz}\Big) + e^{a+(b+2c)z} \sum_{j=0}^{n} \frac{(-1)^j (b+2c)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Big(\frac{b+2c}{2c}, \ldots, \frac{b+2c}{2c}, 1; \frac{b+2c}{2c}+1, \ldots, \frac{b+2c}{2c}+1; e^{2cz}\Big)\Bigg) /; n \in \mathbb{N}$$

01.22.21.0162.01

$$\int z^n \cosh(b z) \coth(c z)\, dz = -\frac{1}{2} n! \left(-e^{-b z} \sum_{j=0}^{n} \frac{b^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(-\frac{b}{2c}, \ldots, -\frac{b}{2c}, 1; 1-\frac{b}{2c}, \ldots, 1-\frac{b}{2c}; e^{2cz}\right) + e^{b z} \sum_{j=0}^{n} \frac{(-1)^j b^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b}{2c}, \ldots, \frac{b}{2c}, 1; \frac{b}{2c}+1, \ldots, \frac{b}{2c}+1; e^{2cz}\right) + e^{(2c-b) z} \sum_{j=0}^{n} \frac{(-1)^j (2c-b)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2c-b}{2c}, \ldots, \frac{2c-b}{2c}, 1; \frac{2c-b}{2c}+1, \ldots, \frac{2c-b}{2c}+1; e^{2cz}\right) + e^{(b+2c) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2c)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2c}{2c}, \ldots, \frac{b+2c}{2c}, 1; \frac{b+2c}{2c}+1, \ldots, \frac{b+2c}{2c}+1; e^{2cz}\right)\right) /; n \in \mathbb{N}$$

Involving powers of cosh and power

Involving $z^n \cosh^u(b z) \coth(c z)$

01.22.21.0163.01

$$\int z^n \cosh^u(b z) \coth(c z)\, dz = -2^{-u} \binom{u}{\frac{u}{2}} n! (1 - u \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + 2 e^{2cz} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}(1, \ldots, 1; 2, \ldots, 2; e^{2cz})\right) - 2^{-u} n! \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{u}{k} \left(e^{-b(u-2k) z} \sum_{j=0}^{n} \frac{(-1)^j (-b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(-\frac{b(u-2k)}{2c}, \ldots, -\frac{b(u-2k)}{2c}, 1; 1-\frac{b(u-2k)}{2c}, \ldots, 1-\frac{b(u-2k)}{2c}; e^{2cz}\right) + e^{b(u-2k) z} \sum_{j=0}^{n} \frac{(-1)^j (b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b(u-2k)}{2c}, \ldots, \frac{b(u-2k)}{2c}, 1; \frac{b(u-2k)}{2c}+1, \ldots, \frac{b(u-2k)}{2c}+1; e^{2cz}\right) + e^{(2c-b(u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c-b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2c-b(u-2k)}{2c}, \ldots, \frac{2c-b(u-2k)}{2c}, 1; \frac{2c-b(u-2k)}{2c}+1, \ldots, \frac{2c-b(u-2k)}{2c}+1; e^{2cz}\right) + e^{(2c+b(u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c+b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2c+b(u-2k)}{2c}, \ldots, \frac{2c+b(u-2k)}{2c}, 1; \frac{2c+b(u-2k)}{2c}+1, \ldots, \frac{2c+b(u-2k)}{2c}+1; e^{2cz}\right)\right) /; n \in \mathbb{N} \land u \in \mathbb{N}^+$$

Involving hyperbolic and exponential functions

Involving sinh and exp

Involving e^{pz} sinh(bz) coth(cz)

01.22.21.0164.01

$$\int e^{pz}\sinh(bz)\coth(cz)\,dz = \frac{1}{4}\left(\frac{2\,e^{(p-b)z}\,{}_2F_1\left(\frac{p-b}{2c},1;\frac{-b+2c+p}{2c};e^{2cz}\right)}{p-b}+\frac{2\,e^{(-b+2c+p)z}\,{}_2F_1\left(\frac{-b+2c+p}{2c},1;\frac{-b+4c+p}{2c};e^{2cz}\right)}{-b+2c+p}-\frac{2\,e^{(b+p)z}\,{}_2F_1\left(\frac{b+p}{2c},1;\frac{b+2c+p}{2c};e^{2cz}\right)}{b+p}-\frac{2\,e^{(b+2c+p)z}\,{}_2F_1\left(\frac{b+2c+p}{2c},1;\frac{b+4c+p}{2c};e^{2cz}\right)}{b+2c+p}\right)$$

Involving powers of sinh and exp

Involving e^{pz} sinh^u(bz) coth(cz)

01.22.21.0165.01

$$\int e^{pz}\sinh^u(bz)\coth(cz)\,dz = -\frac{1}{p(2c+p)}\left(\frac{i}{2}\right)^u e^{pz}\binom{u}{\frac{u}{2}}\left((2c+p)\,{}_2F_1\left(\frac{p}{2c},1;\frac{p}{2c}+1;e^{2cz}\right)+e^{2cz}\,p\,{}_2F_1\left(\frac{p}{2c}+1,1;\frac{p}{2c}+2;e^{2cz}\right)\right)(1-u \bmod 2)-$$
$$2^{-u}\sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}(-1)^s\binom{u}{s}\left(\left(e^{(p+b(u-2s))z}\left((2c+p+b(u-2s))\,{}_2F_1\left(\frac{p+b(u-2s)}{2c},1;\frac{p+b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(p+b(u-2s))\,{}_2F_1\left(\frac{p+b(u-2s)}{2c}+1,1;\frac{p+b(u-2s)}{2c}+2;e^{2cz}\right)\right)\right)\Big/\left((p+b(u-2s))(2c+p+b(u-2s))\right)+\left((-1)^u e^{(p-b(u-2s))z}\left((2c+p-b(u-2s))\,{}_2F_1\left(\frac{p-b(u-2s)}{2c},1;\frac{p-b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(p-b(u-2s))\,{}_2F_1\left(\frac{p-b(u-2s)}{2c}+1,1;\frac{p-b(u-2s)}{2c}+2;e^{2cz}\right)\right)\right)\Big/\left((p-b(u-2s))(2c+p-b(u-2s))\right)\right)/;\ u\in\mathbb{N}^+$$

01.22.21.0166.01

$$\int e^{pz}\sinh^\mu(cz)\coth(cz)\,dz = -2^{-\mu}\left(-e^{-cz}+e^{cz}\right)^\mu\left(1-e^{2cz}\right)^{-\mu}\left(\frac{e^{pz}\,{}_2F_1\left(\frac{p-c\mu}{2c},1-\mu;\frac{-\mu c+2c+p}{2c};e^{2cz}\right)}{p-c\mu}+\frac{e^{(2c+p)z}\,{}_2F_1\left(\frac{-\mu c+2c+p}{2c},1-\mu;\frac{-\mu c+4c+p}{2c};e^{2cz}\right)}{-\mu c+2c+p}\right)$$

Involving cosh and exp

Involving e^{pz} cosh(bz) coth(cz)

01.22.21.0167.01

$$\int e^{pz}\cosh(bz)\coth(cz)\,dz = -\frac{1}{4}\left(\frac{2\,e^{(p-b)z}\,{}_2F_1\!\left(\frac{p-b}{2c},1;\frac{-b+2c+p}{2c};e^{2cz}\right)}{p-b}+\frac{2\,e^{(b+p)z}\,{}_2F_1\!\left(\frac{b+p}{2c},1;\frac{b+2c+p}{2c};e^{2cz}\right)}{b+p}+\frac{2\,e^{(-b+2c+p)z}\,{}_2F_1\!\left(\frac{-b+2c+p}{2c},1;\frac{-b+4c+p}{2c};e^{2cz}\right)}{-b+2c+p}+\frac{2\,e^{(b+2c+p)z}\,{}_2F_1\!\left(\frac{b+2c+p}{2c},1;\frac{b+4c+p}{2c};e^{2cz}\right)}{b+2c+p}\right)$$

01.22.21.0168.01

$$\int e^{bz}\coth(cz)\cosh(bz)\,dz = \frac{1}{4bc(b+c)}\left(b\left(2(b+c)\log(\sinh(cz))-c\,e^{2(b+c)z}\,{}_2F_1\!\left(\frac{b+c}{c},1;\frac{b}{c}+2;e^{2cz}\right)\right)-c(b+c)\,e^{2bz}\,{}_2F_1\!\left(\frac{b}{c},1;\frac{b+c}{c};e^{2cz}\right)\right)$$

01.22.21.0169.01

$$\int e^{-bz}\coth(cz)\cosh(bz)\,dz = \frac{e^{-2bz}}{4b(b-c)c}\left(bc\,e^{2cz}\,{}_2F_1\!\left(1-\frac{b}{c},1;2-\frac{b}{c};e^{2cz}\right)+(b-c)\left(c\,{}_2F_1\!\left(-\frac{b}{c},1;1-\frac{b}{c};e^{2cz}\right)+2b\,e^{2bz}\log(\sinh(cz))\right)\right)$$

01.22.21.0170.01

$$\int e^{cz}\coth(cz)\cosh(cz)\,dz = \frac{-2cz+e^{2cz}+4\log\left(-1+e^{2cz}\right)}{4c}$$

Involving powers of cosh and exp

Involving $e^{pz}\cosh^u(bz)\coth(cz)$

01.22.21.0171.01

$$\int e^{pz}\cosh^u(bz)\coth(cz)\,dz = -\frac{1}{p(2c+p)}\left(2^{-u}e^{pz}\binom{u}{\frac{u}{2}}\left((2c+p)\,{}_2F_1\!\left(\frac{p}{2c},1;\frac{p}{2c}+1;e^{2cz}\right)+e^{2cz}p\,{}_2F_1\!\left(\frac{p}{2c}+1,1;\frac{p}{2c}+2;e^{2cz}\right)\right)(1-u \bmod 2)\right)-2^{-u}\sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{s}\left(\left(e^{(p+b(u-2s))z}\left((2c+p+b(u-2s))\,{}_2F_1\!\left(\frac{p+b(u-2s)}{2c},1;\frac{p+b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(p+b(u-2s))\,{}_2F_1\!\left(\frac{p+b(u-2s)}{2c}+1,1;\frac{p+b(u-2s)}{2c}+2;e^{2cz}\right)\right)\right)\Big/((p+b(u-2s))(2c+p+b(u-2s)))+\left(e^{(p-b(u-2s))z}\left((2c+p-b(u-2s))\,{}_2F_1\!\left(\frac{p-b(u-2s)}{2c},1;\frac{p-b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(p-b(u-2s))\,{}_2F_1\!\left(\frac{p-b(u-2s)}{2c}+1,1;\frac{p-b(u-2s)}{2c}+2;e^{2cz}\right)\right)\right)\Big/((p-b(u-2s))(2c+p-b(u-2s)))\right)\;/;\;u\in\mathbb{N}^+$$

01.22.21.0172.01

$$\int e^{pz}\cosh^{\mu}(cz)\coth(cz)\,dz = \left(1+e^{-2cz}\right)^{-\mu}\cosh^{\mu}(cz)\left(\frac{e^{pz}\,F_1\!\left(-\frac{p+c\mu}{2c};-\mu,1;\frac{(3-\mu)c-c-p}{2c};-e^{-2cz},e^{-2cz}\right)}{(\mu-1)c+c+p}+\frac{e^{(p-2c)z}\,F_1\!\left(-\frac{\mu c-2c+p}{2c};-\mu,1;\frac{(3-\mu)c+c-p}{2c};-e^{-2cz},e^{-2cz}\right)}{(\mu-1)c-c+p}\right)$$

Involving powers of tanh and exp

Involving $e^{pz}\tanh^{\mu}(cz)\coth(cz)$

01.22.21.0173.01

$$\int e^{pz}\tanh^{\mu}(cz)\coth(cz)\,dz = \frac{e^{pz}\left(1-e^{-2cz}\right)^{-\mu}\left(1+e^{-2cz}\right)^{\mu}\tanh^{\mu}(cz)}{p}F_1\!\left(-\frac{p}{2c};\mu-1,1-\mu;1-\frac{p}{2c};-e^{-2cz},e^{-2cz}\right)$$

Involving hyperbolic and trigonometric functions

Involving sin and sinh

Involving $\sin(az)\sinh(bz)\coth(cz)$

01.22.21.0174.01

$$\int \sin(az)\sinh(bz)\coth(cz)\,dz = \frac{1}{4}i\left(\frac{e^{(-b-ia)z}\,{}_2F_1\!\left(\frac{-b-ia}{2c},1;\frac{-b+2c-ia}{2c};e^{2cz}\right)}{-b-ia}+\frac{e^{(b+ia)z}\,{}_2F_1\!\left(\frac{b+ia}{2c},1;\frac{b+2c+ia}{2c};e^{2cz}\right)}{b+ia}+\frac{e^{(-b+2c-ia)z}\,{}_2F_1\!\left(\frac{-b+2c-ia}{2c},1;\frac{-b+4c-ia}{2c};e^{2cz}\right)}{-b+2c-ia}+\frac{e^{(b+2c+ia)z}\,{}_2F_1\!\left(\frac{b+2c+ia}{2c},1;\frac{b+4c+ia}{2c};e^{2cz}\right)}{b+2c+ia}-\frac{e^{(ia-b)z}\,{}_2F_1\!\left(\frac{ia-b}{2c},1;\frac{-b+2c+ia}{2c};e^{2cz}\right)}{ia-b}-\frac{e^{(b-ia)z}\,{}_2F_1\!\left(\frac{b-ia}{2c},1;\frac{b+2c-ia}{2c};e^{2cz}\right)}{b-ia}-\frac{e^{(-b+2c+ia)z}\,{}_2F_1\!\left(\frac{-b+2c+ia}{2c},1;\frac{-b+4c+ia}{2c};e^{2cz}\right)}{-b+2c+ia}-\frac{e^{(b+2c-ia)z}\,{}_2F_1\!\left(\frac{b+2c-ia}{2c},1;\frac{b+4c-ia}{2c};e^{2cz}\right)}{b+2c-ia}\right)$$

Involving powers of sin and powers of sinh

Involving $\sin^{m}(az)\sinh^{u}(bz)\coth(cz)$

01.22.21.0175.01

$$\int \sin^{m}(az)\sinh^{u}(bz)\coth(cz)\,dz = \frac{i^{u}\,2^{-m-u}\log(\sinh(cz))(1-m\bmod 2)(1-u\bmod 2)}{c}\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}} - i^{u+1}\,2^{-m-u}\binom{u}{\frac{u}{2}}(1-u\bmod 2)$$

$$\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \Bigg(\Bigg(e^{\frac{i m \pi}{2} - i a (m-2k) z} \Bigg((2c - i a (m-2k))\, {}_2F_1\Bigg(-\frac{i a (m-2k)}{2c}, 1; 1 - \frac{i a (m-2k)}{2c}; e^{2cz}\Bigg) - i a e^{2cz} (m-2k)$$

$$ {}_2F_1\Bigg(1 - \frac{i a (m-2k)}{2c}, 1; 2 - \frac{i a (m-2k)}{2c}; e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg/ (a (m-2k) (2c - i a (m-2k))) -$$

$$\Bigg(e^{i a (m-2k) z - \frac{i m \pi}{2}} \Bigg((2c + a i (m-2k))\, {}_2F_1\Bigg(\frac{i a (m-2k)}{2c}, 1; \frac{a i (m-2k)}{2c} + 1; e^{2cz}\Bigg) + a e^{2cz} i (m-2k)$$

$$ {}_2F_1\Bigg(\frac{a i (m-2k)}{2c} + 1, 1; \frac{a i (m-2k)}{2c} + 2; e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg/ (a (m-2k) (2c + a i (m-2k)))\Bigg) -$$

$$2^{-m-u} \binom{m}{\frac{m}{2}} (1 - m \bmod 2) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{u}{k} \Bigg(\Bigg(e^{b (u-2k) z} \Bigg((2c + b (u-2k))\, {}_2F_1\Bigg(\frac{b (u-2k)}{2c}, 1; \frac{b (u-2k)}{2c} + 1; e^{2cz}\Bigg) +$$

$$b e^{2cz} (u-2k)\, {}_2F_1\Bigg(\frac{b (u-2k)}{2c} + 1, 1; \frac{b (u-2k)}{2c} + 2; e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg/ (b (u-2k) (2c + b (u-2k))) -$$

$$\Bigg((-1)^u e^{-b (u-2k) z} \Bigg((2c - b (u-2k))\, {}_2F_1\Bigg(-\frac{b (u-2k)}{2c}, 1; 1 - \frac{b (u-2k)}{2c}; e^{2cz}\Bigg) -$$

$$b e^{2cz} (u-2k)\, {}_2F_1\Bigg(1 - \frac{b (u-2k)}{2c}, 1; 2 - \frac{b (u-2k)}{2c}; e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg/ (b (u-2k) (2c - b (u-2k)))\Bigg) -$$

$$2^{-m-u} \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^{k+s} \binom{m}{k} \binom{u}{s} \Bigg(\Bigg(e^{\frac{i \pi m}{2} + (b (u-2s) - i a (m-2k)) z} \Bigg((2c - i a (m-2k) + b (u-2s))\, {}_2F_1$$

$$\Bigg(\frac{b (u-2s) - i a (m-2k)}{2c}, 1; \frac{b (u-2s) - i a (m-2k)}{2c} + 1; e^{2cz}\Bigg) + e^{2cz} (b (u-2s) -$$

$$i a (m-2k))\, {}_2F_1\Bigg(\frac{b (u-2s) - i a (m-2k)}{2c} + 1, 1; \frac{b (u-2s) - i a (m-2k)}{2c} + 2; e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg/$$

$$((b (u-2s) - i a (m-2k)) (2c - i a (m-2k) + b (u-2s))) + \Bigg(e^{(a i (m-2k) + b (u-2s)) z - \frac{i m \pi}{2}}$$

$$\Bigg((2c + a i (m-2k) + b (u-2s))\, {}_2F_1\Bigg(\frac{a i (m-2k) + b (u-2s)}{2c}, 1; \frac{a i (m-2k) + b (u-2s)}{2c} + 1; e^{2cz}\Bigg) +$$

$$e^{2cz} (a i (m-2k) + b (u-2s))\, {}_2F_1\Bigg(\frac{a i (m-2k) + b (u-2s)}{2c} + 1, 1; \frac{a i (m-2k) + b (u-2s)}{2c} + 2;$$

$$e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg/ ((a i (m-2k) + b (u-2s)) (2c + a i (m-2k) + b (u-2s))) +$$

$$\Bigg((-1)^u e^{\frac{i \pi m}{2} + (-i a (m-2k) - b (u-2s)) z} \Bigg((2c - i a (m-2k) - b (u-2s))\, {}_2F_1\Bigg(\frac{-i a (m-2k) - b (u-2s)}{2c},$$

$$1; \frac{-i a (m-2k) - b (u-2s)}{2c} + 1; e^{2cz}\Bigg) + e^{2cz} (-i a (m-2k) - b (u-2s))\, {}_2F_1$$

$$\Bigg(\frac{-i a (m-2k) - b (u-2s)}{2c} + 1, 1; \frac{-i a (m-2k) - b (u-2s)}{2c} + 2; e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg/$$

$$((-i a (m-2k) - b (u-2s)) (2c - i a (m-2k) - b (u-2s))) + \Bigg((-1)^u e^{(i a (m-2k) - b (u-2s)) z - \frac{i m \pi}{2}}$$

$$\left((2c + a\,i\,(m-2k) - b\,(u-2s))\,{}_2F_1\left(\frac{i\,a\,(m-2k)-b\,(u-2s)}{2c},\,1;\,\frac{i\,a\,(m-2k)-b\,(u-2s)}{2c}+1;\,e^{2cz}\right)+\right.$$
$$e^{2cz}\,(i\,a\,(m-2k)-b\,(u-2s))\,{}_2F_1\left(\frac{i\,a\,(m-2k)-b\,(u-2s)}{2c}+1,\,1;\,\frac{i\,a\,(m-2k)-b\,(u-2s)}{2c}+2;\right.$$
$$\left.\left.\left.e^{2cz}\right)\right)\right)\Big/\left((i\,a\,(m-2k)-b\,(u-2s))\,(2c+a\,i\,(m-2k)-b\,(u-2s))\right)\,/;\,m\in\mathbb{N}^+\bigwedge u\in\mathbb{N}^+$$

01.22.21.0176.01

$$\int \sin^m(a\,z)\sinh^\mu(c\,z)\coth(c\,z)\,dz = -2^{-m-\mu}\,(-e^{-cz}+e^{cz})^\mu\,\left(1-e^{2cz}\right)^{-\mu}$$
$$\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(\frac{e^{\frac{i\pi m}{2}+(2c-i\,a\,(m-2k))z}\,{}_2F_1\left(\frac{-(\mu-2)c-i\,a\,(m-2k)}{2c},\,1-\mu;\,\frac{-(\mu-4)c-i\,a\,(m-2k)}{2c};\,e^{2cz}\right)}{i\,a\,(2k-m)-c\,(\mu-2)}+\right.$$
$$\frac{e^{(2c+a\,i\,(m-2k))z-\frac{i\,m\pi}{2}}\,{}_2F_1\left(\frac{i\,a\,(m-2k)-c\,(\mu-2)}{2c},\,1-\mu;\,\frac{i\,a\,(m-2k)-c\,(\mu-4)}{2c};\,e^{2cz}\right)}{i\,a\,(m-2k)-c\,(\mu-2)}+$$
$$\frac{e^{\frac{i\,m\pi}{2}-i\,a\,(m-2k)z}\,{}_2F_1\left(\frac{-i\,a\,(m-2k)-c\,\mu}{2c},\,1-\mu;\,\frac{-(\mu-2)c-i\,a\,(m-2k)}{2c};\,e^{2cz}\right)}{-i\,a\,(m-2k)-c\,\mu}+$$
$$\left.\frac{e^{i\,a\,(m-2k)z-\frac{i\,m\pi}{2}}\,{}_2F_1\left(\frac{i\,a\,(m-2k)-c\,\mu}{2c},\,1-\mu;\,\frac{i\,a\,(m-2k)-c\,(\mu-2)}{2c};\,e^{2cz}\right)}{i\,a\,(m-2k)-c\,\mu}\right)-\frac{1}{c\,(\mu-2)\,\mu}\,2^{-m-\mu}\,(-e^{-cz}+e^{cz})^\mu$$
$$\left(1-e^{2cz}\right)^{-\mu}\binom{m}{\frac{m}{2}}\left((\mu-2)\,{}_2F_1\left(-\frac{\mu}{2},\,1-\mu;\,1-\frac{\mu}{2};\,e^{2cz}\right)+e^{2cz}\,\mu\,{}_2F_1\left(1-\frac{\mu}{2},\,1-\mu;\,2-\frac{\mu}{2};\,e^{2cz}\right)\right)$$
$$(m \bmod 2-1)\,/;\,m\in\mathbb{N}^+$$

Involving cos and sinh

Involving $\cos(a\,z)\sinh(b\,z)\coth(c\,z)$

01.22.21.0177.01

$$\int\cos(a\,z)\sinh(b\,z)\coth(c\,z)\,dz = \frac{1}{4}\left(\frac{e^{(-b-i\,a)z}\,{}_2F_1\left(\frac{-b-i\,a}{2c},\,1;\,\frac{-b+2c-i\,a}{2c};\,e^{2cz}\right)}{-b-i\,a}+\frac{e^{(i\,a-b)z}\,{}_2F_1\left(\frac{i\,a-b}{2c},\,1;\,\frac{-b+2c+i\,a}{2c};\,e^{2cz}\right)}{i\,a-b}+\right.$$
$$\frac{e^{(-b+2c-i\,a)z}\,{}_2F_1\left(\frac{-b+2c-i\,a}{2c},\,1;\,\frac{-b+4c-i\,a}{2c};\,e^{2cz}\right)}{-b+2c-i\,a}+\frac{e^{(-b+2c+i\,a)z}\,{}_2F_1\left(\frac{-b+2c+i\,a}{2c},\,1;\,\frac{-b+4c+i\,a}{2c};\,e^{2cz}\right)}{-b+2c+i\,a}-$$
$$\frac{e^{(b-i\,a)z}\,{}_2F_1\left(\frac{b-i\,a}{2c},\,1;\,\frac{b+2c-i\,a}{2c};\,e^{2cz}\right)}{b-i\,a}-\frac{e^{(b+i\,a)z}\,{}_2F_1\left(\frac{b+i\,a}{2c},\,1;\,\frac{b+2c+i\,a}{2c};\,e^{2cz}\right)}{b+i\,a}-$$
$$\left.\frac{e^{(b+2c-i\,a)z}\,{}_2F_1\left(\frac{b+2c-i\,a}{2c},\,1;\,\frac{b+4c-i\,a}{2c};\,e^{2cz}\right)}{b+2c-i\,a}-\frac{e^{(b+2c+i\,a)z}\,{}_2F_1\left(\frac{b+2c+i\,a}{2c},\,1;\,\frac{b+4c+i\,a}{2c};\,e^{2cz}\right)}{b+2c+i\,a}\right)$$

Involving powers of cos and powers of sinh

Involving $\cos^m(a z) \sinh^u(b z) \coth(c z)$

01.22.21.0178.01

$$\int \cos^m(a z) \sinh^u(b z) \coth(c z)\, dz = \frac{i^u\, 2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} \log(\sinh(c z))\, (1 - m \bmod 2)\, (1 - u \bmod 2)}{c} - i^{u+1}\, 2^{-m-u} \binom{u}{\frac{u}{2}} (1 - u \bmod 2)$$
$$\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \Bigg(\Bigg(e^{-i a (m-2k) z} \bigg((2c - i a (m-2k))\, {}_2F_1\bigg(-\frac{i a (m-2k)}{2c}, 1; 1 - \frac{i a (m-2k)}{2c}; e^{2cz}\bigg) - i a\, e^{2cz} (m-2k)$$
$${}_2F_1\bigg(1 - \frac{i a (m-2k)}{2c}, 1; 2 - \frac{i a (m-2k)}{2c}; e^{2cz}\bigg)\bigg)\Bigg) \Big/ (a (m-2k) (2c - i a (m-2k))) -$$
$$\Bigg(e^{i a (m-2k) z} \bigg((2c + a i (m-2k))\, {}_2F_1\bigg(\frac{i a (m-2k)}{2c}, 1; \frac{a i (m-2k)}{2c} + 1; e^{2cz}\bigg) + a\, e^{2cz}\, i (m-2k)$$
$${}_2F_1\bigg(\frac{a i (m-2k)}{2c} + 1, 1; \frac{a i (m-2k)}{2c} + 2; e^{2cz}\bigg)\bigg)\Bigg) \Big/ (a (m-2k) (2c + a i (m-2k)))\Bigg) -$$
$$2^{-m-u} \binom{m}{\frac{m}{2}} (1 - m \bmod 2) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{u}{k} \Bigg(\Bigg(e^{b (u-2k) z} \bigg((2c + b (u-2k))\, {}_2F_1\bigg(\frac{b (u-2k)}{2c}, 1; \frac{b (u-2k)}{2c} + 1; e^{2cz}\bigg) +$$
$$b\, e^{2cz} (u-2k)\, {}_2F_1\bigg(\frac{b (u-2k)}{2c} + 1, 1; \frac{b (u-2k)}{2c} + 2; e^{2cz}\bigg)\bigg)\Bigg) \Big/ (b (u-2k) (2c + b (u-2k))) -$$
$$\Bigg((-1)^u\, e^{-b (u-2k) z} \bigg((2c - b (u-2k))\, {}_2F_1\bigg(-\frac{b (u-2k)}{2c}, 1; 1 - \frac{b (u-2k)}{2c}; e^{2cz}\bigg) -$$
$$b\, e^{2cz} (u-2k)\, {}_2F_1\bigg(1 - \frac{b (u-2k)}{2c}, 1; 2 - \frac{b (u-2k)}{2c}; e^{2cz}\bigg)\bigg)\Bigg) \Big/ (b (u-2k) (2c - b (u-2k)))\Bigg) -$$
$$2^{-m-u} \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^s \binom{m}{k} \binom{u}{s} \Bigg(\Bigg(e^{(b (u-2s) - i a (m-2k)) z} \bigg((2c - i a (m-2k) + b (u-2s))\, {}_2F_1\bigg(\frac{b (u-2s) - i a (m-2k)}{2c},$$
$$1; \frac{b (u-2s) - i a (m-2k)}{2c} + 1; e^{2cz}\bigg) + e^{2cz} (b (u-2s) - i a (m-2k))\, {}_2F_1$$
$$\bigg(\frac{b (u-2s) - i a (m-2k)}{2c} + 1, 1; \frac{b (u-2s) - i a (m-2k)}{2c} + 2; e^{2cz}\bigg)\bigg)\Bigg) \Big/$$
$$((b (u-2s) - i a (m-2k)) (2c - i a (m-2k) + b (u-2s))) + \Bigg(e^{(a i (m-2k) + b (u-2s)) z}$$
$$\bigg((2c + a i (m-2k) + b (u-2s))\, {}_2F_1\bigg(\frac{a i (m-2k) + b (u-2s)}{2c}, 1; \frac{a i (m-2k) + b (u-2s)}{2c} + 1; e^{2cz}\bigg) +$$
$$e^{2cz} (a i (m-2k) + b (u-2s))\, {}_2F_1\bigg(\frac{a i (m-2k) + b (u-2s)}{2c} + 1, 1; \frac{a i (m-2k) + b (u-2s)}{2c} + 2;$$

$$\left.\left.\left.e^{2cz}\right)\right)\right) \Big/ \left((a\,i\,(m-2k)+b\,(u-2s))\,(2c+a\,i\,(m-2k)+b\,(u-2s))\right)+$$

$$\left((-1)^u\, e^{(-i\,a\,(m-2k)-b\,(u-2s))\,z}\left((2c-i\,a\,(m-2k)-b\,(u-2s))\,{}_2F_1\left(\frac{-i\,a\,(m-2k)-b\,(u-2s)}{2c},\right.\right.\right.$$

$$\left.1;\ \frac{-i\,a\,(m-2k)-b\,(u-2s)}{2c}+1;\ e^{2cz}\right)+e^{2cz}\,(-i\,a\,(m-2k)-b\,(u-2s))\,{}_2F_1$$

$$\left.\left.\left(\frac{-i\,a\,(m-2k)-b\,(u-2s)}{2c}+1,\ 1;\ \frac{-i\,a\,(m-2k)-b\,(u-2s)}{2c}+2;\ e^{2cz}\right)\right)\right)\Big/$$

$$((-i\,a\,(m-2k)-b\,(u-2s))\,(2c-i\,a\,(m-2k)-b\,(u-2s)))+\left((-1)^u\, e^{(i\,a\,(m-2k)-b\,(u-2s))\,z}\right.$$

$$\left((2c+a\,i\,(m-2k)-b\,(u-2s))\,{}_2F_1\left(\frac{i\,a\,(m-2k)-b\,(u-2s)}{2c},\ 1;\ \frac{i\,a\,(m-2k)-b\,(u-2s)}{2c}+1;\ e^{2cz}\right)+\right.$$

$$e^{2cz}\,(i\,a\,(m-2k)-b\,(u-2s))\,{}_2F_1\left(\frac{i\,a\,(m-2k)-b\,(u-2s)}{2c}+1,\ 1;\ \frac{i\,a\,(m-2k)-b\,(u-2s)}{2c}+2;\right.$$

$$\left.\left.\left.\left.e^{2cz}\right)\right)\right)\Big/\left((i\,a\,(m-2k)-b\,(u-2s))\,(2c+a\,i\,(m-2k)-b\,(u-2s))\right)\right)\ /;\ m\in\mathbb{N}^+\bigwedge u\in\mathbb{N}^+$$

01.22.21.0179.01

$$\int \cos^m(a\,z)\sinh^\mu(c\,z)\coth(c\,z)\,dz == \frac{1}{c\,(\mu-2)\,\mu}\,2^{-m-\mu}\,(-e^{-cz}+e^{cz})^\mu\,(-1)\binom{m}{\frac{m}{2}}(m \bmod 2-1)$$

$$\left(1-e^{2cz}\right)^{-\mu}\left((\mu-2)\,{}_2F_1\left(-\frac{\mu}{2},\ 1-\mu;\ 1-\frac{\mu}{2};\ e^{2cz}\right)+e^{2cz}\,\mu\,{}_2F_1\left(1-\frac{\mu}{2},\ 1-\mu;\ 2-\frac{\mu}{2};\ e^{2cz}\right)\right)-$$

$$2^{-m-\mu}\,(-e^{-cz}+e^{cz})^\mu\left(1-e^{2cz}\right)^{-\mu}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(\frac{e^{(2c-i\,a\,(m-2k))\,z}\,{}_2F_1\left(\frac{-(\mu-2)\,c-i\,a\,(m-2k)}{2c},\ 1-\mu;\ \frac{-(\mu-4)\,c-i\,a\,(m-2k)}{2c};\ e^{2cz}\right)}{i\,a\,(2k-m)-c\,(\mu-2)}+\right.$$

$$\frac{e^{(2c+a\,i\,(m-2k))\,z}\,{}_2F_1\left(\frac{i\,a\,(m-2k)-c\,(\mu-2)}{2c},\ 1-\mu;\ \frac{i\,a\,(m-2k)-c\,(\mu-4)}{2c};\ e^{2cz}\right)}{i\,a\,(m-2k)-c\,(\mu-2)}+$$

$$\frac{e^{-i\,a\,(m-2k)\,z}\,{}_2F_1\left(\frac{-i\,a\,(m-2k)-c\,\mu}{2c},\ 1-\mu;\ \frac{-(\mu-2)\,c-i\,a\,(m-2k)}{2c};\ e^{2cz}\right)}{-i\,a\,(m-2k)-c\,\mu}+$$

$$\left.\frac{e^{i\,a\,(m-2k)\,z}\,{}_2F_1\left(\frac{i\,a\,(m-2k)-c\,\mu}{2c},\ 1-\mu;\ \frac{i\,a\,(m-2k)-c\,(\mu-2)}{2c};\ e^{2cz}\right)}{i\,a\,(m-2k)-c\,\mu}\right)\ /;\ m\in\mathbb{N}^+$$

Involving sin and cosh

Involving sin(*a z*) cosh(*b z*) coth(*c z*)

01.22.21.0180.01

$$\int \sin(a z)\cosh(b z)\coth(c z)\,dz = \frac{1}{4} i \left(-\frac{e^{(-b-i a) z}\, {}_2F_1\left(\frac{-b-i a}{2 c}, 1; \frac{-b+2 c-i a}{2 c}; e^{2 c z}\right)}{-b-i a} + \frac{e^{(i a-b) z}\, {}_2F_1\left(\frac{i a-b}{2 c}, 1; \frac{-b+2 c+i a}{2 c}; e^{2 c z}\right)}{i a-b} + \frac{e^{(b+i a) z}\, {}_2F_1\left(\frac{b+i a}{2 c}, 1; \frac{b+2 c+i a}{2 c}; e^{2 c z}\right)}{b+i a} + \frac{e^{(-b+2 c+i a) z}\, {}_2F_1\left(\frac{-b+2 c+i a}{2 c}, 1; \frac{-b+4 c+i a}{2 c}; e^{2 c z}\right)}{-b+2 c+i a} + \frac{e^{(b+2 c+i a) z}\, {}_2F_1\left(\frac{b+2 c+i a}{2 c}, 1; \frac{b+4 c+i a}{2 c}; e^{2 c z}\right)}{b+2 c+i a} - \frac{e^{(b-i a) z}\, {}_2F_1\left(\frac{b-i a}{2 c}, 1; \frac{b+2 c-i a}{2 c}; e^{2 c z}\right)}{b-i a} - \frac{e^{(-b+2 c-i a) z}\, {}_2F_1\left(\frac{-b+2 c-i a}{2 c}, 1; \frac{-b+4 c-i a}{2 c}; e^{2 c z}\right)}{-b+2 c-i a} - \frac{e^{(b+2 c-i a) z}\, {}_2F_1\left(\frac{b+2 c-i a}{2 c}, 1; \frac{b+4 c-i a}{2 c}; e^{2 c z}\right)}{b+2 c-i a} \right)$$

Involving powers of sin and powers of cosh

Involving $\sin^m(a z)\cosh^u(b z)\coth(c z)$

01.22.21.0181.01

$$\int \sin^m(a z)\cosh^u(b z)\coth(c z)\,dz = -2^{-m-u} \binom{u}{\frac{u}{2}} (1-u \bmod 2) \sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor} (-1)^k \binom{m}{k} \Bigg(\Bigg(i\, e^{\frac{i m \pi}{2} - i a (m-2 k) z} \left((2 c - i a (m-2 k))\, {}_2F_1\left(-\frac{i a (m-2 k)}{2 c}, 1; 1-\frac{i a (m-2 k)}{2 c}; e^{2 c z}\right) - i a\, e^{2 c z} (m-2 k)\, {}_2F_1\left(1-\frac{i a (m-2 k)}{2 c}, 1; 2-\frac{i a (m-2 k)}{2 c}; e^{2 c z}\right)\right)\Bigg) \Big/ (a (m-2 k) (2 c - i a (m-2 k))) - \Bigg(i\, e^{i a (m-2 k) z - \frac{i m \pi}{2}} \left((2 c + a i (m-2 k))\, {}_2F_1\left(\frac{i a (m-2 k)}{2 c}, 1; \frac{a i (m-2 k)}{2 c}+1; e^{2 c z}\right) + a\, e^{2 c z} i (m-2 k)\, {}_2F_1\left(\frac{a i (m-2 k)}{2 c}+1, 1; \frac{a i (m-2 k)}{2 c}+2; e^{2 c z}\right)\right)\Bigg) \Big/ (a (m-2 k) (2 c + a i (m-2 k))) \Bigg) + \frac{2^{-m-u} \log(\sinh(c z)) (1-m \bmod 2) (1-u \bmod 2)}{c} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} - 2^{-m-u} \binom{m}{\frac{m}{2}} (1-m \bmod 2) \sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor} \binom{u}{k} \Bigg(\Bigg(e^{b (u-2 k) z} \left((2 c + b (u-2 k))\, {}_2F_1\left(\frac{b (u-2 k)}{2 c}, 1; \frac{b (u-2 k)}{2 c}+1; e^{2 c z}\right) + b\, e^{2 c z} (u-2 k)\, {}_2F_1\left(\frac{b (u-2 k)}{2 c}+1, 1; \frac{b (u-2 k)}{2 c}+2; e^{2 c z}\right)\right)\Bigg) \Big/ (b (u-2 k) (2 c + b (u-2 k))) - \Bigg(e^{-b (u-2 k) z} \left((2 c - b (u-2 k))\, {}_2F_1\left(-\frac{b (u-2 k)}{2 c}, 1; 1-\frac{b (u-2 k)}{2 c}; e^{2 c z}\right) - b\, e^{2 c z} (u-2 k)\, {}_2F_1\left(1-\frac{b (u-2 k)}{2 c}, 1; 2-\frac{b (u-2 k)}{2 c}; e^{2 c z}\right)\right)\Bigg) \Big/ (b (u-2 k) (2 c - b (u-2 k))) \Bigg) - 2^{-m-u} \sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor} \sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor} (-1)^k \binom{m}{k} \binom{u}{s} \Bigg(\Bigg(e^{\frac{i \pi m}{2} + (b (u-2 s) - i a (m-2 k)) z} \Big((2 c - i a (m-2 k) + b (u-2 s))\, {}_2F_1$$

$$\left(\frac{b\,(u-2\,s)-i\,a\,(m-2\,k)}{2\,c},\,1;\,\frac{b\,(u-2\,s)-i\,a\,(m-2\,k)}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{2\,c\,z}\,(b\,(u-2\,s)-$$

$$i\,a\,(m-2\,k))\,{}_2F_1\!\left(\frac{b\,(u-2\,s)-i\,a\,(m-2\,k)}{2\,c}+1,\,1;\,\frac{b\,(u-2\,s)-i\,a\,(m-2\,k)}{2\,c}+2;\,e^{2\,c\,z}\right)\Bigg)\Bigg)\Bigg/$$

$$((b\,(u-2\,s)-i\,a\,(m-2\,k))\,(2\,c-i\,a\,(m-2\,k)+b\,(u-2\,s)))+\Bigg(e^{(a\,i\,(m-2\,k)+b\,(u-2\,s))\,z-\frac{i\,m\,\pi}{2}}$$

$$\Bigg((2\,c+a\,i\,(m-2\,k)+b\,(u-2\,s))\,{}_2F_1\!\left(\frac{a\,i\,(m-2\,k)+b\,(u-2\,s)}{2\,c},\,1;\,\frac{a\,i\,(m-2\,k)+b\,(u-2\,s)}{2\,c}+1;\,e^{2\,c\,z}\right)+$$

$$e^{2\,c\,z}\,(a\,i\,(m-2\,k)+b\,(u-2\,s))\,{}_2F_1\!\Bigg(\frac{a\,i\,(m-2\,k)+b\,(u-2\,s)}{2\,c}+1,\,1;\,\frac{a\,i\,(m-2\,k)+b\,(u-2\,s)}{2\,c}+2;$$

$$e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg/((a\,i\,(m-2\,k)+b\,(u-2\,s))\,(2\,c+a\,i\,(m-2\,k)+b\,(u-2\,s)))+$$

$$\Bigg(e^{\frac{i\,\pi\,m}{2}+(-i\,a\,(m-2\,k)-b\,(u-2\,s))\,z}\Bigg((2\,c-i\,a\,(m-2\,k)-b\,(u-2\,s))\,{}_2F_1\!\Bigg(\frac{-i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c},\,1;$$

$$\frac{-i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+e^{2\,c\,z}\,(-i\,a\,(m-2\,k)-b\,(u-2\,s))\,{}_2F_1$$

$$\left(\frac{-i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+1,\,1;\,\frac{-i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+2;\,e^{2\,c\,z}\right)\Bigg)\Bigg)\Bigg/$$

$$((-i\,a\,(m-2\,k)-b\,(u-2\,s))\,(2\,c-i\,a\,(m-2\,k)-b\,(u-2\,s)))+\Bigg(e^{(i\,a\,(m-2\,k)-b\,(u-2\,s))\,z-\frac{i\,m\,\pi}{2}}$$

$$\Bigg((2\,c+a\,i\,(m-2\,k)-b\,(u-2\,s))\,{}_2F_1\!\left(\frac{i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c},\,1;\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+1;\,e^{2\,c\,z}\right)+$$

$$e^{2\,c\,z}\,(i\,a\,(m-2\,k)-b\,(u-2\,s))\,{}_2F_1\!\Bigg(\frac{i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+1,\,1;\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+2;$$

$$e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg/((i\,a\,(m-2\,k)-b\,(u-2\,s))\,(2\,c+a\,i\,(m-2\,k)-b\,(u-2\,s)))\Bigg)\,/;\,m\in\mathbb{N}^+\bigwedge u\in\mathbb{N}^+$$

01.22.21.0182.01

$$\int \sin^m(a z) \cosh^\mu(c z) \coth(c z)\, dz = 2^{-m} \left(1 + e^{-2 c z}\right)^{-\mu} \cosh^\mu(c z)$$
$$\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(\frac{e^{(i a (m-2k) - 2c) z - \frac{i m \pi}{2}} F_1\left(-\frac{(\mu-2) c + a i (m-2k)}{2c}; -\mu, 1; \frac{c(4-\mu) - i a (m-2k)}{2c}; -e^{-2cz}, e^{-2cz}\right)}{a i (m - 2k) + c(\mu - 2)} + \right.$$
$$\left(e^{\frac{i \pi m}{2} + (-2c - i a (m-2k)) z} F_1\left(-\frac{a i (2k - m) + c(\mu - 2)}{2c}; -\mu, 1; \frac{a i (m - 2k) + c(4 - \mu)}{2c}; -e^{-2cz}, e^{-2cz}\right)\right) \Big/$$
$$(c(\mu - 2) - i a (m - 2k)) + \frac{e^{\frac{i m \pi}{2} - i a (m-2k) z} F_1\left(-\frac{a i (2k-m) + c\mu}{2c}; -\mu, 1; \frac{-\mu c + 2c - 2 i a k + i a m}{2c}; -e^{-2cz}, e^{-2cz}\right)}{a i (2k - m) + c \mu} +$$
$$\left. \frac{e^{i a (m-2k) z - \frac{i m \pi}{2}} F_1\left(-\frac{a i (m-2k) + c\mu}{2c}; -\mu, 1; \frac{c(2-\mu) - i a (m-2k)}{2c}; -e^{-2cz}, e^{-2cz}\right)}{a i (m - 2k) + c \mu} \right) - \frac{1}{c(\mu - 2)\mu} 2^{-m} e^{-2cz}$$
$$\left(1 + e^{-2cz}\right)^{-\mu} \left(e^{2cz} (\mu - 2) F_1\left(-\frac{\mu}{2}; -\mu, 1; 1 - \frac{\mu}{2}; -e^{-2cz}, e^{-2cz}\right) + \mu F_1\left(1 - \frac{\mu}{2}; -\mu, 1; 2 - \frac{\mu}{2}; -e^{-2cz}, e^{-2cz}\right)\right)$$
$$\binom{m}{\frac{m}{2}} \cosh^\mu(c z) (m \bmod 2 - 1) \;/;\; m \in \mathbb{N}^+$$

Involving cos and cosh

Involving $\cos(a z) \cosh(b z) \coth(c z)$

01.22.21.0183.01

$$\int \cos(a z) \cosh(b z) \coth(c z)\, dz =$$
$$\frac{1}{4} \left(-\frac{e^{(-b - i a) z} {}_2F_1\left(\frac{-b - i a}{2c}, 1; \frac{-b + 2c - i a}{2c}; e^{2cz}\right)}{-b - i a} - \frac{e^{(i a - b) z} {}_2F_1\left(\frac{i a - b}{2c}, 1; \frac{-b + 2c + i a}{2c}; e^{2cz}\right)}{i a - b} - \frac{e^{(b - i a) z} {}_2F_1\left(\frac{b - i a}{2c}, 1; \frac{b + 2c - i a}{2c}; e^{2cz}\right)}{b - i a} - \right.$$
$$\frac{e^{(b + i a) z} {}_2F_1\left(\frac{b + i a}{2c}, 1; \frac{b + 2c + i a}{2c}; e^{2cz}\right)}{b + i a} - \frac{e^{(-b + 2c - i a) z} {}_2F_1\left(\frac{-b + 2c - i a}{2c}, 1; \frac{-b + 4c - i a}{2c}; e^{2cz}\right)}{-b + 2c - i a} -$$
$$\frac{e^{(-b + 2c + i a) z} {}_2F_1\left(\frac{-b + 2c + i a}{2c}, 1; \frac{-b + 4c + i a}{2c}; e^{2cz}\right)}{-b + 2c + i a} -$$
$$\left. \frac{e^{(b + 2c - i a) z} {}_2F_1\left(\frac{b + 2c - i a}{2c}, 1; \frac{b + 4c - i a}{2c}; e^{2cz}\right)}{b + 2c - i a} - \frac{e^{(b + 2c + i a) z} {}_2F_1\left(\frac{b + 2c + i a}{2c}, 1; \frac{b + 4c + i a}{2c}; e^{2cz}\right)}{b + 2c + i a} \right)$$

Involving powers of cos and powers of cosh

Involving $\cos^m(a z) \cosh^u(b z) \coth(c z)$

01.22.21.0184.01

$$\int \cos^m(a z)\cosh^u(b z)\coth(c z)\,dz = -2^{-m-u}\binom{u}{\frac{u}{2}}(1-u \bmod 2)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\Bigg(\Bigg(i\,e^{-i a (m-2k) z}\left((2c-i a (m-2k))\,{}_2F_1\left(-\frac{i a (m-2k)}{2c}, 1; 1-\frac{i a (m-2k)}{2c}; e^{2cz}\right)-\right.$$

$$\left.\left. i a e^{2cz}(m-2k)\,{}_2F_1\left(1-\frac{i a (m-2k)}{2c}, 1; 2-\frac{i a (m-2k)}{2c}; e^{2cz}\right)\right)\right)\Big/(a(m-2k)(2c-i a(m-2k)))-$$

$$\Bigg(i\,e^{i a (m-2k) z}\left((2c+a i (m-2k))\,{}_2F_1\left(\frac{i a (m-2k)}{2c}, 1; \frac{a i (m-2k)}{2c}+1; e^{2cz}\right)+a e^{2cz} i (m-2k)\right.$$

$$\left.\left.{}_2F_1\left(\frac{a i (m-2k)}{2c}+1, 1; \frac{a i (m-2k)}{2c}+2; e^{2cz}\right)\right)\right)\Big/(a(m-2k)(2c+a i (m-2k)))\Bigg)+$$

$$\frac{2^{-m-u}\log(\sinh(c z))(1-m \bmod 2)(1-u \bmod 2)}{c}\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}}-2^{-m-u}\binom{m}{\frac{m}{2}}(1-m \bmod 2)$$

$$\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{k}\Bigg(\Bigg(e^{b(u-2k)z}\left((2c+b(u-2k))\,{}_2F_1\left(\frac{b(u-2k)}{2c}, 1; \frac{b(u-2k)}{2c}+1; e^{2cz}\right)+\right.$$

$$\left.\left. b e^{2cz}(u-2k)\,{}_2F_1\left(\frac{b(u-2k)}{2c}+1, 1; \frac{b(u-2k)}{2c}+2; e^{2cz}\right)\right)\right)\Big/(b(u-2k)(2c+b(u-2k)))-$$

$$\Bigg(e^{-b(u-2k)z}\left((2c-b(u-2k))\,{}_2F_1\left(-\frac{b(u-2k)}{2c}, 1; 1-\frac{b(u-2k)}{2c}; e^{2cz}\right)-b e^{2cz}(u-2k)\right.$$

$$\left.\left.{}_2F_1\left(1-\frac{b(u-2k)}{2c}, 1; 2-\frac{b(u-2k)}{2c}; e^{2cz}\right)\right)\right)\Big/(b(u-2k)(2c-b(u-2k)))\Bigg)-$$

$$2^{-m-u}\sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\binom{u}{s}\Bigg(\Bigg(e^{(b(u-2s)-i a (m-2k))z}\left((2c-i a(m-2k)+b(u-2s))\,{}_2F_1\left(\frac{b(u-2s)-i a (m-2k)}{2c},\right.\right.$$

$$\left.1; \frac{b(u-2s)-i a(m-2k)}{2c}+1; e^{2cz}\right)+e^{2cz}(b(u-2s)-i a (m-2k))\,{}_2F_1$$

$$\left.\left.\left(\frac{b(u-2s)-i a(m-2k)}{2c}+1, 1; \frac{b(u-2s)-i a (m-2k)}{2c}+2; e^{2cz}\right)\right)\right)\Big/$$

$$((b(u-2s)-i a(m-2k))(2c-i a(m-2k)+b(u-2s)))+\Bigg(e^{(a i (m-2k)+b(u-2s))z}$$

$$\left((2c+a i(m-2k)+b(u-2s))\,{}_2F_1\left(\frac{a i (m-2k)+b(u-2s)}{2c}, 1; \frac{a i (m-2k)+b(u-2s)}{2c}+1; e^{2cz}\right)+\right.$$

$$e^{2cz}(a i (m-2k)+b(u-2s))\,{}_2F_1\left(\frac{a i (m-2k)+b(u-2s)}{2c}+1, 1; \frac{a i (m-2k)+b(u-2s)}{2c}+2;\right.$$

$$\left.\left.\left. e^{2cz}\right)\right)\right)\Big/((a i (m-2k)+b(u-2s))(2c+a i (m-2k)+b(u-2s)))+$$

$$\Bigg(e^{(-i a (m-2k)-b(u-2s))z}\left((2c-i a(m-2k)-b(u-2s))\,{}_2F_1\left(\frac{-i a(m-2k)-b(u-2s)}{2c}, 1;\right.\right.$$

$$\left.\frac{-i a (m-2k)-b(u-2s)}{2c}+1; e^{2cz}\right)+e^{2cz}(-i a(m-2k)-b(u-2s))\,{}_2F_1$$

$$\left(\frac{-i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+1,\,1;\,\frac{-i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+2;\,e^{2\,c\,z}\right)\Bigg)\Bigg)\Bigg/$$

$$((-i\,a\,(m-2\,k)-b\,(u-2\,s))\,(2\,c-i\,a\,(m-2\,k)-b\,(u-2\,s)))+\Bigg(e^{(i\,a\,(m-2\,k)-b\,(u-2\,s))\,z}$$

$$\left((2\,c+a\,i\,(m-2\,k)-b\,(u-2\,s))\,{}_2F_1\!\left(\frac{i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c},\,1;\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+1;\,e^{2\,c\,z}\right)+\right.$$

$$e^{2\,c\,z}\,(i\,a\,(m-2\,k)-b\,(u-2\,s))\,{}_2F_1\!\left(\frac{i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+1,\,1;\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,s)}{2\,c}+2;\right.$$

$$\left.\left.e^{2\,c\,z}\right)\right)\Bigg)\Bigg/((i\,a\,(m-2\,k)-b\,(u-2\,s))\,(2\,c+a\,i\,(m-2\,k)-b\,(u-2\,s)))\Bigg)\,/;\,m\in\mathbb{N}^+\bigwedge u\in\mathbb{N}^+$$

01.22.21.0185.01

$$\int\cos^m(a\,z)\cosh^\mu(c\,z)\coth(c\,z)\,dz=\frac{2^{-m}\cosh^\mu(c\,z)\left(1+e^{2\,c\,z}\right)^{-\mu}F_1\!\left(-\frac{\mu}{2};\,1,\,-\mu-1;\,1-\frac{\mu}{2};\,e^{2\,c\,z},\,-e^{2\,c\,z}\right)\binom{m}{\frac{m}{2}}(1-m\bmod 2)}{c\,\mu}-$$

$$2^{-m}\cosh^\mu(c\,z)\left(1+e^{2\,c\,z}\right)^{-\mu}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(\frac{e^{i\,a\,(m-2\,k)\,z}\,F_1\!\left(\frac{i\,a\,(m-2\,k)-c\,\mu}{2\,c};\,1,\,-\mu-1;\,\frac{1}{2}\left(\frac{a\,i\,(m-2\,k)}{c}-\mu+2\right);\,e^{2\,c\,z},\,-e^{2\,c\,z}\right)}{i\,a\,(m-2\,k)-c\,\mu}-\right.$$

$$\left.\frac{e^{-i\,a\,(m-2\,k)\,z}\,F_1\!\left(\frac{-i\,a\,(m-2\,k)-c\,\mu}{2\,c};\,1,\,-\mu-1;\,\frac{1}{2}\left(\frac{-i\,a\,(m-2\,k)}{c}-\mu+2\right);\,e^{2\,c\,z},\,-e^{2\,c\,z}\right)}{a\,i\,(m-2\,k)+c\,\mu}\right)/;\,m\in\mathbb{N}^+$$

Involving powers of sin and powers of tanh

Involving $\sin^m(a\,z)\tanh^\mu(c\,z)\coth(c\,z)$

01.22.21.0186.01

$$\int\sin^m(a\,z)\tanh^\mu(c\,z)\coth(c\,z)\,dz=\frac{2^{-m}\,i\left(1-e^{-2\,c\,z}\right)^{-\mu}\left(1+e^{-2\,c\,z}\right)^{\mu}}{a}\tanh^\mu(c\,z)$$

$$\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\frac{(-1)^k}{m-2\,k}\binom{m}{k}\left(e^{\frac{i\,m\,\pi}{2}-i\,a\,(m-2\,k)\,z}\,F_1\!\left(\frac{i\,a\,(m-2\,k)}{2\,c};\,\mu-1,\,1-\mu;\,\frac{a\,i\,(m-2\,k)}{2\,c}+1;\,-e^{-2\,c\,z},\,e^{-2\,c\,z}\right)-\right.$$

$$\left.e^{i\,a\,(m-2\,k)\,z-\frac{i\,m\,\pi}{2}}\,F_1\!\left(-\frac{i\,a\,(m-2\,k)}{2\,c};\,\mu-1,\,1-\mu;\,1-\frac{i\,a\,(m-2\,k)}{2\,c};\,-e^{-2\,c\,z},\,e^{-2\,c\,z}\right)\right)+$$

$$\frac{2^{-m}\,(1-m\bmod 2)\tanh^\mu(c\,z)}{c\,\mu}\binom{m}{\frac{m}{2}}\,{}_2F_1\!\left(\frac{\mu}{2},\,1;\,\frac{\mu}{2}+1;\,\tanh^2(c\,z)\right)\,/;\,m\in\mathbb{N}^+$$

Involving powers of cos and powers of tanh

Involving $\cos^m(a\,z)\tanh^\mu(c\,z)\coth(c\,z)$

01.22.21.0187.01

$$\int \cos^m(a z) \tanh^\mu(c z) \coth(c z)\, dz = \frac{2^{-m}\, i \left(1 - e^{-2 c z}\right)^{-\mu} \left(1 + e^{-2 c z}\right)^{\mu} \tanh^\mu(c z)}{a}$$

$$\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \frac{1}{m - 2k} \binom{m}{k} \left(e^{-i a (m-2k) z} F_1\left(\frac{i a (m - 2k)}{2c}; \mu - 1, 1 - \mu; \frac{a i (m - 2k)}{2c} + 1; -e^{-2cz}, e^{-2cz}\right) - \right.$$

$$\left. e^{i a (m-2k) z} F_1\left(-\frac{i a (m - 2k)}{2c}; \mu - 1, 1 - \mu; 1 - \frac{i a (m - 2k)}{2c}; -e^{-2cz}, e^{-2cz}\right)\right) +$$

$$\frac{2^{-m} (1 - m \bmod 2) \tanh^\mu(c z)}{c \mu} \binom{m}{\frac{m}{2}} {}_2F_1\left(\frac{\mu}{2}, 1; \frac{\mu}{2} + 1; \tanh^2(c z)\right) /; m \in \mathbb{N}^+$$

Involving hyperbolic, exponential and a power functions

Involving sinh, exp and power

Involving $z^n\, e^{p z} \sinh(a + b z) \coth(c z)$

01.22.21.0188.01

$$\int z^n\, e^{p z} \sinh(a + b z) \coth(c z)\, dz =$$

$$-\frac{1}{2} n! \left(-e^{(p-b) z - a} \sum_{j=0}^{n} \frac{(-1)^j (p - b)^{-j-1} z^{n-j}}{(n - j)!} {}_{j+2}F_{j+1}\left(\frac{p - b}{2c}, \ldots, \frac{p - b}{2c}, 1; \frac{p - b}{2c} + 1, \ldots, \frac{p - b}{2c} + 1; e^{2cz}\right) + \right.$$

$$e^{a + (b+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b + p)^{-j-1} z^{n-j}}{(n - j)!} {}_{j+2}F_{j+1}\left(\frac{b + p}{2c}, \ldots, \frac{b + p}{2c}, 1; \frac{b + p}{2c} + 1, \ldots, \frac{b + p}{2c} + 1; e^{2cz}\right) -$$

$$e^{(-b+2c+p) z - a} \sum_{j=0}^{n} \frac{(-1)^j (-b + 2c + p)^{-j-1} z^{n-j}}{(n - j)!} {}_{j+2}F_{j+1}\left(\frac{-b + 2c + p}{2c}, \ldots, \frac{-b + 2c + p}{2c}, 1; \right.$$

$$\left. \frac{-b + 2c + p}{2c} + 1, \ldots, \frac{-b + 2c + p}{2c} + 1; e^{2cz}\right) + e^{a + (b+2c+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b + 2c + p)^{-j-1} z^{n-j}}{(n - j)!}$$

$$\left. {}_{j+2}F_{j+1}\left(\frac{b + 2c + p}{2c}, \ldots, \frac{b + 2c + p}{2c}, 1; \frac{b + 2c + p}{2c} + 1, \ldots, \frac{b + 2c + p}{2c} + 1; e^{2cz}\right)\right) /; n \in \mathbb{N}$$

01.22.21.0189.01

$$\int z^n e^{p z} \sinh(b z) \coth(c z) \, dz = -\frac{1}{2} n! \left(-e^{(p-b) z} \sum_{j=0}^{n} \frac{(-1)^j (p-b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p-b}{2 c}, \ldots, \frac{p-b}{2 c}, 1; \frac{p-b}{2 c}+1, \ldots, \frac{p-b}{2 c}+1; e^{2 c z}\right) + e^{(b+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b+p}{2 c}, \ldots, \frac{b+p}{2 c}, 1; \frac{b+p}{2 c}+1, \ldots, \frac{b+p}{2 c}+1; e^{2 c z}\right) - e^{(-b+2 c+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b+2 c+p}{2 c}, \ldots, \frac{-b+2 c+p}{2 c}, 1; \frac{-b+2 c+p}{2 c}+1, \ldots, \frac{-b+2 c+p}{2 c}+1; e^{2 c z}\right) + e^{(b+2 c+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b+2 c+p}{2 c}, \ldots, \frac{b+2 c+p}{2 c}, 1; \frac{b+2 c+p}{2 c}+1, \ldots, \frac{b+2 c+p}{2 c}+1; e^{2 c z}\right)\right) /; n \in \mathbb{N}$$

01.22.21.0190.01

$$\int z^n e^{b z} \sinh(b z) \coth(c z) \, dz = \frac{1}{2} \left(\frac{z^{n+1}}{n+1} + 2 e^{2 c z} n! \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(1, \ldots, 1; 2, \ldots, 2; e^{2 c z}) - n! \left(e^{2 b z} \sum_{j=0}^{n} \frac{(-1)^j (2 b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b}{c}, \ldots, \frac{b}{c}, 1; \frac{b}{c}+1, \ldots, \frac{b}{c}+1; e^{2 c z}\right) + e^{2 (b+c) z} \sum_{j=0}^{n} \frac{(-1)^j (2 b+2 c)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b+c}{c}, \ldots, \frac{b+c}{c}, 1; \frac{b+c}{c}+1, \ldots, \frac{b+c}{c}+1; e^{2 c z}\right)\right)\right) /; n \in \mathbb{N}$$

01.22.21.0191.01

$$\int z^n e^{-b z} \sinh(b z) \coth(c z) \, dz = -\frac{1}{2} \left(\frac{z^{n+1}}{n+1} + 2 e^{2 c z} n! \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(1, \ldots, 1; 2, \ldots, 2; e^{2 c z}) - n! \left(e^{-2 b z} \sum_{j=0}^{n} \frac{(-1)^j (-2 b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(-\frac{b}{c}, \ldots, -\frac{b}{c}, 1; 1-\frac{b}{c}, \ldots, 1-\frac{b}{c}; e^{2 c z}\right) + e^{2 (c-b) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c-2 b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{c-b}{c}, \ldots, \frac{c-b}{c}, 1; \frac{c-b}{c}+1, \ldots, \frac{c-b}{c}+1; e^{2 c z}\right)\right)\right) /; n \in \mathbb{N}$$

Involving powers of sinh, exp and power

Involving $z^n e^{p z} \sinh^u(b z) \coth(c z)$

01.22.21.0192.01

$$\int z^n e^{p z} \sinh^u(b z) \coth(c z)\, dz = -\left(\frac{i}{2}\right)^u \binom{u}{\frac{u}{2}} n!\, (1 - u \bmod 2) \left(e^{p z} \sum_{j=0}^{n} \frac{(-1)^j p^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p}{2c}, \ldots, \frac{p}{2c}, 1; \frac{p}{2c}+1, \ldots, \frac{p}{2c}+1; e^{2cz}\right) + e^{(2c+p) z} \sum_{j=0}^{n} \frac{(-1)^j (2c+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p+2c}{2c}, \ldots, \frac{p+2c}{2c}, 1; \frac{p+2c}{2c}+1, \ldots, \frac{p+2c}{2c}+1; e^{2cz}\right)\right) - 2^{-u} n! \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{u}{k} \left((-1)^u \left(e^{(p-b(u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (p-b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p-b(u-2k)}{2c}, \ldots, \frac{p-b(u-2k)}{2c}, 1; \frac{p-b(u-2k)}{2c}+1, \ldots, \frac{p-b(u-2k)}{2c}+1; e^{2cz}\right) + e^{(2c+p-b(u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c+p-b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c+p-b(u-2k)}{2c}, \ldots, \frac{2c+p-b(u-2k)}{2c}, 1; \frac{2c+p-b(u-2k)}{2c}+1, \ldots, \frac{2c+p-b(u-2k)}{2c}+1; e^{2cz}\right)\right) + e^{(p+b(u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (p+b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p+b(u-2k)}{2c}, \ldots, \frac{p+b(u-2k)}{2c}, 1; \frac{p+b(u-2k)}{2c}+1, \ldots, \frac{p+b(u-2k)}{2c}+1; e^{2cz}\right) + e^{(2c+p+b(u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c+p+b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c+p+b(u-2k)}{2c}, \ldots, \frac{2c+p+b(u-2k)}{2c}, 1; \frac{2c+p+b(u-2k)}{2c}+1, \ldots, \frac{2c+p+b(u-2k)}{2c}+1; e^{2cz}\right)\right) /; n \in \mathbb{N} \land u \in \mathbb{N}^+$$

Involving cosh, exp and power

Involving $z^n e^{p z} \cosh(a + b z) \coth(c z)$

01.22.21.0193.01

$$\int z^n e^{pz}\cosh(a+bz)\coth(cz)\,dz = -\frac{1}{2}n!\left(e^{(p-b)z-a}\sum_{j=0}^{n}\frac{(-1)^j(p-b)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{p-b}{2c},\ldots,\frac{p-b}{2c},1;\frac{p-b}{2c}+1,\ldots,\frac{p-b}{2c}+1;e^{2cz}\right)+\right.$$

$$e^{a+(b+p)z}\sum_{j=0}^{n}\frac{(-1)^j(b+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{b+p}{2c},\ldots,\frac{b+p}{2c},1;\frac{b+p}{2c}+1,\ldots,\frac{b+p}{2c}+1;e^{2cz}\right)+$$

$$e^{(-b+2c+p)z-a}\sum_{j=0}^{n}\frac{(-1)^j(-b+2c+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{-b+2c+p}{2c},\ldots,\frac{-b+2c+p}{2c},1;\right.$$

$$\left.\frac{-b+2c+p}{2c}+1,\ldots,\frac{-b+2c+p}{2c}+1;e^{2cz}\right)+e^{a+(b+2c+p)z}\sum_{j=0}^{n}\frac{(-1)^j(b+2c+p)^{-j-1}z^{n-j}}{(n-j)!}$$

$$\left.{}_{j+2}F_{j+1}\!\left(\frac{b+2c+p}{2c},\ldots,\frac{b+2c+p}{2c},1;\frac{b+2c+p}{2c}+1,\ldots,\frac{b+2c+p}{2c}+1;e^{2cz}\right)\right)/;\ n\in\mathbb{N}$$

01.22.21.0194.01

$$\int z^n e^{pz}\cosh(bz)\coth(cz)\,dz = -\frac{1}{2}n!\left(e^{(p-b)z}\sum_{j=0}^{n}\frac{(-1)^j(p-b)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{p-b}{2c},\ldots,\frac{p-b}{2c},1;\frac{p-b}{2c}+1,\ldots,\frac{p-b}{2c}+1;e^{2cz}\right)+\right.$$

$$e^{(b+p)z}\sum_{j=0}^{n}\frac{(-1)^j(b+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{b+p}{2c},\ldots,\frac{b+p}{2c},1;\frac{b+p}{2c}+1,\ldots,\frac{b+p}{2c}+1;e^{2cz}\right)+$$

$$e^{(-b+2c+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-b+2c+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{-b+2c+p}{2c},\ldots,\frac{-b+2c+p}{2c},1;\right.$$

$$\left.\frac{-b+2c+p}{2c}+1,\ldots,\frac{-b+2c+p}{2c}+1;e^{2cz}\right)+e^{(b+2c+p)z}\sum_{j=0}^{n}\frac{(-1)^j(b+2c+p)^{-j-1}z^{n-j}}{(n-j)!}$$

$$\left.{}_{j+2}F_{j+1}\!\left(\frac{b+2c+p}{2c},\ldots,\frac{b+2c+p}{2c},1;\frac{b+2c+p}{2c}+1,\ldots,\frac{b+2c+p}{2c}+1;e^{2cz}\right)\right)/;\ n\in\mathbb{N}$$

01.22.21.0195.01

$$\int z^n e^{bz}\cosh(bz)\coth(cz)\,dz = -\frac{1}{2}\left(\frac{z^{n+1}}{n+1}+2e^{2cz}n!\sum_{j=0}^{n}\frac{(-1)^j 2^{-j-1}c^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}(1,\ldots,1;2,\ldots,2;e^{2cz})+\right.$$

$$n!\left(e^{2bz}\sum_{j=0}^{n}\frac{(-1)^j(2b)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{b}{c},\ldots,\frac{b}{c},1;\frac{b}{c}+1,\ldots,\frac{b}{c}+1;e^{2cz}\right)+\right.$$

$$\left.\left.e^{2(b+c)z}\sum_{j=0}^{n}\frac{(-1)^j(2b+2c)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{b+c}{c},\ldots,\frac{b+c}{c},1;\frac{b+c}{c}+1,\ldots,\frac{b+c}{c}+1;e^{2cz}\right)\right)\right)/;\ n\in\mathbb{N}$$

01.22.21.0196.01

$$\int z^n e^{-b z} \cosh(b z) \coth(c z) \, dz = -\frac{1}{2}\left(\frac{z^{n+1}}{n+1} + 2 e^{2 c z} n! \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(1, \ldots, 1; 2, \ldots, 2; e^{2 c z}\right) + n! \left(e^{-2 b z} \sum_{j=0}^{n} \frac{(-1)^j (-2 b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(-\frac{b}{c}, \ldots, -\frac{b}{c}, 1; 1-\frac{b}{c}, \ldots, 1-\frac{b}{c}; e^{2 c z}\right) + e^{2 (c-b) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c - 2 b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{c-b}{c}, \ldots, \frac{c-b}{c}, 1; \frac{c-b}{c}+1, \ldots, \frac{c-b}{c}+1; e^{2 c z}\right)\right)\right) /; n \in \mathbb{N}$$

01.22.21.0197.01

$$\int z^n e^{p z} \cosh(c z) \coth(c z) \, dz = -e^{(c+p) z} n! \sum_{j=0}^{n} \frac{(-1)^j (c+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{c+p}{2 c}, \ldots, \frac{c+p}{2 c}, 1; \frac{c+p}{2 c}+1, \ldots, \frac{c+p}{2 c}+1; e^{2 c z}\right) - \frac{1}{2} e^{c z} n! \left(e^{(p-2 c) z} \sum_{j=0}^{n} \frac{(-1)^j (p-c)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p-c}{2 c}, \ldots, \frac{p-c}{2 c}, 1; \frac{p-c}{2 c}+1, \ldots, \frac{p-c}{2 c}+1; e^{2 c z}\right) + e^{(2 c+p) z} \sum_{j=0}^{n} \frac{(-1)^j (3 c+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{3 c+p}{2 c}, \ldots, \frac{3 c+p}{2 c}, 1; \frac{3 c+p}{2 c}+1, \ldots, \frac{3 c+p}{2 c}+1; e^{2 c z}\right)\right) /; n \in \mathbb{N}$$

Involving powers of cosh, exp and power

Involving $z^n e^{p z} \cosh^u(b z) \coth(c z)$

01.22.21.0198.01

$$\int z^n e^{pz} \cosh^u(bz)\coth(cz)\,dz = -2^{-u}\binom{u}{\frac{u}{2}} n!\,(1 - u \bmod 2)\left(e^{pz}\sum_{j=0}^{n}\frac{(-1)^j p^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p}{2c},\ldots,\frac{p}{2c},1;\frac{p}{2c}+1,\ldots,\frac{p}{2c}+1;e^{2cz}\right)+ e^{(2c+p)z}\sum_{j=0}^{n}\frac{(-1)^j (2c+p)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c+p}{2c},\ldots,\frac{2c+p}{2c},1;\frac{2c+p}{2c}+1,\ldots,\frac{2c+p}{2c}+1;e^{2cz}\right)\right) - 2^{-u} n! \sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{s}\left(e^{(p+2bs-bu)z}\sum_{j=0}^{n}\frac{(-1)^j (p+2bs-bu)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+2bs-bu}{2c},\ldots,\frac{p+2bs-bu}{2c},1;\frac{p+2bs-bu}{2c}+1,\ldots,\frac{p+2bs-bu}{2c}+1;e^{2cz}\right)+ e^{(2c+p+2bs-bu)z}\sum_{j=0}^{n}\frac{(-1)^j (2c+p+2bs-bu)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c+p+2bs-bu}{2c},\ldots,\frac{2c+p+2bs-bu}{2c},1;\frac{2c+p+2bs-bu}{2c}+1,\ldots,\frac{2c+p+2bs-bu}{2c}+1;e^{2cz}\right)+ e^{(p-2bs+bu)z}\sum_{j=0}^{n}\frac{(-1)^j (p-2bs+bu)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p-2bs+bu}{2c},\ldots,\frac{p-2bs+bu}{2c},1;\frac{p-2bs+bu}{2c}+1,\ldots,\frac{p-2bs+bu}{2c}+1;e^{2cz}\right)+ e^{(2c+p-2bs+bu)z}\sum_{j=0}^{n}\frac{(-1)^j (2c+p-2bs+bu)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c+p-2bs+bu}{2c},\ldots,\frac{2c+p-2bs+bu}{2c},1;\frac{2c+p-2bs+bu}{2c}+1,\ldots,\frac{2c+p-2bs+bu}{2c}+1;e^{2cz}\right)\right) /;\ n\in\mathbb{N}\land u\in\mathbb{N}^+$$

01.22.21.0199.01

$$\int z^n e^{pz}\cosh^u(cz)\coth(cz)\,dz = -2^{-u} e^{(c+p)z}\binom{u+1}{\frac{u+1}{2}} n!\,(1-(u+1)\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j (c+p)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{c+p}{2c},\ldots,\frac{c+p}{2c},1;\frac{c+p}{2c}+1,\ldots,\frac{c+p}{2c}+1;e^{2cz}\right)-$$
$$2^{-u} e^{cz} n!\sum_{s=0}^{\left\lfloor\frac{u}{2}\right\rfloor}\binom{u+1}{s}\left(e^{(p-c(-2s+u+1))z}\sum_{j=0}^{n}\frac{(-1)^j (p-c(u-2s))^{-j-1} z^{n-j}}{(n-j)!}\right.$$
$${}_{j+2}F_{j+1}\left(\frac{p-c(u-2s)}{2c},\ldots,\frac{p-c(u-2s)}{2c},1;\frac{p-c(u-2s)}{2c}+1,\ldots,\frac{p-c(u-2s)}{2c}+1;e^{2cz}\right)+$$
$$e^{(p+c(-2s+u+1))z}\sum_{j=0}^{n}\frac{(-1)^j (p+c(-2s+u+2))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+c(-2s+u+2)}{2c},\ldots,\right.$$
$$\left.\left.\frac{p+c(-2s+u+2)}{2c},1;\frac{p+c(-2s+u+2)}{2c}+1,\ldots,\frac{p+c(-2s+u+2)}{2c}+1;e^{2cz}\right)\right)\ /;\ n\in\mathbb{N}\land u\in\mathbb{N}^+$$

Involving hyperbolic, exponential and trigonometric functions

Involving sin, sinh and exp

Involving $e^{pz}\sin(az)\sinh(bz)\coth(cz)$

01.22.21.0200.01

$$\int e^{pz}\sin(az)\sinh(bz)\coth(cz)\,dz =$$
$$\frac{1}{4}i\left(\frac{e^{(-b-ia+p)z}\,{}_2F_1\left(\frac{-b-ia+p}{2c},1;\frac{-b+2c-ia+p}{2c};e^{2cz}\right)}{-b-ia+p}+\frac{e^{(b+ia+p)z}\,{}_2F_1\left(\frac{b+ia+p}{2c},1;\frac{b+2c+ia+p}{2c};e^{2cz}\right)}{b+ia+p}+\right.$$
$$\frac{e^{(-b+2c-ia+p)z}\,{}_2F_1\left(\frac{-b+2c-ia+p}{2c},1;\frac{-b+4c-ia+p}{2c};e^{2cz}\right)}{-b+2c-ia+p}-\frac{e^{(b+2c-ia+p)z}\,{}_2F_1\left(\frac{b+2c-ia+p}{2c},1;\frac{b+4c-ia+p}{2c};e^{2cz}\right)}{b+2c-ia+p}+$$
$$\frac{e^{(b+2c+ia+p)z}\,{}_2F_1\left(\frac{b+2c+ia+p}{2c},1;\frac{b+4c+ia+p}{2c};e^{2cz}\right)}{b+2c+ia+p}-\frac{e^{(-b+ia+p)z}\,{}_2F_1\left(\frac{-b+ia+p}{2c},1;\frac{-b+2c+ia+p}{2c};e^{2cz}\right)}{-b+ia+p}-$$
$$\left.\frac{e^{(b-ia+p)z}\,{}_2F_1\left(\frac{b-ia+p}{2c},1;\frac{b+2c-ia+p}{2c};e^{2cz}\right)}{b-ia+p}-\frac{e^{(-b+2c+ia+p)z}\,{}_2F_1\left(\frac{-b+2c+ia+p}{2c},1;\frac{-b+4c+ia+p}{2c};e^{2cz}\right)}{-b+2c+ia+p}\right)$$

Involving powers of sin, powers of sinh and exp

Involving $e^{pz}\sin^m(az)\sinh^u(bz)\coth(cz)$

01.22.21.0201.01

$$\int e^{p z} \sin^m(a z) \sinh^u(b z) \coth(c z)\, dz = -\frac{1}{p(2c+p)} \left(i^u 2^{-m-u} e^{p z} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} \left((2c+p)\, {}_2F_1\left(\frac{p}{2c}, 1; \frac{p}{2c}+1; e^{2cz}\right) + e^{2cz} p\, {}_2F_1\left(\frac{p}{2c}+1, 1; \frac{p}{2c}+2; e^{2cz}\right)\right) (1 - m \bmod 2)(1 - u \bmod 2)\right) - i^u 2^{-m-u} \binom{u}{\frac{u}{2}} (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(\left(e^{\frac{i\pi m}{2} + (p - i a (m-2k)) z} \left((2c - i a (m-2k) + p)\, {}_2F_1\left(\frac{p - i a (m-2k)}{2c}, 1; \frac{p - i a (m-2k)}{2c} + 1; e^{2cz}\right) + e^{2cz} (p - i a (m-2k))\, {}_2F_1\left(\frac{p - i a (m-2k)}{2c} + 1, 1; \frac{p - i a (m-2k)}{2c} + 2; e^{2cz}\right)\right)\right) \Big/ ((p - i a (m-2k))(2c - i a (m-2k) + p)) + \left(e^{(a i (m-2k)+p) z - \frac{i m \pi}{2}} \left((2c + a i (m-2k) + p)\, {}_2F_1\left(\frac{a i (m-2k)+p}{2c}, 1; \frac{a i (m-2k)+p}{2c} + 1; e^{2cz}\right) + e^{2cz} (a i (m-2k)+p)\, {}_2F_1\left(\frac{a i (m-2k)+p}{2c} + 1, 1; \frac{a i (m-2k)+p}{2c} + 2; e^{2cz}\right)\right)\right) \Big/ ((a i (m-2k)+p)(2c + a i (m-2k) + p)) \right) - 2^{-m-u} \binom{m}{\frac{m}{2}} (1 - m \bmod 2) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{u}{k} \left(\left(e^{(p + b(u-2k)) z} \left((2c + p + b(u-2k))\, {}_2F_1\left(\frac{p + b(u-2k)}{2c}, 1; \frac{p + b(u-2k)}{2c} + 1; e^{2cz}\right) + e^{2cz} (p + b(u-2k))\, {}_2F_1\left(\frac{p + b(u-2k)}{2c} + 1, 1; \frac{p + b(u-2k)}{2c} + 2; e^{2cz}\right)\right)\right) \Big/ ((p + b(u-2k))(2c + p + b(u-2k))) + \left((-1)^u e^{(p - b(u-2k)) z} \left((2c + p - b(u-2k))\, {}_2F_1\left(\frac{p - b(u-2k)}{2c}, 1; \frac{p - b(u-2k)}{2c} + 1; e^{2cz}\right) + e^{2cz} (p - b(u-2k))\, {}_2F_1\left(\frac{p - b(u-2k)}{2c} + 1, 1; \frac{p - b(u-2k)}{2c} + 2; e^{2cz}\right)\right)\right) \Big/ ((p - b(u-2k))(2c + p - b(u-2k))) \right) - 2^{-m-u} \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^{k+s} \binom{m}{k} \binom{u}{s} \left(\left((-1)^u \left(e^{(a i (m-2k) + p - b(u-2s)) z - \frac{i m \pi}{2}} \left((2c + a i (m-2k) + p - b(u-2s))\, {}_2F_1\left(\frac{a i (m-2k) + p - b(u-2s)}{2c}, 1; \frac{a i (m-2k) + p - b(u-2s)}{2c} + 1; e^{2cz}\right) + e^{2cz} (a i (m-2k) + p - b(u-2s))\, {}_2F_1\left(\frac{a i (m-2k) + p - b(u-2s)}{2c} + 1, 1; \frac{a i (m-2k) + p - b(u-2s)}{2c} + 2; e^{2cz}\right)\right)\right)\right) \Big/ ((a i (m-2k) + p - b(u-2s))(2c + a i (m-2k) + p - b(u-2s))) + \left((-1)^u \left(e^{\frac{i\pi m}{2} + (-i a (m-2k) + p - b(u-2s)) z} \left((2c - i a (m-2k) + p - b(u-2s))\, {}_2F_1\left(\frac{-i a (m-2k) + p - b(u-2s)}{2c}, \right.\right.\right.\right.$$

$$1;\ \frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+e^{2\,c\,z}\,(-i\,a\,(m-2\,k)+p-b\,(u-2\,s))$$

$${}_2F_1\left(\frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,s)}{2\,c}+1,\ 1;\ \frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,s)}{2\,c}+2;\ e^{2\,c\,z}\right)\Bigg)\Bigg)\Bigg)\Bigg)\Bigg/$$

$$((-i\,a\,(m-2\,k)+p-b\,(u-2\,s))\,(2\,c-i\,a\,(m-2\,k)+p-b\,(u-2\,s)))+$$

$$\Bigg(e^{\frac{i\,\pi\,m}{2}+(-i\,a\,(m-2\,k)+p+b\,(u-2\,s))\,z}\Bigg((2\,c-i\,a\,(m-2\,k)+p+b\,(u-2\,s))\,{}_2F_1\Bigg(\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,s)}{2\,c},$$

$$1;\ \frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+e^{2\,c\,z}\,(-i\,a\,(m-2\,k)+p+b\,(u-2\,s))\,{}_2F_1$$

$$\left(\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,s)}{2\,c}+1,\ 1;\ \frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,s)}{2\,c}+2;\ e^{2\,c\,z}\right)\Bigg)\Bigg)\Bigg/$$

$$((-i\,a\,(m-2\,k)+p+b\,(u-2\,s))\,(2\,c-i\,a\,(m-2\,k)+p+b\,(u-2\,s)))+$$

$$\Bigg(e^{(a\,i\,(m-2\,k)+p+b\,(u-2\,s))\,z-\frac{i\,m\,\pi}{2}}\Bigg((2\,c+a\,i\,(m-2\,k)+p+b\,(u-2\,s))\,{}_2F_1\Bigg(\frac{a\,i\,(m-2\,k)+p+b\,(u-2\,s)}{2\,c},$$

$$1;\ \frac{a\,i\,(m-2\,k)+p+b\,(u-2\,s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+e^{2\,c\,z}\,(a\,i\,(m-2\,k)+p+b\,(u-2\,s))\,{}_2F_1$$

$$\left(\frac{a\,i\,(m-2\,k)+p+b\,(u-2\,s)}{2\,c}+1,\ 1;\ \frac{a\,i\,(m-2\,k)+p+b\,(u-2\,s)}{2\,c}+2;\ e^{2\,c\,z}\right)\Bigg)\Bigg)\Bigg/$$

$$((a\,i\,(m-2\,k)+p+b\,(u-2\,s))\,(2\,c+a\,i\,(m-2\,k)+p+b\,(u-2\,s)))\Bigg)\ /;\ m\in\mathbb{N}^+\bigwedge u\in\mathbb{N}^+$$

01.22.21.0202.01

$$\int e^{p\,z}\sin^m(a\,z)\sinh^\mu(c\,z)\coth(c\,z)\,dz = -2^{-m-\mu}\,(-e^{-c\,z}+e^{c\,z})^\mu\left(1-e^{2\,c\,z}\right)^{-\mu}\binom{m}{\frac{m}{2}}$$

$$\left(\frac{e^{p\,z}\,{}_2F_1\left(\frac{p-c\,\mu}{2\,c},\ 1-\mu;\ \frac{-\mu\,c+2\,c+p}{2\,c};\ e^{2\,c\,z}\right)}{p-c\,\mu}+\frac{e^{(2\,c+p)\,z}\,{}_2F_1\left(\frac{-\mu\,c+2\,c+p}{2\,c},\ 1-\mu;\ \frac{-\mu\,c+4\,c+p}{2\,c};\ e^{2\,c\,z}\right)}{-\mu\,c+2\,c+p}\right)(1-m \bmod 2)\ -2^{-m-\mu}$$

$$(-e^{-c\,z}+e^{c\,z})^\mu\left(1-e^{2\,c\,z}\right)^{-\mu}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(\frac{e^{\frac{i\,\pi\,m}{2}+(p-i\,a\,(m-2\,k))\,z}\,{}_2F_1\left(\frac{-i\,a\,(m-2\,k)+p-c\,\mu}{2\,c},\ 1-\mu;\ \frac{-\mu\,c+2\,c-i\,a\,(m-2\,k)+p}{2\,c};\ e^{2\,c\,z}\right)}{-i\,a\,(m-2\,k)+p-c\,\mu}+\right.$$

$$\frac{e^{(a\,i\,(m-2\,k)+p)\,z-\frac{i\,m\,\pi}{2}}\,{}_2F_1\left(\frac{a\,i\,(m-2\,k)+p-c\,\mu}{2\,c},\ 1-\mu;\ \frac{-\mu\,c+2\,c+a\,i\,(m-2\,k)+p}{2\,c};\ e^{2\,c\,z}\right)}{a\,i\,(m-2\,k)+p-c\,\mu}+$$

$$\frac{e^{(2\,c+a\,i\,(m-2\,k)+p)\,z-\frac{i\,m\,\pi}{2}}\,{}_2F_1\left(\frac{-\mu\,c+2\,c+a\,i\,(m-2\,k)+p}{2\,c},\ 1-\mu;\ \frac{-\mu\,c+4\,c+a\,i\,(m-2\,k)+p}{2\,c};\ e^{2\,c\,z}\right)}{-\mu\,c+2\,c+a\,i\,(m-2\,k)+p}+$$

$$\left.\frac{e^{\frac{i\,\pi\,m}{2}+(2\,c-i\,a\,(m-2\,k)+p)\,z}\,{}_2F_1\left(\frac{-\mu\,c+2\,c-i\,a\,(m-2\,k)+p}{2\,c},\ 1-\mu;\ \frac{-\mu\,c+4\,c-i\,a\,(m-2\,k)+p}{2\,c};\ e^{2\,c\,z}\right)}{-\mu\,c+2\,c-i\,a\,(m-2\,k)+p}\right)\ /;\ m\in\mathbb{N}^+$$

Involving cos, sinh and exp

Involving $e^{pz}\cos(az)\sinh(bz)\coth(cz)$

01.22.21.0203.01

$$\int e^{pz}\cos(az)\sinh(bz)\coth(cz)\,dz = \frac{1}{4}\left(\frac{e^{(-b-ia+p)z}\,{}_2F_1\left(\frac{-b-ia+p}{2c},1;\frac{-b+2c-ia+p}{2c};e^{2cz}\right)}{-b-ia+p}+\frac{e^{(-b+ia+p)z}\,{}_2F_1\left(\frac{-b+ia+p}{2c},1;\frac{-b+2c+ia+p}{2c};e^{2cz}\right)}{-b+ia+p}+\frac{e^{(-b+2c-ia+p)z}\,{}_2F_1\left(\frac{-b+2c-ia+p}{2c},1;\frac{-b+4c-ia+p}{2c};e^{2cz}\right)}{-b+2c-ia+p}+\frac{e^{(-b+2c+ia+p)z}\,{}_2F_1\left(\frac{-b+2c+ia+p}{2c},1;\frac{-b+4c+ia+p}{2c};e^{2cz}\right)}{-b+2c+ia+p}-\frac{e^{(b+2c-ia+p)z}\,{}_2F_1\left(\frac{b+2c-ia+p}{2c},1;\frac{b+4c-ia+p}{2c};e^{2cz}\right)}{b+2c-ia+p}-\frac{e^{(b-ia+p)z}\,{}_2F_1\left(\frac{b-ia+p}{2c},1;\frac{b+2c-ia+p}{2c};e^{2cz}\right)}{b-ia+p}-\frac{e^{(b+ia+p)z}\,{}_2F_1\left(\frac{b+ia+p}{2c},1;\frac{b+2c+ia+p}{2c};e^{2cz}\right)}{b+ia+p}-\frac{e^{(b+2c+ia+p)z}\,{}_2F_1\left(\frac{b+2c+ia+p}{2c},1;\frac{b+4c+ia+p}{2c};e^{2cz}\right)}{b+2c+ia+p}\right)$$

Involving powers of cos, powers of sinh and exp

Involving $e^{pz}\cos^m(az)\sinh^u(bz)\coth(cz)$

01.22.21.0204.01

$$\int e^{pz}\cos^m(az)\sinh^u(bz)\coth(cz)\,dz = -\frac{1}{p(2c+p)}\left(i^u\,2^{-m-u}\,e^{pz}\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}}\left((2c+p)\,{}_2F_1\left(\frac{p}{2c},1;\frac{p}{2c}+1;e^{2cz}\right)+e^{2cz}\,p\,{}_2F_1\left(\frac{p}{2c}+1,1;\frac{p}{2c}+2;e^{2cz}\right)\right)(1-m \bmod 2)(1-u \bmod 2)\right)-i^u\,2^{-m-u}\binom{u}{\frac{u}{2}}(1-u \bmod 2)$$

$$\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\Bigg(\Bigg(e^{(p-ia(m-2k))z}\left((2c-ia(m-2k)+p)\,{}_2F_1\left(\frac{p-ia(m-2k)}{2c},1;\frac{p-ia(m-2k)}{2c}+1;e^{2cz}\right)+e^{2cz}(p-ia(m-2k))\,{}_2F_1\left(\frac{p-ia(m-2k)}{2c}+1,1;\frac{p-ia(m-2k)}{2c}+2;e^{2cz}\right)\right)\Bigg)\Big/((p-ia(m-2k))(2c-ia(m-2k)+p))+\left(e^{(ai(m-2k)+p)z}\left((2c+ai(m-2k)+p)\,{}_2F_1\left(\frac{ai(m-2k)+p}{2c},1;\frac{ai(m-2k)+p}{2c}+1;e^{2cz}\right)+e^{2cz}(ai(m-2k)+p)\,{}_2F_1\left(\frac{ai(m-2k)+p}{2c}+1,1;\frac{ai(m-2k)+p}{2c}+2;e^{2cz}\right)\right)\right)\Big/((ai(m-2k)+p)(2c+ai(m-2k)+p))\Bigg)-2^{-m-u}\binom{m}{\frac{m}{2}}(1-m \bmod 2)$$

$$\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}(-1)^k\binom{u}{k}\Bigg(\Bigg((-1)^u\left(e^{(p-b(u-2k))z}\left((2c+p-b(u-2k))\,{}_2F_1\left(\frac{p-b(u-2k)}{2c},1;\frac{p-b(u-2k)}{2c}+1;e^{2cz}\right)+\right.\right.$$

$$e^{2cz}(p-b(u-2k))\,{}_2F_1\left(\frac{p-b(u-2k)}{2c}+1,1;\frac{p-b(u-2k)}{2c}+2;e^{2cz}\right)\Bigg)\Bigg)\Bigg)\Big/((p-b(u-2k))$$

$$(2c+p-b(u-2k)))+\Bigg(e^{(p+b(u-2k))z}\Bigg(\!(2c+p+b(u-2k))\,{}_2F_1\left(\frac{p+b(u-2k)}{2c},1;\frac{p+b(u-2k)}{2c}+1;\right.$$

$$\left.e^{2cz}\right)+e^{2cz}(p+b(u-2k))\,{}_2F_1\left(\frac{p+b(u-2k)}{2c}+1,1;\frac{p+b(u-2k)}{2c}+2;e^{2cz}\right)\Bigg)\Bigg)\Big/$$

$$((p+b(u-2k))(2c+p+b(u-2k)))\Bigg)-2^{-m-u}\sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^s\binom{m}{k}\binom{u}{s}$$

$$\Bigg(\Bigg((-1)^u\Bigg(e^{(-i a(m-2k)+p-b(u-2s))z}\Bigg((2c-i a(m-2k)+p-b(u-2s))\,{}_2F_1\left(\frac{-i a(m-2k)+p-b(u-2s)}{2c},\right.$$

$$\left.1;\frac{-i a(m-2k)+p-b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(-i a(m-2k)+p-b(u-2s))$$

$${}_2F_1\left(\frac{-i a(m-2k)+p-b(u-2s)}{2c}+1,1;\frac{-i a(m-2k)+p-b(u-2s)}{2c}+2;e^{2cz}\right)\Bigg)\Bigg)\Bigg)\Big/$$

$$((-i a(m-2k)+p-b(u-2s))(2c-i a(m-2k)+p-b(u-2s)))+$$

$$\Bigg(e^{(-i a(m-2k)+p+b(u-2s))z}\Bigg((2c-i a(m-2k)+p+b(u-2s))\,{}_2F_1\left(\frac{-i a(m-2k)+p+b(u-2s)}{2c},1;\right.$$

$$\left.\frac{-i a(m-2k)+p+b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(-i a(m-2k)+p+b(u-2s))\,{}_2F_1$$

$$\left(\frac{-i a(m-2k)+p+b(u-2s)}{2c}+1,1;\frac{-i a(m-2k)+p+b(u-2s)}{2c}+2;e^{2cz}\right)\Bigg)\Bigg)\Big/$$

$$((-i a(m-2k)+p+b(u-2s))(2c-i a(m-2k)+p+b(u-2s)))+$$

$$\Bigg(e^{(a i(m-2k)+p+b(u-2s))z}\Bigg((2c+a i(m-2k)+p+b(u-2s))\,{}_2F_1\left(\frac{a i(m-2k)+p+b(u-2s)}{2c},1;\right.$$

$$\left.\frac{a i(m-2k)+p+b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(a i(m-2k)+p+b(u-2s))\,{}_2F_1$$

$$\left(\frac{a i(m-2k)+p+b(u-2s)}{2c}+1,1;\frac{a i(m-2k)+p+b(u-2s)}{2c}+2;e^{2cz}\right)\Bigg)\Bigg)\Big/$$

$$((a i(m-2k)+p+b(u-2s))(2c+a i(m-2k)+p+b(u-2s)))+$$

$$\Bigg((-1)^u e^{(a i(m-2k)+p-b(u-2s))z}\Bigg((2c+a i(m-2k)+p-b(u-2s))\,{}_2F_1\left(\frac{a i(m-2k)+p-b(u-2s)}{2c},\right.$$

$$\left.1;\frac{a i(m-2k)+p-b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(a i(m-2k)+p-b(u-2s))\,{}_2F_1$$

$$\left(\frac{a i(m-2k)+p-b(u-2s)}{2c}+1,1;\frac{a i(m-2k)+p-b(u-2s)}{2c}+2;e^{2cz}\right)\Bigg)\Bigg)\Big/$$

$$((a i(m-2k)+p-b(u-2s))(2c+a i(m-2k)+p-b(u-2s)))\Bigg)\ /;\ m\in\mathbb{N}^+\land u\in\mathbb{N}^+$$

01.22.21.0205.01

$$\int e^{p z} \cos^m(a z) \sinh^\mu(c z) \coth(c z)\, dz = -2^{-m-\mu} \left(-e^{-c z} + e^{c z}\right)^\mu \left(1 - e^{2 c z}\right)^{-\mu} \binom{m}{\frac{m}{2}} \left(\frac{e^{p z}\, {}_2F_1\!\left(\frac{p - c\mu}{2 c}, 1 - \mu; \frac{-\mu c + 2 c + p}{2 c}; e^{2 c z}\right)}{p - c\mu} + \frac{e^{(2 c + p) z}\, {}_2F_1\!\left(\frac{-\mu c + 2 c + p}{2 c}, 1 - \mu; \frac{-\mu c + 4 c + p}{2 c}; e^{2 c z}\right)}{-\mu c + 2 c + p}\right) (1 - m \bmod 2) - 2^{-m-\mu} \left(-e^{-c z} + e^{c z}\right)^\mu \left(1 - e^{2 c z}\right)^{-\mu} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(\frac{e^{(p - i a (m - 2 k)) z}\, {}_2F_1\!\left(\frac{-i a (m - 2 k) + p - c\mu}{2 c}, 1 - \mu; \frac{-\mu c + 2 c - i a (m - 2 k) + p}{2 c}; e^{2 c z}\right)}{-i a (m - 2 k) + p - c\mu} + \frac{e^{(a i (m - 2 k) + p) z}\, {}_2F_1\!\left(\frac{a i (m - 2 k) + p - c\mu}{2 c}, 1 - \mu; \frac{-\mu c + 2 c + a i (m - 2 k) + p}{2 c}; e^{2 c z}\right)}{a i (m - 2 k) + p - c\mu} + \frac{e^{(2 c + a i (m - 2 k) + p) z}\, {}_2F_1\!\left(\frac{-\mu c + 2 c + a i (m - 2 k) + p}{2 c}, 1 - \mu; \frac{-\mu c + 4 c + a i (m - 2 k) + p}{2 c}; e^{2 c z}\right)}{-\mu c + 2 c + a i (m - 2 k) + p} + \frac{e^{(2 c - i a (m - 2 k) + p) z}\, {}_2F_1\!\left(\frac{-\mu c + 2 c - i a (m - 2 k) + p}{2 c}, 1 - \mu; \frac{-\mu c + 4 c - i a (m - 2 k) + p}{2 c}; e^{2 c z}\right)}{-\mu c + 2 c - i a (m - 2 k) + p}\right) /;\ m \in \mathbb{N}^+$$

Involving sin, cosh and exp

Involving $e^{p z} \sin(a z) \cosh(b z) \coth(c z)$

01.22.21.0206.01

$$\int e^{p z} \sin(a z) \cosh(b z) \coth(c z)\, dz = \frac{1}{4} i \left(-\frac{e^{(-b - i a + p) z}\, {}_2F_1\!\left(\frac{-b - i a + p}{2 c}, 1; \frac{-b + 2 c - i a + p}{2 c}; e^{2 c z}\right)}{-b - i a + p} + \frac{e^{(-b + i a + p) z}\, {}_2F_1\!\left(\frac{-b + i a + p}{2 c}, 1; \frac{-b + 2 c + i a + p}{2 c}; e^{2 c z}\right)}{-b + i a + p} - \frac{e^{(b - i a + p) z}\, {}_2F_1\!\left(\frac{b - i a + p}{2 c}, 1; \frac{b + 2 c - i a + p}{2 c}; e^{2 c z}\right)}{b - i a + p} + \frac{e^{(b + i a + p) z}\, {}_2F_1\!\left(\frac{b + i a + p}{2 c}, 1; \frac{b + 2 c + i a + p}{2 c}; e^{2 c z}\right)}{b + i a + p} + \frac{e^{(-b + 2 c + i a + p) z}\, {}_2F_1\!\left(\frac{-b + 2 c + i a + p}{2 c}, 1; \frac{-b + 4 c + i a + p}{2 c}; e^{2 c z}\right)}{-b + 2 c + i a + p} + \frac{e^{(b + 2 c + i a + p) z}\, {}_2F_1\!\left(\frac{b + 2 c + i a + p}{2 c}, 1; \frac{b + 4 c + i a + p}{2 c}; e^{2 c z}\right)}{b + 2 c + i a + p} - \frac{e^{(-b + 2 c - i a + p) z}\, {}_2F_1\!\left(\frac{-b + 2 c - i a + p}{2 c}, 1; \frac{-b + 4 c - i a + p}{2 c}; e^{2 c z}\right)}{-b + 2 c - i a + p} - \frac{e^{(b + 2 c - i a + p) z}\, {}_2F_1\!\left(\frac{b + 2 c - i a + p}{2 c}, 1; \frac{b + 4 c - i a + p}{2 c}; e^{2 c z}\right)}{b + 2 c - i a + p}\right)$$

Involving powers of sin, powers of cosh and exp

Involving $e^{p z} \sin^m(a z) \cosh^u(b z) \coth(c z)$

01.22.21.0207.01

$$\int e^{p z} \sin^m(a z) \cosh^u(b z) \coth(c z) \, dz = -2^{-m-u} \binom{u}{\frac{u}{2}} (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \Bigg(\Bigg(e^{\frac{i \pi m}{2} + (p - i a (m-2k)) z} \Bigg((2c - i a (m-2k) + p) \, {}_2F_1\!\left(\frac{p - i a (m-2k)}{2c}, 1; \frac{p - i a (m-2k)}{2c} + 1; e^{2cz} \right) + e^{2cz} (p - i a (m-2k)) \, {}_2F_1\!\left(\frac{p - i a (m-2k)}{2c} + 1, 1; \frac{p - i a (m-2k)}{2c} + 2; e^{2cz} \right) \Bigg) \Bigg) \Big/ ((p - i a (m-2k)) (2c - i a (m-2k) + p)) + \Bigg(e^{(a i (m-2k) + p) z - \frac{i m \pi}{2}} \Bigg((2c + a i (m-2k) + p) \, {}_2F_1\!\left(\frac{a i (m-2k) + p}{2c}, 1; \frac{a i (m-2k) + p}{2c} + 1; e^{2cz} \right) + e^{2cz} (a i (m-2k) + p) \, {}_2F_1\!\left(\frac{a i (m-2k) + p}{2c} + 1, 1; \frac{a i (m-2k) + p}{2c} + 2; e^{2cz} \right) \Bigg) \Bigg) \Big/ ((a i (m-2k) + p) (2c + a i (m-2k) + p)) \Bigg) - \frac{1}{p (2c + p)} \Bigg(2^{-m-u} e^{p z} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} \Bigg((2c + p) \, {}_2F_1\!\left(\frac{p}{2c}, 1; \frac{p}{2c} + 1; e^{2cz} \right) + e^{2cz} p \, {}_2F_1\!\left(\frac{p}{2c} + 1, 1; \frac{p}{2c} + 2; e^{2cz} \right) \Bigg) (1 - m \bmod 2) (1 - u \bmod 2) \Bigg) - 2^{-m-u} \binom{m}{\frac{m}{2}} (1 - m \bmod 2) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{u}{k} \Bigg(\Bigg(e^{(p + b (u-2k)) z} \Bigg((2c + p + b (u-2k)) \, {}_2F_1\!\left(\frac{p + b (u-2k)}{2c}, 1; \frac{p + b (u-2k)}{2c} + 1; e^{2cz} \right) + e^{2cz} (p + b (u-2k)) \, {}_2F_1\!\left(\frac{p + b (u-2k)}{2c} + 1, 1; \frac{p + b (u-2k)}{2c} + 2; e^{2cz} \right) \Bigg) \Bigg) \Big/ ((p + b (u-2k)) (2c + p + b (u-2k))) + \Bigg(e^{(p - b (u-2k)) z} \Bigg((2c + p - b (u-2k)) \, {}_2F_1\!\left(\frac{p - b (u-2k)}{2c}, 1; \frac{p - b (u-2k)}{2c} + 1; e^{2cz} \right) + e^{2cz} (p - b (u-2k)) \, {}_2F_1\!\left(\frac{p - b (u-2k)}{2c} + 1, 1; \frac{p - b (u-2k)}{2c} + 2; e^{2cz} \right) \Bigg) \Bigg) \Big/ ((p - b (u-2k)) (2c + p - b (u-2k))) \Bigg) - 2^{-m-u} \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \binom{u}{s} \Bigg(\Bigg(e^{\frac{i \pi m}{2} + (-i a (m-2k) + p + b (u-2s)) z} \Bigg((2c - i a (m-2k) + p + b (u-2s)) \, {}_2F_1\!\left(\frac{-i a (m-2k) + p + b (u-2s)}{2c}, 1; \frac{-i a (m-2k) + p + b (u-2s)}{2c} + 1; e^{2cz} \right) + e^{2cz} (-i a (m-2k) + p + b (u-2s)) \, {}_2F_1\!\left(\frac{-i a (m-2k) + p + b (u-2s)}{2c} + 1, 1; \frac{-i a (m-2k) + p + b (u-2s)}{2c} + 2; e^{2cz} \right) \Bigg) \Bigg) \Big/ ((-i a (m-2k) + p + b (u-2s)) (2c - i a (m-2k) + p + b (u-2s))) + \Bigg(e^{(a i (m-2k) + p + b (u-2s)) z - \frac{i m \pi}{2}} \Bigg((2c + a i (m-2k) + p + b (u-2s)) \, {}_2F_1\!\left(\frac{a i (m-2k) + p + b (u-2s)}{2c}, 1; \frac{a i (m-2k) + p + b (u-2s)}{2c} + 1; e^{2cz} \right) + e^{2cz} (a i (m-2k) + p + b (u-2s)) \, {}_2F_1$$

$$\left(\frac{a\,i\,(m-2k)+p+b\,(u-2s)}{2c}+1,\,1;\,\frac{a\,i\,(m-2k)+p+b\,(u-2s)}{2c}+2;\,e^{2cz}\right)\Bigg)\Bigg)\Bigg/$$
$$((a\,i\,(m-2k)+p+b\,(u-2s))\,(2c+a\,i\,(m-2k)+p+b\,(u-2s)))+$$
$$\Bigg(e^{\frac{i\pi m}{2}+(-i\,a\,(m-2k)+p-b\,(u-2s))\,z}\Bigg((2c-i\,a\,(m-2k)+p-b\,(u-2s))\,{}_2F_1\Bigg(\frac{-i\,a\,(m-2k)+p-b\,(u-2s)}{2c},$$
$$1;\,\frac{-i\,a\,(m-2k)+p-b\,(u-2s)}{2c}+1;\,e^{2cz}\Bigg)+e^{2cz}\,(-i\,a\,(m-2k)+p-b\,(u-2s))\,{}_2F_1$$
$$\left(\frac{-i\,a\,(m-2k)+p-b\,(u-2s)}{2c}+1,\,1;\,\frac{-i\,a\,(m-2k)+p-b\,(u-2s)}{2c}+2;\,e^{2cz}\right)\Bigg)\Bigg)\Bigg/$$
$$((-i\,a\,(m-2k)+p-b\,(u-2s))\,(2c-i\,a\,(m-2k)+p-b\,(u-2s)))+$$
$$\Bigg(e^{(a\,i\,(m-2k)+p-b\,(u-2s))\,z-\frac{i\,m\pi}{2}}\Bigg((2c+a\,i\,(m-2k)+p-b\,(u-2s))\,{}_2F_1\Bigg(\frac{a\,i\,(m-2k)+p-b\,(u-2s)}{2c},$$
$$1;\,\frac{a\,i\,(m-2k)+p-b\,(u-2s)}{2c}+1;\,e^{2cz}\Bigg)+e^{2cz}\,(a\,i\,(m-2k)+p-b\,(u-2s))\,{}_2F_1$$
$$\left(\frac{a\,i\,(m-2k)+p-b\,(u-2s)}{2c}+1,\,1;\,\frac{a\,i\,(m-2k)+p-b\,(u-2s)}{2c}+2;\,e^{2cz}\right)\Bigg)\Bigg)\Bigg/$$
$$((a\,i\,(m-2k)+p-b\,(u-2s))\,(2c+a\,i\,(m-2k)+p-b\,(u-2s)))\Bigg)\,/;\,m\in\mathbb{N}^+\wedge u\in\mathbb{N}^+$$

01.22.21.0208.01

$$\int e^{pz}\sin^m(a\,z)\cosh^\mu(c\,z)\coth(c\,z)\,dz=$$
$$2^{-m}\binom{m}{\frac{m}{2}}(1-m\bmod 2)\left(1+e^{-2cz}\right)^{-\mu}\cosh^\mu(c\,z)\left(\frac{e^{pz}\,F_1\left(-\frac{p+c\,\mu}{2c};\,-\mu,\,1;\,\frac{(3-\mu)\,c-c-p}{2c};\,-e^{-2cz},\,e^{-2cz}\right)}{(\mu-1)\,c+c+p}+\right.$$
$$\left.\frac{e^{(p-2c)\,z}\,F_1\left(-\frac{\mu\,c-2c+p}{2c};\,-\mu,\,1;\,\frac{(3-\mu)\,c+c-p}{2c};\,-e^{-2cz},\,e^{-2cz}\right)}{(\mu-1)\,c-c+p}\right)+2^{-m}\cosh^\mu(c\,z)\left(1+e^{-2cz}\right)^{-\mu}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}$$
$$\Bigg(\Bigg(e^{\frac{i\pi m}{2}+(p-i\,a\,(m-2k))\,z}\,F_1\Bigg(-\frac{-i\,a\,(m-2k)+p+c\,\mu}{2c};\,-\mu,\,1;\,\frac{(3-\mu)\,c-c+a\,i\,(m-2k)-p}{2c};\,-e^{-2cz},\,e^{-2cz}\Bigg)\Bigg)\Bigg/$$
$$((\mu-1)\,c+c-i\,a\,(m-2k)+p)+\Bigg(e^{(a\,i\,(m-2k)+p)\,z-\frac{i\,m\pi}{2}}\,F_1\Bigg(-\frac{a\,i\,(m-2k)+p+c\,\mu}{2c};\,-\mu,\,1;$$
$$\frac{(3-\mu)\,c-c-i\,a\,(m-2k)-p}{2c};\,-e^{-2cz},\,e^{-2cz}\Bigg)\Bigg)\Bigg/((\mu-1)\,c+c+a\,i\,(m-2k)+p)+$$
$$\Bigg(e^{(-2c+a\,i\,(m-2k)+p)\,z-\frac{i\,m\pi}{2}}\,F_1\Bigg(-\frac{\mu\,c-2c+a\,i\,(m-2k)+p}{2c};\,-\mu,\,1;\,\frac{(3-\mu)\,c+c-i\,a\,(m-2k)-p}{2c};\,-e^{-2cz},$$
$$e^{-2cz}\Bigg)\Bigg)\Bigg/((\mu-1)\,c-c+a\,i\,(m-2k)+p)+\Bigg(e^{\frac{i\pi m}{2}+(-2c-i\,a\,(m-2k)+p)\,z}\,F_1\Bigg(-\frac{\mu\,c-2c-i\,a\,(m-2k)+p}{2c};$$
$$-\mu,\,1;\,\frac{(3-\mu)\,c+c+a\,i\,(m-2k)-p}{2c};\,-e^{-2cz},\,e^{-2cz}\Bigg)\Bigg)\Bigg/((\mu-1)\,c-c-i\,a\,(m-2k)+p)\Bigg)\,/;\,m\in\mathbb{N}^+$$

Involving cos, cosh and exp

Involving $e^{p z} \cos(a z) \cosh(b z) \coth(c z)$

01.22.21.0209.01

$$\int e^{p z} \cos(a z) \cosh(b z) \coth(c z)\, dz = \frac{1}{4}\left(-\frac{e^{(-b-i a+p) z}\, {}_2F_1\left(\frac{-b-i a+p}{2 c}, 1; \frac{-b+2 c-i a+p}{2 c}; e^{2 c z}\right)}{-b-i a+p} - \frac{e^{(-b+i a+p) z}\, {}_2F_1\left(\frac{-b+i a+p}{2 c}, 1; \frac{-b+2 c+i a+p}{2 c}; e^{2 c z}\right)}{-b+i a+p} - \frac{e^{(b-i a+p) z}\, {}_2F_1\left(\frac{b-i a+p}{2 c}, 1; \frac{b+2 c-i a+p}{2 c}; e^{2 c z}\right)}{b-i a+p} - \frac{e^{(b+i a+p) z}\, {}_2F_1\left(\frac{b+i a+p}{2 c}, 1; \frac{b+2 c+i a+p}{2 c}; e^{2 c z}\right)}{b+i a+p} - \frac{e^{(-b+2 c-i a+p) z}\, {}_2F_1\left(\frac{-b+2 c-i a+p}{2 c}, 1; \frac{-b+4 c-i a+p}{2 c}; e^{2 c z}\right)}{-b+2 c-i a+p} - \frac{e^{(-b+2 c+i a+p) z}\, {}_2F_1\left(\frac{-b+2 c+i a+p}{2 c}, 1; \frac{-b+4 c+i a+p}{2 c}; e^{2 c z}\right)}{-b+2 c+i a+p} - \frac{e^{(b+2 c-i a+p) z}\, {}_2F_1\left(\frac{b+2 c-i a+p}{2 c}, 1; \frac{b+4 c-i a+p}{2 c}; e^{2 c z}\right)}{b+2 c-i a+p} - \frac{e^{(b+2 c+i a+p) z}\, {}_2F_1\left(\frac{b+2 c+i a+p}{2 c}, 1; \frac{b+4 c+i a+p}{2 c}; e^{2 c z}\right)}{b+2 c+i a+p}\right)$$

Involving powers of cos, powers of cosh and exp

Involving $e^{p z} \cos^m(a z) \cosh^u(b z) \coth(c z)$

01.22.21.0210.01

$$\int e^{p z} \cos^m(a z) \cosh^u(b z) \coth(c z)\, dz = -2^{-m-u} \binom{u}{\frac{u}{2}} (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(\left(e^{(p-i a (m-2 k)) z} \left((2 c - i a (m-2 k) + p)\, {}_2F_1\left(\frac{p-i a (m-2 k)}{2 c}, 1; \frac{p-i a (m-2 k)}{2 c} + 1; e^{2 c z}\right) + e^{2 c z} (p - i a (m-2 k))\, {}_2F_1\left(\frac{p-i a (m-2 k)}{2 c} + 1, 1; \frac{p-i a (m-2 k)}{2 c} + 2; e^{2 c z}\right)\right)\right) \Big/ ((p - i a (m-2 k)) (2 c - i a (m-2 k) + p)) + \left(e^{(a i (m-2 k)+p) z} \left((2 c + a i (m-2 k) + p)\, {}_2F_1\left(\frac{a i (m-2 k)+p}{2 c}, 1; \frac{a i (m-2 k)+p}{2 c} + 1; e^{2 c z}\right) + e^{2 c z} (a i (m-2 k) + p)\, {}_2F_1\left(\frac{a i (m-2 k)+p}{2 c} + 1, 1; \frac{a i (m-2 k)+p}{2 c} + 2; e^{2 c z}\right)\right)\right) \Big/ ((a i (m-2 k) + p) (2 c + a i (m-2 k) + p))\right) - \frac{1}{p (2 c + p)} 2^{-m-u} e^{p z} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} \left((2 c + p)\, {}_2F_1\left(\frac{p}{2 c}, 1; \frac{p}{2 c} + 1; e^{2 c z}\right) + e^{2 c z} p\, {}_2F_1\left(\frac{p}{2 c} + 1, 1; \frac{p}{2 c} + 2; e^{2 c z}\right)\right) (1 - m \bmod 2) (1 - u \bmod 2) - 2^{-m-u} \binom{m}{\frac{m}{2}} (1 - m \bmod 2)$$

$$\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{k}\Bigg(\Bigg(e^{(p+b(u-2k))z}\left((2c+p+b(u-2k))\,{}_2F_1\!\left(\frac{p+b(u-2k)}{2c},1;\frac{p+b(u-2k)}{2c}+1;e^{2cz}\right)+e^{2cz}(p+b(u-2k))\,{}_2F_1\!\left(\frac{p+b(u-2k)}{2c}+1,1;\frac{p+b(u-2k)}{2c}+2;e^{2cz}\right)\right)\Bigg)\Big/((p+b(u-2k))(2c+p+b(u-2k)))+$$
$$\left(e^{(p-b(u-2k))z}\left((2c+p-b(u-2k))\,{}_2F_1\!\left(\frac{p-b(u-2k)}{2c},1;\frac{p-b(u-2k)}{2c}+1;e^{2cz}\right)+e^{2cz}(p-b(u-2k))\,{}_2F_1\!\left(\frac{p-b(u-2k)}{2c}+1,1;\frac{p-b(u-2k)}{2c}+2;e^{2cz}\right)\right)\right)\Big/((p-b(u-2k))(2c+p-b(u-2k)))\Bigg)-$$
$$2^{-m-u}\sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\binom{u}{s}\Bigg(\Bigg(e^{(-ia(m-2k)+p+b(u-2s))z}\left((2c-ia(m-2k)+p+b(u-2s))\,{}_2F_1\!\left(\frac{-ia(m-2k)+p+b(u-2s)}{2c},1;\frac{-ia(m-2k)+p+b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(-ia(m-2k)+p+b(u-2s))\,{}_2F_1\!\left(\frac{-ia(m-2k)+p+b(u-2s)}{2c}+1,1;\frac{-ia(m-2k)+p+b(u-2s)}{2c}+2;e^{2cz}\right)\right)\Bigg)\Big/$$
$$((-ia(m-2k)+p+b(u-2s))(2c-ia(m-2k)+p+b(u-2s)))+$$
$$\left(e^{(ai(m-2k)+p+b(u-2s))z}\left((2c+ai(m-2k)+p+b(u-2s))\,{}_2F_1\!\left(\frac{ai(m-2k)+p+b(u-2s)}{2c},1;\frac{ai(m-2k)+p+b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(ai(m-2k)+p+b(u-2s))\,{}_2F_1\!\left(\frac{ai(m-2k)+p+b(u-2s)}{2c}+1,1;\frac{ai(m-2k)+p+b(u-2s)}{2c}+2;e^{2cz}\right)\right)\right)\Big/$$
$$((ai(m-2k)+p+b(u-2s))(2c+ai(m-2k)+p+b(u-2s)))+$$
$$\left(e^{(-ia(m-2k)+p-b(u-2s))z}\left((2c-ia(m-2k)+p-b(u-2s))\,{}_2F_1\!\left(\frac{-ia(m-2k)+p-b(u-2s)}{2c},1;\frac{-ia(m-2k)+p-b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(-ia(m-2k)+p-b(u-2s))\,{}_2F_1\!\left(\frac{-ia(m-2k)+p-b(u-2s)}{2c}+1,1;\frac{-ia(m-2k)+p-b(u-2s)}{2c}+2;e^{2cz}\right)\right)\right)\Big/$$
$$((-ia(m-2k)+p-b(u-2s))(2c-ia(m-2k)+p-b(u-2s)))+$$
$$\left(e^{(ai(m-2k)+p-b(u-2s))z}\left((2c+ai(m-2k)+p-b(u-2s))\,{}_2F_1\!\left(\frac{ai(m-2k)+p-b(u-2s)}{2c},1;\frac{ai(m-2k)+p-b(u-2s)}{2c}+1;e^{2cz}\right)+e^{2cz}(ai(m-2k)+p-b(u-2s))\,{}_2F_1\!\left(\frac{ai(m-2k)+p-b(u-2s)}{2c}+1,1;\frac{ai(m-2k)+p-b(u-2s)}{2c}+2;e^{2cz}\right)\right)\right)\Big/$$
$$((ai(m-2k)+p-b(u-2s))(2c+ai(m-2k)+p-b(u-2s)))\Bigg)\;/;\;m\in\mathbb{N}^+\land u\in\mathbb{N}^+$$

01.22.21.0211.01

$$\int e^{pz}\cos^m(az)\cosh^\mu(cz)\coth(cz)\,dz = 2^{-m}\binom{m}{\frac{m}{2}}(1-m \bmod 2)\left(1+e^{-2cz}\right)^{-\mu}\cosh^\mu(cz)\left(\frac{e^{pz}F_1\left(-\frac{p+c\mu}{2c};-\mu,1;\frac{(3-\mu)c-c-p}{2c};-e^{-2cz},e^{-2cz}\right)}{(\mu-1)c+c+p}+\frac{e^{(p-2c)z}F_1\left(-\frac{\mu c-2c+p}{2c};-\mu,1;\frac{(3-\mu)c+c-p}{2c};-e^{-2cz},e^{-2cz}\right)}{(\mu-1)c-c+p}\right)+2^{-m}\cosh^\mu(cz)\left(1+e^{-2cz}\right)^{-\mu}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(\left(e^{(p-ia(m-2k))z}F_1\left(-\frac{-ia(m-2k)+p+c\mu}{2c};-\mu,1;\frac{(3-\mu)c-c+ai(m-2k)-p}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/((\mu-1)c+c-ia(m-2k)+p)+\left(e^{(ai(m-2k)+p)z}F_1\left(-\frac{ai(m-2k)+p+c\mu}{2c};-\mu,1;\frac{(3-\mu)c-c-ia(m-2k)-p}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/((\mu-1)c+c+ai(m-2k)+p)+\left(e^{(-2c+ai(m-2k)+p)z}F_1\left(-\frac{\mu c-2c+ai(m-2k)+p}{2c};-\mu,1;\frac{(3-\mu)c+c-ia(m-2k)-p}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/((\mu-1)c-c+ai(m-2k)+p)+\left(e^{(-2c-ia(m-2k)+p)z}F_1\left(-\frac{\mu c-2c-ia(m-2k)+p}{2c};-\mu,1;\frac{(3-\mu)c+c+ai(m-2k)-p}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/((\mu-1)c-c-ia(m-2k)+p)\right)\;/;\;m\in\mathbb{N}^+$$

Involving powers of sin, powers of tanh and exp

Involving $e^{pz}\sin^m(az)\tanh^\mu(cz)\coth(cz)$

01.22.21.0212.01

$$\int e^{pz}\sin^m(az)\tanh^\mu(cz)\coth(cz)\,dz = 2^{-m}\left(1+e^{-2cz}\right)^{\mu-1}\tanh^{\mu-1}(cz)\left(1-e^{-2cz}\right)^{1-\mu}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(\frac{e^{\frac{i\pi m}{2}+(p-ia(m-2k))z}F_1\left(-\frac{p-ia(m-2k)}{2c};\mu-1,1-\mu;1-\frac{p-ia(m-2k)}{2c};-e^{-2cz},e^{-2cz}\right)}{p-ia(m-2k)}+\frac{e^{(ai(m-2k)+p)z-\frac{im\pi}{2}}F_1\left(-\frac{ai(m-2k)+p}{2c};\mu-1,1-\mu;1-\frac{ai(m-2k)+p}{2c};-e^{-2cz},e^{-2cz}\right)}{ai(m-2k)+p}\right)+\frac{1}{p}2^{-m}e^{pz}\left(1+e^{-2cz}\right)^{\mu}F_1\left(-\frac{p}{2c};\mu-1,1-\mu;1-\frac{p}{2c};-e^{-2cz},e^{-2cz}\right)\binom{m}{\frac{m}{2}}(1-m \bmod 2)\tanh^\mu(cz)\left(1-e^{-2cz}\right)^{-\mu}\;/;\;m\in\mathbb{N}^+$$

Involving powers of cos, powers of tanh and exp

Involving $e^{p z} \cos^m(a z) \tanh^\mu(c z) \coth(c z)$

01.22.21.0213.01

$$\int e^{p z} \cos^m(a z) \tanh^\mu(c z) \coth(c z)\, dz = 2^{-m} \left(1 + e^{-2 c z}\right)^{\mu-1} \tanh^{\mu-1}(c z) \left(1 - e^{-2 c z}\right)^{1-\mu}$$

$$\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(\frac{e^{(p - i a (m-2k)) z} F_1\left(-\frac{p - i a (m-2k)}{2c}; \mu - 1, 1 - \mu; 1 - \frac{p - i a (m-2k)}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{p - i a (m - 2k)} + \right.$$

$$\left. \frac{e^{(a i (m-2k) + p) z} F_1\left(-\frac{a i (m-2k)+p}{2c}; \mu - 1, 1 - \mu; 1 - \frac{a i (m-2k)+p}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{a i (m - 2k) + p} \right) + \frac{1}{p} 2^{-m} e^{p z} \left(1 + e^{-2 c z}\right)^{\mu}$$

$$\binom{m}{\frac{m}{2}} (1 - m \bmod 2) \tanh^\mu(c z) \left(1 - e^{-2 c z}\right)^{-\mu} F_1\left(-\frac{p}{2c}; \mu - 1, 1 - \mu; 1 - \frac{p}{2c}; -e^{-2 c z}, e^{-2 c z}\right) /; m \in \mathbb{N}^+$$

Involving hyperbolic, trigonometric and a power functions

Involving sin, sinh and power

Involving $z^n \sin(a z) \sinh(b z) \coth(c z)$

01.22.21.0214.01

$$\int z^n \sin(a z) \sinh(b z) \coth(c z)\, dz = -\frac{1}{4} i\, n! \left(e^{(i a-b) z} \sum_{j=0}^{n} \frac{(-1)^j (i a-b)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a-b}{2 c}, \ldots, \frac{i a-b}{2 c}, 1; \frac{i a-b}{2 c}+1, \ldots, \frac{i a-b}{2 c}+1; e^{2 c z}\right) + e^{(b-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b-i a}{2 c}, \ldots, \frac{b-i a}{2 c}, 1; \frac{b-i a}{2 c}+1, \ldots, \frac{b-i a}{2 c}+1; e^{2 c z}\right) + e^{(-b+2 c+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c+i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+2 c+i a}{2 c}, \ldots, \frac{-b+2 c+i a}{2 c}, 1; \frac{-b+2 c+i a}{2 c}+1, \ldots, \frac{-b+2 c+i a}{2 c}+1; e^{2 c z}\right) + e^{(b+2 c-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2 c-i a}{2 c}, \ldots, \frac{b+2 c-i a}{2 c}, 1; \frac{b+2 c-i a}{2 c}+1, \ldots, \frac{b+2 c-i a}{2 c}+1; e^{2 c z}\right) - e^{(-b-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b-i a}{2 c}, \ldots, \frac{-b-i a}{2 c}, 1; \frac{-b-i a}{2 c}+1, \ldots, \frac{-b-i a}{2 c}+1; e^{2 c z}\right) - e^{(b+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+i a}{2 c}, \ldots, \frac{b+i a}{2 c}, 1; \frac{b+i a}{2 c}+1, \ldots, \frac{b+i a}{2 c}+1; e^{2 c z}\right) - e^{(-b+2 c-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+2 c-i a}{2 c}, \ldots, \frac{-b+2 c-i a}{2 c}, 1; \frac{-b+2 c-i a}{2 c}+1, \ldots, \frac{-b+2 c-i a}{2 c}+1; e^{2 c z}\right) - e^{(b+2 c+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c+i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2 c+i a}{2 c}, \ldots, \frac{b+2 c+i a}{2 c}, 1; \frac{b+2 c+i a}{2 c}+1, \ldots, \frac{b+2 c+i a}{2 c}+1; e^{2 c z}\right)\right) /; n \in \mathbb{N}$$

Involving powers of sin, powers of sinh and power

Involving $z^n \sin^m(a z) \sinh^u(b z) \coth(c z)$

01.22.21.0215.01

$$\int z^n \sin^m(a z) \sinh^u(b z) \coth(c z)\, dz = -i^u 2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} n! (1 - m \bmod 2) (1 - u \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + 2 e^{2 c z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}(1, \ldots, 1; 2, \ldots, 2; e^{2 c z})\right) - i^u 2^{-m-u} \binom{u}{\frac{u}{2}} n! (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(e^{\frac{i m \pi}{2}} \left(e^{-i a (m-2 k) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2 k))^{-j-1} z^{n-j}}{(n-j)!}\right.\right.$$

$$ {}_{j+2}F_{j+1}\left(-\frac{i\,a\,(m-2\,k)}{2\,c},\,\ldots,\,-\frac{i\,a\,(m-2\,k)}{2\,c},\,1;\,1-\frac{i\,a\,(m-2\,k)}{2\,c},\,\ldots,\,1-\frac{i\,a\,(m-2\,k)}{2\,c};\,e^{2\,c\,z}\right)+ $$

$$ e^{(2\,c-i\,a\,(m-2\,k))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c-i\,a\,(m-2\,k))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{2\,c-i\,a\,(m-2\,k)}{2\,c},\,\ldots,\right. $$

$$ \left.\left.\frac{2\,c-i\,a\,(m-2\,k)}{2\,c},\,1;\,\frac{2\,c-i\,a\,(m-2\,k)}{2\,c}+1,\,\ldots,\,\frac{2\,c-i\,a\,(m-2\,k)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)+ $$

$$ e^{-\frac{1}{2}\,i\,m\,\pi}\left(e^{i\,a\,(m-2\,k)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(i\,a\,(m-2\,k))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2\,k)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)}{2\,c},\right.\right. $$

$$ \left.1;\,\frac{i\,a\,(m-2\,k)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)}{2\,c}+1;\,e^{2\,c\,z}\right)+ $$

$$ e^{(2\,c+a\,i\,(m-2\,k))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+a\,i\,(m-2\,k))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{2\,c+i\,a\,(m-2\,k)}{2\,c},\,\ldots,\right. $$

$$ \left.\left.\left.\frac{2\,c+i\,a\,(m-2\,k)}{2\,c},\,1;\,\frac{2\,c+i\,a\,(m-2\,k)}{2\,c}+1,\,\ldots,\,\frac{2\,c+i\,a\,(m-2\,k)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)\right)- $$

$$ i^u\,2^{-m-u}\binom{m}{\frac{m}{2}}n!\,(1-m\bmod 2)\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}(-1)^i\binom{u}{i}\left(e^{\frac{i\,\pi\,u}{2}}\left(e^{-b\,(u-2\,i)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\right.\right. $$

$$ {}_{j+2}F_{j+1}\left(-\frac{b\,(u-2\,i)}{2\,c},\,\ldots,\,-\frac{b\,(u-2\,i)}{2\,c},\,1;\,1-\frac{b\,(u-2\,i)}{2\,c},\,\ldots,\,1-\frac{b\,(u-2\,i)}{2\,c};\,e^{2\,c\,z}\right)+ $$

$$ e^{(2\,c-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{2\,c-b\,(u-2\,i)}{2\,c},\,\ldots,\right. $$

$$ \left.\left.\frac{2\,c-b\,(u-2\,i)}{2\,c},\,1;\,\frac{2\,c-b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{2\,c-b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)+ $$

$$ e^{-\frac{1}{2}\,i\,\pi\,u}\left(e^{b\,(u-2\,i)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{b\,(u-2\,i)}{2\,c},\,1;\,\frac{b\,(u-2\,i)}{2\,c}+1,\right.\right. $$

$$ \left.\ldots,\,\frac{b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{(2\,c+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1} $$

$$ \left.\left.\left.\left(\frac{2\,c+b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{2\,c+b\,(u-2\,i)}{2\,c},\,1;\,\frac{2\,c+b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{2\,c+b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)\right)\right)- $$

$$ i^u\,2^{-m-u}\,n!\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^{i+k}\binom{m}{k}\binom{u}{i}\left(e^{\frac{1}{2}\,i\,\pi\,(m+u)}\left(e^{(-i\,a\,(m-2\,k)-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\right.\right. $$

$$ {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\,1;\right. $$

$$ \left.\frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\right)+ $$

$$e^{(2c-i a(m-2k)-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c-i a(m-2k)-b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Bigg(\frac{2c-i a(m-2k)-b(u-2i)}{2c},\,\ldots,\,\frac{2c-i a(m-2k)-b(u-2i)}{2c},\,1;$$
$$\frac{2c-i a(m-2k)-b(u-2i)}{2c}+1,\,\ldots,\,\frac{2c-i a(m-2k)-b(u-2i)}{2c}+1;\,e^{2cz}\Bigg)\Bigg)+$$
$$e^{\frac{1}{2}i\pi(u-m)}\Bigg(e^{(i a(m-2k)-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(i a(m-2k)-b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Bigg(\frac{i a(m-2k)-b(u-2i)}{2c},$$
$$\ldots,\,\frac{i a(m-2k)-b(u-2i)}{2c},\,1;\,\frac{i a(m-2k)-b(u-2i)}{2c}+1,\,\ldots,\,\frac{i a(m-2k)-b(u-2i)}{2c}+1;$$
$$e^{2cz}\Bigg)+e^{(2c+a i(m-2k)-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c+a i(m-2k)-b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$
$${}_{j+2}F_{j+1}\Bigg(\frac{2c+i a(m-2k)-b(u-2i)}{2c},\,\ldots,\,\frac{2c+i a(m-2k)-b(u-2i)}{2c},\,1;$$
$$\frac{2c+i a(m-2k)-b(u-2i)}{2c}+1,\,\ldots,\,\frac{2c+i a(m-2k)-b(u-2i)}{2c}+1;\,e^{2cz}\Bigg)\Bigg)+$$
$$e^{\frac{1}{2}i\pi(m-u)}\Bigg(e^{(b(u-2i)-i a(m-2k))z}\sum_{j=0}^{n}\frac{(-1)^j\,(b(u-2i)-i a(m-2k))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Bigg(\frac{b(u-2i)-i a(m-2k)}{2c},$$
$$\ldots,\,\frac{b(u-2i)-i a(m-2k)}{2c},\,1;\,\frac{b(u-2i)-i a(m-2k)}{2c}+1,\,\ldots,\,\frac{b(u-2i)-i a(m-2k)}{2c}+1;$$
$$e^{2cz}\Bigg)+e^{(2c-i a(m-2k)+b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c-i a(m-2k)+b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$
$${}_{j+2}F_{j+1}\Bigg(\frac{2c-i a(m-2k)+b(u-2i)}{2c},\,\ldots,\,\frac{2c-i a(m-2k)+b(u-2i)}{2c},\,1;$$
$$\frac{2c-i a(m-2k)+b(u-2i)}{2c}+1,\,\ldots,\,\frac{2c-i a(m-2k)+b(u-2i)}{2c}+1;\,e^{2cz}\Bigg)\Bigg)+$$
$$e^{-\frac{1}{2}i\pi(m+u)}\Bigg(e^{(a i(m-2k)+b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(a i(m-2k)+b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}$$
$$\Bigg(\frac{i a(m-2k)+b(u-2i)}{2c},\,\ldots,\,\frac{i a(m-2k)+b(u-2i)}{2c},\,1;\,\frac{i a(m-2k)+b(u-2i)}{2c}+1,$$
$$\ldots,\,\frac{i a(m-2k)+b(u-2i)}{2c}+1;\,e^{2cz}\Bigg)+e^{(2c+a i(m-2k)+b(u-2i))z}$$
$$\sum_{j=0}^{n}\frac{(-1)^j\,(2c+a i(m-2k)+b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Bigg(\frac{2c+i a(m-2k)+b(u-2i)}{2c},$$
$$\ldots,\,\frac{2c+i a(m-2k)+b(u-2i)}{2c},\,1;\,\frac{2c+i a(m-2k)+b(u-2i)}{2c}+1,$$

Involving cos, sinh and power

Involving $z^n \cos(a z) \sinh(b z) \coth(c z)$

01.22.21.0216.01

$$\int z^n \cos(a z) \sinh(b z) \coth(c z)\, dz = -\frac{1}{4} n! \left(-e^{(i a-b) z} \sum_{j=0}^{n} \frac{(-1)^j (i a-b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a-b}{2 c}, \ldots, \frac{i a-b}{2 c}, 1; \frac{i a-b}{2 c}+1, \ldots, \frac{i a-b}{2 c}+1; e^{2 c z}\right) + e^{(b-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b-i a}{2 c}, \ldots, \frac{b-i a}{2 c}, 1; \frac{b-i a}{2 c}+1, \ldots, \frac{b-i a}{2 c}+1; e^{2 c z}\right) - e^{(-b+2 c+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c+i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b+2 c+i a}{2 c}, \ldots, \frac{-b+2 c+i a}{2 c}, 1; \frac{-b+2 c+i a}{2 c}+1, \ldots, \frac{-b+2 c+i a}{2 c}+1; e^{2 c z}\right) + e^{(b+2 c-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c-i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b+2 c-i a}{2 c}, \ldots, \frac{b+2 c-i a}{2 c}, 1; \frac{b+2 c-i a}{2 c}+1, \ldots, \frac{b+2 c-i a}{2 c}+1; e^{2 c z}\right) - e^{(-b-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b-i a}{2 c}, \ldots, \frac{-b-i a}{2 c}, 1; \frac{-b-i a}{2 c}+1, \ldots, \frac{-b-i a}{2 c}+1; e^{2 c z}\right) + e^{(b+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b+i a}{2 c}, \ldots, \frac{b+i a}{2 c}, 1; \frac{b+i a}{2 c}+1, \ldots, \frac{b+i a}{2 c}+1; e^{2 c z}\right) - e^{(-b+2 c-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c-i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b+2 c-i a}{2 c}, \ldots, \frac{-b+2 c-i a}{2 c}, 1; \frac{-b+2 c-i a}{2 c}+1, \ldots, \frac{-b+2 c-i a}{2 c}+1; e^{2 c z}\right) + e^{(b+2 c+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c+i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b+2 c+i a}{2 c}, \ldots, \frac{b+2 c+i a}{2 c}, 1; \frac{b+2 c+i a}{2 c}+1, \ldots, \frac{b+2 c+i a}{2 c}+1; e^{2 c z}\right)\right) /; n \in \mathbb{N}$$

Involving powers of cos, powers of sinh and power

Involving $z^n \cos^m(a z) \sinh^u(b z) \coth(c z)$

01.22.21.0217.01

$$\int z^n \cos^m(a z) \sinh^u(b z) \coth(c z)\, dz = -i^u 2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} n! \, (1 - m \bmod 2) (1 - u \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + 2 e^{2 c z} \sum_{j=0}^{n} \frac{(-1)^j (2 c)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(1, \ldots, 1; 2, \ldots, 2; e^{2 c z}\right)\right) -$$

$$i^u\, 2^{-m-u} \binom{u}{\frac{u}{2}} n!\, (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \Bigg(e^{-i a (m-2k) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(-\frac{i a (m-2k)}{2c}, \ldots, -\frac{i a (m-2k)}{2c}, 1; 1 - \frac{i a (m-2k)}{2c}, \ldots, 1 - \frac{i a (m-2k)}{2c}; e^{2cz}\right) +$$

$$e^{i a (m-2k) z} \sum_{j=0}^{n} \frac{(-1)^j (i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\left(\frac{i a (m-2k)}{2c}, \ldots, \frac{i a (m-2k)}{2c}, 1; \frac{i a (m-2k)}{2c} + 1,\right.$$

$$\left. \ldots, \frac{i a (m-2k)}{2c} + 1; e^{2cz}\right) + e^{(2c - i a (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}$$

$$\left(\frac{2c - i a (m-2k)}{2c}, \ldots, \frac{2c - i a (m-2k)}{2c}, 1; \frac{2c - i a (m-2k)}{2c} + 1, \ldots, \frac{2c - i a (m-2k)}{2c} + 1; e^{2cz}\right) +$$

$$e^{(2c + a i (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c + a i (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\left(\frac{2c + i a (m-2k)}{2c}, \ldots,\right.$$

$$\left.\left. \frac{2c + i a (m-2k)}{2c}, 1; \frac{2c + i a (m-2k)}{2c} + 1, \ldots, \frac{2c + i a (m-2k)}{2c} + 1; e^{2cz}\right)\right) -$$

$$2^{-m-u} \binom{m}{\frac{m}{2}} n!\, (1 - m \bmod 2) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{u}{k} \Bigg(e^{b (u-2k) z} \sum_{j=0}^{n} \frac{(-1)^j (b (u-2k))^{-j-1} z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(\frac{b (u-2k)}{2c}, \ldots, \frac{b (u-2k)}{2c}, 1; \frac{b (u-2k)}{2c} + 1, \ldots, \frac{b (u-2k)}{2c} + 1; e^{2cz}\right) +$$

$$(-1)^u \Bigg(e^{-b (u-2k) z} \sum_{j=0}^{n} \frac{(-1)^j (-b (u-2k))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\left(-\frac{b (u-2k)}{2c}, \ldots, -\frac{b (u-2k)}{2c}, 1; 1 - \frac{b (u-2k)}{2c},\right.$$

$$\left. \ldots, 1 - \frac{b (u-2k)}{2c}; e^{2cz}\right) + e^{(2c - b (u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c - b (u-2k))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}$$

$$\left.\left(\frac{2c - b (u-2k)}{2c}, \ldots, \frac{2c - b (u-2k)}{2c}, 1; \frac{2c - b (u-2k)}{2c} + 1, \ldots, \frac{2c - b (u-2k)}{2c} + 1; e^{2cz}\right)\right) +$$

$$e^{(2c + b (u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c + b (u-2k))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\left(\frac{2c + b (u-2k)}{2c}, \ldots, \frac{2c + b (u-2k)}{2c},\right.$$

$$\left.\left. 1; \frac{2c + b (u-2k)}{2c} + 1, \ldots, \frac{2c + b (u-2k)}{2c} + 1; e^{2cz}\right)\right) -$$

$$2^{-m-u} n! \sum_{i=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^i \binom{m}{k} \binom{u}{i} \Bigg((-1)^u \Bigg(e^{(-i a (m-2k) - b (u-2i)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k) - b (u-2i))^{-j-1} z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(\frac{-i a (m-2k) - b (u-2i)}{2c}, \ldots, \frac{-i a (m-2k) - b (u-2i)}{2c}, 1;\right.$$

$$\frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\,1;$$

$$\frac{2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{(i\,a\,(m-2\,k)-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(i\,a\,(m-2\,k)-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},$$

$$\ldots,\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\,1;\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1;$$

$$e^{2\,c\,z}\Bigg)+e^{(2\,c+a\,i\,(m-2\,k)-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+a\,i\,(m-2\,k)-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{2\,c+i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{2\,c+i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\,1;$$

$$\frac{2\,c+i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{2\,c+i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)\Bigg)+$$

$$e^{(b\,(u-2\,i)-i\,a\,(m-2\,k))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b\,(u-2\,i)-i\,a\,(m-2\,k))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{b\,(u-2\,i)-i\,a\,(m-2\,k)}{2\,c},\,\ldots,$$

$$\frac{b\,(u-2\,i)-i\,a\,(m-2\,k)}{2\,c},\,1;\,\frac{b\,(u-2\,i)-i\,a\,(m-2\,k)}{2\,c}+1,\,\ldots,\,\frac{b\,(u-2\,i)-i\,a\,(m-2\,k)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c-i\,a\,(m-2\,k)+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c-i\,a\,(m-2\,k)+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{2\,c-i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{2\,c-i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c},\,1;$$

$$\frac{2\,c-i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{2\,c-i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{(a\,i\,(m-2\,k)+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c},\,\ldots,$$

$$\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c},\,1;\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c+a\,i\,(m-2\,k)+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+a\,i\,(m-2\,k)+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{2\,c+i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{2\,c+i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c},\,1;\,\frac{2\,c+i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c}+$$

$$1,\,\ldots,\,\frac{2\,c+i\,a\,(m-2\,k)+b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)\Bigg)$$

Involving sin, cosh and power

Involving $z^n \sin(a z) \cosh(b z) \coth(c z)$

01.22.21.0218.01

$$\int z^n \sin(a z) \cosh(b z) \coth(c z)\, dz = -\frac{i}{4} n! \Bigg(-e^{(b+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+i a}{2 c}, \ldots, \frac{b+i a}{2 c}, 1; \frac{b+i a}{2 c}+1, \ldots, \frac{b+i a}{2 c}+1; e^{2 c z}\right) +$$
$$e^{(-b-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b-i a}{2 c}, \ldots, \frac{-b-i a}{2 c}, 1; \frac{-b-i a}{2 c}+1, \ldots, \frac{-b-i a}{2 c}+1; e^{2 c z}\right) -$$
$$e^{(i a-b) z} \sum_{j=0}^{n} \frac{(-1)^j (i a-b)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a-b}{2 c}, \ldots, \frac{i a-b}{2 c}, 1; \frac{i a-b}{2 c}+1, \ldots, \frac{i a-b}{2 c}+1; e^{2 c z}\right) +$$
$$e^{(b-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b-i a}{2 c}, \ldots, \frac{b-i a}{2 c}, 1; \frac{b-i a}{2 c}+1, \ldots, \frac{b-i a}{2 c}+1; e^{2 c z}\right) +$$
$$e^{(-b+2 c-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+2 c-i a}{2 c}, \ldots, \frac{-b+2 c-i a}{2 c}, 1;\right.$$
$$\left.\frac{-b+2 c-i a}{2 c}+1, \ldots, \frac{-b+2 c-i a}{2 c}+1; e^{2 c z}\right) - e^{(-b+2 c+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c+i a)^{-j-1} z^{n-j}}{(n-j)!}$$
$${}_{j+2}F_{j+1}\left(\frac{-b+2 c+i a}{2 c}, \ldots, \frac{-b+2 c+i a}{2 c}, 1; \frac{-b+2 c+i a}{2 c}+1, \ldots, \frac{-b+2 c+i a}{2 c}+1; e^{2 c z}\right) +$$
$$e^{(b+2 c-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2 c-i a}{2 c}, \ldots, \frac{b+2 c-i a}{2 c}, 1; \frac{b+2 c-i a}{2 c}+1,\right.$$
$$\left.\ldots, \frac{b+2 c-i a}{2 c}+1; e^{2 c z}\right) - e^{(b+2 c+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c+i a)^{-j-1} z^{n-j}}{(n-j)!}$$
$${}_{j+2}F_{j+1}\left(\frac{b+2 c+i a}{2 c}, \ldots, \frac{b+2 c+i a}{2 c}, 1; \frac{b+2 c+i a}{2 c}+1, \ldots, \frac{b+2 c+i a}{2 c}+1; e^{2 c z}\right)\Bigg) /; n \in \mathbb{N}$$

01.22.21.0219.01

$$\int z^n \sin(a z)\cosh(c z)\coth(c z)\,dz = -\frac{1}{2} e^{c z}\, i\, n! \left(e^{-i a z} \sum_{j=0}^{n} \frac{(-1)^j (c - i a)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(\frac{c - i a}{2 c}, \ldots, \frac{c - i a}{2 c}, 1; \frac{c - i a}{2 c} + 1, \ldots, \frac{c - i a}{2 c} + 1; e^{2 c z}\right) - e^{i a z} \sum_{j=0}^{n} \frac{(-1)^j (c + i a)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(\frac{c + i a}{2 c}, \ldots, \frac{c + i a}{2 c}, 1; \frac{c + i a}{2 c} + 1, \ldots, \frac{c + i a}{2 c} + 1; e^{2 c z}\right)\right) - \frac{1}{4} i e^{c z} n! \left(-e^{(i a - 2 c) z} \sum_{j=0}^{n} \frac{(-1)^j (i a - c)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(\frac{i a - c}{2 c}, \ldots, \frac{i a - c}{2 c}, 1; \frac{i a - c}{2 c} + 1, \ldots, \frac{i a - c}{2 c} + 1; e^{2 c z}\right) + e^{(-2 c - i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-c - i a)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(\frac{-c - i a}{2 c}, \ldots, \frac{-c - i a}{2 c}, 1; \frac{-c - i a}{2 c} + 1, \ldots, \frac{-c - i a}{2 c} + 1; e^{2 c z}\right) - e^{(2 c + i a) z} \sum_{j=0}^{n} \frac{(-1)^j (3 c + i a)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(\frac{3 c + i a}{2 c}, \ldots, \frac{3 c + i a}{2 c}, 1; \frac{3 c + i a}{2 c} + 1, \ldots, \frac{3 c + i a}{2 c} + 1; e^{2 c z}\right) + e^{(2 c - i a) z} \sum_{j=0}^{n} \frac{(-1)^j (3 c - i a)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(\frac{3 c - i a}{2 c}, \ldots, \frac{3 c - i a}{2 c}, 1; \frac{3 c - i a}{2 c} + 1, \ldots, \frac{3 c - i a}{2 c} + 1; e^{2 c z}\right)\right) /; n \in \mathbb{N}$$

Involving powers of sin, powers of cosh and power

Involving $z^n \sin^m(a z) \cosh^u(c z) \coth(c z)$

01.22.21.0220.01

$$\int z^n \sin^m(a z)\cosh^u(b z)\coth(c z)\,dz = -2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} n!\,(1 - m \bmod 2)\,(1 - u \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + 2 e^{2 c z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(1, \ldots, 1; 2, \ldots, 2; e^{2 c z}\right)\right) - 2^{-m-u} \binom{u}{\frac{u}{2}} n!\,(1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(e^{\frac{i m \pi}{2}} \left(e^{-i a (m - 2 k) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m - 2 k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(-\frac{i a (m - 2 k)}{2 c}, \ldots, -\frac{i a (m - 2 k)}{2 c}, 1; 1 - \frac{i a (m - 2 k)}{2 c}, \ldots, 1 - \frac{i a (m - 2 k)}{2 c}; e^{2 c z}\right) + e^{(2 c - i a (m - 2 k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c - i a (m - 2 k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(\frac{2 c - i a (m - 2 k)}{2 c}, \ldots, \frac{2 c - i a (m - 2 k)}{2 c}, 1; \frac{2 c - i a (m - 2 k)}{2 c} + 1, \ldots, \frac{2 c - i a (m - 2 k)}{2 c} + 1; e^{2 c z}\right)\right) + e^{-\frac{1}{2} i m \pi} \left(e^{i a (m - 2 k) z} \sum_{j=0}^{n} \frac{(-1)^j (i a (m - 2 k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\!\left(\frac{i a (m - 2 k)}{2 c}, \ldots, \frac{i a (m - 2 k)}{2 c}, \right.\right.$$

$$1;\ \frac{i\,a\,(m-2\,k)}{2\,c}+1,\ \ldots,\ \frac{i\,a\,(m-2\,k)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c+a\,i\,(m-2\,k))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+a\,i\,(m-2\,k))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{2\,c+i\,a\,(m-2\,k)}{2\,c},\ \ldots,$$

$$\frac{2\,c+i\,a\,(m-2\,k)}{2\,c},\ 1;\ \frac{2\,c+i\,a\,(m-2\,k)}{2\,c}+1,\ \ldots,\ \frac{2\,c+i\,a\,(m-2\,k)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)-$$

$$2^{-m-u}\binom{m}{\frac{m}{2}}n!\,(1-m\bmod 2)\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{i}\Bigg(e^{-b\,(u-2\,i)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(-\frac{b\,(u-2\,i)}{2\,c},\ \ldots,\ -\frac{b\,(u-2\,i)}{2\,c},\ 1;\ 1-\frac{b\,(u-2\,i)}{2\,c},\ \ldots,\ 1-\frac{b\,(u-2\,i)}{2\,c};\ e^{2\,c\,z}\Bigg)+e^{b\,(u-2\,i)\,z}$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{b\,(u-2\,i)}{2\,c},\ 1;\ \frac{b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{2\,c-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{2\,c-b\,(u-2\,i)}{2\,c},\ 1;$$

$$\frac{2\,c-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+e^{(2\,c+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{2\,c+b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{2\,c+b\,(u-2\,i)}{2\,c},\ 1;\ \frac{2\,c+b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c+b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)-$$

$$2^{-m-u}\,n!\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\binom{u}{i}\Bigg(e^{\frac{i\,\pi\,m}{2}}\Bigg(e^{(-i\,a\,(m-2\,k)-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\ 1;$$

$$\frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\ 1;$$

$$\frac{2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c-i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)+$$

$$e^{-\frac{1}{2}\,i\,\pi\,m}\Bigg(e^{(i\,a\,(m-2\,k)-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(i\,a\,(m-2\,k)-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},$$

$$\ldots,\ \frac{i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c},\ 1;\ \frac{i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{i\,a\,(m-2\,k)-b\,(u-2\,i)}{2\,c}+1;$$

$$e^{2cz}\Bigg) + e^{(2c+a\,i\,(m-2k)-b\,(u-2i))\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(2c+a\,i\,(m-2k)-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$
$$_{j+2}F_{j+1}\Bigg(\frac{2c+i\,a\,(m-2k)-b\,(u-2i)}{2c}, \ldots, \frac{2c+i\,a\,(m-2k)-b\,(u-2i)}{2c}, 1;$$
$$\frac{2c+i\,a\,(m-2k)-b\,(u-2i)}{2c}+1, \ldots, \frac{2c+i\,a\,(m-2k)-b\,(u-2i)}{2c}+1; e^{2cz}\Bigg)\Bigg) +$$
$$e^{\frac{i\pi m}{2}}\Bigg(e^{(b\,(u-2i)-i\,a\,(m-2k))\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(b\,(u-2i)-i\,a\,(m-2k))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{b\,(u-2i)-i\,a\,(m-2k)}{2c},$$
$$\ldots, \frac{b\,(u-2i)-i\,a\,(m-2k)}{2c}, 1; \frac{b\,(u-2i)-i\,a\,(m-2k)}{2c}+1, \ldots, \frac{b\,(u-2i)-i\,a\,(m-2k)}{2c}+1;$$
$$e^{2cz}\Bigg) + e^{(2c-i\,a\,(m-2k)+b\,(u-2i))\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(2c-i\,a\,(m-2k)+b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$
$$_{j+2}F_{j+1}\Bigg(\frac{2c-i\,a\,(m-2k)+b\,(u-2i)}{2c}, \ldots, \frac{2c-i\,a\,(m-2k)+b\,(u-2i)}{2c}, 1;$$
$$\frac{2c-i\,a\,(m-2k)+b\,(u-2i)}{2c}+1, \ldots, \frac{2c-i\,a\,(m-2k)+b\,(u-2i)}{2c}+1; e^{2cz}\Bigg)\Bigg) +$$
$$e^{-\frac{1}{2}i\pi m}\Bigg(e^{(a\,i\,(m-2k)+b\,(u-2i))\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(a\,i\,(m-2k)+b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$
$$\Bigg(\frac{i\,a\,(m-2k)+b\,(u-2i)}{2c}, \ldots, \frac{i\,a\,(m-2k)+b\,(u-2i)}{2c}, 1; \frac{i\,a\,(m-2k)+b\,(u-2i)}{2c}+1,$$
$$\ldots, \frac{i\,a\,(m-2k)+b\,(u-2i)}{2c}+1; e^{2cz}\Bigg) + e^{(2c+a\,i\,(m-2k)+b\,(u-2i))\,z}$$
$$\sum_{j=0}^{n} \frac{(-1)^j\,(2c+a\,i\,(m-2k)+b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{2c+i\,a\,(m-2k)+b\,(u-2i)}{2c},$$
$$\ldots, \frac{2c+i\,a\,(m-2k)+b\,(u-2i)}{2c}, 1; \frac{2c+i\,a\,(m-2k)+b\,(u-2i)}{2c}+1,$$
$$\ldots, \frac{2c+i\,a\,(m-2k)+b\,(u-2i)}{2c}+1; e^{2cz}\Bigg)\Bigg)\Bigg) /; n \in \mathbb{N} \land m \in \mathbb{N}^+ \land u \in \mathbb{N}^+$$

Involving cos, cosh and power

Involving $z^n \cos(a\,z) \cosh(b\,z) \coth(c\,z)$

01.22.21.0221.01

$$\int z^n \cos(a z) \cosh(b z) \coth(c z)\, dz = -\frac{1}{4} n! \left(e^{(-b-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b - i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a - b}{2 c}, \ldots, \frac{-i a - b}{2 c}, 1; \frac{-i a - b}{2 c} + 1, \ldots, \frac{-i a - b}{2 c} + 1; e^{2 c z} \right) + e^{(i a - b) z} \sum_{j=0}^{n} \frac{(-1)^j (i a - b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a - b}{2 c}, \ldots, \frac{i a - b}{2 c}, 1; \frac{i a - b}{2 c} + 1, \ldots, \frac{i a - b}{2 c} + 1; e^{2 c z} \right) + e^{(b - i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b - i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b - i a}{2 c}, \ldots, \frac{b - i a}{2 c}, 1; \frac{b - i a}{2 c} + 1, \ldots, \frac{b - i a}{2 c} + 1; e^{2 c z} \right) + e^{(b + i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b + i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a + b}{2 c}, \ldots, \frac{i a + b}{2 c}, 1; \frac{i a + b}{2 c} + 1, \ldots, \frac{i a + b}{2 c} + 1; e^{2 c z} \right) + e^{(-b + 2 c - i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b + 2 c - i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a - b + 2 c}{2 c}, \ldots, \frac{-i a - b + 2 c}{2 c}, 1; \frac{-i a - b + 2 c}{2 c} + 1, \ldots, \frac{-i a - b + 2 c}{2 c} + 1; e^{2 c z} \right) + e^{(-b + 2 c + i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b + 2 c + i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a - b + 2 c}{2 c}, \ldots, \frac{i a - b + 2 c}{2 c}, 1; \frac{i a - b + 2 c}{2 c} + 1, \ldots, \frac{i a - b + 2 c}{2 c} + 1; e^{2 c z} \right) + e^{(b + 2 c - i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b + 2 c - i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a + b + 2 c}{2 c}, \ldots, \frac{-i a + b + 2 c}{2 c}, 1; \frac{-i a + b + 2 c}{2 c} + 1, \ldots, \frac{-i a + b + 2 c}{2 c} + 1; e^{2 c z} \right) + e^{(b + 2 c + i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b + 2 c + i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a + b + 2 c}{2 c}, \ldots, \frac{i a + b + 2 c}{2 c}, 1; \frac{i a + b + 2 c}{2 c} + 1, \ldots, \frac{i a + b + 2 c}{2 c} + 1; e^{2 c z} \right) \right) /; n \in \mathbb{N} \land v \in \mathbb{Z}$$

01.22.21.0222.01

$$\int z^n \cos(a z) \cosh(c z) \coth(c z)\, dz = -\frac{1}{2} e^{c z} n! \left(e^{-i a z} \sum_{j=0}^{n} \frac{(-1)^j (c - i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{c - i a}{2 c}, \ldots, \frac{c - i a}{2 c}, 1; \frac{c - i a}{2 c} + 1, \ldots, \frac{c - i a}{2 c} + 1; e^{2 c z}\right) + e^{i a z} \sum_{j=0}^{n} \frac{(-1)^j (c + i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a + c}{2 c}, \ldots, \frac{i a + c}{2 c}, 1; \frac{i a + c}{2 c} + 1, \ldots, \frac{i a + c}{2 c} + 1; e^{2 c z}\right)\right) - \frac{1}{4} e^{c z} n! \left(e^{(-2 c - i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-c - i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a - c}{2 c}, \ldots, \frac{-i a - c}{2 c}, 1; \frac{-i a - c}{2 c} + 1, \ldots, \frac{-i a - c}{2 c} + 1; e^{2 c z}\right) + e^{(i a - 2 c) z} \sum_{j=0}^{n} \frac{(-1)^j (i a - c)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a - c}{2 c}, \ldots, \frac{i a - c}{2 c}, 1; \frac{i a - c}{2 c} + 1, \ldots, \frac{i a - c}{2 c} + 1; e^{2 c z}\right) + e^{(2 c - i a) z} \sum_{j=0}^{n} \frac{(-1)^j (3 c - i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{3 c - i a}{2 c}, \ldots, \frac{3 c - i a}{2 c}, 1; \frac{3 c - i a}{2 c} + 1, \ldots, \frac{3 c - i a}{2 c} + 1; e^{2 c z}\right) + e^{(2 c + i a) z} \sum_{j=0}^{n} \frac{(-1)^j (3 c + i a)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a + 3 c}{2 c}, \ldots, \frac{i a + 3 c}{2 c}, 1; \frac{i a + 3 c}{2 c} + 1, \ldots, \frac{i a + 3 c}{2 c} + 1; e^{2 c z}\right)\right) /; n \in \mathbb{N}$$

Involving powers of cos, powers of cosh and power

Involving $z^n \cos^m(a z) \cosh^u(c z) \coth(c z)$

01.22.21.0223.01

$$\int z^n \cos^m(a z) \cosh^u(b z) \coth(c z)\, dz = -2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} n! (1 - m \bmod 2) (1 - u \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + 2 e^{2 c z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(1, \ldots, 1; 2, \ldots, 2; e^{2 c z}) \right) - 2^{-m-u} \binom{u}{\frac{u}{2}} n! (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(e^{-i a (m - 2 k) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m - 2 k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(-\frac{i a (m - 2 k)}{2 c}, \ldots, -\frac{i a (m - 2 k)}{2 c}, 1; 1 - \frac{i a (m - 2 k)}{2 c}, \ldots, 1 - \frac{i a (m - 2 k)}{2 c}; e^{2 c z}\right) + e^{i a (m - 2 k) z} \sum_{j=0}^{n} \frac{(-1)^j (i a (m - 2 k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a (m - 2 k)}{2 c}, \ldots, \frac{i a (m - 2 k)}{2 c}, 1; \frac{i a (m - 2 k)}{2 c} + 1, \ldots, \frac{i a (m - 2 k)}{2 c} + 1; e^{2 c z}\right) + e^{(2 c - i a (m - 2 k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c - i a (m - 2 k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 c - i a (m - 2 k)}{2 c}, \ldots, \frac{2 c - i a (m - 2 k)}{2 c}, 1; \frac{2 c - i a (m - 2 k)}{2 c} + 1, \ldots, \frac{2 c - i a (m - 2 k)}{2 c} + 1; e^{2 c z}\right) + \right.$$

$$e^{(2c+a\,i\,(m-2k))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c+a\,i\,(m-2k))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{2c+i\,a\,(m-2k)}{2c},\,\ldots,\right.$$

$$\left.\frac{2c+i\,a\,(m-2k)}{2c},\,1;\,\frac{2c+i\,a\,(m-2k)}{2c}+1,\,\ldots,\,\frac{2c+i\,a\,(m-2k)}{2c}+1;\,e^{2cz}\right)\Bigg)-$$

$$2^{-m-u}\binom{m}{\frac{m}{2}}n!\,(1-m\bmod 2)\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{i}\Bigg(e^{-b\,(u-2i)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(-\frac{b\,(u-2i)}{2c},\,\ldots,\,-\frac{b\,(u-2i)}{2c},\,1;\,1-\frac{b\,(u-2i)}{2c},\,\ldots,\,1-\frac{b\,(u-2i)}{2c};\,e^{2cz}\right)+e^{b\,(u-2i)\,z}$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{b\,(u-2i)}{2c},\,\ldots,\,\frac{b\,(u-2i)}{2c},\,1;\,\frac{b\,(u-2i)}{2c}+1,\,\ldots,\,\frac{b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(2c-b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{2c-b\,(u-2i)}{2c},\,\ldots,\,\frac{2c-b\,(u-2i)}{2c},\,1;\right.$$

$$\left.\frac{2c-b\,(u-2i)}{2c}+1,\,\ldots,\,\frac{2c-b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+e^{(2c+b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c+b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{2c+b\,(u-2i)}{2c},\,\ldots,\,\frac{2c+b\,(u-2i)}{2c},\,1;\,\frac{2c+b\,(u-2i)}{2c}+1,\,\ldots,\,\frac{2c+b\,(u-2i)}{2c}+1;\,e^{2cz}\right)\Bigg)-$$

$$2^{-m-u}\,n!\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\binom{u}{i}\Bigg(e^{(-i\,a\,(m-2k)-b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)-b\,(u-2i)}{2c},\,\ldots,\,\frac{-i\,a\,(m-2k)-b\,(u-2i)}{2c},\,1;\right.$$

$$\left.\frac{-i\,a\,(m-2k)-b\,(u-2i)}{2c}+1,\,\ldots,\,\frac{-i\,a\,(m-2k)-b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(2c-i\,a\,(m-2k)-b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c-i\,a\,(m-2k)-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{2c-i\,a\,(m-2k)-b\,(u-2i)}{2c},\,\ldots,\,\frac{2c-i\,a\,(m-2k)-b\,(u-2i)}{2c},\,1;\right.$$

$$\left.\frac{2c-i\,a\,(m-2k)-b\,(u-2i)}{2c}+1,\,\ldots,\,\frac{2c-i\,a\,(m-2k)-b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(i\,a\,(m-2k)-b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(i\,a\,(m-2k)-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)-b\,(u-2i)}{2c},\,\ldots,\right.$$

$$\left.\frac{i\,a\,(m-2k)-b\,(u-2i)}{2c},\,1;\,\frac{i\,a\,(m-2k)-b\,(u-2i)}{2c}+1,\,\ldots,\,\frac{i\,a\,(m-2k)-b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(2c+a\,i\,(m-2k)-b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c+a\,i\,(m-2k)-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{2c+i a(m-2k)-b(u-2i)}{2c}, \ldots, \frac{2c+i a(m-2k)-b(u-2i)}{2c}, 1; \frac{2c+i a(m-2k)-b(u-2i)}{2c}+1, \ldots, \frac{2c+i a(m-2k)-b(u-2i)}{2c}+1; e^{2cz}\right)+ $$

$$ e^{(b(u-2i)-i a(m-2k))z} \sum_{j=0}^{n} \frac{(-1)^j (b(u-2i)-i a(m-2k))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b(u-2i)-i a(m-2k)}{2c}, \ldots, \frac{b(u-2i)-i a(m-2k)}{2c}, 1; \frac{b(u-2i)-i a(m-2k)}{2c}+1, \ldots, \frac{b(u-2i)-i a(m-2k)}{2c}+1; e^{2cz}\right)+ $$

$$ e^{(2c-i a(m-2k)+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (2c-i a(m-2k)+b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} $$

$$ {}_{j+2}F_{j+1}\left(\frac{2c-i a(m-2k)+b(u-2i)}{2c}, \ldots, \frac{2c-i a(m-2k)+b(u-2i)}{2c}, 1; \frac{2c-i a(m-2k)+b(u-2i)}{2c}+1, \ldots, \frac{2c-i a(m-2k)+b(u-2i)}{2c}+1; e^{2cz}\right)+ $$

$$ e^{(a i(m-2k)+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (a i(m-2k)+b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a(m-2k)+b(u-2i)}{2c}, \ldots, \frac{i a(m-2k)+b(u-2i)}{2c}, 1; \frac{i a(m-2k)+b(u-2i)}{2c}+1, \ldots, \frac{i a(m-2k)+b(u-2i)}{2c}+1; e^{2cz}\right)+ $$

$$ e^{(2c+a i(m-2k)+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (2c+a i(m-2k)+b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1} $$

$$ \left(\frac{2c+i a(m-2k)+b(u-2i)}{2c}, \ldots, \frac{2c+i a(m-2k)+b(u-2i)}{2c}, 1; \frac{2c+i a(m-2k)+b(u-2i)}{2c}+1, \ldots, \frac{2c+i a(m-2k)+b(u-2i)}{2c}+1; e^{2cz}\right)\Bigg) /; n \in \mathbb{N} \land m \in \mathbb{N}^+ \land u \in \mathbb{N}^+ $$

Involving hyperbolic, exponential, trigonometric and a power functions

Involving sin, sinh, exp and power

Involving $z^n e^{p z} \sin(a z) \sinh(b z) \coth(c z)$

01.22.21.0224.01

$$\int z^n e^{p z} \sin(a z) \sinh(b z) \coth(c z)\, dz = -\frac{i}{4} n! \left(-e^{(-b-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b - i a + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b - i a + p}{2 c}, \ldots, \frac{-b - i a + p}{2 c}, 1; \frac{-b - i a + p}{2 c} + 1, \ldots, \frac{-b - i a + p}{2 c} + 1; e^{2 c z} \right) - e^{(-b+2 c-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b + 2 c - i a + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b + 2 c - i a + p}{2 c}, \ldots, \frac{-b + 2 c - i a + p}{2 c}, 1; \frac{-b + 2 c - i a + p}{2 c} + 1, \ldots, \frac{-b + 2 c - i a + p}{2 c} + 1; e^{2 c z} \right) + e^{(-b+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b + i a + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b + i a + p}{2 c}, \ldots, \frac{-b + i a + p}{2 c}, 1; \frac{-b + i a + p}{2 c} + 1, \ldots, \frac{-b + i a + p}{2 c} + 1; e^{2 c z} \right) + e^{(-b+2 c+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b + 2 c + i a + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b + 2 c + i a + p}{2 c}, \ldots, \frac{-b + 2 c + i a + p}{2 c}, 1; \frac{-b + 2 c + i a + p}{2 c} + 1, \ldots, \frac{-b + 2 c + i a + p}{2 c} + 1; e^{2 c z} \right) + e^{(b-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b - i a + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b - i a + p}{2 c}, \ldots, \frac{b - i a + p}{2 c}, 1; \frac{b - i a + p}{2 c} + 1, \ldots, \frac{b - i a + p}{2 c} + 1; e^{2 c z} \right) + e^{(b+2 c-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b + 2 c - i a + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b + 2 c - i a + p}{2 c}, \ldots, \frac{b + 2 c - i a + p}{2 c}, 1; \frac{b + 2 c - i a + p}{2 c} + 1, \ldots, \frac{b + 2 c - i a + p}{2 c} + 1; e^{2 c z} \right) - e^{(b+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b + i a + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b + i a + p}{2 c}, \ldots, \frac{b + i a + p}{2 c}, 1; \frac{b + i a + p}{2 c} + 1, \ldots, \frac{b + i a + p}{2 c} + 1; e^{2 c z} \right) - e^{(b+2 c+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b + 2 c + i a + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b + 2 c + i a + p}{2 c}, \ldots, \frac{b + 2 c + i a + p}{2 c}, 1; \frac{b + 2 c + i a + p}{2 c} + 1, \ldots, \frac{b + 2 c + i a + p}{2 c} + 1; e^{2 c z} \right) \right) /; n \in \mathbb{N}$$

Involving powers of sin, powers of sinh, exp and power

Involving $z^n e^{p z} \sin^m(a z) \sinh^u(b z) \coth(c z)$

01.22.21.0225.01

$$\int z^n e^{p z} \sin^m(a z) \sinh^u(b z) \coth(c z) \, dz = -i^u 2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} n! \, (1 - m \bmod 2) (1 - u \bmod 2) \left(e^{p z} \sum_{j=0}^{n} \frac{(-1)^j p^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p}{2c}, \ldots, \frac{p}{2c}, 1; \frac{p}{2c}+1, \ldots, \frac{p}{2c}+1; e^{2 c z}\right) + e^{(2c+p) z} \sum_{j=0}^{n} \frac{(-1)^j (2c+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c+p}{2c}, \ldots, \frac{2c+p}{2c}, 1; \frac{2c+p}{2c}+1, \ldots, \frac{2c+p}{2c}+1; e^{2 c z}\right)\right) -$$

$$i^u 2^{-m-u} \binom{u}{\frac{u}{2}} n! \, (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(e^{\frac{i m \pi}{2}} \left(e^{(p - i a (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (p - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1} \left(\frac{p - i a (m-2k)}{2c}, \ldots, \frac{p - i a (m-2k)}{2c}, 1; \frac{p - i a (m-2k)}{2c}+1, \ldots, \frac{p - i a (m-2k)}{2c}+1; e^{2 c z}\right) + e^{(2c - i a (m-2k) + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2c - i a (m-2k) + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c - i a (m-2k) + p}{2c}, \ldots, \frac{2c - i a (m-2k) + p}{2c}, 1; \frac{2c - i a (m-2k) + p}{2c}+1, \ldots, \frac{2c - i a (m-2k) + p}{2c}+1; e^{2 c z}\right)\right) + e^{-\frac{1}{2} i m \pi} \left(e^{(a i (m-2k) + p) z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k) + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a (m-2k) + p}{2c}, \ldots, \frac{i a (m-2k) + p}{2c}, 1; \frac{i a (m-2k) + p}{2c}+1, \ldots, \frac{i a (m-2k) + p}{2c}+1; e^{2 c z}\right) + e^{(2c + a i (m-2k) + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2c + a i (m-2k) + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c + i a (m-2k) + p}{2c}, \ldots, \frac{2c + i a (m-2k) + p}{2c}, 1; \frac{2c + i a (m-2k) + p}{2c}+1, \ldots, \frac{2c + i a (m-2k) + p}{2c}+1; e^{2 c z}\right)\right)\right) -$$

$$2^{-m-u} \binom{m}{\frac{m}{2}} n! \, (1 - m \bmod 2) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{u}{k} \left((-1)^u \left(e^{(p - b (u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (p - b (u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p - b (u-2k)}{2c}, \ldots, \frac{p - b (u-2k)}{2c}, 1; \frac{p - b (u-2k)}{2c}+1, \ldots, \frac{p - b (u-2k)}{2c}+1; e^{2 c z}\right) + e^{(2c + p - b (u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2c + p - b (u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2c + p - b (u-2k)}{2c}, \ldots, \frac{2c + p - b (u-2k)}{2c}, 1; \frac{2c + p - b (u-2k)}{2c}+1, \ldots, \frac{2c + p - b (u-2k)}{2c}+1; e^{2 c z}\right)\right) + e^{(p + b (u-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (p + b (u-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p + b (u-2k)}{2c}, \ldots, \frac{p + b (u-2k)}{2c},\right.$$

$$1;\ \frac{p+b(u-2k)}{2c}+1,\ \ldots,\ \frac{p+b(u-2k)}{2c}+1;\ e^{2cz}\Bigg)+$$

$$e^{(2c+p+b(u-2k))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c+p+b(u-2k))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{2c+p+b(u-2k)}{2c},\ \ldots,$$

$$\frac{2c+p+b(u-2k)}{2c},\ 1;\ \frac{2c+p+b(u-2k)}{2c}+1,\ \ldots,\ \frac{2c+p+b(u-2k)}{2c}+1;\ e^{2cz}\Bigg)\Bigg)-$$

$$2^{-m-u}\,n!\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^{i+k}\binom{m}{k}\binom{u}{i}\Bigg((-1)^u\,e^{\frac{i m\pi}{2}}\Bigg(e^{(-i a(m-2k)+p-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i a(m-2k)+p-b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i a(m-2k)+p-b(u-2i)}{2c},\ \ldots,\ \frac{-i a(m-2k)+p-b(u-2i)}{2c},\ 1;$$

$$\frac{-i a(m-2k)+p-b(u-2i)}{2c}+1,\ \ldots,\ \frac{-i a(m-2k)+p-b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)+$$

$$e^{(2c-i a(m-2k)+p-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c-i a(m-2k)+p-b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{2c-i a(m-2k)+p-b(u-2i)}{2c},\ \ldots,\ \frac{2c-i a(m-2k)+p-b(u-2i)}{2c},\ 1;$$

$$\frac{2c-i a(m-2k)+p-b(u-2i)}{2c}+1,\ \ldots,\ \frac{2c-i a(m-2k)+p-b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)\Bigg)+$$

$$(-1)^u\,e^{-\frac{1}{2}i m\pi}\Bigg(e^{(a i(m-2k)+p-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(a i(m-2k)+p-b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{i a(m-2k)+p-b(u-2i)}{2c},\ \ldots,\ \frac{i a(m-2k)+p-b(u-2i)}{2c},\ 1;$$

$$\frac{i a(m-2k)+p-b(u-2i)}{2c}+1,\ \ldots,\ \frac{i a(m-2k)+p-b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)+$$

$$e^{(2c+a i(m-2k)+p-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c+a i(m-2k)+p-b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{2c+i a(m-2k)+p-b(u-2i)}{2c},\ \ldots,\ \frac{2c+i a(m-2k)+p-b(u-2i)}{2c},\ 1;$$

$$\frac{2c+i a(m-2k)+p-b(u-2i)}{2c}+1,\ \ldots,\ \frac{2c+i a(m-2k)+p-b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)\Bigg)+$$

$$e^{\frac{i m\pi}{2}}\Bigg(e^{(-i a(m-2k)+p+b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i a(m-2k)+p+b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{-i a(m-2k)+p+b(u-2i)}{2c},\ \ldots,\ \frac{-i a(m-2k)+p+b(u-2i)}{2c},\ 1;$$

$$\frac{-i a(m-2k)+p+b(u-2i)}{2c}+1,\ \ldots,\ \frac{-i a(m-2k)+p+b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)+$$

$$e^{(2c - i a (m-2k)+p+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (2c - i a (m-2k) + p + b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2c - i a (m-2k) + p + b(u-2i)}{2c}, \ldots, \frac{2c - i a (m-2k) + p + b(u-2i)}{2c}, 1; \frac{2c - i a (m-2k) + p + b(u-2i)}{2c} + 1, \ldots, \frac{2c - i a (m-2k) + p + b(u-2i)}{2c} + 1; e^{2cz}\right)\Bigg) +$$

$$e^{-\frac{1}{2} i m \pi}\Bigg(e^{(a i (m-2k)+p+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k) + p + b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a (m-2k) + p + b(u-2i)}{2c}, \ldots, \frac{i a (m-2k) + p + b(u-2i)}{2c}, 1; \frac{i a (m-2k) + p + b(u-2i)}{2c} + 1, \ldots, \frac{i a (m-2k) + p + b(u-2i)}{2c} + 1; e^{2cz}\right) +$$

$$e^{(2c + a i (m-2k)+p+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (2c + a i (m-2k) + p + b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2c + i a (m-2k) + p + b(u-2i)}{2c}, \ldots, \frac{2c + i a (m-2k) + p + b(u-2i)}{2c}, 1; \frac{2c + i a (m-2k) + p + b(u-2i)}{2c} + 1, \ldots, \frac{2c + i a (m-2k) + p + b(u-2i)}{2c} + 1; e^{2cz}\right)\Bigg)\Bigg) /; n \in \mathbb{N} \land m \in \mathbb{N}^+ \land u \in \mathbb{N}^+$$

Involving cos, sinh, exp and power

Involving $z^n e^{p z} \cos(a z) \sinh(b z) \coth(c z)$

01.22.21.0226.01

$$\int z^n e^{p z} \cos(a z) \sinh(b z) \coth(c z)\, dz = \frac{n!}{4} \left(e^{(-b-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b-i a+p}{2 c}, \ldots, \frac{-b-i a+p}{2 c}, 1; \frac{-b-i a+p}{2 c}+1, \ldots, \frac{-b-i a+p}{2 c}+1; e^{2 c z} \right) + e^{(-b+2 c-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c-i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+2 c-i a+p}{2 c}, \ldots, \frac{-b+2 c-i a+p}{2 c}, 1; \frac{-b+2 c-i a+p}{2 c}+1, \ldots, \frac{-b+2 c-i a+p}{2 c}+1; e^{2 c z} \right) + e^{(-b+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+i a+p}{2 c}, \ldots, \frac{-b+i a+p}{2 c}, 1; \frac{-b+i a+p}{2 c}+1, \ldots, \frac{-b+i a+p}{2 c}+1; e^{2 c z} \right) + e^{(-b+2 c+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c+i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+2 c+i a+p}{2 c}, \ldots, \frac{-b+2 c+i a+p}{2 c}, 1; \frac{-b+2 c+i a+p}{2 c}+1, \ldots, \frac{-b+2 c+i a+p}{2 c}+1; e^{2 c z} \right) - e^{(b-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b-i a+p}{2 c}, \ldots, \frac{b-i a+p}{2 c}, 1; \frac{b-i a+p}{2 c}+1, \ldots, \frac{b-i a+p}{2 c}+1; e^{2 c z} \right) - e^{(b+2 c-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c-i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2 c-i a+p}{2 c}, \ldots, \frac{b+2 c-i a+p}{2 c}, 1; \frac{b+2 c-i a+p}{2 c}+1, \ldots, \frac{b+2 c-i a+p}{2 c}+1; e^{2 c z} \right) - e^{(b+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+i a+p}{2 c}, \ldots, \frac{b+i a+p}{2 c}, 1; \frac{b+i a+p}{2 c}+1, \ldots, \frac{b+i a+p}{2 c}+1; e^{2 c z} \right) - e^{(b+2 c+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c+i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2 c+i a+p}{2 c}, \ldots, \frac{b+2 c+i a+p}{2 c}, 1; \frac{b+2 c+i a+p}{2 c}+1, \ldots, \frac{b+2 c+i a+p}{2 c}+1; e^{2 c z} \right) \right) /; n \in \mathbb{N}$$

Involving powers of cos, powers of sinh, exp and power

Involving $z^n e^{p z} \cos^m(a z) \sinh^u(b z) \coth(c z)$

01.22.21.0227.01

$$\int z^n e^{pz} \cos^m(az) \sinh^u(bz) \coth(cz)\, dz = -i^u\, 2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} n!\, (1 - m \bmod 2)$$

$$(1 - u \bmod 2) \left(e^{pz} \sum_{j=0}^{n} \frac{(-1)^j p^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{p}{2c}, \ldots, \frac{p}{2c}, 1; \frac{p}{2c} + 1, \ldots, \frac{p}{2c} + 1; e^{2cz} \right) + \right.$$

$$\left. e^{(2c+p)z} \sum_{j=0}^{n} \frac{(-1)^j (2c+p)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{2c+p}{2c}, \ldots, \frac{2c+p}{2c}, 1; \frac{2c+p}{2c} + 1, \ldots, \frac{2c+p}{2c} + 1; e^{2cz} \right) \right) -$$

$$i^u\, 2^{-m-u} \binom{u}{\frac{u}{2}} n!\, (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(e^{(p - i a (m-2k))z} \sum_{j=0}^{n} \frac{(-1)^j (p - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$${}_{j+2}F_{j+1}\left(\frac{p - i a (m-2k)}{2c}, \ldots, \frac{p - i a (m-2k)}{2c}, 1; \frac{p - i a (m-2k)}{2c} + 1, \ldots, \frac{p - i a (m-2k)}{2c} + 1; e^{2cz} \right) +$$

$$e^{(2c - i a (m-2k) + p)z} \sum_{j=0}^{n} \frac{(-1)^j (2c - i a (m-2k) + p)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{2c - i a (m-2k) + p}{2c}, \ldots, \right.$$

$$\left. \frac{2c - i a (m-2k) + p}{2c}, 1; \frac{2c - i a (m-2k) + p}{2c} + 1, \ldots, \frac{2c - i a (m-2k) + p}{2c} + 1; e^{2cz} \right) +$$

$$e^{(a i (m-2k) + p)z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k) + p)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{i a (m-2k) + p}{2c}, \ldots, \frac{i a (m-2k) + p}{2c}, \right.$$

$$\left. 1; \frac{i a (m-2k) + p}{2c} + 1, \ldots, \frac{i a (m-2k) + p}{2c} + 1; e^{2cz} \right) +$$

$$e^{(2c + a i (m-2k) + p)z} \sum_{j=0}^{n} \frac{(-1)^j (2c + a i (m-2k) + p)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{2c + i a (m-2k) + p}{2c}, \ldots, \right.$$

$$\left. \left. \frac{2c + i a (m-2k) + p}{2c}, 1; \frac{2c + i a (m-2k) + p}{2c} + 1, \ldots, \frac{2c + i a (m-2k) + p}{2c} + 1; e^{2cz} \right) \right) -$$

$$2^{-m-u} \binom{m}{\frac{m}{2}} n!\, (1 - m \bmod 2) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{u}{k} \left((-1)^u \left(e^{(p - b(u-2k))z} \sum_{j=0}^{n} \frac{(-1)^j (p - b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} \right. \right.$$

$${}_{j+2}F_{j+1}\left(\frac{p - b(u-2k)}{2c}, \ldots, \frac{p - b(u-2k)}{2c}, 1; \frac{p - b(u-2k)}{2c} + 1, \ldots, \frac{p - b(u-2k)}{2c} + 1; e^{2cz} \right) +$$

$$e^{(2c + p - b(u-2k))z} \sum_{j=0}^{n} \frac{(-1)^j (2c + p - b(u-2k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{2c + p - b(u-2k)}{2c}, \ldots, \right.$$

$$\left. \left. \frac{2c + p - b(u-2k)}{2c}, 1; \frac{2c + p - b(u-2k)}{2c} + 1, \ldots, \frac{2c + p - b(u-2k)}{2c} + 1; e^{2cz} \right) \right) +$$

$$e^{(p + b(u-2k))z} \sum_{j=0}^{n} \frac{(-1)^j (p + b(u-2k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{p + b(u-2k)}{2c}, \ldots, \frac{p + b(u-2k)}{2c}, \right.$$

$$1;\ \frac{p+b\,(u-2\,k)}{2\,c}+1,\ \ldots,\ \frac{p+b\,(u-2\,k)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c+p+b\,(u-2\,k))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+p+b\,(u-2\,k))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{2\,c+p+b\,(u-2\,k)}{2\,c},\ \ldots,$$

$$\frac{2\,c+p+b\,(u-2\,k)}{2\,c},\ 1;\ \frac{2\,c+p+b\,(u-2\,k)}{2\,c}+1,\ \ldots,\ \frac{2\,c+p+b\,(u-2\,k)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)-$$

$$2^{-m-u}\,n!\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^i\binom{m}{k}\binom{u}{i}\Bigg((-1)^u\Bigg(e^{(-i\,a\,(m-2\,k)+p-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+p-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c},\ 1;$$

$$\frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c-i\,a\,(m-2\,k)+p-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c-i\,a\,(m-2\,k)+p-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{2\,c-i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{2\,c-i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c},\ 1;$$

$$\frac{2\,c-i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c-i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(a\,i\,(m-2\,k)+p-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c},\ 1;$$

$$\frac{i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c+a\,i\,(m-2\,k)+p-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c+a\,i\,(m-2\,k)+p-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{2\,c+i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{2\,c+i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c},\ 1;$$

$$\frac{2\,c+i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c+i\,a\,(m-2\,k)+p-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)+$$

$$e^{(-i\,a\,(m-2\,k)+p+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+p+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)}{2\,c},\ 1;$$

$$\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(2c-i a (m-2k)+p+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (2c - i a (m-2k) + p + b(u-2i))^{-j-1} z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\left(\frac{2c - i a (m-2k) + p + b(u-2i)}{2c}, \ldots, \frac{2c - i a (m-2k) + p + b(u-2i)}{2c}, 1;\right.$$

$$\left.\frac{2c - i a (m-2k) + p + b(u-2i)}{2c} + 1, \ldots, \frac{2c - i a (m-2k) + p + b(u-2i)}{2c} + 1; e^{2cz}\right) +$$

$$e^{(a i (m-2k)+p+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k) + p + b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \, _{j+2}F_{j+1}$$

$$\left(\frac{i a (m-2k) + p + b(u-2i)}{2c}, \ldots, \frac{i a (m-2k) + p + b(u-2i)}{2c}, 1; \frac{i a (m-2k) + p + b(u-2i)}{2c} + 1,\right.$$

$$\left.\ldots, \frac{i a (m-2k) + p + b(u-2i)}{2c} + 1; e^{2cz}\right) + e^{(2c+a i (m-2k)+p+b(u-2i))z}$$

$$\sum_{j=0}^{n} \frac{(-1)^j (2c + a i (m-2k) + p + b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \, _{j+2}F_{j+1}\left(\frac{2c + i a (m-2k) + p + b(u-2i)}{2c},\right.$$

$$\ldots, \frac{2c + i a (m-2k) + p + b(u-2i)}{2c}, 1; \frac{2c + i a (m-2k) + p + b(u-2i)}{2c} + 1,$$

$$\left.\left.\ldots, \frac{2c + i a (m-2k) + p + b(u-2i)}{2c} + 1; e^{2cz}\right)\right) /; n \in \mathbb{N} \bigwedge m \in \mathbb{N}^+ \bigwedge u \in \mathbb{N}^+$$

Involving sin, cosh, exp and power

Involving $z^n e^{p z} \sin(a z) \cosh(b z) \coth(c z)$

01.22.21.0228.01

$$\int z^n e^{p z} \sin(a z) \cosh(b z) \coth(c z) \, dz = \frac{i}{4} n! \left(-e^{(-b-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b-i a+p}{2 c}, \ldots, \frac{-b-i a+p}{2 c}, 1; \frac{-b-i a+p}{2 c}+1, \ldots, \frac{-b-i a+p}{2 c}+1; e^{2 c z} \right) - e^{(-b+2 c-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c-i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+2 c-i a+p}{2 c}, \ldots, \frac{-b+2 c-i a+p}{2 c}, 1; \frac{-b+2 c-i a+p}{2 c}+1, \ldots, \frac{-b+2 c-i a+p}{2 c}+1; e^{2 c z} \right) + e^{(-b+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+i a+p}{2 c}, \ldots, \frac{-b+i a+p}{2 c}, 1; \frac{-b+i a+p}{2 c}+1, \ldots, \frac{-b+i a+p}{2 c}+1; e^{2 c z} \right) + e^{(-b+2 c+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c+i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+2 c+i a+p}{2 c}, \ldots, \frac{-b+2 c+i a+p}{2 c}, 1; \frac{-b+2 c+i a+p}{2 c}+1, \ldots, \frac{-b+2 c+i a+p}{2 c}+1; e^{2 c z} \right) - e^{(b-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b-i a+p}{2 c}, \ldots, \frac{b-i a+p}{2 c}, 1; \frac{b-i a+p}{2 c}+1, \ldots, \frac{b-i a+p}{2 c}+1; e^{2 c z} \right) - e^{(b+2 c-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c-i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2 c-i a+p}{2 c}, \ldots, \frac{b+2 c-i a+p}{2 c}, 1; \frac{b+2 c-i a+p}{2 c}+1, \ldots, \frac{b+2 c-i a+p}{2 c}+1; e^{2 c z} \right) + e^{(b+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+i a+p}{2 c}, \ldots, \frac{b+i a+p}{2 c}, 1; \frac{b+i a+p}{2 c}+1, \ldots, \frac{b+i a+p}{2 c}+1; e^{2 c z} \right) + e^{(b+2 c+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c+i a+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2 c+i a+p}{2 c}, \ldots, \frac{b+2 c+i a+p}{2 c}, 1; \frac{b+2 c+i a+p}{2 c}+1, \ldots, \frac{b+2 c+i a+p}{2 c}+1; e^{2 c z} \right) \right) /; n \in \mathbb{N}$$

01.22.21.0229.01

$$\int z^n e^{p z} \sin(a z) \cosh(c z) \coth(c z) \, dz = -\frac{1}{2} e^{c z} i \, n! \left(e^{(-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (c - i a + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{c - i a + p}{2 c}, \ldots, \frac{c - i a + p}{2 c}, 1; \frac{c - i a + p}{2 c} + 1, \ldots, \frac{c - i a + p}{2 c} + 1; e^{2 c z}\right) - e^{(i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (c + i a + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{c + i a + p}{2 c}, \ldots, \frac{c + i a + p}{2 c}, 1; \frac{c + i a + p}{2 c} + 1, \ldots, \frac{c + i a + p}{2 c} + 1; e^{2 c z}\right)\right) - \frac{1}{4} i e^{c z} n! \left(-e^{(-2 c+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-c + i a + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-c + i a + p}{2 c}, \ldots, \frac{-c + i a + p}{2 c}, 1; \frac{-c + i a + p}{2 c} + 1, \ldots, \frac{-c + i a + p}{2 c} + 1; e^{2 c z}\right) + e^{(-2 c-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-c - i a + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-c - i a + p}{2 c}, \ldots, \frac{-c - i a + p}{2 c}, 1; \frac{-c - i a + p}{2 c} + 1, \ldots, \frac{-c - i a + p}{2 c} + 1; e^{2 c z}\right) - e^{(2 c+i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (3 c + i a + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{3 c + i a + p}{2 c}, \ldots, \frac{3 c + i a + p}{2 c}, 1; \frac{3 c + i a + p}{2 c} + 1, \ldots, \frac{3 c + i a + p}{2 c} + 1; e^{2 c z}\right) + e^{(2 c-i a+p) z} \sum_{j=0}^{n} \frac{(-1)^j (3 c - i a + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{3 c - i a + p}{2 c}, \ldots, \frac{3 c - i a + p}{2 c}, 1; \frac{3 c - i a + p}{2 c} + 1, \ldots, \frac{3 c - i a + p}{2 c} + 1; e^{2 c z}\right)\right) /; n \in \mathbb{N}$$

Involving powers of sin, powers of cosh, exp and power

Involving $z^n e^{p z} \sin^m(a z) \cosh^u(b z) \coth(c z)$

01.22.21.0230.01

$$\int z^n e^{p z} \sin^m(a z) \cosh^u(b z) \coth(c z) \, dz = -2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} n! \, (1 - m \bmod 2) (1 - u \bmod 2) \left(e^{p z} \sum_{j=0}^{n} \frac{(-1)^j p^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p}{2 c}, \ldots, \frac{p}{2 c}, 1; \frac{p}{2 c} + 1, \ldots, \frac{p}{2 c} + 1; e^{2 c z}\right) + e^{(2 c+p) z} \sum_{j=0}^{n} \frac{\left((-1)^j (2 c + p)^{-j-1} z^{n-j}\right)}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 c + p}{2 c}, \ldots, \frac{2 c + p}{2 c}, 1; \frac{2 c + p}{2 c} + 1, \ldots, \frac{2 c + p}{2 c} + 1; e^{2 c z}\right)\right) - 2^{-m-u} \binom{u}{\frac{u}{2}} n! \, (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(e^{\frac{i \pi m}{2} + (2 i a k - i a m + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2 i a k - i a m + p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1} \right.$$

$$\left(\frac{2 i a k - i a m + p}{2 c}, \ldots, \frac{2 i a k - i a m + p}{2 c}, 1; \frac{2 i a k - i a m + p}{2 c} + 1, \ldots, \frac{2 i a k - i a m + p}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{\frac{i \pi m}{2} + (2 c + 2 i a k - i a m + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + 2 i a k - i a m + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2 c + 2 i a k - i a m + p}{2 c},\right.$$

$$\left.\ldots, \frac{2 c + 2 i a k - i a m + p}{2 c}, 1; \frac{2 c + 2 i a k - i a m + p}{2 c} + 1, \ldots, \frac{2 c + 2 i a k - i a m + p}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(-2 a i k + i a m + p) z - \frac{i m \pi}{2}} \sum_{j=0}^{n} \frac{(-1)^j (-2 a i k + i a m + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-2 i a k + i a m + p}{2 c}, \ldots,\right.$$

$$\left.\frac{-2 i a k + i a m + p}{2 c}, 1; \frac{-2 i a k + i a m + p}{2 c} + 1, \ldots, \frac{-2 i a k + i a m + p}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(2 c - 2 i a k + i a m + p) z - \frac{i m \pi}{2}} \sum_{j=0}^{n} \frac{(-1)^j (2 c - 2 i a k + i a m + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2 c - 2 i a k + i a m + p}{2 c},\right.$$

$$\left.\left.\ldots, \frac{2 c - 2 i a k + i a m + p}{2 c}, 1; \frac{2 c - 2 i a k + i a m + p}{2 c} + 1, \ldots, \frac{2 c - 2 i a k + i a m + p}{2 c} + 1; e^{2 c z}\right)\right) -$$

$$2^{-m-u} \binom{m}{\frac{m}{2}} n! \,(1 - m \bmod 2) \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{u}{s} \left(e^{(p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}\right.$$

$${}_{j+2}F_{j+1}\left(\frac{p + 2 b s - b u}{2 c}, \ldots, \frac{p + 2 b s - b u}{2 c}, 1; \frac{p + 2 b s - b u}{2 c} + 1, \ldots, \frac{p + 2 b s - b u}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(2 c + p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2 c + p + 2 b s - b u}{2 c}, \ldots,\right.$$

$$\left.\frac{2 c + p + 2 b s - b u}{2 c}, 1; \frac{2 c + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{2 c + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(p - 2 b s + b u) z} \sum_{j=0}^{n} \frac{(-1)^j (p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{p - 2 b s + b u}{2 c}, \ldots, \frac{p - 2 b s + b u}{2 c},\right.$$

$$\left.1; \frac{p - 2 b s + b u}{2 c} + 1, \ldots, \frac{p - 2 b s + b u}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(2 c + p - 2 b s + b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2 c + p - 2 b s + b u}{2 c}, \ldots,\right.$$

$$\left.\left.\frac{2 c + p - 2 b s + b u}{2 c}, 1; \frac{2 c + p - 2 b s + b u}{2 c} + 1, \ldots, \frac{2 c + p - 2 b s + b u}{2 c} + 1; e^{2 c z}\right)\right) -$$

$$2^{-m-u} n! \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \binom{u}{s} \left(e^{\frac{i \pi m}{2} + (2 i a k - i a m + p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 i a k - i a m + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}\right.$$

$${}_{j+2}F_{j+1}\left(\frac{2 i a k - i a m + p + 2 b s - b u}{2 c}, \ldots, \frac{2 i a k - i a m + p + 2 b s - b u}{2 c}, 1;\right.$$

$$\frac{2 i a k - i a m + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{2 i a k - i a m + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{\frac{i \pi m}{2} + (2 c + 2 i a k - i a m + p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + 2 i a k - i a m + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{2 c + 2 i a k - i a m + p + 2 b s - b u}{2 c}, \ldots, \frac{2 c + 2 i a k - i a m + p + 2 b s - b u}{2 c}, 1;$$

$$\frac{2 c + 2 i a k - i a m + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{2 c + 2 i a k - i a m + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(-2 a i k + i a m + p + 2 b s - b u) z - \frac{i m \pi}{2}} \sum_{j=0}^{n} \frac{(-1)^j (-2 a i k + i a m + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{-2 i a k + i a m + p + 2 b s - b u}{2 c}, \ldots, \frac{-2 i a k + i a m + p + 2 b s - b u}{2 c}, 1;$$

$$\frac{-2 i a k + i a m + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{-2 i a k + i a m + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(2 c - 2 i a k + i a m + p + 2 b s - b u) z - \frac{i m \pi}{2}} \sum_{j=0}^{n} \frac{(-1)^j (2 c - 2 i a k + i a m + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{2 c - 2 i a k + i a m + p + 2 b s - b u}{2 c}, \ldots, \frac{2 c - 2 i a k + i a m + p + 2 b s - b u}{2 c}, 1;$$

$$\frac{2 c - 2 i a k + i a m + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{2 c - 2 i a k + i a m + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{\frac{i \pi m}{2} + (2 i a k - i a m + p - 2 b s + b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 i a k - i a m + p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{2 i a k - i a m + p - 2 b s + b u}{2 c}, \ldots, \frac{2 i a k - i a m + p - 2 b s + b u}{2 c}, 1;$$

$$\frac{2 i a k - i a m + p - 2 b s + b u}{2 c} + 1, \ldots, \frac{2 i a k - i a m + p - 2 b s + b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{\frac{i \pi m}{2} + (2 c + 2 i a k - i a m + p - 2 b s + b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + 2 i a k - i a m + p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{2 c + 2 i a k - i a m + p - 2 b s + b u}{2 c}, \ldots, \frac{2 c + 2 i a k - i a m + p - 2 b s + b u}{2 c}, 1;$$

$$\frac{2 c + 2 i a k - i a m + p - 2 b s + b u}{2 c} + 1, \ldots, \frac{2 c + 2 i a k - i a m + p - 2 b s + b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(-2 a i k + i a m + p - 2 b s + b u) z - \frac{i m \pi}{2}} \sum_{j=0}^{n} \frac{(-1)^j (-2 a i k + i a m + p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{-2 i a k + i a m + p - 2 b s + b u}{2 c}, \ldots, \frac{-2 i a k + i a m + p - 2 b s + b u}{2 c}, 1;$$

$$\frac{-2 i a k + i a m + p - 2 b s + b u}{2 c} + 1, \ldots, \frac{-2 i a k + i a m + p - 2 b s + b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(2c-2iak+iam+p-2bs+bu)z-\frac{im\pi}{2}}\sum_{j=0}^{n}\frac{(-1)^j(2c-2iak+iam+p-2bs+bu)^{-j-1}z^{n-j}}{(n-j)!}$$
$$_{j+2}F_{j+1}\left(\frac{2c-2iak+iam+p-2bs+bu}{2c},\ldots,\frac{2c-2iak+iam+p-2bs+bu}{2c},\right.$$
$$1;\frac{2c-2iak+iam+p-2bs+bu}{2c}+1,\ldots,$$
$$\left.\left.\frac{2c-2iak+iam+p-2bs+bu}{2c}+1;e^{2cz}\right)\right)/;n\in\mathbb{N}\land m\in\mathbb{N}^+\land u\in\mathbb{N}^+$$

01.22.21.0231.01

$$\int z^n e^{pz}\sin^m(az)\cosh^u(cz)\coth(cz)\,dz==$$
$$-2^{-m-u}e^{(c+p)z}\binom{m}{\frac{m}{2}}\binom{u+1}{\frac{u+1}{2}}n!\,(1-m\bmod 2)(1-(u+1)\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(c+p)^{-j-1}z^{n-j}}{(n-j)!}$$
$$_{j+2}F_{j+1}\left(\frac{c+p}{2c},\ldots,\frac{c+p}{2c},1;\frac{c+p}{2c}+1,\ldots,\frac{c+p}{2c}+1;e^{2cz}\right)-2^{-m-u}e^{cz}\binom{u+1}{\frac{u+1}{2}}n!\,(1-(u+1)\bmod 2)$$
$$\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(e^{\frac{i\pi m}{2}+(p-ia(m-2k))z}\sum_{j=0}^{n}\frac{(-1)^j(c-ia(m-2k)+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{c-ia(m-2k)+p}{2c},\right.\right.$$
$$\left.\ldots,\frac{c-ia(m-2k)+p}{2c},1;\frac{c-ia(m-2k)+p}{2c}+1,\ldots,\frac{c-ia(m-2k)+p}{2c}+1;e^{2cz}\right)+$$
$$e^{(ai(m-2k)+p)z-\frac{im\pi}{2}}\sum_{j=0}^{n}\frac{(-1)^j(c+ai(m-2k)+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{c+ia(m-2k)+p}{2c},\ldots,\right.$$
$$\left.\left.\frac{c+ia(m-2k)+p}{2c},1;\frac{c+ia(m-2k)+p}{2c}+1,\ldots,\frac{c+ia(m-2k)+p}{2c}+1;e^{2cz}\right)\right)+$$
$$2^{-m-u}e^{cz}\binom{m}{\frac{m}{2}}n!\,(m\bmod 2-1)\sum_{s=0}^{\left\lfloor\frac{u}{2}\right\rfloor}\binom{u+1}{s}\left(e^{(p-c(-2s+u+1))z}\sum_{j=0}^{n}\frac{(-1)^j(-(-2s+u+1)c+c+p)^{-j-1}z^{n-j}}{(n-j)!}\right.$$
$$_{j+2}F_{j+1}\left(\frac{p-c(u-2s)}{2c},\ldots,\frac{p-c(u-2s)}{2c},1;\frac{p-c(u-2s)}{2c}+1,\ldots,\frac{p-c(u-2s)}{2c}+1;e^{2cz}\right)+$$
$$e^{(p+c(-2s+u+1))z}\sum_{j=0}^{n}\frac{(-1)^j((-2s+u+1)c+c+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+c(-2s+u+2)}{2c},\ldots,\right.$$
$$\left.\left.\frac{p+c(-2s+u+2)}{2c},1;\frac{p+c(-2s+u+2)}{2c}+1,\ldots,\frac{p+c(-2s+u+2)}{2c}+1;e^{2cz}\right)\right)-2^{-m-u}e^{cz}n!$$
$$\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\sum_{s=0}^{\left\lfloor\frac{u}{2}\right\rfloor}(-1)^k\binom{m}{k}\binom{u+1}{s}\left(e^{\frac{i\pi m}{2}+(-ia(m-2k)+p-c(-2s+u+1))z}\sum_{j=0}^{n}\frac{(-1)^j(-(-2s+u+1)c+c-ia(m-2k)+p)^{-j-1}z^{n-j}}{(n-j)!}\right.$$
$$_{j+2}F_{j+1}\left(\frac{-ia(m-2k)+p-c(u-2s)}{2c},\ldots,\frac{-ia(m-2k)+p-c(u-2s)}{2c},1;\right.$$

$$\frac{-i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{(a\,i\,(m-2\,k)+p-c\,(-2\,s+u+1))\,z-\frac{i\,m\,\pi}{2}}\sum_{j=0}^{n}\frac{(-1)^j\,(-(-2\,s+u+1)\,c+c+a\,i\,(m-2\,k)+p)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c},\,1;$$

$$\frac{i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{\frac{i\,\pi\,m}{2}+(-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+1))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,((-2\,s+u+1)\,c+c-i\,a\,(m-2\,k)+p)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c},\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c},\,1;$$

$$\frac{-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{(a\,i\,(m-2\,k)+p+c\,(-2\,s+u+1))\,z-\frac{i\,m\,\pi}{2}}\sum_{j=0}^{n}\frac{(-1)^j\,((-2\,s+u+1)\,c+c+a\,i\,(m-2\,k)+p)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c},$$

$$1;\,\frac{i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c}+1,\,\ldots,$$

$$\frac{i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\,/;\,n\in\mathbb{N}\wedge m\in\mathbb{N}^+\wedge u\in\mathbb{N}^+\wedge v\in\mathbb{N}^+$$

Involving cos, cosh, exp and power

Involving $z^n\,e^{p\,z}\cos(a\,z)\cosh(b\,z)\coth(c\,z)$

01.22.21.0232.01

$$\int z^n e^{pz}\cos(az)\cosh(bz)\coth(cz)\,dz = -\frac{1}{4}n!\left(e^{(-b-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-b-ia+p)^{-j-1}z^{n-j}}{(n-j)!}\right.$$
$${}_{j+2}F_{j+1}\left(\frac{-ia-b+p}{2c},\ldots,\frac{-ia-b+p}{2c},1;\frac{-ia-b+p}{2c}+1,\ldots,\frac{-ia-b+p}{2c}+1;e^{2cz}\right)+e^{(-b+ia+p)z}$$
$$\sum_{j=0}^{n}\frac{(-1)^j(-b+ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia-b+p}{2c},\ldots,\frac{ia-b+p}{2c},1;\frac{ia-b+p}{2c}+1,\ldots,\frac{ia-b+p}{2c}+1;e^{2cz}\right)+$$
$$e^{(b-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(b-ia+p)^{-j-1}z^{n-j}}{(n-j)!}$$
$${}_{j+2}F_{j+1}\left(\frac{-ia+b+p}{2c},\ldots,\frac{-ia+b+p}{2c},1;\frac{-ia+b+p}{2c}+1,\ldots,\frac{-ia+b+p}{2c}+1;e^{2cz}\right)+e^{(b+ia+p)z}$$
$$\sum_{j=0}^{n}\frac{(-1)^j(b+ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia+b+p}{2c},\ldots,\frac{ia+b+p}{2c},1;\frac{ia+b+p}{2c}+1,\ldots,\frac{ia+b+p}{2c}+1;e^{2cz}\right)+$$
$$e^{(-b+2c-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-b+2c-ia+p)^{-j-1}z^{n-j}}{(n-j)!}$$
$${}_{j+2}F_{j+1}\left(\frac{-ia-b+2c+p}{2c},\ldots,\frac{-ia-b+2c+p}{2c},1;\frac{-ia-b+2c+p}{2c}+1,\ldots,\frac{-ia-b+2c+p}{2c}+1;e^{2cz}\right)+$$
$$e^{(-b+2c+ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-b+2c+ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia-b+2c+p}{2c},\ldots,\frac{ia-b+2c+p}{2c},1;\right.$$
$$\left.\frac{ia-b+2c+p}{2c}+1,\ldots,\frac{ia-b+2c+p}{2c}+1;e^{2cz}\right)+e^{(b+2c-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(b+2c-ia+p)^{-j-1}z^{n-j}}{(n-j)!}$$
$${}_{j+2}F_{j+1}\left(\frac{-ia+b+2c+p}{2c},\ldots,\frac{-ia+b+2c+p}{2c},1;\frac{-ia+b+2c+p}{2c}+1,\ldots,\frac{-ia+b+2c+p}{2c}+1;e^{2cz}\right)+$$
$$e^{(b+2c+ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(b+2c+ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia+b+2c+p}{2c},\ldots,\frac{ia+b+2c+p}{2c},\right.$$
$$\left.\left.1;\frac{ia+b+2c+p}{2c}+1,\ldots,\frac{ia+b+2c+p}{2c}+1;e^{2cz}\right)\right)\;/;\;n\in\mathbb{N}$$

01.22.21.0233.01

$$\int z^n e^{pz}\cos(az)\cosh(cz)\coth(cz)\,dz = -\frac{1}{2}e^{cz}\,n!\left(e^{(-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(c-ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-ia+c+p}{2c},\ldots,\frac{-ia+c+p}{2c},1;\frac{-ia+c+p}{2c}+1,\ldots,\frac{-ia+c+p}{2c}+1;e^{2cz}\right)+e^{(ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(c+ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia+p+c}{2c},\ldots,\frac{ia+p+c}{2c},1;\frac{ia+p+c}{2c}+1,\ldots,\frac{ia+p+c}{2c}+1;e^{2cz}\right)\right)-\frac{1}{4}e^{cz}\,n!\left(e^{(-2c-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-c-ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-ia-c+p}{2c},\ldots,\frac{-ia-c+p}{2c},1;\frac{-ia-c+p}{2c}+1,\ldots,\frac{-ia-c+p}{2c}+1;e^{2cz}\right)+e^{(-2c+ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-c+ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia-c+p}{2c},\ldots,\frac{ia-c+p}{2c},1;\frac{ia-c+p}{2c}+1,\ldots,\frac{ia-c+p}{2c}+1;e^{2cz}\right)+e^{(2c-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(3c-ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-ia+3c+p}{2c},\ldots,\frac{-ia+3c+p}{2c},1;\frac{-ia+3c+p}{2c}+1,\ldots,\frac{-ia+3c+p}{2c}+1;e^{2cz}\right)+e^{(2c+ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(3c+ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia+3c+p}{2c},\ldots,\frac{ia+3c+p}{2c},1;\frac{ia+3c+p}{2c}+1,\ldots,\frac{ia+3c+p}{2c}+1;e^{2cz}\right)\right)\;/;\;n\in\mathbb{N}$$

Involving powers of cos, powers of cosh, exp and power

Involving $z^n e^{pz}\cos^m(az)\cosh^u(bz)\coth(cz)$

01.22.21.0234.01

$$\int z^n e^{pz}\cos^m(az)\cosh^u(bz)\coth(cz)\,dz = -2^{-m-u}\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}}n!\,(1-m \bmod 2)(1-u \bmod 2)\left(e^{pz}\sum_{j=0}^{n}\frac{(-1)^j p^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p}{2c},\ldots,\frac{p}{2c},1;\frac{p}{2c}+1,\ldots,\frac{p}{2c}+1;e^{2cz}\right)+e^{(2c+p)z}\sum_{j=0}^{n}\frac{(-1)^j(2c+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2c+p}{2c},\ldots,\frac{2c+p}{2c},1;\frac{2c+p}{2c}+1,\ldots,\frac{2c+p}{2c}+1;e^{2cz}\right)\right)-2^{-m-u}\binom{u}{\frac{u}{2}}n!\,(1-u \bmod 2)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(e^{(2iak-iam+p)z}\sum_{j=0}^{n}\frac{(-1)^j(2iak-iam+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\right.$$

$$\left(\frac{2 i a k - i a m + p}{2 c}, \ldots, \frac{2 i a k - i a m + p}{2 c}, 1; \frac{2 i a k - i a m + p}{2 c} + 1, \ldots, \frac{2 i a k - i a m + p}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(2 c + 2 i a k - i a m + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + 2 i a k - i a m + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2 c + 2 i a k - i a m + p}{2 c}, \ldots,\right.$$

$$\left.\frac{2 c + 2 i a k - i a m + p}{2 c}, 1; \frac{2 c + 2 i a k - i a m + p}{2 c} + 1, \ldots, \frac{2 c + 2 i a k - i a m + p}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(-2 a i k + i a m + p) z} \sum_{j=0}^{n} \frac{(-1)^j (-2 a i k + i a m + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-2 i a k + i a m + p}{2 c}, \ldots,\right.$$

$$\left.\frac{-2 i a k + i a m + p}{2 c}, 1; \frac{-2 i a k + i a m + p}{2 c} + 1, \ldots, \frac{-2 i a k + i a m + p}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(2 c - 2 i a k + i a m + p) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c - 2 i a k + i a m + p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2 c - 2 i a k + i a m + p}{2 c}, \ldots,\right.$$

$$\left.\left.\frac{2 c - 2 i a k + i a m + p}{2 c}, 1; \frac{2 c - 2 i a k + i a m + p}{2 c} + 1, \ldots, \frac{2 c - 2 i a k + i a m + p}{2 c} + 1; e^{2 c z}\right)\right) -$$

$$2^{-m-u} \binom{m}{\frac{m}{2}} n! (1 - m \bmod 2) \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{u}{s} \left(e^{(p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}\right.$$

$${}_{j+2}F_{j+1}\left(\frac{p + 2 b s - b u}{2 c}, \ldots, \frac{p + 2 b s - b u}{2 c}, 1; \frac{p + 2 b s - b u}{2 c} + 1, \ldots, \frac{p + 2 b s - b u}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(2 c + p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2 c + p + 2 b s - b u}{2 c}, \ldots,\right.$$

$$\left.\frac{2 c + p + 2 b s - b u}{2 c}, 1; \frac{2 c + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{2 c + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(p - 2 b s + b u) z} \sum_{j=0}^{n} \frac{(-1)^j (p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{p - 2 b s + b u}{2 c}, \ldots, \frac{p - 2 b s + b u}{2 c},\right.$$

$$\left.1; \frac{p - 2 b s + b u}{2 c} + 1, \ldots, \frac{p - 2 b s + b u}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(2 c + p - 2 b s + b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2 c + p - 2 b s + b u}{2 c}, \ldots,\right.$$

$$\left.\left.\frac{2 c + p - 2 b s + b u}{2 c}, 1; \frac{2 c + p - 2 b s + b u}{2 c} + 1, \ldots, \frac{2 c + p - 2 b s + b u}{2 c} + 1; e^{2 c z}\right)\right) -$$

$$2^{-m-u} n! \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{m}{k} \binom{u}{s} \left(e^{(2 i a k - i a m + p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 i a k - i a m + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}\right.$$

$${}_{j+2}F_{j+1}\left(\frac{2 i a k - i a m + p + 2 b s - b u}{2 c}, \ldots, \frac{2 i a k - i a m + p + 2 b s - b u}{2 c}, 1;\right.$$

$$\frac{2 i a k - i a m + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{2 i a k - i a m + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(2 c + 2 i a k - i a m + p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + 2 i a k - i a m + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{2 c + 2 i a k - i a m + p + 2 b s - b u}{2 c}, \ldots, \frac{2 c + 2 i a k - i a m + p + 2 b s - b u}{2 c}, 1;$$

$$\frac{2 c + 2 i a k - i a m + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{2 c + 2 i a k - i a m + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(-2 a i k + i a m + p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (-2 a i k + i a m + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-2 i a k + i a m + p + 2 b s - b u}{2 c}, \ldots, \frac{-2 i a k + i a m + p + 2 b s - b u}{2 c}, 1;$$

$$\frac{-2 i a k + i a m + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{-2 i a k + i a m + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(2 c - 2 i a k + i a m + p + 2 b s - b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c - 2 i a k + i a m + p + 2 b s - b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{2 c - 2 i a k + i a m + p + 2 b s - b u}{2 c}, \ldots, \frac{2 c - 2 i a k + i a m + p + 2 b s - b u}{2 c}, 1;$$

$$\frac{2 c - 2 i a k + i a m + p + 2 b s - b u}{2 c} + 1, \ldots, \frac{2 c - 2 i a k + i a m + p + 2 b s - b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(2 i a k - i a m + p - 2 b s + b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 i a k - i a m + p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{2 i a k - i a m + p - 2 b s + b u}{2 c}, \ldots, \frac{2 i a k - i a m + p - 2 b s + b u}{2 c}, 1;$$

$$\frac{2 i a k - i a m + p - 2 b s + b u}{2 c} + 1, \ldots, \frac{2 i a k - i a m + p - 2 b s + b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(2 c + 2 i a k - i a m + p - 2 b s + b u) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c + 2 i a k - i a m + p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{2 c + 2 i a k - i a m + p - 2 b s + b u}{2 c}, \ldots, \frac{2 c + 2 i a k - i a m + p - 2 b s + b u}{2 c}, 1;$$

$$\frac{2 c + 2 i a k - i a m + p - 2 b s + b u}{2 c} + 1, \ldots, \frac{2 c + 2 i a k - i a m + p - 2 b s + b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(-2 a i k + i a m + p - 2 b s + b u) z} \sum_{j=0}^{n} \frac{(-1)^j (-2 a i k + i a m + p - 2 b s + b u)^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-2 i a k + i a m + p - 2 b s + b u}{2 c}, \ldots, \frac{-2 i a k + i a m + p - 2 b s + b u}{2 c}, 1;$$

$$\frac{-2 i a k + i a m + p - 2 b s + b u}{2 c} + 1, \ldots, \frac{-2 i a k + i a m + p - 2 b s + b u}{2 c} + 1; e^{2 c z}\Bigg) +$$

$$e^{(2c-2ia k+ia m+p-2bs+bu)z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c-2iak+iam+p-2bs+bu)^{-j-1}\,z^{n-j}}{(n-j)!}$$
$$_{j+2}F_{j+1}\left(\frac{2c-2iak+iam+p-2bs+bu}{2c},\,\ldots,\,\frac{2c-2iak+iam+p-2bs+bu}{2c},\right.$$
$$1;\,\frac{2c-2iak+iam+p-2bs+bu}{2c}+1,\,\ldots,$$
$$\left.\left.\frac{2c-2iak+iam+p-2bs+bu}{2c}+1;\,e^{2cz}\right)\right)/;\,n\in\mathbb{N}\bigwedge m\in\mathbb{N}^+\bigwedge u\in\mathbb{N}^+$$

01.22.21.0235.01

$$\int z^n\,e^{pz}\cos^m(az)\cosh^u(cz)\coth(cz)\,dz=$$
$$-2^{-m-u}\,e^{(c+p)z}\binom{m}{\frac{m}{2}}\binom{u+1}{\frac{u+1}{2}}n!\,(1-m\bmod 2)\,(1-(u+1)\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(c+p)^{-j-1}\,z^{n-j}}{(n-j)!}$$
$$_{j+2}F_{j+1}\left(\frac{c+p}{2c},\,\ldots,\,\frac{c+p}{2c},\,1;\,\frac{c+p}{2c}+1,\,\ldots,\,\frac{c+p}{2c}+1;\,e^{2cz}\right)-2^{-m-u}\,e^{cz}\binom{u+1}{\frac{u+1}{2}}n!\,(1-(u+1)\bmod 2)$$
$$\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(e^{(p-ia(m-2k))z}\sum_{j=0}^{n}\frac{(-1)^j\,(c-ia(m-2k)+p)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{c-ia(m-2k)+p}{2c},\,\ldots,\,\frac{c-ia(m-2k)+p}{2c},\right.\right.$$
$$\left.1;\,\frac{c-ia(m-2k)+p}{2c}+1,\,\ldots,\,\frac{c-ia(m-2k)+p}{2c}+1;\,e^{2cz}\right)+$$
$$e^{(ai(m-2k)+p)z}\sum_{j=0}^{n}\frac{(-1)^j\,(c+ai(m-2k)+p)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{c+ia(m-2k)+p}{2c},\,\ldots,\right.$$
$$\left.\left.\frac{c+ia(m-2k)+p}{2c},\,1;\,\frac{c+ia(m-2k)+p}{2c}+1,\,\ldots,\,\frac{c+ia(m-2k)+p}{2c}+1;\,e^{2cz}\right)\right)-$$
$$2^{-m-u}\,e^{cz}\binom{m}{\frac{m}{2}}n!\,(1-m\bmod 2)\sum_{s=0}^{\left\lfloor\frac{u}{2}\right\rfloor}\binom{u+1}{s}\left(e^{(p-c(-2s+u+1))z}\sum_{j=0}^{n}\frac{(-1)^j\,(p-c(u-2s))^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$
$$_{j+2}F_{j+1}\left(\frac{p-c(u-2s)}{2c},\,\ldots,\,\frac{p-c(u-2s)}{2c},\,1;\,\frac{p-c(u-2s)}{2c}+1,\,\ldots,\,\frac{p-c(u-2s)}{2c}+1;\,e^{2cz}\right)+$$
$$e^{(p+c(-2s+u+1))z}\sum_{j=0}^{n}\frac{(-1)^j\,(p+c(-2s+u+2))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{p+c(-2s+u+2)}{2c},\,\ldots,\right.$$
$$\left.\left.\frac{p+c(-2s+u+2)}{2c},\,1;\,\frac{p+c(-2s+u+2)}{2c}+1,\,\ldots,\,\frac{p+c(-2s+u+2)}{2c}+1;\,e^{2cz}\right)\right)-$$
$$2^{-m-u}\,e^{cz}\,n!\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\sum_{s=0}^{\left\lfloor\frac{u}{2}\right\rfloor}\binom{m}{k}\binom{u+1}{s}\left(e^{(-ia(m-2k)+p-c(-2s+u+1))z}\sum_{j=0}^{n}\frac{(-1)^j\,(-ia(m-2k)+p-c(u-2s))^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$
$$_{j+2}F_{j+1}\left(\frac{-ia(m-2k)+p-c(u-2s)}{2c},\,\ldots,\,\frac{-ia(m-2k)+p-c(u-2s)}{2c},\,1;\right.$$

$$\frac{-i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c}+1;\,e^{2\,c\,z}\Big)+$$

$$e^{(a\,i\,(m-2\,k)+p-c\,(-2\,s+u+1))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p-c\,(u-2\,s))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}$$

$$\Big(\frac{i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c},\,1;\,\frac{i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c}+1,$$

$$\ldots,\,\frac{i\,a\,(m-2\,k)+p-c\,(u-2\,s)}{2\,c}+1;\,e^{2\,c\,z}\Big)+e^{(-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+1))\,z}$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Big(\frac{-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c},$$

$$\ldots,\,\frac{-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c},\,1;\,\frac{-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c}+1,$$

$$\ldots,\,\frac{-i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c}+1;\,e^{2\,c\,z}\Big)+e^{(a\,i\,(m-2\,k)+p+c\,(-2\,s+u+1))\,z}$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p+c\,(-2\,s+u+2))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Big(\frac{i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c},$$

$$\ldots,\,\frac{i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c},\,1;\,\frac{i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c}+1,$$

$$\ldots,\,\frac{i\,a\,(m-2\,k)+p+c\,(-2\,s+u+2)}{2\,c}+1;\,e^{2\,c\,z}\Big)\Big)\,/;\,n\in\mathbb{N}\land m\in\mathbb{N}^+\land u\in\mathbb{N}^+$$

Involving functions of the direct function

Involving powers of the direct function

Involving powers of coth

Linear argument

01.22.21.0236.01

$$\int\coth^{\nu}(c\,z)\,dz=\frac{\coth^{\nu+1}(c\,z)}{\nu\,c+c}\;{}_2F_1\Big(\frac{\nu+1}{2},\,1;\,\frac{\nu+3}{2};\,\coth^2(c\,z)\Big)$$

01.22.21.0237.01

$$\int\coth^2(c\,z)\,dz=z-\frac{\coth(c\,z)}{c}$$

01.22.21.0238.01

$$\int\coth^3(c\,z)\,dz=-\frac{\operatorname{csch}^2(c\,z)-2\log(\sinh(c\,z))}{2\,c}$$

01.22.21.0239.01

$$\int \coth^4(c z)\, dz = \frac{3 c z - \coth(c z)\left(\operatorname{csch}^2(c z) + 4\right)}{3 c}$$

01.22.21.0240.01

$$\int \coth^5(c z)\, dz = -\frac{\operatorname{csch}^4(c z) + 4 \operatorname{csch}^2(c z) - 4 \log(\sinh(c z))}{4 c}$$

01.22.21.0241.01

$$\int \coth^6(c z)\, dz = \frac{15 c z - \coth(c z)\left(3 \operatorname{csch}^4(c z) + 11 \operatorname{csch}^2(c z) + 23\right)}{15 c}$$

01.22.21.0242.01

$$\int \coth^7(c z)\, dz = -\frac{2 \operatorname{csch}^6(c z) + 9 \operatorname{csch}^4(c z) + 18 \operatorname{csch}^2(c z) - 12 \log(\sinh(c z))}{12 c}$$

01.22.21.0243.01

$$\int \coth^8(c z)\, dz = \frac{105 c z - \coth(c z)\left(15 \operatorname{csch}^6(c z) + 66 \operatorname{csch}^4(c z) + 122 \operatorname{csch}^2(c z) + 176\right)}{105 c}$$

01.22.21.0499.01

$$\int \coth^{2n}(a z)\, dz = z - \frac{\tanh(a z)}{a} \sum_{k=1}^{n} \frac{\coth^{2k}(a z)}{2k - 1} \; /;\; n \in \mathbb{N}$$

01.22.21.0500.01

$$\int \coth^{2n+1}(a z)\, dz = \frac{\log(\sinh(a z))}{a} - \frac{(-1)^n S_{n+1}^{(2)}}{2 a\, n!} - \frac{1}{2a} \sum_{k=1}^{n} \frac{\coth^{2k}(a z)}{k} \; /;\; n \in \mathbb{N}$$

01.22.21.0501.01

$$\int \coth^{2n}(a z)\, dz = \frac{a z - \tanh^{-1}(\coth(a z))}{a} + \frac{\coth^{2n+1}(a z)}{a(2n+1)}\, {}_2F_1\!\left(1, n + \frac{1}{2}; n + \frac{3}{2}; \coth^2(a z)\right) /;\; n \in \mathbb{N}$$

01.22.21.0502.01

$$\int \coth^{2n+1}(a z)\, dz = \frac{\coth^{2n+2}(a z)}{2 a (n+1)}\, {}_2F_1\!\left(n+1, 1; n+2; \coth^2(a z)\right) + \frac{\log\left(-\operatorname{csch}^2(a z)\right) + 2 \log(\sinh(a z))}{2a} - \frac{(-1)^n S_{n+1}^{(2)}}{2 a\, n!} \; /;\; n \in \mathbb{N}$$

01.22.21.0244.01

$$\int \coth^{\frac{1}{2}}(c z)\, dz = -\frac{2 \tan^{-1}\left(\coth^{\frac{1}{2}}(c z)\right) + \log\left(\coth^{\frac{1}{2}}(c z) - 1\right) - \log\left(\coth^{\frac{1}{2}}(c z) + 1\right)}{2 c}$$

01.22.21.0245.01

$$\int \frac{1}{\coth^{\frac{1}{2}}(c z)}\, dz = \frac{2 \tan^{-1}\left(\coth^{\frac{1}{2}}(c z)\right) - \log\left(\coth^{\frac{1}{2}}(c z) - 1\right) + \log\left(\coth^{\frac{1}{2}}(c z) + 1\right)}{2 c}$$

Involving products of the direct functions

01.22.21.0246.01

$$\int \coth(a z + b) \coth(a z)\, dz = \frac{a z + \coth(b)\left(\log(\sinh(a z)) - \log(\sinh(b + a z))\right)}{a}$$

01.22.21.0247.01

$$\int \coth(b - a z) \coth(a z) \, dz = \frac{\coth(b) (\log(-\sinh(a z)) - \log(\sinh(b - a z))) - a z}{a}$$

Involving powers of products of the direct function

01.22.21.0248.01

$$\int \sqrt{\coth(c z) \coth(2 c z)} \, dz = \frac{1}{c \cosh^{\frac{1}{2}}(2 c z)} \left(\sqrt{\coth(c z) \coth(2 c z)} \left(\sqrt{2} \log\left(\sqrt{2} \cosh(c z) + \cosh^{\frac{1}{2}}(2 c z) \right) - \tanh^{-1}\left(\frac{\cosh(c z)}{\cosh^{\frac{1}{2}}(2 c z)} \right) \right) \sinh(c z) \right)$$

Involving rational functions of the direct function

Involving $(a + b \coth(c z))^{-n}$

01.22.21.0249.01

$$\int \frac{1}{a + b \coth(c z)} \, dz = \frac{a c z - b \log(b \cosh(c z) + a \sinh(c z))}{a^2 c - b^2 c}$$

01.22.21.0250.01

$$\int \frac{1}{(a + b \coth(c z))^2} \, dz = \left(c z a^3 + b a^2 - 2 b \log(b \cosh(c z) + a \sinh(c z)) a^2 + b^2 c z a - b^3 + b \coth(c z) \left(\left(a^2 + b^2\right) c z - 2 a b \log(b \cosh(c z) + a \sinh(c z)) \right) \right) \Big/ \left((a - b)^2 (a + b)^2 c (a + b \coth(c z)) \right)$$

01.22.21.0251.01

$$\int \frac{A + B \coth(z)}{(a + b \coth(z))^2} \, dz = \left((A + B \coth(z)) \operatorname{csch}(z) (b \cosh(z) + a \sinh(z)) \left(\frac{\left(A a^2 - 2 b B a + A b^2\right) z (b \cosh(z) + a \sinh(z))}{(a - b)^2 (a + b)^2} + \frac{\left(B a^2 - 2 A b a + b^2 B\right) \log(b \cosh(z) + a \sinh(z)) (b \cosh(z) + a \sinh(z))}{\left(a^2 - b^2\right)^2} + \frac{A b \sinh(z) - a B \sinh(z)}{a^2 - b^2} \right) \right) \Big/ \left((a + b \coth(z))^2 (B \cosh(z) + A \sinh(z)) \right)$$

01.22.21.0252.01

$$\int \frac{A+B\coth(z)}{(a+b\coth(z))^3}\,dz = \Bigg((A+B\coth(z))\operatorname{csch}^2(z)\,(b\cosh(z)+a\sinh(z)) \left(\frac{(A\,b-a\,B)\,b^2}{(a-b)^2\,(a+b)^2} + \frac{2\left(A\,a^3-3\,b\,B\,a^2+3\,A\,b^2\,a-b^3\,B\right)z\,(b\cosh(z)+a\sinh(z))^2}{(a-b)^3\,(a+b)^3} + \frac{1}{\left(a^2-b^2\right)^3}\left(2\left(B\,a^3-3\,A\,b\,a^2+3\,b^2\,B\,a-A\,b^3\right)\log(b\cosh(z)+a\sinh(z))\,(b\cosh(z)+a\sinh(z))^2\right) - \frac{2\left(2\,B\,a^2-3\,A\,b\,a+b^2\,B\right)\sinh(z)\,(b\cosh(z)+a\sinh(z))}{(a-b)^2\,(a+b)^2}\right)\Bigg) \Big/ \left(2\,(a+b\coth(z))^3\,(B\cosh(z)+A\sinh(z))\right)$$

01.22.21.0253.01

$$\int \frac{A+B\coth(z)+C\coth^2(z)}{(a+b\coth(z))^3}\,dz = \Bigg(\left(C\coth^2(z)+B\coth(z)+A\right)\operatorname{csch}(z)\,(b\cosh(z)+a\sinh(z)) \left(\frac{b\left(A\,b^2+a\,(a\,C-b\,B)\right)}{(a-b)^2\,(a+b)^2} + \frac{2\left(C\,a^3-2\,b\,B\,a^2+b^2\,(3\,A+2\,C)\,a-b^3\,B\right)\sinh(z)\,(b\cosh(z)+a\sinh(z))}{(a-b)^2\,b\,(a+b)^2} + \frac{2\left((A+C)\,a^3-3\,b\,B\,a^2+3\,b^2\,(A+C)\,a-b^3\,B\right)z\,(b\cosh(z)+a\sinh(z))^2}{(a-b)^3\,(a+b)^3} + \frac{1}{\left(a^2-b^2\right)^3}\left(2\left(B\,a^3-3\,b\,(A+C)\,a^2+3\,b^2\,B\,a-b^3\,(A+C)\right)\log(b\cosh(z)+a\sinh(z))\,(b\cosh(z)+a\sinh(z))^2\right)\right)\Bigg) \Big/ \left((a+b\coth(z))^3\,(-A+C+(A+C)\cosh(2\,z)+B\sinh(2\,z))\right)$$

Involving $\left(a+b\coth^2(c\,z)\right)^{-n}$

01.22.21.0254.01

$$\int \frac{1}{a+b\coth^2(c\,z)}\,dz = \frac{1}{a+b}\left(z-\frac{\sqrt{b}}{\sqrt{a}\,c}\tan^{-1}\left(\frac{\sqrt{a}\,\tanh(c\,z)}{\sqrt{b}}\right)\right)$$

01.22.21.0255.01

$$\int \frac{1}{\left(a+b\coth^2(c\,z)\right)^2}\,dz = \Bigg((-a+b+(a+b)\cosh(2\,c\,z))\operatorname{csch}^4(c\,z)\Bigg(2\,z\,(-a+b+(a+b)\cosh(2\,c\,z)) - \frac{\sqrt{b}\,(3\,a+b)\tan^{-1}\left(\frac{\sqrt{a}\,\tanh(c\,z)}{\sqrt{b}}\right)(-a+b+(a+b)\cosh(2\,c\,z))}{a^{3/2}\,c} + \frac{b\,(a+b)\sinh(2\,c\,z)}{a\,c}\Bigg)\Bigg) \Big/ \left(8\,(a+b)^2\left(b\coth^2(c\,z)+a\right)^2\right)$$

Involving algebraic functions of the direct function

Involving $(a + b\coth(c z))^{\beta}$

01.22.21.0256.01

$$\int (a+b\coth(c z))^{\beta}\,dz = \frac{(a+b\coth(c z))^{\beta+1}}{2(b-a)(a+b)c(\beta+1)}\left((a+b)\,{}_2F_1\!\left(\beta+1,1;\beta+2;\frac{a+b\coth(c z)}{a-b}\right)+(b-a)\,{}_2F_1\!\left(\beta+1,1;\beta+2;\frac{a+b\coth(c z)}{a+b}\right)\right)$$

01.22.21.0257.01

$$\int \sqrt{a+b\coth(c z)}\,dz = \left(\left(\sqrt{i(a-b)}\,(a+b)\tanh^{-1}\!\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a+b)}}\right)-(a-b)\sqrt{i(a+b)}\,\tanh^{-1}\!\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a-b)}}\right)\right)\sqrt{i(a+b\coth(c z))}\,\sqrt{a+b\coth(c z)}\,\sinh(c z)\right)\Big/\left(\sqrt{i(a-b)}\,\sqrt{i(a+b)}\,c\,(b\cosh(c z)+a\sinh(c z))\right)$$

01.22.21.0258.01

$$\int \frac{1}{\sqrt{a+b\coth(c z)}}\,dz = -\frac{\sqrt{i(a+b\coth(c z))}}{c\sqrt{a+b\coth(c z)}}\left(\frac{\tanh^{-1}\!\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a-b)}}\right)}{\sqrt{i(a-b)}}-\frac{\tanh^{-1}\!\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a+b)}}\right)}{\sqrt{i(a+b)}}\right)$$

01.22.21.0259.01

$$\int \coth(c z)(a+b\coth(c z))^{\beta}\,dz = \frac{(a+b\coth(c z))^{\beta+1}}{2(a-b)(a+b)c(\beta+1)}\left((a+b)\,{}_2F_1\!\left(\beta+1,1;\beta+2;\frac{a+b\coth(c z)}{a-b}\right)+(a-b)\,{}_2F_1\!\left(\beta+1,1;\beta+2;\frac{a+b\coth(c z)}{a+b}\right)\right)$$

01.22.21.0260.01

$$\int \coth(c z)\sqrt{a+b\coth(c z)}\,dz = \left(\sqrt{a+b\coth(c z)}\left((a-b)\sqrt{i(a+b)}\,\tanh^{-1}\!\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a-b)}}\right)\sqrt{i(a+b\coth(c z))}\,\sinh(c z)+\sqrt{i(a-b)}\left((a+b)\tanh^{-1}\!\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a+b)}}\right)\sqrt{i(a+b\coth(c z))}\,\sinh(c z)-2\sqrt{i(a+b)}\,(b\cosh(c z)+a\sinh(c z))\right)\right)\right)\Big/\left(\sqrt{i(a-b)}\,\sqrt{i(a+b)}\,c\,(b\cosh(c z)+a\sinh(c z))\right)$$

01.22.21.0261.01

$$\int \frac{\coth(c z)}{\sqrt{a+b\coth(c z)}}\,dz = \frac{\sqrt{i(a+b\coth(c z))}}{c\sqrt{a+b\coth(c z)}}\left(\frac{\tanh^{-1}\!\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a-b)}}\right)}{\sqrt{i(a-b)}}+\frac{\tanh^{-1}\!\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a+b)}}\right)}{\sqrt{i(a+b)}}\right)$$

Involving $((a + b\coth(c z))^{n})^{\beta}$

01.22.21.0262.01

$$\int ((a+b\coth(c z))^n)^\beta \, dz = \frac{(a+b\coth(c z))\,((a+b\coth(c z))^n)^\beta}{2(b-a)(a+b)\,c\,(n\beta+1)} \left((a+b)\,{}_2F_1\left(n\beta+1, 1; n\beta+2; \frac{a+b\coth(c z)}{a-b}\right) + (b-a)\,{}_2F_1\left(n\beta+1, 1; n\beta+2; \frac{a+b\coth(c z)}{a+b}\right)\right)$$

01.22.21.0263.01

$$\int \sqrt{(a+b\coth(c z))^3}\, dz = \left(\sqrt{(a+b\coth(c z))^3}\,\sinh(c z)\left(\sqrt{i(a-b)}\left((a+b)^2\tanh^{-1}\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a+b)}}\right)\sqrt{i(a+b\coth(c z))}\,\sinh(c z) - 2b\sqrt{i(a+b)}\,(b\cosh(c z)+a\sinh(c z))\right) - (a-b)^2\sqrt{i(a+b)}\,\tanh^{-1}\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a-b)}}\right)\sqrt{i(a+b\coth(c z))}\,\sinh(c z)\right)\right) \Big/ \left(\sqrt{i(a-b)}\,\sqrt{i(a+b)}\,c\,(b\cosh(c z)+a\sinh(c z))^2\right)$$

01.22.21.0264.01

$$\int \frac{1}{\sqrt{(a+b\coth(c z))^3}}\, dz = \left(\sqrt{i(a+b)}\,(a+b\coth(c z))\left(i\tanh^{-1}\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a-b)}}\right)\sqrt{i(a+b\coth(c z))}\,(i(a+b))^{3/2} + \sqrt{i(a-b)}\left(2\sqrt{i(a+b)}\,b + (a-b)\tanh^{-1}\left(\frac{\sqrt{i(a+b\coth(c z))}}{\sqrt{i(a+b)}}\right)\sqrt{i(a+b\coth(c z))}\right)\right)\right) \Big/ \left((i(a-b))^{3/2}(a+b)^2\,c\,\sqrt{(a+b\coth(c z))^3}\right)$$

01.22.21.0265.01

$$\int \coth(c z)\,((a+b\coth(c z))^n)^\beta\, dz = \frac{1}{2\left(a^2-b^2\right)c\,(n\beta+1)}\left((a+b\coth(c z))\,((a+b\coth(c z))^n)^\beta \left((a+b)\,{}_2F_1\left(n\beta+1, 1; n\beta+2; \frac{a+b\coth(c z)}{a-b}\right) + (a-b)\,{}_2F_1\left(n\beta+1, 1; n\beta+2; \frac{a+b\coth(c z)}{a+b}\right)\right)\right)$$

01.22.21.0266.01

$$\int \coth(c z)\sqrt{(a+b\coth(c z))^3}\, dz = \frac{1}{3c\,(a+b\coth(c z))^{3/2}}\left(\sqrt{(a+b\coth(c z))^3}\left(3\tanh^{-1}\left(\frac{\sqrt{a+b\coth(c z)}}{\sqrt{a-b}}\right)(a-b)^{3/2} + 3(a+b)^{3/2}\tanh^{-1}\left(\frac{\sqrt{a+b\coth(c z)}}{\sqrt{a+b}}\right) - 2\sqrt{a+b\coth(c z)}\,(4a+b\coth(c z))\right)\right)$$

01.22.21.0267.01

$$\int \frac{\coth(c z)}{\sqrt{(a + b \coth(c z))^3}}\, dz = -\left(\sqrt{i (a+b)}\, (a + b \coth(c z)) \left(i \tanh^{-1}\left(\frac{\sqrt{i (a + b \coth(c z))}}{\sqrt{i (a-b)}}\right) \sqrt{i (a + b \coth(c z))}\, (i (a+b))^{3/2} + \sqrt{i (a-b)} \left(2 a \sqrt{i (a+b)} - (a-b) \tanh^{-1}\left(\frac{\sqrt{i (a + b \coth(c z))}}{\sqrt{i (a+b)}}\right) \sqrt{i (a + b \coth(c z))}\right)\right)\right) \Big/ \left((i (a-b))^{3/2} (a+b)^2\, c \sqrt{(a + b \coth(c z))^3}\right)$$

Involving $\left(a + b \coth^2(c z)\right)^\beta$

01.22.21.0268.01

$$\int \left(a + b \coth^2(c z)\right)^\beta dz = \frac{\coth(c z) \left(b \coth^2(c z) + a\right)^\beta \left(\frac{b \coth^2(c z)}{a} + 1\right)^{-\beta}}{c} F_1\left(\frac{1}{2}; 1, -\beta; \frac{3}{2}; \coth^2(c z), -\frac{b \coth^2(c z)}{a}\right)$$

01.22.21.0269.01

$$\int \sqrt{a+b\coth^2(c z)}\, dz = -\left(\sqrt{b\coth^2(c z)+a}\left(\sqrt{b}\,\log\left(-\frac{4\left(\left(b+\frac{\sqrt{b}\sqrt{(-a+b+(a+b)\cosh(2 c z))\operatorname{sech}^4\left(\frac{c z}{2}\right)}}{\sqrt{2}}\right)\coth^2\left(\frac{c z}{2}\right)+2 a+b\right)}{b^{3/2}}\right)+\sqrt{b}\log\left(\frac{2 b\tanh^2\left(\frac{c z}{2}\right)+4 a+2 b+\sqrt{2}\sqrt{b}\sqrt{(-a+b+(a+b)\cosh(2 c z))\operatorname{sech}^4\left(\frac{c z}{2}\right)}}{\sqrt{b}}\right)-2\sqrt{a+b}\,\log\left(-\frac{\cosh^2\left(\frac{c z}{2}\right)\left((a+b)\tanh^2\left(\frac{c z}{2}\right)+a+b+\frac{\sqrt{a+b}\sqrt{(-a+b+(a+b)\cosh(2 c z))\operatorname{sech}^4\left(\frac{c z}{2}\right)}}{\sqrt{2}}\right)}{(a+b)^{3/2}}\right)\right)\tanh\left(\frac{c z}{2}\right)\right)\Bigg/\left(\sqrt{2}\,c\sqrt{\frac{-a+b+(a+b)\cosh(2 c z)}{(\cosh(c z)+1)^2}}\right)$$

01.22.21.0270.01

$$\int \frac{1}{\sqrt{a+b\coth^2(c z)}}\, dz = \left(\sqrt{-a+b+(a+b)\cosh(2 c z)}\,\coth(c z)\log\left(\sqrt{2}\sqrt{(a+b)\cosh^2(c z)}+\sqrt{-a+b+(a+b)\cosh(2 c z)}\right)\right)\Big/\left(\sqrt{2}\,c\sqrt{(a+b)\cosh^2(c z)}\sqrt{b\coth^2(c z)+a}\right)$$

01.22.21.0271.01

$$\int \coth(c z)\left(a+b\coth^2(c z)\right)^{\beta} dz = \frac{\left(b\coth^2(c z)+a\right)^{\beta+1}}{2(a+b)c(\beta+1)}\, {}_2F_1\left(\beta+1,\, 1;\, \beta+2;\, \frac{b\coth^2(c z)+a}{a+b}\right)$$

01.22.21.0272.01

$$\int \coth(c\,z)\sqrt{a+b\coth^2(c\,z)}\,dz = \frac{\sqrt{b\coth^2(c\,z)+a}}{c}\left(\frac{\sqrt{2}\,\log\left(\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}+\sqrt{2}\,\sqrt{(a+b)\sinh^2(c\,z)}\right)\sqrt{(a+b)\sinh^2(c\,z)}}{\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}}-1\right)$$

01.22.21.0273.01

$$\int \frac{\coth(c\,z)}{\sqrt{a+b\coth^2(c\,z)}}\,dz = \frac{\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}\,\log\left(\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}+\sqrt{2}\,\sqrt{(a+b)\sinh^2(c\,z)}\right)}{\sqrt{2}\,c\,\sqrt{b\coth^2(c\,z)+a}\,\sqrt{(a+b)\sinh^2(c\,z)}}$$

Involving $\left(\left(a+b\coth^2(c\,z)\right)^n\right)^\beta$

01.22.21.0274.01

$$\int \left(\left(a+b\coth^2(c\,z)\right)^n\right)^\beta dz = \frac{\coth(c\,z)\left(\left(b\coth^2(c\,z)+a\right)^n\right)^\beta\left(\frac{b\coth^2(c\,z)}{a}+1\right)^{-n\,\beta}}{c}\,F_1\left(\frac{1}{2};1,-n\,\beta;\frac{3}{2};\coth^2(c\,z),-\frac{b\coth^2(c\,z)}{a}\right)$$

01.22.21.0275.01

$$\int \sqrt{\left(a+b\coth^2(c z)\right)^3}\,dz = \frac{1}{c}\left(\sqrt{\left(b\coth^2(c z)+a\right)^3}\,\sinh(c z)\left(\left(\left((\cosh(c z)+1)\sqrt{\frac{-a+b+(a+b)\cosh(2 c z)}{(\cosh(c z)+1)^2}}\left(4\log\left(-\frac{1}{2\sqrt{a+b}}\cosh^2\left(\frac{c z}{2}\right)\left((a+b)\tanh^2\left(\frac{c z}{2}\right)+a+b+\frac{\sqrt{a+b}\sqrt{(-a+b+(a+b)\cosh(2 c z))\operatorname{sech}^4\left(\frac{c z}{2}\right)}}{\sqrt{2}}\right)\right)(a+b)^2-\sqrt{b}\,(3 a+2 b)\log\left(-\frac{4\left(\left(b+\frac{\sqrt{b}\sqrt{(-a+b+(a+b)\cosh(2 c z))\operatorname{sech}^4\left(\frac{c z}{2}\right)}}{\sqrt{2}}\right)\coth^2\left(\frac{c z}{2}\right)+2 a+b\right)}{\sqrt{b}}\right)\sqrt{a+b}-\sqrt{b}\,(3 a+2 b)\log\left(\frac{1}{\sqrt{b}}\left(2 b\tanh^2\left(\frac{c z}{2}\right)+4 a+2 b+\sqrt{2}\sqrt{b}\sqrt{(-a+b+(a+b)\cosh(2 c z))\operatorname{sech}^4\left(\frac{c z}{2}\right)}\right)\right)\sqrt{a+b}\right)\sinh^2(c z)\right)\Big/\left(\sqrt{2}\sqrt{a+b}\,(-a+b+(a+b)\cosh(2 c z))^2\right)-\frac{b\cosh(c z)}{-a+b+(a+b)\cosh(2 c z)}\right)\right)$$

01.22.21.0276.01

$$\int \frac{1}{\sqrt{\left(a+b\coth^2(c z)\right)^3}}\,dz = \left(\operatorname{csch}^2(c z)\left(\sqrt{2}\sqrt{(a+b)\cosh^2(c z)}\,\operatorname{csch}(2 c z)\log\left(\sqrt{2}\sqrt{(a+b)\cosh^2(c z)}+\sqrt{-a+b+(a+b)\cosh(2 c z)}\right)(-a+b+(a+b)\cosh(2 c z))^{3/2}+\frac{b(a+b)\coth(c z)(-a+b+(a+b)\cosh(2 c z))}{a}\right)\right)\Big/\left(2(a+b)^2 c\sqrt{\left(b\coth^2(c z)+a\right)^3}\right)$$

01.22.21.0277.01

$$\int \coth(c\,z)\left(\left(a+b\coth^2(c\,z)\right)^n\right)^\beta\,dz = \frac{\left(b\coth^2(c\,z)+a\right)\left(\left(b\coth^2(c\,z)+a\right)^n\right)^\beta}{2\,(a+b)\,c\,(n\,\beta+1)}\,{}_2F_1\!\left(n\,\beta+1,\,1;\,n\,\beta+2;\,\frac{b\coth^2(c\,z)+a}{a+b}\right)$$

01.22.21.0278.01

$$\int \coth(c\,z)\sqrt{\left(a+b\coth^2(c\,z)\right)^5}\,dz = \frac{1}{c}\left(\sqrt{\left(b\coth^2(c\,z)+a\right)^5}\,\sinh^5(c\,z)\right.$$
$$\left(\left(4\sqrt{2}\,\operatorname{csch}^5(c\,z)\log\left(\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}+\sqrt{2}\sqrt{(a+b)\sinh^2(c\,z)}\right)\left((a+b)\sinh^2(c\,z)\right)^{5/2}\right)\right/$$
$$\left.\left.(-a+b+(a+b)\cosh(2\,c\,z))^{5/2} - \frac{4\operatorname{csch}(c\,z)\left(3\,b^2\operatorname{csch}^4(c\,z)+11\,b\,(a+b)\operatorname{csch}^2(c\,z)+23\,(a+b)^2\right)}{15\,(-a+b+(a+b)\cosh(2\,c\,z))^2}\right)\right)$$

01.22.21.0279.01

$$\int \coth(c\,z)\sqrt{\left(a+b\coth^2(c\,z)\right)^3}\,dz =$$
$$-\left(2\sqrt{\left(b\coth^2(c\,z)+a\right)^3}\left(-3\sqrt{2}\log\left(\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}+\sqrt{2}\sqrt{(a+b)\sinh^2(c\,z)}\right)\left((a+b)\sinh^2(c\,z)\right)^{3/2} -\right.\right.$$
$$(2\,a+b)\sqrt{-a+b+(a+b)\cosh(2\,c\,z)} +$$
$$\left.\left.2\,(a+b)\cosh(2\,c\,z)\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}\right)\right)\Big/\left(3\,c\,(-a+b+(a+b)\cosh(2\,c\,z))^{3/2}\right)$$

01.22.21.0280.01

$$\int \frac{\coth(c\,z)}{\sqrt{\left(a+b\coth^2(c\,z)\right)^3}}\,dz =$$
$$-\left((-a+b+(a+b)\cosh(2\,c\,z))\operatorname{csch}^4(c\,z)\left(-a-b+(a+b)\cosh(2\,c\,z)-\sqrt{2}\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}\right.\right.$$
$$\log\left(\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}+\sqrt{2}\sqrt{(a+b)\sinh^2(c\,z)}\right)$$
$$\left.\left.\sqrt{(a+b)\sinh^2(c\,z)}\right)\right)\Big/\left(4\,(a+b)^2\,c\sqrt{\left(b\coth^2(c\,z)+a\right)^3}\right)$$

01.22.21.0281.01

$$\int \frac{\coth(c z)}{\sqrt{\left(a+b\coth^2(c z)\right)^5}}\,dz = \left((-a+b+(a+b)\cosh(2 c z))\operatorname{csch}^6(c z)\left(-2\cosh(4 c z)(a+b)^2+\cosh(2 c z)\left(8 a+2 b+3\sqrt{2}\sqrt{-a+b+(a+b)\cosh(2 c z)}\right.\right.\right.$$
$$\left.\log\left(\sqrt{-a+b+(a+b)\cosh(2 c z)}+\sqrt{2}\sqrt{(a+b)\sinh^2(c z)}\right)\sqrt{(a+b)\sinh^2(c z)}\right)(a+b)-$$
$$3\left(2 a(a+b)+\sqrt{2}(a-b)\sqrt{-a+b+(a+b)\cosh(2 c z)}\log\left(\sqrt{-a+b+(a+b)\cosh(2 c z)}+\right.\right.$$
$$\left.\left.\left.\left.\sqrt{2}\sqrt{(a+b)\sinh^2(c z)}\right)\sqrt{(a+b)\sinh^2(c z)}\right)\right)\right)\Big/\left(24(a+b)^3 c\sqrt{\left(b\coth^2(c z)+a\right)^5}\right)$$

Involving $\left(a+b\coth^{\frac{1}{2}}(c z)\right)^{\beta}$

01.22.21.0282.01

$$\int\left(a+b\coth^{\frac{1}{2}}(c z)\right)^{\beta} dz = \frac{1}{2\left(a^4-b^4\right)c(\beta+1)}\left(\left(a+b\coth^{\frac{1}{2}}(c z)\right)^{\beta+1}\left(\left(a^3+b a^2+b^2 a+b^3\right){}_2F_1\left(\beta+1,1;\beta+2;\frac{a+b\coth^{\frac{1}{2}}(c z)}{a-b}\right)-\right.\right.$$
$$(a-b)\left((a-i b)\left((a+b)\,{}_2F_1\left(\beta+1,1;\beta+2;\frac{a+b\coth^{\frac{1}{2}}(c z)}{a+i b}\right)-(a+i b)\,{}_2F_1\left(\beta+1,1;\beta+2;\frac{a+b\coth^{\frac{1}{2}}(c z)}{a+b}\right)\right)+\right.$$
$$\left.\left.\left.\left(a^2+b(1+i)a+b^2 i\right){}_2F_1\left(\beta+1,1;\beta+2;\frac{a+b\coth^{\frac{1}{2}}(c z)}{a-i b}\right)\right)\right)\right)$$

01.22.21.0283.01

$$\int\sqrt{a+b\coth^{\frac{1}{2}}(c z)}\,dz = \left((a-b)\sqrt{a+b}\sqrt{a+i b}\sqrt{a-i b}\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a-b}}\right)+\right.$$
$$\sqrt{a-b}\left(\sqrt{a-i b}\left(\sqrt{a+i b}(a+b)\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a+b}}\right)-(a+i b)\sqrt{a+b}\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a+i b}}\right)\right)-\right.$$
$$\left.\left.(a-i b)\sqrt{a+i b}\sqrt{a+b}\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a-i b}}\right)\right)\right)\Big/\left(\sqrt{a-b}\sqrt{a-i b}\sqrt{a+i b}\sqrt{a+b}\,c\right)$$

01.22.21.0284.01

$$\int \frac{1}{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}\,dz = \frac{1}{(a^4-b^4)\,c}\left(\sqrt{a-b}\,\left(a^3+b\,a^2+b^2\,a+b^3\right)\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a-b}}\right) - (a-b)\left((a-i\,b)\left(\sqrt{a+i\,b}\,(a+b)\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a+i\,b}}\right) - (a+i\,b)\sqrt{a+b}\,\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a+b}}\right)\right) + \sqrt{a-i\,b}\,\left(a^2+b\,(1+i)\,a+b^2\,i\right)\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a-i\,b}}\right)\right)\right)$$

01.22.21.0285.01

$$\int \coth(c z)\left(a+b\coth^{\frac{1}{2}}(c z)\right)^{\beta} dz = \frac{1}{c\left(2\left(a^4-b^4\right)(\beta+1)\right)}\left(\left(a+b\coth^{\frac{1}{2}}(c z)\right)^{\beta+1}\left(\left(a^3+b\,a^2+b^2\,a+b^3\right){}_2F_1\left(\beta+1,\,1;\,\beta+2;\,\frac{a+b\coth^{\frac{1}{2}}(c z)}{a-b}\right) + (a-b)\left((a-i\,b)\left((a+i\,b)\,{}_2F_1\left(\beta+1,\,1;\,\beta+2;\,\frac{a+b\coth^{\frac{1}{2}}(c z)}{a+b}\right) + (a+b)\,{}_2F_1\left(\beta+1,\,1;\,\beta+2;\,\frac{a+b\coth^{\frac{1}{2}}(c z)}{a+i\,b}\right)\right) + \left(a^2+b\,(1+i)\,a+b^2\,i\right){}_2F_1\left(\beta+1,\,1;\,\beta+2;\,\frac{a+b\coth^{\frac{1}{2}}(c z)}{a-i\,b}\right)\right)\right)\right)$$

01.22.21.0286.01

$$\int \coth(c z)\sqrt{a+b\coth^{\frac{1}{2}}(c z)}\,dz = \left((a-b)\sqrt{a+b}\,\sqrt{a+i b}\,\sqrt{a-i b}\,\sqrt{a+b\coth^{\frac{1}{2}}(c z)}\,\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a-b}}\right)+\right.$$

$$\sqrt{a-b}\left(\sqrt{a+b}\,\sqrt{a+i b}\,(a-i b)\sqrt{a+b\coth^{\frac{1}{2}}(c z)}\,\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a-i b}}\right)+\right.$$

$$\sqrt{a-i b}\left(\sqrt{a+b}\,(a+i b)\sqrt{a+b\coth^{\frac{1}{2}}(c z)}\,\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a+i b}}\right)+\right.$$

$$\left.\left.\left.\left.\sqrt{a+i b}\left((a+b)\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a+b}}\right)\sqrt{a+b\coth^{\frac{1}{2}}(c z)}\,-4\sqrt{a+b}\left(a+b\coth^{\frac{1}{2}}(c z)\right)\right)\right)\right)\right)\Big/$$

$$\left(\sqrt{a-b}\,\sqrt{a-i b}\,\sqrt{a+i b}\,\sqrt{a+b}\,c\sqrt{a+b\coth^{\frac{1}{2}}(c z)}\right)$$

01.22.21.0287.01

$$\int \frac{\coth(c z)}{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}\,dz = \frac{1}{\left(a^4-b^4\right)c}\left(\sqrt{a-b}\,\left(a^3+b a^2+b^2 a+b^3\right)\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a-b}}\right)+\right.$$

$$(a-b)\left((a-i b)\left(\sqrt{a+b}\,(a+i b)\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a+b}}\right)+(a+b)\sqrt{a+i b}\,\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a+i b}}\right)\right)+\right.$$

$$\left.\left.\sqrt{a-i b}\,\left(a^2+b(1+i)a+b^2 i\right)\tanh^{-1}\left(\frac{\sqrt{a+b\coth^{\frac{1}{2}}(c z)}}{\sqrt{a-i b}}\right)\right)\right)$$

01.22.21.0288.01

$$\int \frac{\coth(c z)}{\left(a + b \coth^{\frac{1}{2}}(c z)\right)^2} \, dz = -\frac{1}{4 c} \left(\frac{8 a^3}{(a^4 - b^4)\left(a + b \coth^{\frac{1}{2}}(c z)\right)} + \frac{2 i \tan^{-1}\left(\coth^{\frac{1}{2}}(c z)\right)}{(a + i b)^2} + \frac{2 \log\left(\coth^{\frac{1}{2}}(c z) - 1\right)}{(a + b)^2} + \frac{2 \log\left(\coth^{\frac{1}{2}}(c z) + 1\right)}{(a - b)^2} + \frac{\log(\coth(c z) + 1)}{(a + i b)^2} + \frac{\log(\coth(c z) + 1)}{(a - i b)^2} - \frac{2 i \tan^{-1}\left(\coth^{\frac{1}{2}}(c z)\right)}{(a - i b)^2} - \frac{8 (a^6 + 3 b^4 a^2) \log\left(a + b \coth^{\frac{1}{2}}(c z)\right)}{(a^4 - b^4)^2} \right)$$

Involving functions of the direct function and a power function

Involving powers of the direct function and a power function

Involving powers of coth and power

Involving z^n and linear arguments

01.22.21.0289.01

$$\int z^n \coth^\nu(c z) \, dz = \frac{(-1)^\nu z^{n+1}}{n+1} + (-1)^\nu e^{2 c \nu z} n! \sum_{j=0}^{n} \frac{(-1)^j (2 c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(\nu, \ldots, \nu; \nu + 1, \ldots, \nu + 1; e^{2 c z}) + (-1)^\nu e^{2 c z} \nu \, n! \sum_{j=0}^{n} \frac{(-1)^j (2 c)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+3}F_{j+2}(1, \ldots, 1, \nu + 1; 2, \ldots, 2; e^{2 c z}) + (-1)^\nu e^{c \nu z} \binom{\nu}{\frac{\nu}{2}} n! \, (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{\nu}{2}, \ldots, \frac{\nu}{2}, \nu; \frac{\nu}{2} + 1, \ldots, \frac{\nu}{2} + 1; e^{2 c z}\right) + (-1)^\nu n! \sum_{s=1}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{2 c s z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(s, \ldots, s, \nu; s + 1, \ldots, s + 1; e^{2 c z}) + e^{2 c (\nu - s) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(\nu - s, \ldots, \nu - s, \nu; -s + \nu + 1, \ldots, -s + \nu + 1; e^{2 c z}) \right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0290.01

$$\int z\coth^{\nu}(c\,z)\,dz = \frac{1}{2}(-1)^{\nu} z^2 + \frac{(-1)^{\nu} e^{2c\nu z}}{4c^2\nu^2}\left(2c\nu z\,{}_2F_1(\nu,\nu;\nu+1;e^{2cz}) - {}_3F_2(\nu,\nu,\nu;\nu+1,\nu+1;e^{2cz})\right) + \frac{(-1)^{\nu} e^{2cz}\nu}{4c^2}\left(2cz\,{}_3F_2(1,1,\nu+1;2,2;e^{2cz}) - {}_4F_3(1,1,1,\nu+1;2,2,2;e^{2cz})\right) + \frac{(-1)^{\nu} e^{c\nu z}(1-\nu \bmod 2)}{c^2\nu^2}\binom{\nu}{\frac{\nu}{2}}\left(c\nu z\,{}_2F_1\left(\frac{\nu}{2},\nu;\frac{\nu}{2}+1;e^{2cz}\right) - {}_3F_2\left(\frac{\nu}{2},\frac{\nu}{2},\nu;\frac{\nu}{2}+1,\frac{\nu}{2}+1;e^{2cz}\right)\right) + \frac{1}{4c^2}(-1)^{\nu}\sum_{s=1}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\left(\frac{e^{2csz}}{s^2}\left(2csz\,{}_2F_1(s,\nu;s+1;e^{2cz}) - {}_3F_2(s,s,\nu;s+1,s+1;e^{2cz})\right) - \frac{1}{(s-\nu)^2}e^{2c(\nu-s)z}\left(2c(s-\nu)z\,{}_2F_1(\nu,\nu-s;-s+\nu+1;e^{2cz}) + {}_3F_2(\nu,\nu-s,\nu-s;-s+\nu+1,-s+\nu+1;e^{2cz})\right)\right) /;\ \nu\in\mathbb{N}^+$$

01.22.21.0291.01

$$\int z\coth^2(c\,z)\,dz = \frac{z^2}{2} - \frac{\coth(c\,z)\,z}{c} + \frac{\log(\sinh(c\,z))}{c^2}$$

01.22.21.0292.01

$$\int z\coth^3(c\,z)\,dz = -\frac{\coth(c\,z) + c\,z\left(\operatorname{csch}^2(c\,z) - c\,z - 2\log\left(1-e^{-2cz}\right)\right) + \operatorname{Li}_2\left(e^{-2cz}\right)}{2c^2}$$

01.22.21.0293.01

$$\int z\coth^4(c\,z)\,dz = -\frac{-3c^2z^2 + 2c\coth(c\,z)\left(\operatorname{csch}^2(c\,z)+4\right)z + \operatorname{csch}^2(c\,z) - 8\log(\sinh(c\,z))}{6c^2}$$

01.22.21.0294.01

$$\int z\coth^5(c\,z)\,dz = -\frac{1}{12c^2}\left(\coth(c\,z)\left(\operatorname{csch}^2(c\,z)+10\right) + 3c\,z\left(\operatorname{csch}^4(c\,z) + 4\operatorname{csch}^2(c\,z) - 2c\,z - 4\log\left(1-e^{-2cz}\right)\right) + 6\operatorname{Li}_2\left(e^{-2cz}\right)\right)$$

01.22.21.0295.01

$$\int z^2\coth^2(c\,z)\,dz = \frac{c\,z\left(c\,z\,(c\,z+3) - 3c\,z\coth(c\,z) + 6\log\left(1-e^{-2cz}\right)\right) - 3\operatorname{Li}_2\left(e^{-2cz}\right)}{3c^3}$$

01.22.21.0296.01

$$\int z^3\coth^3(c\,z)\,dz = \frac{1}{64c^4}\left(-16c^4z^4 - 32c^3\operatorname{csch}^2(c\,z)\,z^3 + 64c^3\log\left(1-e^{2cz}\right)z^3 + 96c^2z^2 - 96c^2\coth(c\,z)\,z^2 + 96c^2\operatorname{Li}_2\left(e^{2cz}\right)z^2 + 192c\log\left(1-e^{-2cz}\right)z - 96c\operatorname{Li}_3\left(e^{2cz}\right)z + \pi^4 - 96\operatorname{Li}_2\left(e^{-2cz}\right) + 48\operatorname{Li}_4\left(e^{2cz}\right)\right)$$

Involving functions of the direct function and exponential function

Involving powers of the direct function and exponential function

Involving exp

Involving $e^{b\,z}$

01.22.21.0297.01

$$\int e^{bz}\coth^{\nu}(cz)\,dz = \frac{e^{bz}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(cz)}{b}\,F_1\!\left(-\frac{b}{2c};-\nu,\nu;1-\frac{b}{2c};-e^{-2cz},e^{-2cz}\right)/;\,b\neq 2c$$

01.22.21.0298.01

$$\int e^{2cz}\coth^{\nu}(cz)\,dz = \frac{2^{-\nu-1}\left(1-e^{2cz}\right)^{\nu}\left(1+e^{2cz}\right)\coth^{\nu}(cz)}{c\,(\nu+1)}\,{}_2F_1\!\left(\nu+1,\nu;\nu+2;\frac{1}{2}\left(1+e^{2cz}\right)\right)$$

01.22.21.0299.01

$$\int e^{cz}\coth^{2}(cz)\,dz = \frac{1}{c}\left(e^{cz}\left(1-\frac{2}{-1+e^{2cz}}\right)+\log(-1+e^{cz})-\log(1+e^{cz})\right)$$

01.22.21.0300.01

$$\int e^{2cz}\coth^{2}(cz)\,dz = \frac{1}{2c}\left(4\log\left(-1+e^{2cz}\right)+e^{2cz}-\frac{4}{-1+e^{2cz}}\right)$$

01.22.21.0301.01

$$\int e^{2cz}\coth^{3}(cz)\,dz = \frac{\frac{8-12e^{2cz}}{\left(-1+e^{2cz}\right)^2}+e^{2cz}+6\log\left(-1+e^{2cz}\right)}{2c}$$

01.22.21.0302.01

$$\int e^{2cz}\coth^{4}(cz)\,dz = \frac{24\log\left(-1+e^{2cz}\right)\left(-1+e^{2cz}\right)^3+93e^{2cz}-63e^{4cz}-9e^{6cz}+3e^{8cz}-40}{6c\left(-1+e^{2cz}\right)^3}$$

01.22.21.0303.01

$$\int e^{-2cz}\coth^{4}(cz)\,dz = -\frac{1}{6c}\left(\frac{8e^{2cz}\left(9-12e^{2cz}+5e^{4cz}\right)}{\left(-1+e^{2cz}\right)^3}+3e^{-2cz}+24\log\left(-1+e^{-2cz}\right)\right)$$

Involving functions of the direct function, exponential and a power functions

Involving powers of the direct function, exponential and a power functions

Involving exp and power

Involving $z^n e^{bz}$

01.22.21.0304.01

$$\int z^n e^{bz} \coth^\nu(cz)\,dz = (-1)^\nu e^{(b+c\nu)z} \binom{\nu}{\frac{\nu}{2}} n!\,(1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b+c\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+c\nu}{2c}, \ldots, \frac{b+c\nu}{2c}, \nu; \frac{b+c\nu}{2c}+1, \ldots, \frac{b+c\nu}{2c}+1; e^{2cz}\right) + (-1)^\nu n! \sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor} \binom{\nu}{s} \left(e^{(b+2cs)z} \sum_{j=0}^{n} \frac{(-1)^j (b+2cs)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2cs}{2c}, \ldots, \frac{b+2cs}{2c}, \nu; \frac{b+2cs}{2c}+1, \ldots, \frac{b+2cs}{2c}+1; e^{2cz}\right) + e^{(b+2c(\nu-s))z} \sum_{j=0}^{n} \frac{(-1)^j (b+2c(\nu-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2c(\nu-s)}{2c}, \ldots, \frac{b+2c(\nu-s)}{2c}, \nu; \frac{b+2c(\nu-s)}{2c}+1, \ldots, \frac{b+2c(\nu-s)}{2c}+1; e^{2cz}\right)\right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

Involving functions of the direct function and trigonometric functions

Involving powers of the direct function and trigonometric functions

Involving sin

Involving sin$(b z)$

01.22.21.0305.01

$$\int \sin(bz) \coth^\nu(cz)\,dz = -\frac{1}{2b} e^{-ibz} \left(1-e^{-2cz}\right)^\nu \left(1+e^{-2cz}\right)^{-\nu} \coth^\nu(cz) \left(F_1\left(\frac{ib}{2c}; -\nu, \nu; 1+\frac{ib}{2c}; -e^{-2cz}, e^{-2cz}\right) + e^{2ibz} F_1\left(-\frac{ib}{2c}; -\nu, \nu; 1-\frac{ib}{2c}; -e^{-2cz}, e^{-2cz}\right)\right)$$

Involving powers of sin

Involving sin$^m(b z)$

01.22.21.0306.01

$$\int \sin^m(bz) \coth^\nu(cz)\,dz = \frac{2^{-m} \coth^{\nu+1}(cz)\,(1-m \bmod 2)}{c(\nu+1)} \binom{m}{\frac{m}{2}} {}_2F_1\left(\frac{\nu+1}{2}, 1; \frac{\nu+1}{2}+1; \coth^2(cz)\right) + \frac{2^{-m} i^{1-m} \left(1-e^{-2cz}\right)^\nu \left(1+e^{-2cz}\right)^{-\nu} \coth^\nu(cz)}{b} \sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor} \frac{(-1)^k e^{-ib(m-2k)z}}{2k-m} \binom{m}{k} \left(e^{2ib(m-2k)z} F_1\left(-\frac{ib(m-2k)}{2c}; -\nu, \nu; 1-\frac{ib(m-2k)}{2c}; -e^{-2cz}, e^{-2cz}\right) - (-1)^m F_1\left(\frac{ib(m-2k)}{2c}; -\nu, \nu; \frac{bi(m-2k)}{2c}+1; -e^{-2cz}, e^{-2cz}\right)\right) /; m \in \mathbb{N}^+$$

Involving cos

Involving cos(*b z*)

01.22.21.0307.01

$$\int \cos(b z) \coth^{\nu}(c z)\, dz = -\frac{1}{2 b} \left(i\, e^{-i b z} \left(1 - e^{-2 c z}\right)^{\nu} \left(1 + e^{-2 c z}\right)^{-\nu} \left(e^{2 i b z} F_1\left(-\frac{i b}{2 c}; -\nu, \nu; 1 - \frac{i b}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) - F_1\left(\frac{i b}{2 c}; -\nu, \nu; 1 + \frac{i b}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \coth^{\nu}(c z)\right)$$

Involving powers of cos

Involving cos^m(*b z*)

01.22.21.0308.01

$$\int \cos^m(b z) \coth^{\nu}(c z)\, dz = \frac{2^{-m} \coth^{\nu+1}(c z) (1 - m \bmod 2)}{c (\nu + 1)} \binom{m}{\frac{m}{2}} {}_2F_1\left(\frac{\nu+1}{2}, 1; \frac{\nu+1}{2} + 1; \coth^2(c z)\right) + \frac{2^{-m}\, i \left(1 - e^{-2 c z}\right)^{\nu} \left(1 + e^{-2 c z}\right)^{-\nu} \coth^{\nu}(c z)}{b} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \frac{1}{m - 2 k} \binom{m}{k} \left(e^{-i b (m - 2 k) z} F_1\left(\frac{i b (m - 2 k)}{2 c}; -\nu, \nu; \frac{b\, i (m - 2 k)}{2 c} + 1; -e^{-2 c z}, e^{-2 c z}\right) - e^{i b (m - 2 k) z} F_1\left(-\frac{i b (m - 2 k)}{2 c}; -\nu, \nu; 1 - \frac{i b (m - 2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) /; m \in \mathbb{N}^+$$

Involving functions of the direct function, trigonometric and a power functions

Involving powers of the direct function, trigonometric and a power functions

Involving sin and power

Involving z^n sin(*a* + *b z*) coth$^{\nu}$(*c z*)

01.22.21.0309.01

$$\int z^n \sin(a+b\,z)\coth^{\nu}(c\,z)\,dz == \frac{1}{2}\,i\,(-1)^{\nu-1}\,n!\left(-e^{-i\,a+(-i\,b+c\,\nu)\,z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,b+c\,\nu)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-i\,b+c\,\nu}{2\,c},\,\ldots,\,\frac{-i\,b+c\,\nu}{2\,c},\,\nu;\,\frac{-i\,b+c\,\nu}{2\,c}+1,\,\ldots,\,\frac{-i\,b+c\,\nu}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{i\,a+(i\,b+c\,\nu)\,z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(i\,b+c\,\nu)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{i\,b+c\,\nu}{2\,c},\,\ldots,\,\frac{i\,b+c\,\nu}{2\,c},\,\nu;\,\frac{i\,b+c\,\nu}{2\,c}+1,\,\ldots,\,\frac{i\,b+c\,\nu}{2\,c}+1;\,e^{2\,c\,z}\right)-\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\left(e^{-i\,a+(-i\,b+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,b+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-i\,b+2\,c\,s}{2\,c},\,\ldots,\,\frac{-i\,b+2\,c\,s}{2\,c},\,\nu;\,\frac{-i\,b+2\,c\,s}{2\,c}+1,\,\ldots,\,\frac{-i\,b+2\,c\,s}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{-i\,a+(-i\,b+2\,c\,(\nu-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,b+2\,c\,(\nu-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-i\,b+2\,c\,(\nu-s)}{2\,c},\,\ldots,\,\frac{-i\,b+2\,c\,(\nu-s)}{2\,c},\,\nu;\,\frac{-i\,b+2\,c\,(\nu-s)}{2\,c}+1,\,\ldots,\,\frac{-i\,b+2\,c\,(\nu-s)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)+\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\left(e^{i\,a+(i\,b+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(i\,b+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{i\,b+2\,c\,s}{2\,c},\,\ldots,\,\frac{i\,b+2\,c\,s}{2\,c},\,\nu;\,\frac{i\,b+2\,c\,s}{2\,c}+1,\,\ldots,\,\frac{i\,b+2\,c\,s}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{i\,a+(i\,b+2\,c\,(\nu-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(i\,b+2\,c\,(\nu-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{i\,b+2\,c\,(\nu-s)}{2\,c},\,\ldots,\,\frac{i\,b+2\,c\,(\nu-s)}{2\,c},\,\nu;\,\frac{i\,b+2\,c\,(\nu-s)}{2\,c}+1,\,\ldots,\,\frac{i\,b+2\,c\,(\nu-s)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)\right)\;/;\;n\in\mathbb{N}\land\nu\in\mathbb{N}^+$$

01.22.21.0310.01

$$\int z^n \sin(b z) \coth^\nu(c z)\, dz = -\frac{1}{2} i (-1)^\nu n! \left(-e^{(-i b + c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-i b + c \nu)^{-j-1} z^{n-j}}{(n-j)!} \right.$$
$$ {}_{j+2}F_{j+1}\left(\frac{c\nu - i b}{2c}, \ldots, \frac{c\nu - i b}{2c}, \nu; \frac{c\nu - i b}{2c} + 1, \ldots, \frac{c\nu - i b}{2c} + 1; e^{2 c z} \right) + e^{(i b + c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2)$$
$$\sum_{j=0}^{n} \frac{(-1)^j (i b + c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b + c\nu}{2c}, \ldots, \frac{i b + c\nu}{2c}, \nu; \frac{i b + c\nu}{2c} + 1, \ldots, \frac{i b + c\nu}{2c} + 1; e^{2 c z} \right) -$$
$$\sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{(-i b + 2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-i b + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 c s - i b}{2c}, \ldots, \frac{2 c s - i b}{2c}, \nu; \frac{2 c s - i b}{2c} + 1, \right. \right.$$
$$\left. \ldots, \frac{2 c s - i b}{2c} + 1; e^{2 c z} \right) + e^{(-i b + 2 c (\nu - s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i b + 2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!}$$
$$\left. {}_{j+2}F_{j+1}\left(\frac{2 c (\nu - s) - i b}{2c}, \ldots, \frac{2 c (\nu - s) - i b}{2c}, \nu; \frac{2 c (\nu - s) - i b}{2c} + 1, \ldots, \frac{2 c (\nu - s) - i b}{2c} + 1; e^{2 c z} \right) \right) +$$
$$\sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{(i b + 2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (i b + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b + 2 c s}{2c}, \ldots, \frac{i b + 2 c s}{2c}, \nu; \frac{i b + 2 c s}{2c} + 1, \right. \right.$$
$$\left. \ldots, \frac{i b + 2 c s}{2c} + 1; e^{2 c z} \right) + e^{(i b + 2 c (\nu - s)) z} \sum_{j=0}^{n} \frac{(-1)^j (i b + 2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b + 2 c (\nu - s)}{2c}, \right.$$
$$\left. \left. \left. \ldots, \frac{i b + 2 c (\nu - s)}{2c}, \nu; \frac{i b + 2 c (\nu - s)}{2c} + 1, \ldots, \frac{i b + 2 c (\nu - s)}{2c} + 1; e^{2 c z} \right) \right) \right) /; n \in \mathbb{N} \land u \in \mathbb{N}^+$$

Involving powers of sin and power

Involving $z^n \operatorname{sih}^m(b z) \coth^\nu(c z)$

01.22.21.0311.01

$$\int z^n \sin^m(b z) \coth^\nu(c z)\, dz =$$
$$n! \left(\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^{k+\nu} \binom{m}{k} \left((-1)^m e^{(c \nu - i b (m - 2k)) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c \nu - i b (m - 2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1} \right. \right.$$
$$\left(\frac{c\nu - i b (m - 2k)}{2c}, \ldots, \frac{c\nu - i b (m - 2k)}{2c}, \nu; \frac{c\nu - i b (m - 2k)}{2c} + 1, \ldots, \frac{c\nu - i b (m - 2k)}{2c} + 1; e^{2 c z} \right) +$$
$$e^{(b i (m - 2k) + c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b i (m - 2k) + c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{i\,b\,(m-2\,k)+c\,v}{2\,c},\,\ldots,\,\frac{i\,b\,(m-2\,k)+c\,v}{2\,c},\,v;\,\frac{i\,b\,(m-2\,k)+c\,v}{2\,c}+1,\,\ldots,\,\frac{i\,b\,(m-2\,k)+c\,v}{2\,c}+1;\,e^{2\,c\,z}\right)+$$

$$(-1)^m \sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(2\,c\,s-i\,b\,(m-2\,k))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,s-i\,b\,(m-2\,k))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{2\,c\,s-i\,b\,(m-2\,k)}{2\,c},\right.\right.$$

$$\left.\ldots,\,\frac{2\,c\,s-i\,b\,(m-2\,k)}{2\,c},\,v;\,\frac{2\,c\,s-i\,b\,(m-2\,k)}{2\,c}+1,\,\ldots,\,\frac{2\,c\,s-i\,b\,(m-2\,k)}{2\,c}+1;\,e^{2\,c\,z}\right)+$$

$$e^{(2\,c\,(v-s)-i\,b\,(m-2\,k))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,(v-s)-i\,b\,(m-2\,k))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}$$

$$\left(\frac{2\,c\,(v-s)-i\,b\,(m-2\,k)}{2\,c},\,\ldots,\,\frac{2\,c\,(v-s)-i\,b\,(m-2\,k)}{2\,c},\,v;\right.$$

$$\left.\left.\frac{2\,c\,(v-s)-i\,b\,(m-2\,k)}{2\,c}+1,\,\ldots,\,\frac{2\,c\,(v-s)-i\,b\,(m-2\,k)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(b\,i\,(m-2\,k)+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b\,i\,(m-2\,k)+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{i\,b\,(m-2\,k)+2\,c\,s}{2\,c},\right.\right.$$

$$\left.\ldots,\,\frac{i\,b\,(m-2\,k)+2\,c\,s}{2\,c},\,v;\,\frac{i\,b\,(m-2\,k)+2\,c\,s}{2\,c}+1,\,\ldots,\,\frac{i\,b\,(m-2\,k)+2\,c\,s}{2\,c}+1;\,e^{2\,c\,z}\right)+$$

$$e^{(b\,i\,(m-2\,k)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b\,i\,(m-2\,k)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}$$

$$\left(\frac{i\,b\,(m-2\,k)+2\,c\,(v-s)}{2\,c},\,\ldots,\,\frac{i\,b\,(m-2\,k)+2\,c\,(v-s)}{2\,c},\,v;\,\frac{i\,b\,(m-2\,k)+2\,c\,(v-s)}{2\,c}+1,\right.$$

$$\left.\left.\left.\left.\ldots,\,\frac{i\,b\,(m-2\,k)+2\,c\,(v-s)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)\right)\right)(2\,i)^{-m}+(-1)^v\,2^{-m}\binom{m}{\frac{m}{2}}n!$$

$$(1-m\bmod 2)\left(\frac{z^{n+1}}{(n+1)!}+e^{2\,c\,v\,z}\sum_{j=0}^{n}\frac{(-1)^j\,2^{-j-1}\,(c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}(v,\,\ldots,\,v;\,v+1,\,\ldots,\,v+1;\,e^{2\,c\,z})+\right.$$

$$e^{2\,c\,z}\,v$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,2^{-j-1}\,c^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+3}F_{j+2}(1,\,\ldots,\,1,\,v+1;\,2,\,\ldots,\,2;\,e^{2\,c\,z})+$$

$$e^{c\,v\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{v}{2},\,\ldots,\,\frac{v}{2},\,v;\,\frac{v}{2}+1,\,\ldots,\,\frac{v}{2}+1;\,e^{2\,c\,z}\right)+$$

$$\sum_{s=1}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{2\,c\,s\,z}\sum_{j=0}^{n}\frac{(-1)^j\,2^{-j-1}\,(c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}(s,\,\ldots,\,s,\,v;\,s+1,\,\ldots,\,s+1;\,e^{2\,c\,z})+\right.$$

$$e^{2\,c\,(v-s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,2^{-j-1}\,(c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

Involving cos and power

Involving $z^n \cos(a + b z) \coth^\nu(c z)$

01.22.21.0312.01

$$\int z^n \cos(a+bz)\coth^\nu(cz)\,dz = \frac{1}{2}(-1)^\nu n!\Bigg(e^{-ia+(-ib+c\nu)z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(-ib+c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{-ib+c\nu}{2c},\ldots,\frac{-ib+c\nu}{2c},\nu;\frac{-ib+c\nu}{2c}+1,\ldots,\frac{-ib+c\nu}{2c}+1;e^{2cz}\Big)+e^{ia+(ib+c\nu)z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(ib+c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{ib+c\nu}{2c},\ldots,\frac{ib+c\nu}{2c},\nu;\frac{ib+c\nu}{2c}+1,\ldots,\frac{ib+c\nu}{2c}+1;e^{2cz}\Big)+\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\Big(e^{-ia+(-ib+2cs)z}\sum_{j=0}^{n}\frac{(-1)^j(-ib+2cs)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{-ib+2cs}{2c},\ldots,\frac{-ib+2cs}{2c},\nu;\frac{-ib+2cs}{2c}+1,\ldots,\frac{-ib+2cs}{2c}+1;e^{2cz}\Big)+e^{-ia+(-ib+2c(\nu-s))z}\sum_{j=0}^{n}\frac{(-1)^j(-ib+2c(\nu-s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{-ib+2c(\nu-s)}{2c},\ldots,\frac{-ib+2c(\nu-s)}{2c},\nu;\frac{-ib+2c(\nu-s)}{2c}+1,\ldots,\frac{-ib+2c(\nu-s)}{2c}+1;e^{2cz}\Big)\Big)+\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\Big(e^{ia+(ib+2cs)z}\sum_{j=0}^{n}\frac{(-1)^j(ib+2cs)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{ib+2cs}{2c},\ldots,\frac{ib+2cs}{2c},\nu;\frac{ib+2cs}{2c}+1,\ldots,\frac{ib+2cs}{2c}+1;e^{2cz}\Big)+e^{ia+(ib+2c(\nu-s))z}\sum_{j=0}^{n}\frac{(-1)^j(ib+2c(\nu-s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{ib+2c(\nu-s)}{2c},\ldots,\frac{ib+2c(\nu-s)}{2c},\nu;\frac{ib+2c(\nu-s)}{2c}+1,\ldots,\frac{ib+2c(\nu-s)}{2c}+1;e^{2cz}\Big)\Big)\Bigg)\,/;\,n\in\mathbb{N}\land\nu\in\mathbb{N}^+$$

01.22.21.0313.01

$$\int z^n \cos(b z) \coth^\nu(c z)\, dz = \frac{1}{2} (-1)^\nu n! \Bigg(e^{(-i b+c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-i b+c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{c \nu-i b}{2 c}, \ldots, \frac{c \nu-i b}{2 c}, \nu; \frac{c \nu-i b}{2 c}+1, \ldots, \frac{c \nu-i b}{2 c}+1; e^{2 c z}\right) + e^{(i b+c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (i b+c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b+c \nu}{2 c}, \ldots, \frac{i b+c \nu}{2 c}, \nu; \frac{i b+c \nu}{2 c}+1, \ldots, \frac{i b+c \nu}{2 c}+1; e^{2 c z}\right) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{(-i b+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-i b+2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 c s-i b}{2 c}, \ldots, \frac{2 c s-i b}{2 c}, \nu; \frac{2 c s-i b}{2 c}+1, \ldots, \frac{2 c s-i b}{2 c}+1; e^{2 c z}\right) + e^{(-i b+2 c (\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i b+2 c (\nu-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 c (\nu-s)-i b}{2 c}, \ldots, \frac{2 c (\nu-s)-i b}{2 c}, \nu; \frac{2 c (\nu-s)-i b}{2 c}+1, \ldots, \frac{2 c (\nu-s)-i b}{2 c}+1; e^{2 c z}\right)\Bigg) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{(i b+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (i b+2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b+2 c s}{2 c}, \ldots, \frac{i b+2 c s}{2 c}, \nu; \frac{i b+2 c s}{2 c}+1, \ldots, \frac{i b+2 c s}{2 c}+1; e^{2 c z}\right) + e^{(i b+2 c (\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (i b+2 c (\nu-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b+2 c (\nu-s)}{2 c}, \ldots, \frac{i b+2 c (\nu-s)}{2 c}, \nu; \frac{i b+2 c (\nu-s)}{2 c}+1, \ldots, \frac{i b+2 c (\nu-s)}{2 c}+1; e^{2 c z}\right)\Bigg)\Bigg) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

Involving powers of cos and power

Involving $z^n \cos^m(b z) \coth^\nu(c z)$

01.22.21.0314.01

$$\int z^n \cos^m(b z) \coth^\nu(c z)\, dz = (-1)^\nu 2^{-m} \binom{m}{\frac{m}{2}} n! (1-m \bmod 2) \Bigg(\frac{z^{n+1}}{(n+1)!} + e^{2 c \nu z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} (c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(\nu, \ldots, \nu; \nu+1, \ldots, \nu+1; e^{2 c z}) + e^{2 c z} \nu \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+3}F_{j+2}(1, \ldots, 1, \nu+1; 2, \ldots, 2; e^{2 c z}) + e^{c \nu z} \binom{\nu}{\frac{\nu}{2}} (1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{\nu}{2}, \ldots, \frac{\nu}{2}, \nu; \frac{\nu}{2}+1, \ldots, \frac{\nu}{2}+1; e^{2 c z}\right) +$$

$$\sum_{s=1}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{2 c s z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} (c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(s, \ldots, s, v; s+1, \ldots, s+1; e^{2 c z}\right) + \right.$$

$$\left. e^{2 c (v-s) z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} (c (v-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(v-s, \ldots, v-s, v; -s+v+1, \ldots, -s+v+1; e^{2 c z}\right) \right) \Bigg) +$$

$$(-1)^v 2^{-m} n! \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(e^{(c v - i b (m-2k)) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c v - i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1} \right.$$

$$\left(\frac{c v - i b (m-2k)}{2c}, \ldots, \frac{c v - i b (m-2k)}{2c}, v; \frac{c v - i b (m-2k)}{2c} + 1, \ldots, \frac{c v - i b (m-2k)}{2c} + 1; e^{2 c z} \right) +$$

$$e^{(b i (m-2k) + c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b i (m-2k) + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{i b (m-2k) + c v}{2c}, \ldots, \frac{i b (m-2k) + c v}{2c}, v; \frac{i b (m-2k) + c v}{2c} + 1, \ldots, \frac{i b (m-2k) + c v}{2c} + 1; e^{2 c z} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(2 c s - i b (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s - i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 c s - i b (m-2k)}{2c}, \ldots, \right.\right.$$

$$\left. \frac{2 c s - i b (m-2k)}{2c}, v; \frac{2 c s - i b (m-2k)}{2c} + 1, \ldots, \frac{2 c s - i b (m-2k)}{2c} + 1; e^{2 c z} \right) +$$

$$e^{(2 c (v-s) - i b (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (v-s) - i b (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{2 c (v-s) - i b (m-2k)}{2c}, \ldots, \frac{2 c (v-s) - i b (m-2k)}{2c}, v; \right.$$

$$\left.\left. \frac{2 c (v-s) - i b (m-2k)}{2c} + 1, \ldots, \frac{2 c (v-s) - i b (m-2k)}{2c} + 1; e^{2 c z} \right) \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(b i (m-2k) + 2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (b i (m-2k) + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i b (m-2k) + 2 c s}{2c}, \right.\right.$$

$$\left. \ldots, \frac{i b (m-2k) + 2 c s}{2c}, v; \frac{i b (m-2k) + 2 c s}{2c} + 1, \ldots, \frac{i b (m-2k) + 2 c s}{2c} + 1; e^{2 c z} \right) +$$

$$e^{(b i (m-2k) + 2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b i (m-2k) + 2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{i b (m-2k) + 2 c (v-s)}{2c}, \ldots, \frac{i b (m-2k) + 2 c (v-s)}{2c}, v; \frac{i b (m-2k) + 2 c (v-s)}{2c} + 1, \right.$$

$$\left.\left.\left. \ldots, \frac{i b (m-2k) + 2 c (v-s)}{2c} + 1; e^{2 c z} \right) \right) \right) /; n \in \mathbb{N} \land m \in \mathbb{N}^+ \land v \in \mathbb{N}^+$$

Involving functions of the direct function, trigonometric and exponential functions

Involving powers of the direct function, trigonometric and exponential functions

Involving sin and exp

Involving $e^{p z} \sin(a z) \coth^{\nu}(c z)$

01.22.21.0315.01

$$\int e^{p z} \sin(a z) \coth^{\nu}(c z) \, dz = \frac{1}{2} i \left(1 - e^{-2 c z}\right)^{\nu} \left(1 + e^{-2 c z}\right)^{-\nu} \coth^{\nu}(c z) \left(\frac{e^{(-i a + p) z} F_1\left(-\frac{-i a + p}{2 c}; -\nu, \nu; 1 - \frac{-i a + p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{-i a + p} - \frac{e^{(i a + p) z} F_1\left(-\frac{i a + p}{2 c}; -\nu, \nu; 1 - \frac{i a + p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{i a + p}\right)$$

01.22.21.0316.01

$$\int e^{i a z} \sin(a z) \coth^{\nu}(c z) \, dz = \frac{i \coth^{\nu+1}(c z)}{2 c (\nu + 1)} {}_2F_1\left(\frac{\nu + 1}{2}, 1; \frac{\nu + 3}{2}; \coth^2(c z)\right) - \frac{e^{2 i a z} \left(1 - e^{-2 c z}\right)^{\nu} \left(1 + e^{-2 c z}\right)^{-\nu} \coth^{\nu}(c z)}{4 a} F_1\left(-\frac{i a}{c}; -\nu, \nu; 1 - \frac{i a}{c}; -e^{-2 c z}, e^{-2 c z}\right)$$

01.22.21.0317.01

$$\int e^{-i a z} \sin(a z) \coth^{\nu}(c z) \, dz = -\frac{e^{-2 i a z} \left(1 - e^{-2 c z}\right)^{\nu} \left(1 + e^{-2 c z}\right)^{-\nu} \coth^{\nu}(c z)}{4 a} F_1\left(\frac{i a}{c}; -\nu, \nu; 1 + \frac{i a}{c}; -e^{-2 c z}, e^{-2 c z}\right) - \frac{i \coth^{\nu+1}(c z)}{2 c (\nu + 1)} {}_2F_1\left(\frac{\nu + 1}{2}, 1; \frac{\nu + 3}{2}; \coth^2(c z)\right)$$

Involving powers of sin and exp

Involving $e^{p z} \sin^m(a z) \coth^{\nu}(c z)$

01.22.21.0318.01

$$\int e^{p z} \sin^m(a z) \coth^{\nu}(c z) \, dz = \frac{1}{p} 2^{-m} e^{p z} \left(1 - e^{-2 c z}\right)^{\nu} \left(1 + e^{-2 c z}\right)^{-\nu} \binom{m}{\frac{m}{2}} \coth^{\nu}(c z) (1 - m \bmod 2) F_1\left(-\frac{p}{2 c}; -\nu, \nu; 1 - \frac{p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) + 2^{-m} i^{-m} \left(1 - e^{-2 c z}\right)^{\nu} \left(1 + e^{-2 c z}\right)^{-\nu} \coth^{\nu}(c z) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(\frac{(-1)^m e^{(p - i a (m - 2 k)) z} F_1\left(-\frac{p - i a (m - 2 k)}{2 c}; -\nu, \nu; 1 - \frac{p - i a (m - 2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p - i a (m - 2 k)} + \frac{e^{(a i (m - 2 k) + p) z} F_1\left(-\frac{a i (m - 2 k) + p}{2 c}; -\nu, \nu; 1 - \frac{a i (m - 2 k) + p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{a i (m - 2 k) + p}\right) /; m \in \mathbb{N}^+$$

Involving cos and exp

Involving $e^{pz}\cos(az)\coth^{\nu}(cz)$

01.22.21.0319.01

$$\int e^{pz}\cos(az)\coth^{\nu}(cz)\,dz = \frac{1}{2}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(cz)\left(\frac{e^{(-ia+p)z}F_1\left(-\frac{-ia+p}{2c};-\nu,\nu;1-\frac{-ia+p}{2c};-e^{-2cz},e^{-2cz}\right)}{-ia+p}+\frac{e^{(ia+p)z}F_1\left(-\frac{ia+p}{2c};-\nu,\nu;1-\frac{ia+p}{2c};-e^{-2cz},e^{-2cz}\right)}{ia+p}\right)$$

01.22.21.0320.01

$$\int e^{iaz}\cos(az)\coth^{\nu}(cz)\,dz = \frac{\coth^{\nu+1}(cz)}{2c(\nu+1)}\,{}_2F_1\left(\frac{\nu+1}{2},1;\frac{\nu+3}{2};\coth^2(cz)\right)-\frac{i\,e^{2iaz}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(cz)}{4a}F_1\left(-\frac{ia}{c};-\nu,\nu;1-\frac{ia}{c};-e^{-2cz},e^{-2cz}\right)$$

01.22.21.0321.01

$$\int e^{-iaz}\cos(az)\coth^{\nu}(cz)\,dz = \frac{i\,e^{-2iaz}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(cz)}{4a}F_1\left(\frac{ia}{c};-\nu,\nu;1+\frac{ia}{c};-e^{-2cz},e^{-2cz}\right)+\frac{\coth^{\nu+1}(cz)}{2c(\nu+1)}\,{}_2F_1\left(\frac{\nu+1}{2},1;\frac{\nu+3}{2};\coth^2(cz)\right)$$

Involving powers of cos and exp

Involving $e^{pz}\cos^m(az)\coth^{\nu}(cz)$

01.22.21.0322.01

$$\int e^{pz}\cos^m(az)\coth^{\nu}(cz)\,dz = 2^{-m}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(cz)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(\frac{e^{(p-ia(m-2k))z}F_1\left(-\frac{p-ia(m-2k)}{2c};-\nu,\nu;1-\frac{p-ia(m-2k)}{2c};-e^{-2cz},e^{-2cz}\right)}{p-ia(m-2k)}+\frac{e^{(ai(m-2k)+p)z}F_1\left(-\frac{ai(m-2k)+p}{2c};-\nu,\nu;1-\frac{ai(m-2k)+p}{2c};-e^{-2cz},e^{-2cz}\right)}{ai(m-2k)+p}\right)+\frac{1}{p}2^{-m}e^{pz}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(cz)\binom{m}{\frac{m}{2}}(1-m\bmod 2)F_1\left(-\frac{p}{2c};-\nu,\nu;1-\frac{p}{2c};-e^{-2cz},e^{-2cz}\right)\;/;\;m\in\mathbb{N}^+$$

Involving functions of the direct function, trigonometric, exponential and a power functions

Involving powers of the direct function, trigonometric, exponential and a power functions

Involving sin, exp and power

Involving $z^n e^{pz}\sin(a+bz)\coth^{\nu}(cz)$

01.22.21.0323.01

$$\int z^n e^{p z} \sin(a + b z) \coth^{\nu}(c z)\, dz = \frac{i}{2} (-1)^{\nu} n! \left(e^{(-i b+p+c \nu) z - i a} \binom{\nu}{\frac{\nu}{2}} (1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-i b + p + c \nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i b + p + c \nu}{2 c}, \ldots, \frac{-i b + p + c \nu}{2 c}, \nu; \frac{-i b + p + c \nu}{2 c} + 1, \ldots, \frac{-i b + p + c \nu}{2 c} + 1; e^{2 c z}\right) - e^{i a+(i b+p+c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (i b + p + c \nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i b + p + c \nu}{2 c}, \ldots, \frac{i b + p + c \nu}{2 c}, \nu; \frac{i b + p + c \nu}{2 c} + 1, \ldots, \frac{i b + p + c \nu}{2 c} + 1; e^{2 c z}\right) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{(-i b+p+2 c s) z - i a} \sum_{j=0}^{n} \frac{(-1)^j (-i b + p + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i b + p + 2 c s}{2 c}, \ldots, \frac{-i b + p + 2 c s}{2 c}, \nu; \frac{-i b + p + 2 c s}{2 c} + 1, \ldots, \frac{-i b + p + 2 c s}{2 c} + 1; e^{2 c z}\right) + e^{(-i b+p+2 c (\nu-s)) z - i a} \sum_{j=0}^{n} \frac{(-1)^j (-i b + p + 2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i b + p + 2 c (\nu - s)}{2 c}, \ldots, \frac{-i b + p + 2 c (\nu - s)}{2 c}, \nu; \frac{-i b + p + 2 c (\nu - s)}{2 c} + 1, \ldots, \frac{-i b + p + 2 c (\nu - s)}{2 c} + 1; e^{2 c z}\right)\right) - \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{i a+(i b+p+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (i b + p + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i b + p + 2 c s}{2 c}, \ldots, \frac{i b + p + 2 c s}{2 c}, \nu; \frac{i b + p + 2 c s}{2 c} + 1, \ldots, \frac{i b + p + 2 c s}{2 c} + 1; e^{2 c z}\right) + e^{i a+(i b+p+2 c (\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (i b + p + 2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i b + p + 2 c (\nu - s)}{2 c}, \ldots, \frac{i b + p + 2 c (\nu - s)}{2 c}, \nu; \frac{i b + p + 2 c (\nu - s)}{2 c} + 1, \ldots, \frac{i b + p + 2 c (\nu - s)}{2 c} + 1; e^{2 c z}\right)\right)\right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0324.01

$$\int z^n e^{pz}\sin(bz)\coth^{\nu}(cz)\,dz = \frac{i}{2}(-1)^{\nu}\binom{\nu}{\frac{\nu}{2}} n!\,(1-\nu \bmod 2)\left(e^{(-ib+p+c\nu)z}\sum_{j=0}^{n}\frac{(-1)^j(-ib+p+c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-ib+p+c\nu}{2c},\ldots,\frac{-ib+p+c\nu}{2c},\nu;\frac{-ib+p+c\nu}{2c}+1,\ldots,\frac{-ib+p+c\nu}{2c}+1;e^{2cz}\right)-e^{(ib+p+c\nu)z}\sum_{j=0}^{n}\frac{(-1)^j(ib+p+c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ib+p+c\nu}{2c},\ldots,\frac{ib+p+c\nu}{2c},\nu;\frac{ib+p+c\nu}{2c}+1,\ldots,\frac{ib+p+c\nu}{2c}+1;e^{2cz}\right)\right)+\frac{i}{2}(-1)^{\nu}n!\sum_{i=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{i}\left(e^{(-ib+2ci+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-ib+2ci+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-ib+2ci+p}{2c},\ldots,\frac{-ib+2ci+p}{2c},\nu;\frac{-ib+2ci+p}{2c}+1,\ldots,\frac{-ib+2ci+p}{2c}+1;e^{2cz}\right)-e^{(ib+2ci+p)z}\sum_{j=0}^{n}\frac{(-1)^j(ib+2ci+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ib+2ci+p}{2c},\ldots,\frac{ib+2ci+p}{2c},\nu;\frac{ib+2ci+p}{2c}+1,\ldots,\frac{ib+2ci+p}{2c}+1;e^{2cz}\right)+e^{(-ib-2ci+p+2c\nu)z}\sum_{j=0}^{n}\frac{(-1)^j(-ib-2ci+p+2c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-ib-2ci+p+2c\nu}{2c},\ldots,\frac{-ib-2ci+p+2c\nu}{2c},\nu;\frac{-ib-2ci+p+2c\nu}{2c}+1,\ldots,\frac{-ib-2ci+p+2c\nu}{2c}+1;e^{2cz}\right)-e^{(ib-2ci+p+2c\nu)z}\sum_{j=0}^{n}\frac{(-1)^j(ib-2ci+p+2c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ib-2ci+p+2c\nu}{2c},\ldots,\frac{ib-2ci+p+2c\nu}{2c},\nu;\frac{ib-2ci+p+2c\nu}{2c}+1,\ldots,\frac{ib-2ci+p+2c\nu}{2c}+1;e^{2cz}\right)\right)\;/;\;n\in\mathbb{N}\land\nu\in\mathbb{N}^+$$

Involving powers of sin, exp and power

Involving $z^n e^{pz}\sin^m(bz)\coth^{\nu}(cz)$

01.22.21.0325.01

$$\int z^n e^{pz}\sin^m(bz)\coth^{\nu}(cz)\,dz = 2^{-m}\binom{m}{\frac{m}{2}}(1-m \bmod 2)(-1)^{\nu}n!\left(e^{(p+c\nu)z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(p+c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+c\nu}{2c},\ldots,\frac{p+c\nu}{2c},\nu;\frac{p+c\nu}{2c}+1,\ldots,\frac{p+c\nu}{2c}+1;e^{2cz}\right)+\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\left(e^{(p+2cs)z}\sum_{j=0}^{n}\frac{(-1)^j(p+2cs)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+2cs}{2c},\ldots,\frac{p+2cs}{2c},\nu;\frac{p+2cs}{2c}+\right.\right.\right.$$

$$1,\ \ldots,\ \frac{p+2\,c\,s}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+e^{(p+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(p+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{p+2\,c\,(v-s)}{2\,c},\ \ldots,\ \frac{p+2\,c\,(v-s)}{2\,c},\ v;\ \frac{p+2\,c\,(v-s)}{2\,c}+1,\ \ldots,\ \frac{p+2\,c\,(v-s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)+$$

$$(-1)^v\,i^{-m}\,2^{-m}\,n!\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\Bigg(e^{(b\,i\,(m-2\,k)+p+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(b\,i\,(m-2\,k)+p+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,b\,(m-2\,k)+p+c\,v}{2\,c},\ \ldots,\ \frac{i\,b\,(m-2\,k)+p+c\,v}{2\,c},\ v;\ \frac{i\,b\,(m-2\,k)+p+c\,v}{2\,c}+1,$$

$$\ldots,\ \frac{i\,b\,(m-2\,k)+p+c\,v}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+(-1)^m\Bigg(e^{(-i\,b\,(m-2\,k)+p+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,b\,(m-2\,k)+p+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{-i\,b\,(m-2\,k)+p+c\,v}{2\,c},\ \ldots,$$

$$\frac{-i\,b\,(m-2\,k)+p+c\,v}{2\,c},\ v;\ \frac{-i\,b\,(m-2\,k)+p+c\,v}{2\,c}+1,\ \ldots,\ \frac{-i\,b\,(m-2\,k)+p+c\,v}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(-i\,b\,(m-2\,k)+p+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,b\,(m-2\,k)+p+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{-i\,b\,(m-2\,k)+p+2\,c\,s}{2\,c},\ \ldots,\ \frac{-i\,b\,(m-2\,k)+p+2\,c\,s}{2\,c},\ v;$$

$$\frac{-i\,b\,(m-2\,k)+p+2\,c\,s}{2\,c}+1,\ \ldots,\ \frac{-i\,b\,(m-2\,k)+p+2\,c\,s}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(-i\,b\,(m-2\,k)+p+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,b\,(m-2\,k)+p+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{-i\,b\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c},\ \ldots,\ \frac{-i\,b\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c},\ v;$$

$$\frac{-i\,b\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}+1,\ \ldots,\ \frac{-i\,b\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(b\,i\,(m-2\,k)+p+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b\,i\,(m-2\,k)+p+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{i\,b\,(m-2\,k)+p+2\,c\,s}{2\,c},$$

$$\ldots,\ \frac{i\,b\,(m-2\,k)+p+2\,c\,s}{2\,c},\ v;\ \frac{i\,b\,(m-2\,k)+p+2\,c\,s}{2\,c}+1,$$

$$\ldots,\ \frac{i\,b\,(m-2\,k)+p+2\,c\,s}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+e^{(b\,i\,(m-2\,k)+p+2\,c\,(v-s))\,z}$$

$$\sum_{j=0}^{n} \frac{(-1)^j \, (b\, i\, (m-2\,k)+p+2\,c\,(v-s))^{-j-1}\, z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{i\, b\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}, \ldots, \frac{i\, b\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}, v; \frac{i\, b\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}+1, \ldots, \frac{i\, b\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}+1; e^{2\,c\,z}\right)\Bigg)\Bigg) /; n \in \mathbb{N} \land m \in \mathbb{N}^+ \land v \in \mathbb{N}^+$$

Involving cos, exp and power

Involving $z^n\, e^{p\,z} \cos(a+b\,z) \coth^v(c\,z)$

01.22.21.0326.01

$$\int z^n e^{p z} \cos(a + b z) \coth^\nu(c z)\, dz = \frac{1}{2} (-1)^\nu n! \Bigg(e^{(-i b+p+c \nu) z-i a} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-i b + p + c \nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i b + p + c \nu}{2 c}, \ldots, \frac{-i b + p + c \nu}{2 c}, \nu; \frac{-i b + p + c \nu}{2 c} + 1, \ldots, \frac{-i b + p + c \nu}{2 c} + 1; e^{2 c z}\right) + e^{i a+(i b+p+c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (i b + p + c \nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i b + p + c \nu}{2 c}, \ldots, \frac{i b + p + c \nu}{2 c}, \nu; \frac{i b + p + c \nu}{2 c} + 1, \ldots, \frac{i b + p + c \nu}{2 c} + 1; e^{2 c z}\right) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{(-i b+p+2 c s) z-i a} \sum_{j=0}^{n} \frac{(-1)^j (-i b + p + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i b + p + 2 c s}{2 c}, \ldots, \frac{-i b + p + 2 c s}{2 c}, \nu; \frac{-i b + p + 2 c s}{2 c} + 1, \ldots, \frac{-i b + p + 2 c s}{2 c} + 1; e^{2 c z}\right) + e^{(-i b+p+2 c (\nu-s)) z-i a} \sum_{j=0}^{n} \frac{(-1)^j (-i b + p + 2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i b + p + 2 c (\nu - s)}{2 c}, \ldots, \frac{-i b + p + 2 c (\nu - s)}{2 c}, \nu; \frac{-i b + p + 2 c (\nu - s)}{2 c} + 1, \ldots, \frac{-i b + p + 2 c (\nu - s)}{2 c} + 1; e^{2 c z}\right) \Bigg) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{i a+(i b+p+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (i b + p + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i b + p + 2 c s}{2 c}, \ldots, \frac{i b + p + 2 c s}{2 c}, \nu; \frac{i b + p + 2 c s}{2 c} + 1, \ldots, \frac{i b + p + 2 c s}{2 c} + 1; e^{2 c z}\right) + e^{i a+(i b+p+2 c (\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (i b + p + 2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i b + p + 2 c (\nu - s)}{2 c}, \ldots, \frac{i b + p + 2 c (\nu - s)}{2 c}, \nu; \frac{i b + p + 2 c (\nu - s)}{2 c} + 1, \ldots, \frac{i b + p + 2 c (\nu - s)}{2 c} + 1; e^{2 c z}\right) \Bigg) \Bigg) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0327.01

$$\int z^n e^{pz} \cos(bz) \coth^\nu(cz)\, dz = \frac{1}{2}(-1)^\nu \binom{\nu}{\frac{\nu}{2}} n!\,(1-\nu \bmod 2)\left(e^{(-ib+p+c\nu)z} \sum_{j=0}^{n} \frac{(-1)^j (-ib+p+c\nu)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{-ib+p+c\nu}{2c}, \ldots, \frac{-ib+p+c\nu}{2c}, \nu; \frac{-ib+p+c\nu}{2c}+1, \ldots, \frac{-ib+p+c\nu}{2c}+1; e^{2cz}\right) + e^{(ib+p+c\nu)z} \sum_{j=0}^{n} \frac{(-1)^j (ib+p+c\nu)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{ib+p+c\nu}{2c}, \ldots, \frac{ib+p+c\nu}{2c}, \nu; \frac{ib+p+c\nu}{2c}+1, \ldots, \frac{ib+p+c\nu}{2c}+1; e^{2cz}\right)\right) + \frac{1}{2}(-1)^\nu n! \sum_{i=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor} \binom{\nu}{i} \left(e^{(-ib+2ci+p)z} \sum_{j=0}^{n} \frac{(-1)^j (-ib+2ci+p)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{-ib+2ci+p}{2c}, \ldots, \frac{-ib+2ci+p}{2c}, \nu; \frac{-ib+2ci+p}{2c}+1, \ldots, \frac{-ib+2ci+p}{2c}+1; e^{2cz}\right) + e^{(ib+2ci+p)z} \sum_{j=0}^{n} \frac{(-1)^j (ib+2ci+p)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{ib+2ci+p}{2c}, \ldots, \frac{ib+2ci+p}{2c}, \nu; \frac{ib+2ci+p}{2c}+1, \ldots, \frac{ib+2ci+p}{2c}+1; e^{2cz}\right) + e^{(-ib-2ci+p+2c\nu)z} \sum_{j=0}^{n} \frac{(-1)^j (-ib-2ci+p+2c\nu)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{-ib-2ci+p+2c\nu}{2c}, \ldots, \frac{-ib-2ci+p+2c\nu}{2c}, \nu; \frac{-ib-2ci+p+2c\nu}{2c}+1, \ldots, \frac{-ib-2ci+p+2c\nu}{2c}+1; e^{2cz}\right) + e^{(ib-2ci+p+2c\nu)z} \sum_{j=0}^{n} \frac{(-1)^j (ib-2ci+p+2c\nu)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{ib-2ci+p+2c\nu}{2c}, \ldots, \frac{ib-2ci+p+2c\nu}{2c}, \nu; \frac{ib-2ci+p+2c\nu}{2c}+1, \ldots, \frac{ib-2ci+p+2c\nu}{2c}+1; e^{2cz}\right)\right) /;\, n \in \mathbb{N} \wedge \nu \in \mathbb{N}^+$$

Involving powers of cos, exp and power

Involving $z^n e^{pz} \cos^m(bz) \coth^\nu(cz)$

01.22.21.0328.01

$$\int z^n e^{pz} \cos^m(bz) \coth^\nu(cz)\, dz = (-1)^\nu 2^{-m} e^{(p+c\nu)z} \binom{m}{\frac{m}{2}} \binom{\nu}{\frac{\nu}{2}} n!\,(1-m \bmod 2)(1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (p+c\nu)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{p+c\nu}{2c}, \ldots, \frac{p+c\nu}{2c}, \nu; \frac{p+c\nu}{2c}+1, \ldots, \frac{p+c\nu}{2c}+1; e^{2cz}\right) + (-1)^\nu 2^{-m} \binom{\nu}{\frac{\nu}{2}} n!\,(1-\nu \bmod 2) \sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor} \binom{m}{s} \left(e^{(-ib(m-2s)+p+c\nu)z} \sum_{j=0}^{n} \frac{(-1)^j (-ib(m-2s)+p+c\nu)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{p-ib(m-2s)+c\nu}{2c},\right.\right.$$

$$\ldots,\ \frac{p - i\,b\,(m-2s)+c\,v}{2c},\ v;\ \frac{p - i\,b\,(m-2s)+c\,v}{2c}+1,\ \ldots,\ \frac{p - i\,b\,(m-2s)+c\,v}{2c}+1;\ e^{2cz}\Bigg) +$$

$$e^{(b\,i\,(m-2s)+p+c\,v)\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(b\,i\,(m-2s)+p+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{p + i\,b\,(m-2s)+c\,v}{2c},\ \ldots,$$

$$\frac{p + i\,b\,(m-2s)+c\,v}{2c},\ v;\ \frac{p + i\,b\,(m-2s)+c\,v}{2c}+1,\ \ldots,\ \frac{p + i\,b\,(m-2s)+c\,v}{2c}+1;\ e^{2cz}\Bigg)\Bigg) +$$

$$(-1)^v\,2^{-m}\binom{m}{\frac{m}{2}}\,n!\,(1 - m \bmod 2) \sum_{i=0}^{\left\lfloor \frac{v-1}{2}\right\rfloor}\binom{v}{i}\Bigg(e^{(2ci+p)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2ci+p)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{2ci+p}{2c},\ \ldots,\ \frac{2ci+p}{2c},\ v;\ \frac{2ci+p}{2c}+1,\ \ldots,\ \frac{2ci+p}{2c}+1;\ e^{2cz}\Bigg) +$$

$$e^{(-2ci+p+2cv)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-2ci+p+2cv)^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{-2ci+p+2cv}{2c},\ \ldots,\ \frac{-2ci+p+2cv}{2c},$$

$$v;\ \frac{-2ci+p+2cv}{2c}+1,\ \ldots,\ \frac{-2ci+p+2cv}{2c}+1;\ e^{2cz}\Bigg)\Bigg) + (-1)^v\,2^{-m}\,n!$$

$$\sum_{i=0}^{\left\lfloor \frac{v-1}{2}\right\rfloor}\sum_{s=0}^{\left\lfloor \frac{m-1}{2}\right\rfloor}\binom{m}{s}\binom{v}{i}\Bigg(e^{(2ci+ibm+p-2ibs)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2ci+ibm+p-2ibs)^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{2ci+ibm+p-2ibs}{2c},\ \ldots,$$

$$\frac{2ci+ibm+p-2ibs}{2c},\ v;\ \frac{2ci+ibm+p-2ibs}{2c}+1,\ \ldots,\ \frac{2ci+ibm+p-2ibs}{2c}+1;\ e^{2cz}\Bigg) +$$

$$e^{(2ci-ibm+p+2ibs)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2ci-ibm+p+2ibs)^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{2ci-ibm+p+2ibs}{2c},\ \ldots,$$

$$\frac{2ci-ibm+p+2ibs}{2c},\ v;\ \frac{2ci-ibm+p+2ibs}{2c}+1,\ \ldots,\ \frac{2ci-ibm+p+2ibs}{2c}+1;\ e^{2cz}\Bigg) +$$

$$e^{(-2ci+ibm+p-2ibs+2cv)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-2ci+ibm+p-2ibs+2cv)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-2ci+ibm+p-2ibs+2cv}{2c},\ \ldots,\ \frac{-2ci+ibm+p-2ibs+2cv}{2c},\ v;$$

$$\frac{-2ci+ibm+p-2ibs+2cv}{2c}+1,\ \ldots,\ \frac{-2ci+ibm+p-2ibs+2cv}{2c}+1;\ e^{2cz}\Bigg) +$$

$$e^{(-2ci-ibm+p+2ibs+2cv)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-2ci-ibm+p+2ibs+2cv)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-2ci-ibm+p+2ibs+2cv}{2c},\ \ldots,\ \frac{-2ci-ibm+p+2ibs+2cv}{2c},$$

$$v;\ \frac{-2ci-ibm+p+2ibs+2cv}{2c}+1,\ \ldots,$$

$$\frac{-2ci-ibm+p+2ibs+2cv}{2c}+1;\ e^{2cz}\Bigg)\Bigg)\ /;\ n\in\mathbb{N}\land m\in\mathbb{N}^+\land v\in\mathbb{N}^+$$

Involving functions of the direct function and hyperbolic functions

Involving powers of the direct function and hyperbolic functions

Involving sinh

Involving $\sinh(b\,z)$

01.22.21.0329.01

$$\int \sinh(b\,z)\coth^{\nu}(c\,z)\,dz = \frac{1}{2\,b}\left(e^{-b\,z}\left(1-e^{-2\,c\,z}\right)^{\nu}\left(1+e^{-2\,c\,z}\right)^{-\nu}\left(F_1\left(\frac{b}{2\,c};-\nu,\nu;\frac{b}{2\,c}+1;-e^{-2\,c\,z},e^{-2\,c\,z}\right)+e^{2\,b\,z}F_1\left(-\frac{b}{2\,c};-\nu,\nu;1-\frac{b}{2\,c};-e^{-2\,c\,z},e^{-2\,c\,z}\right)\right)\coth^{\nu}(c\,z)\right)$$

01.22.21.0330.01

$$\int \sinh(c\,z)\coth^{\nu}(c\,z)\,dz = \frac{\cosh(c\,z)\coth^{\nu}(c\,z)\left(-\sinh^2(c\,z)\right)^{\nu/2}}{c\,(\nu+1)}\,{}_2F_1\left(\frac{\nu+1}{2},\frac{\nu}{2};\frac{\nu+3}{2};\cosh^2(c\,z)\right)$$

01.22.21.0331.01

$$\int \sinh(c\,z)\coth^2(c\,z)\,dz = \frac{\cosh(c\,z)-\log\left(\cosh\left(\frac{c\,z}{2}\right)\right)+\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)}{c}$$

01.22.21.0332.01

$$\int \sinh(c\,z)\coth^3(c\,z)\,dz = \frac{\sinh(c\,z)-\operatorname{csch}(c\,z)}{c}$$

01.22.21.0333.01

$$\int \sinh(4\,c\,z)\coth^4(c\,z)\,dz = \frac{-8\operatorname{csch}^2(c\,z)+16\cosh(2\,c\,z)+\cosh(4\,c\,z)+64\log(\sinh(c\,z))}{4\,c}$$

Involving power of sinh

Involving $\sinh^{u}(b\,z)\coth^{\nu}(c\,z)$

01.22.21.0334.01

$$\int \sinh^{u}(b\,z)\coth^{\nu}(c\,z)\,dz = \binom{u}{\frac{u}{2}}\frac{\coth^{\nu+1}(c\,z)\,(1-u \bmod 2)}{c\,(\nu+1)}\left(\frac{i}{2}\right)^{u}{}_2F_1\left(\frac{\nu+1}{2},1;\frac{\nu+1}{2}+1;\coth^2(c\,z)\right)+\frac{2^{-u}\left(1-e^{-2\,c\,z}\right)^{\nu}\left(1+e^{-2\,c\,z}\right)^{-\nu}\coth^{\nu}(c\,z)}{b}$$
$$\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\frac{(-1)^k}{u-2\,k}\binom{u}{k}\left(e^{b\,(u-2\,k)\,z}F_1\left(-\frac{b\,(u-2\,k)}{2\,c};-\nu,\nu;1-\frac{b\,(u-2\,k)}{2\,c};-e^{-2\,c\,z},e^{-2\,c\,z}\right)-\right.$$
$$\left.(-1)^{u}e^{-b\,(u-2\,k)\,z}F_1\left(\frac{b\,(u-2\,k)}{2\,c};-\nu,\nu;\frac{b\,(u-2\,k)}{2\,c}+1;-e^{-2\,c\,z},e^{-2\,c\,z}\right)\right)/;\,u\in\mathbb{N}^{+}$$

01.22.21.0335.01

$$\int \sinh^{\mu}(c\,z)\coth^{\nu}(c\,z)\,dz = -\frac{\left(1-e^{2cz}\right)^{\nu-\mu}\left(1+e^{2cz}\right)^{-\nu}\coth^{\nu}(c\,z)\sinh^{\mu}(c\,z)}{c\,\mu}\,F_1\!\left(-\frac{\mu}{2};\,\nu-\mu,\,-\nu;\,\frac{2-\mu}{2};\,e^{2cz},\,-e^{2cz}\right)$$

01.22.21.0336.01

$$\int \sinh^{\mu}(c\,z)\coth^{\nu}(c\,z)\,dz = -\frac{\cosh(c\,z)\coth^{\nu}(c\,z)\sinh^{\mu+1}(c\,z)\left(-\sinh^2(c\,z)\right)^{\frac{1}{2}(-\mu+\nu-1)}}{c\,(\nu+1)}\,{}_2F_1\!\left(\frac{\nu+1}{2},\,\frac{1}{2}(-\mu+\nu+1);\,\frac{\nu+3}{2};\,\cosh^2(c\,z)\right)$$

01.22.21.0337.01

$$\int \frac{\coth^3(c\,z)}{\sinh^{\frac{1}{2}}(2\,c\,z)}\,dz = \frac{3\,E\!\left(\frac{\pi}{4}-i\,c\,z\,\middle|\,2\right)\sqrt{i\sinh(2\,c\,z)}-2\left(3\cosh^2(c\,z)+\coth^2(c\,z)\right)}{5\,c\sinh^{\frac{1}{2}}(2\,c\,z)}$$

01.22.21.0338.01

$$\int \sqrt{\sinh^3(2\,c\,z)}\,\coth^5(c\,z)\,dz = \frac{\sqrt{\sinh^3(2\,c\,z)}}{15\,c}\left(-6\,\mathrm{csch}^4(c\,z)-78\,\mathrm{csch}^2(c\,z)+231\,\mathrm{csch}^2(2\,c\,z)\,E\!\left(\frac{\pi}{4}-i\,c\,z\,\middle|\,2\right)\sqrt{i\sinh(2\,c\,z)}+5\right)$$

Involving powers of products with sinh

Involving $\sqrt{\sinh^m(c\,z)\coth(c\,z)}$

01.22.21.0339.01

$$\int \sqrt{\sinh(c\,z)\coth(c\,z)}\,dz = -\frac{2\,i}{c}\,E\!\left(\frac{i\,c\,z}{2}\,\middle|\,2\right)$$

01.22.21.0340.01

$$\int \sqrt{\sinh^4(c\,z)\coth(c\,z)}\,dz = \frac{\coth(c\,z)\sqrt{\cosh(c\,z)\sinh^3(c\,z)}\left(3\sqrt[4]{-\sinh^2(c\,z)}+{}_2F_1\!\left(\frac{3}{4},\,\frac{3}{4};\,\frac{7}{4};\,\cosh^2(c\,z)\right)\right)}{6\,c\sqrt[4]{-\sinh^2(c\,z)}}$$

Involving algebraic functions of sinh

01.22.21.0341.01

$$\int \sqrt{a+b\sinh(c\,z)}\,\coth^2(c\,z)\,dz = \frac{1}{4c}\Bigg(-4\sqrt{a+b\sinh(c\,z)}\,\coth(c\,z) + \frac{1}{a\sqrt{\frac{1}{i\,b-a}}\,b}\Bigg(6\Bigg(a\,(a+i\,b)\,i\,E\Bigg(i\sinh^{-1}\Bigg(\sqrt{\frac{1}{i\,b-a}}\,\sqrt{a+b\sinh(c\,z)}\Bigg)\Bigg|\frac{a-i\,b}{a+i\,b}\Bigg) + b\Bigg(a\,F\Bigg(i\sinh^{-1}\Bigg(\sqrt{\frac{1}{i\,b-a}}\,\sqrt{a+b\sinh(c\,z)}\Bigg)\Bigg|\frac{a-i\,b}{a+i\,b}\Bigg) + b\,i\,\Pi\Bigg(1-\frac{i\,b}{a};\,i\sinh^{-1}\Bigg(\sqrt{\frac{1}{i\,b-a}}\,\sqrt{a+b\sinh(c\,z)}\Bigg)\Bigg|\frac{a-i\,b}{a+i\,b}\Bigg)\Bigg)\Bigg)\operatorname{sech}(c\,z)\sqrt{\frac{b-i\,b\sinh(c\,z)}{b+i\,a}}\sqrt{\frac{i\sinh(c\,z)\,b+b}{b-i\,a}}\Bigg) + \frac{6\left((b+i\,a)\,E\left(\frac{1}{4}(\pi-2\,i\,c\,z)\,\middle|\,-\frac{2\,i\,b}{a-i\,b}\right) - i\,a\,F\left(\frac{1}{4}(\pi-2\,i\,c\,z)\,\middle|\,-\frac{2\,i\,b}{a-i\,b}\right)\right)\sqrt{\frac{a+b\sinh(c\,z)}{a-i\,b}}}{\sqrt{a+b\sinh(c\,z)}} + \frac{8\,a\sqrt{\frac{a+b\sinh(c\,z)}{a-i\,b}}\,i\,F\left(\frac{1}{4}(\pi-2\,i\,c\,z)\,\middle|\,-\frac{2\,i\,b}{a-i\,b}\right)}{\sqrt{a+b\sinh(c\,z)}} + \frac{2\,b\sqrt{\frac{a+b\sinh(c\,z)}{a-i\,b}}\,\Pi\left(2;\,\frac{1}{4}(\pi-2\,i\,c\,z)\,\middle|\,-\frac{2\,i\,b}{a-i\,b}\right)}{\sqrt{a+b\sinh(c\,z)}}\Bigg)$$

Involving cosh

Involving cosh(b z)

01.22.21.0342.01

$$\int \cosh(b\,z)\coth^{\nu}(c\,z)\,dz = \frac{1}{2b}\Big(e^{-b\,z}\left(1-e^{-2\,c\,z}\right)^{\nu}\left(1+e^{-2\,c\,z}\right)^{-\nu}\Big(e^{2\,b\,z}F_1\left(-\frac{b}{2c};\,-\nu,\,\nu;\,1-\frac{b}{2c};\,-e^{-2\,c\,z},\,e^{-2\,c\,z}\right) - F_1\left(\frac{b}{2c};\,-\nu,\,\nu;\,\frac{b}{2c}+1;\,-e^{-2\,c\,z},\,e^{-2\,c\,z}\right)\Big)\coth^{\nu}(c\,z)\Big)$$

01.22.21.0343.01

$$\int \cosh(c\,z)\coth^{\nu}(c\,z)\,dz = \frac{\cosh(c\,z)\coth^{\nu+1}(c\,z)\left(-\sinh^2(c\,z)\right)^{\frac{\nu+1}{2}}}{c\,(\nu+2)}\,{}_2F_1\left(\frac{\nu+2}{2},\,\frac{\nu+1}{2};\,\frac{\nu+4}{2};\,\cosh^2(c\,z)\right)$$

01.22.21.0344.01

$$\int \cosh(z)\coth^2(z)\,dz = \sinh(z) - \operatorname{csch}(z)$$

01.22.21.0345.01

$$\int \cosh(z)\coth^3(z)\,dz = \frac{1}{2}\left(2\cosh(z) - \coth(z)\operatorname{csch}(z) - 3\log\left(\cosh\left(\frac{z}{2}\right)\right) + 3\log\left(\sinh\left(\frac{z}{2}\right)\right)\right)$$

01.22.21.0346.01

$$\int \cosh(2z)\coth^3(z)\,dz = \frac{1}{2}\left(-\operatorname{csch}^2(z) + \cosh(2z) + 6\log(\sinh(z))\right)$$

01.22.21.0347.01

$$\int \cosh(4z)\coth^5(z)\,dz = -\frac{1}{4}\operatorname{csch}^4(z) - 5\operatorname{csch}^2(z) + 5\cosh(2z) + \frac{1}{4}\cosh(4z) + 25\log(\sinh(z))$$

01.22.21.0348.01

$$\int \cosh(5z)\coth^5(z)\,dz = -\frac{1}{4}\coth(z)\operatorname{csch}^3(z) - \frac{57}{8}\coth(z)\operatorname{csch}(z) + 50\cosh(z) + \frac{10}{3}\cosh(3z) + \frac{1}{5}\cosh(5z) - \frac{383}{8}\log\left(\cosh\left(\frac{z}{2}\right)\right) + \frac{383}{8}\log\left(\sinh\left(\frac{z}{2}\right)\right)$$

Involving power of cosh

Involving $\cosh^u(b z)\coth^\nu(c z)$

01.22.21.0349.01

$$\int \cosh^u(bz)\coth^\nu(cz)\,dz = \frac{2^{-u}\coth^{\nu+1}(cz)\,(1 - u \bmod 2)}{c(\nu+1)}\binom{u}{\frac{u}{2}}\,{}_2F_1\left(\frac{\nu+1}{2}, 1; \frac{\nu+1}{2}+1; \coth^2(cz)\right) + \frac{1}{b}\left(2^{-u}\left(1 - e^{-2cz}\right)^{\nu}\left(1 + e^{-2cz}\right)^{-\nu}\coth^\nu(cz)\right)$$

$$\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\frac{1}{u-2k}\binom{u}{k}\left(e^{b(u-2k)z}F_1\left(-\frac{b(u-2k)}{2c}; -\nu, \nu; 1 - \frac{b(u-2k)}{2c}; -e^{-2cz}, e^{-2cz}\right) - e^{-b(u-2k)z}F_1\left(\frac{b(u-2k)}{2c}; -\nu, \nu; \frac{b(u-2k)}{2c}+1; -e^{-2cz}, e^{-2cz}\right)\right) /; u \in \mathbb{N}^+$$

01.22.21.0350.01

$$\int \cosh^\mu(cz)\coth^\nu(cz)\,dz = -\frac{\left(1 - e^{2cz}\right)^{\nu}\left(1 + e^{2cz}\right)^{-\mu-\nu}\cosh^\mu(cz)\coth^\nu(cz)}{c\mu}F_1\left(-\frac{\mu}{2}; \nu, -\mu-\nu; \frac{2-\mu}{2}; e^{2cz}, -e^{2cz}\right)$$

01.22.21.0351.01

$$\int \cosh^\mu(cz)\coth^\nu(cz)\,dz = -\frac{\cosh^{\mu+1}(cz)\coth^\nu(cz)\sinh(cz)\left(-\sinh^2(cz)\right)^{\frac{\nu-1}{2}}}{c(\mu+\nu+1)}\,{}_2F_1\left(\frac{1}{2}(\mu+\nu+1), \frac{\nu+1}{2}; \frac{1}{2}(\mu+\nu+3); \cosh^2(cz)\right)$$

01.22.21.0352.01

$$\int \cosh(5z)\coth^5(z)\,dz = -\frac{1}{4}\coth(z)\operatorname{csch}^3(z) - \frac{57}{8}\coth(z)\operatorname{csch}(z) + 50\cosh(z) + \frac{10}{3}\cosh(3z) + \frac{1}{5}\cosh(5z) - \frac{383}{8}\log\left(\cosh\left(\frac{z}{2}\right)\right) + \frac{383}{8}\log\left(\sinh\left(\frac{z}{2}\right)\right)$$

01.22.21.0353.01

$$\int \cosh^2(z)\coth^2(z)\,dz = \frac{1}{4}(6z - 4\coth(z) + \sinh(2z))$$

01.22.21.0354.01

$$\int \sqrt{\cosh^3(2z)}\,\coth^3(z)\,dz = \frac{\sqrt{\cosh^3(2z)}\left(\cosh^{\frac{1}{2}}(2z)\left(-3\,\text{csch}^2(z) + 2\cosh(2z) + 18\right) - 24\tanh^{-1}\left(\cosh^{\frac{1}{2}}(2z)\right)\right)}{6\cosh^{\frac{3}{2}}(2z)}$$

Involving powers of products with cosh

Involving $\sqrt{\cosh^m(c\,z)\coth(c\,z)}$

01.22.21.0355.01

$$\int \sqrt{\cosh(c\,z)\coth(c\,z)}\,dz = \frac{2\sqrt{\cosh(c\,z)\coth(c\,z)}\left(\sqrt[4]{-\sinh^2(c\,z)} - 1\right)\tanh(c\,z)}{c\sqrt[4]{-\sinh^2(c\,z)}}$$

01.22.21.0356.01

$$\int \sqrt{\cosh^m(c\,z)\coth(c\,z)}\,dz = -\frac{\sqrt{\cosh^{m+1}(c\,z)\,\text{csch}(c\,z)}\,\sinh(2\,c\,z)}{c\,(m+3)\sqrt[4]{-\sinh^2(c\,z)}}\,{}_2F_1\left(\frac{m+3}{4}, \frac{3}{4}; \frac{m+7}{4}; \cosh^2(c\,z)\right)$$

Involving algebraic functions of cosh

Involving $(a + b\cosh(c\,z))^\beta$

01.22.21.0357.01

$$\int (a + b\cosh(c\,z))^\beta \coth(c\,z)\,dz = -\frac{1}{2\,(a-b)\,(a+b)\,c\,(\beta+1)}$$
$$\left((a + b\cosh(c\,z))^{\beta+1}\left((a+b)\,{}_2F_1\left(\beta+1, 1; \beta+2; \frac{a + b\cosh(c\,z)}{a-b}\right) + (a-b)\,{}_2F_1\left(\beta+1, 1; \beta+2; \frac{a + b\cosh(c\,z)}{a+b}\right)\right)\right)$$

01.22.21.0358.01

$$\int \sqrt{a + b\cosh(c\,z)}\,\coth(c\,z)\,dz = \frac{1}{\sqrt{-a-b}\,\sqrt{b-a}\,c}$$
$$\left(\sqrt{b-a}\,(a+b)\tan^{-1}\left(\frac{\sqrt{a + b\cosh(c\,z)}}{\sqrt{-a-b}}\right) + \sqrt{-a-b}\left((a-b)\tan^{-1}\left(\frac{\sqrt{a + b\cosh(c\,z)}}{\sqrt{b-a}}\right) + 2\sqrt{b-a}\,\sqrt{a + b\cosh(c\,z)}\right)\right)$$

01.22.21.0359.01

$$\int \frac{\coth(c\,z)}{\sqrt{a + b\cosh(c\,z)}}\,dz = -\frac{1}{c}\left(\frac{1}{\sqrt{a-b}}\tanh^{-1}\left(\frac{\sqrt{a + b\cosh(c\,z)}}{\sqrt{a-b}}\right) + \frac{1}{\sqrt{a+b}}\tanh^{-1}\left(\frac{\sqrt{a + b\cosh(c\,z)}}{\sqrt{a+b}}\right)\right)$$

Involving $(a + b\cosh(2\,c\,z))^\beta$

01.22.21.0360.01

$$\int (a+b\cosh(2cz))^{\beta}\coth^{\nu}(cz)\,dz = -\frac{1}{c(\nu-1)}\left(F_1\left(\frac{1-\nu}{2}; \frac{1-\nu}{2}, -\beta; \frac{3-\nu}{2}; -\sinh^2(cz), -\frac{2b\sinh^2(cz)}{a+b}\right)\right.$$
$$\left.\cosh^2(cz)^{\frac{1-\nu}{2}}(a+b\cosh(2cz))^{\beta}\left(\frac{a+b\cosh(2cz)}{a+b}\right)^{-\beta}\coth^{\nu-1}(cz)\right)$$

01.22.21.0361.01

$$\int \sqrt{a+b\cosh(2cz)}\,\coth^2(cz)\,dz = \frac{1}{c\sqrt{a+b\cosh(2cz)}}\left(-(a+b\cosh(2cz))\coth(cz)-\right.$$
$$\left.2i(a+b)\sqrt{\frac{a+b\cosh(2cz)}{a+b}}\,E\left(icz\,\middle|\,\frac{2b}{a+b}\right)+(a-b)\sqrt{\frac{a+b\cosh(2cz)}{a+b}}\,iF\left(icz\,\middle|\,\frac{2b}{a+b}\right)\right)$$

01.22.21.0362.01

$$\int \sqrt{a-a\cosh(2cz)}\,\coth^2(cz)\,dz = \frac{\sqrt{a-a\cosh(2cz)}\,\operatorname{csch}(cz)\left(\cosh(cz)-\log\left(\cosh\left(\frac{cz}{2}\right)\right)+\log\left(\sinh\left(\frac{cz}{2}\right)\right)\right)}{c}$$

01.22.21.0363.01

$$\int \sqrt{\cosh(2cz)a+a}\,\coth^2(cz)\,dz = \frac{(\cosh(2cz)-3)\sqrt{\cosh(2cz)a+a}\,\operatorname{csch}(cz)\operatorname{sech}(cz)}{2c}$$

01.22.21.0364.01

$$\int \sqrt{a+b\cosh(2cz)}\,\coth^3(cz)\,dz =$$
$$\frac{1}{2\sqrt{a+b}\,c}\left(-2(a+2b)\tanh^{-1}\left(\frac{\sqrt{a+b\cosh(2cz)}}{\sqrt{a+b}}\right)-\sqrt{a+b}\,\sqrt{a+b\cosh(2cz)}\,\left(\operatorname{csch}^2(cz)-2\right)\right)$$

01.22.21.0365.01

$$\int \sqrt{a+b\cosh(2cz)}\,\coth^4(cz)\,dz = \frac{1}{6(a+b)c\sqrt{a+b\cosh(2cz)}}$$
$$\left(-\left(-2a^2-2ba+3b^2+4\left(a^2+ba-b^2\right)\cosh(2cz)+b(2a+3b)\cosh(4cz)\right)\coth(cz)\operatorname{csch}^2(cz)-\right.$$
$$\left.2i\left(7a^2+16ba+9b^2\right)\sqrt{\frac{a+b\cosh(2cz)}{a+b}}\,E\left(icz\,\middle|\,\frac{2b}{a+b}\right)+8\sqrt{\frac{a+b\cosh(2cz)}{a+b}}\,\left(a^2-b^2\right)iF\left(icz\,\middle|\,\frac{2b}{a+b}\right)\right)$$

01.22.21.0366.01

$$\int \frac{\coth^2(cz)}{\sqrt{a+b\cosh(2cz)}}\,dz =$$
$$\frac{1}{(a+b)c\sqrt{a+b\cosh(2cz)}}\left(-(a+b\cosh(2cz))\coth(cz)-i(a+b)\sqrt{\frac{a+b\cosh(2cz)}{a+b}}\,E\left(icz\,\middle|\,\frac{2b}{a+b}\right)\right)$$

01.22.21.0367.01

$$\int \frac{\coth^3(c z)}{\sqrt{a+b\cosh(2 c z)}}\, dz = \frac{1}{2(a+b)^{3/2} c}\left(-\sqrt{a+b}\,\sqrt{a+b\cosh(2 c z)}\,\operatorname{csch}^2(c z) - 2 a \tanh^{-1}\left(\frac{\sqrt{a+b\cosh(2 c z)}}{\sqrt{a+b}}\right)\right)$$

01.22.21.0368.01

$$\int \frac{\coth^4(c z)}{\sqrt{a+b\cosh(2 c z)}}\, dz = \frac{1}{3(a+b)^2 c\sqrt{a+b\cosh(2 c z)}}\left(-\left(\left(2 a^2 - b a + b^2\right)\cosh(2 c z) + a(-a+2 b+b\cosh(4 c z))\right)\coth(c z)\operatorname{csch}^2(c z) - 4 i a (a+b)\sqrt{\frac{a+b\cosh(2 c z)}{a+b}}\, E\left(i c z \,\middle|\, \frac{2 b}{a+b}\right) + \sqrt{\frac{a+b\cosh(2 c z)}{a+b}}\left(a^2-b^2\right) i F\left(i c z \,\middle|\, \frac{2 b}{a+b}\right)\right)$$

Involving $\cosh(c z)(a+b\cosh(2 c z))^\beta$

01.22.21.0369.01

$$\int \cosh(c z)(a+b\cosh(2 c z))^\beta \coth^\nu(c z)\, dz = -\frac{1}{c(\nu-1)}\cosh^2(c z)^{-\frac{\nu}{2}}(a+b\cosh(2 c z))^\beta \left(\frac{a+b\cosh(2 c z)}{a+b}\right)^{-\beta}\coth^\nu(c z)\sinh(c z)\, F_1\left(\frac{1-\nu}{2}; -\frac{\nu}{2}, -\beta; \frac{3-\nu}{2}; -\sinh^2(c z), -\frac{2 b\sinh^2(c z)}{a+b}\right)$$

01.22.21.0370.01

$$\int \cosh(c z)\sqrt{a+b\cosh(2 c z)}\,\coth^2(c z)\, dz = \frac{\sqrt{2}\,(a+5 b)\tanh^{-1}\left(\frac{\sqrt{2}\,\sqrt{b}\,\sinh(c z)}{\sqrt{a+b\cosh(2 c z)}}\right) + \sqrt{b}\,(\cosh(2 c z)-5)\sqrt{a+b\cosh(2 c z)}\,\operatorname{csch}(c z)}{4\sqrt{b}\, c}$$

01.22.21.0371.01

$$\int \frac{\cosh(c z)\coth^2(c z)}{\sqrt{a+b\cosh(2 c z)}}\, dz = \frac{1}{2 c}\left(\frac{\sqrt{2}}{\sqrt{b}}\tanh^{-1}\left(\frac{\sqrt{2}\,\sqrt{b}\,\sinh(c z)}{\sqrt{a+b\cosh(2 c z)}}\right) - \frac{2\sqrt{a+b\cosh(2 c z)}\,\operatorname{csch}(c z)}{a+b}\right)$$

Involving $\cosh(2 c z)(a+b\cosh(2 c z))^\beta$

01.22.21.0372.01

$$\int \cosh(2 c z)\sqrt{a+b\cosh(2 c z)}\,\coth^2(c z)\, dz = \frac{1}{3 b c\sqrt{a+b\cosh(2 c z)}}\left(\frac{1}{2} b (a+b\cosh(2 c z))(\cosh(3 c z)-7\cosh(c z))\operatorname{csch}(c z) - i\left(a^2+10 b a+9 b^2\right)\sqrt{\frac{a+b\cosh(2 c z)}{a+b}}\, E\left(i c z \,\middle|\, \frac{2 b}{a+b}\right) + \sqrt{\frac{a+b\cosh(2 c z)}{a+b}}\left(a^2+3 b a-4 b^2\right) i F\left(i c z \,\middle|\, \frac{2 b}{a+b}\right)\right)$$

01.22.21.0373.01

$$\int \cosh(2\,c\,z)\sqrt{\cosh(2\,c\,z)\,a+a}\,\coth^2(c\,z)\,dz = \frac{\sqrt{\cosh(2\,c\,z)\,a+a}\,(14\cosh(2\,c\,z)+\cosh(4\,c\,z)-27)\operatorname{csch}(c\,z)\operatorname{sech}(c\,z)}{12\,c}$$

01.22.21.0374.01

$$\int \cosh(2\,c\,z)\sqrt{a-a\cosh(2\,c\,z)}\,\coth^2(c\,z)\,dz = \frac{\sqrt{a-a\cosh(2\,c\,z)}\operatorname{csch}(c\,z)\left(9\cosh(c\,z)+\cosh(3\,c\,z)-6\log\left(\cosh\left(\frac{c\,z}{2}\right)\right)+6\log\left(\sinh\left(\frac{c\,z}{2}\right)\right)\right)}{6\,c}$$

Involving tanh

Involving $\tanh(c\,z)\coth^{\nu}(c\,z)$

01.22.21.0375.01

$$\int \tanh(c\,z)\coth^{\nu}(c\,z)\,dz = \frac{\coth^{\nu}(c\,z)}{c\,\nu}\,{}_2F_1\left(\frac{\nu}{2},1;\frac{\nu}{2}+1;\coth^2(c\,z)\right)$$

01.22.21.0376.01

$$\int \tanh(z)\coth^2(z)\,dz = \log(\sinh(z))$$

01.22.21.0377.01

$$\int \tanh(z)\coth^3(z)\,dz = z-\coth(z)$$

Involving power of tanh

Involving $\tanh^{\mu}(c\,z)\coth^{\nu}(c\,z)$

01.22.21.0378.01

$$\int \tanh^{\mu}(c\,z)\coth^{\nu}(c\,z)\,dz = -\frac{\coth^{\nu+1}(c\,z)\tanh^{\mu}(c\,z)}{c\,(\mu-\nu-1)}\,{}_2F_1\left(\frac{1}{2}(-\mu+\nu+1),1;\frac{1}{2}(-\mu+\nu+3);\coth^2(c\,z)\right)$$

01.22.21.0379.01

$$\int \tanh^{\mu}(c\,z)\coth^{\nu}(c\,z)\,dz = \frac{1}{2\,c\,(\mu-\nu-1)}\left(\coth^{\nu}(c\,z)\,{}_2F_1\left(\frac{1}{2}(-\mu+\nu+1),\frac{1}{2}(-\mu+\nu+1);\frac{1}{2}(-\mu+\nu+3);\cosh^2(c\,z)\right)\left(-\sinh^2(c\,z)\right)^{\frac{1}{2}(-\mu+\nu-1)}\sinh(2\,c\,z)\tanh^{\mu}(c\,z)\right)$$

01.22.21.0380.01

$$\int \tanh^{\nu+1}(c\,z)\coth^{\nu}(c\,z)\,dz = \frac{\coth^{\nu}(c\,z)\log(\cosh(c\,z))\tanh^{\nu}(c\,z)}{c}$$

01.22.21.0381.01

$$\int \tanh^2(z)\coth^2(z)\,dz = z$$

Involving powers of products with tanh

Involving $\sqrt{\tanh^m(c\,z)\coth(d\,z)}$

01.22.21.0382.01

$$\int \sqrt{\tanh(c\,z)\coth(2\,c\,z)}\,dz = \frac{\left(\sqrt{2}\,\sinh^{-1}\left(\sqrt{2}\,\sinh(c\,z)\right) - \tanh^{-1}\left(\frac{\sinh(c\,z)}{\cosh^{\frac{1}{2}}(2\,c\,z)}\right)\right)\cosh(c\,z)\sqrt{\coth(2\,c\,z)\tanh(c\,z)}}{c\cosh^{\frac{1}{2}}(2\,c\,z)}$$

01.22.21.0383.01

$$\int \sqrt{\tanh(2\,c\,z)\coth(c\,z)}\,dz = \frac{\cosh^{\frac{1}{2}}(2\,c\,z)\,\mathrm{sech}(c\,z)\sqrt{\coth(c\,z)\tanh(2\,c\,z)}}{\sqrt{2}\,c}\tanh^{-1}\left(\frac{\sqrt{2}\,\sinh(c\,z)}{\cosh^{\frac{1}{2}}(2\,c\,z)}\right)$$

01.22.21.0384.01

$$\int \sqrt{\tanh^m(2\,c\,z)\coth(c\,z)}\,dz = \frac{1}{c\,(m+3)\left(\coth^2(c\,z)-1\right)} \left(2\,F_1\left(\frac{m+3}{4};\,1,\,\frac{m}{2};\,\frac{m+3}{4}+1;\,\coth^2(c\,z),\,-\coth^2(c\,z)\right)\coth(c\,z)\left(\coth^2(c\,z)+1\right)^{m/2}\mathrm{csch}^2(c\,z)\sqrt{\coth(c\,z)\tanh^m(2\,c\,z)}\right)$$

Involving rational functions of the direct function and hyperbolic functions

Involving rational functions of sinh

Involving $(a\sinh(c\,z) + b\coth(c\,z))^{-n}$

01.22.21.0385.01

$$\int \frac{1}{a\sinh(c\,z)+b\coth(c\,z)}\,dz = \frac{\log\left(-b-2\,a\cosh(c\,z)+\sqrt{4\,a^2+b^2}\right)-\log\left(b+2\,a\cosh(c\,z)+\sqrt{4\,a^2+b^2}\right)}{\sqrt{4\,a^2+b^2}\,c}$$

01.22.21.0386.01

$$\int \frac{1}{(a\sinh(c z)+b\coth(c z))^2}\,dz = \left(\operatorname{csch}^2(c z)\left(a\sinh^2(c z)+b\cosh(c z)\right)\left(-\frac{2(b+2a\cosh(c z))\sinh(c z)}{4a^2+b^2}+\left(2\sqrt{2}\left(4a^2+b\left(\sqrt{4a^2+b^2}-b\right)\right)\tan^{-1}\left(\frac{\left(2a-b+\sqrt{4a^2+b^2}\right)\tanh\left(\frac{c z}{2}\right)}{\sqrt{2}\sqrt{b}\sqrt{\sqrt{4a^2+b^2}-b}}\right)\left(a\sinh^2(c z)+b\cosh(c z)\right)\right)\Big/\left(\sqrt{b}\left(4a^2+b^2\right)^{3/2}\sqrt{\sqrt{4a^2+b^2}-b}\right)-\left(2\sqrt{2}\left(b\left(b+\sqrt{4a^2+b^2}\right)-4a^2\right)\tan^{-1}\left(\frac{\left(-2a+b+\sqrt{4a^2+b^2}\right)\tanh\left(\frac{c z}{2}\right)}{\sqrt{2}\sqrt{-b\left(b+\sqrt{4a^2+b^2}\right)}}\right)\left(a\sinh^2(c z)+b\cosh(c z)\right)\right)\Big/\left(\left(4a^2+b^2\right)^{3/2}\sqrt{-b\left(b+\sqrt{4a^2+b^2}\right)}\right)\right)\right)\Big/\left(2c\,(b\coth(c z)+a\sinh(c z))^2\right)$$

Involving rational functions of cosh

Involving $(a\cosh(c z)+b\coth(c z))^{-n}$

01.22.21.0387.01

$$\int \frac{1}{a\cosh(c z)+b\coth(c z)}\,dz = \frac{2a\tan^{-1}\left(\tanh\left(\frac{c z}{2}\right)\right)+b\log(\cosh(c z))-b\log(b+a\sinh(c z))}{c\,a^2+b^2\,c}$$

01.22.21.0388.01

$$\int \frac{1}{(a\cosh(c z)+b\coth(c z))^2}\,dz = \left(\left(-a\cosh(c z)\coth(c z)\,b^2+\frac{2b\left(b^2-2a^2\right)\tan^{-1}\left(\frac{a-b\tanh\left(\frac{c z}{2}\right)}{\sqrt{-a^2-b^2}}\right)\coth(c z)\,(b+a\sinh(c z))}{\sqrt{-a^2-b^2}}+\operatorname{csch}(c z)\,(b+a\sinh(c z))\left(\left(a^2-b^2\right)\sinh(c z)-2ab\right)\right)\tanh(c z)\right)\Big/\left(\left(a^2+b^2\right)^2 c\,(b+a\sinh(c z))\right)$$

Involving rational functions of tanh

Involving $(a\tanh(c z)+b\coth(c z))^{-n}$

01.22.21.0389.01

$$\int \frac{1}{a\tanh(c z)+b\coth(c z)}\,dz = \frac{\log(-a+b+(a+b)\cosh(2 c z))}{2 a c+2 b c}$$

01.22.21.0390.01

$$\int \frac{1}{(a\tanh(c z)+b\coth(c z))^2}\,dz = \left((-a+b+(a+b)\cosh(2 c z))\operatorname{csch}^2(c z)\operatorname{sech}^2(c z)\left(-(a-b)\left(2\sqrt{a}\sqrt{b}\,c z+(a-b)\tan^{-1}\left(\frac{\sqrt{a}\tanh(c z)}{\sqrt{b}}\right)\right)+ (a+b)\cosh(2 c z)\left(2\sqrt{a}\sqrt{b}\,c z+(a-b)\tan^{-1}\left(\frac{\sqrt{a}\tanh(c z)}{\sqrt{b}}\right)\right)-\sqrt{a}\sqrt{b}\,(a+b)\sinh(2 c z)\right)\right)\Big/ \left(8\sqrt{a}\sqrt{b}\,(a+b)^2 c\,(b\coth(c z)+a\tanh(c z))^2\right)$$

Involving $(a+b\tanh(d z)+c\coth(d z))^{-n}$

01.22.21.0391.01

$$\int \frac{1}{a+c\coth(d z)+b\tanh(d z)}\,dz = \left(\operatorname{csch}(d z)\left(2 a(b-c)\tan^{-1}\left(\frac{a+2 b\tanh(d z)}{\sqrt{4 b c-a^2}}\right)+\sqrt{4 b c-a^2}\,(2 a d z-(b+c)\log(-b+c+(b+c)\cosh(2 d z)+a\sinh(2 d z)))\right) \operatorname{sech}(d z)(-b+c+(b+c)\cosh(2 d z)+a\sinh(2 d z))\right)\Big/ \left(4(a-b-c)(a+b+c)\sqrt{4 b c-a^2}\,d\,(a+c\coth(d z)+b\tanh(d z))\right)$$

01.22.21.0392.01

$$\int \frac{1}{(a+b\tanh(d z)+c\coth(d z))^2}\,dz = \Bigg(\operatorname{csch}^2(d z)\operatorname{sech}^2(d z)\,(-b+c+(b+c)\cosh(2 d z)+a\sinh(2 d z))^2$$
$$\Bigg(-\frac{2(b-c)\tan^{-1}\left(\frac{a+2 b\tanh(d z)}{\sqrt{4 b c-a^2}}\right)}{\left(4 b c-a^2\right)^{3/2}}+\frac{2(b-c)\left(-3 a^4-2(b-c)^2 a^2+(b+c)^2\left(b^2+10 c b+c^2\right)\right)\tan^{-1}\left(\frac{a+2 b\tanh(d z)}{\sqrt{4 b c-a^2}}\right)}{(-a+b+c)^2(a+b+c)^2\left(4 b c-a^2\right)^{3/2}}+$$
$$\frac{a(c-b)+\left(a^2-(b+c)^2\right)\sinh(2 d z)}{(b+c)\left(4 b c-a^2\right)(-b+c+(b+c)\cosh(2 d z)+a\sinh(2 d z))}+$$
$$\Big(-4\left(a^4+(b-c)^2 a^2-4 b c(b+c)^2\right) d z\cosh(2 d z)(b+c)^2+(b-c)\big(a^5+4(b+c) d z a^4-2\left(b^2+6 c b+c^2\right) a^3+4(b-c)^2(b+c) d z a^2+(b+c)^2\left(b^2+10 c b+c^2\right) a-16 b c(b+c)^3 d z\big)-\left(a^2+(b+c)^2\right)\left(a^4+4(b+c) d z a^3-8 b c a^2-16 b c(b+c) d z a-(b+c)^2\left(b^2-6 c b+c^2\right)\right)\sinh(2 d z)\Big)\Big/$$
$$\left((b+c)(-a+b+c)^2(a+b+c)^2\left(4 b c-a^2\right)(-b+c+(b+c)\cosh(2 d z)+a\sinh(2 d z))\right)-$$
$$\frac{4 a(b+c)\log(-b+c+(b+c)\cosh(2 d z)+a\sinh(2 d z))}{(-a+b+c)^2(a+b+c)^2}\Bigg)\Bigg)\Big/\left(16 d\left(a+c\coth(d z)+b\tanh(d z)\right)^2\right)$$

Involving $\left(a\tanh^2(c z)+b\coth^2(c z)\right)^{-n}$

01.22.21.0393.01

$$\int \frac{1}{a\tanh^2(c z)+b\coth^2(c z)}\,dz = \frac{1}{2\sqrt[4]{a}\sqrt[4]{b}\,(a+b)\,c}$$
$$\left(2\sqrt[4]{a}\,c z\sqrt[4]{b}+\sqrt[4]{-1}\left(\sqrt{a}+i\sqrt{b}\right)\tan^{-1}\left(\frac{\sqrt[4]{-1}\sqrt[4]{a}\tanh(c z)}{\sqrt[4]{b}}\right)+\sqrt[4]{-1}\left(i\sqrt{a}+\sqrt{b}\right)\tan^{-1}\left(\frac{(-1)^{3/4}\sqrt[4]{a}\tanh(c z)}{\sqrt[4]{b}}\right)\right)$$

01.22.21.0394.01

$$\int \frac{1}{\left(a \tanh^2(c z) + b \coth^2(c z)\right)^2} \, dz = \left(((a+b)(\cosh(4 c z)+3) - 4(a-b)\cosh(2 c z))^2 \operatorname{csch}^4(c z) \operatorname{sech}^4(c z) \left(\frac{1024 c z}{(a+b)^2} + \frac{1}{a^{7/4}\left(\sqrt{a} - i\sqrt{b}\right)^2 b^{7/4}} \left(\sqrt[4]{-1} \left(-i\sqrt{a} + \sqrt{b}\right)\left(20\sqrt{b}\, i\, a^{3/2} + 3 a^2 + 174 b a - 20 i b^{3/2} \sqrt{a} + 3 b^2\right) \tan^{-1}\left(\frac{\sqrt[4]{-1}\, \sqrt[4]{a} \tanh(c z)}{\sqrt[4]{b}}\right)\right) + \frac{1}{a^{7/4}\left(\sqrt{a} + i\sqrt{b}\right)^2 b^{7/4}} \left((-1)^{3/4} \left(i\sqrt{a} + \sqrt{b}\right)\left(-20 i \sqrt{b}\, a^{3/2} + 3 a^2 + 174 b a + 20 b^{3/2} i \sqrt{a} + 3 b^2\right) \tan^{-1}\left(\frac{(-1)^{3/4} \sqrt[4]{a} \tanh(c z)}{\sqrt[4]{b}}\right)\right) + \frac{1}{a^{7/4} b^{7/4}} \left(3\left(\frac{8 a^{3/4} (-2 a + 2 b + (a+b)\cosh(2 c z)) \sinh(2 c z) b^{3/4}}{4(a-b)\cosh(2 c z) - (a+b)(\cosh(4 c z)+3)} - \frac{3(-1)^{3/4}(a+b)^2 \tan^{-1}\left(\frac{\sqrt[4]{-1}\, \sqrt[4]{a} \tanh(c z)}{\sqrt[4]{b}}\right)}{\sqrt{a} + i\sqrt{b}} - \frac{3\sqrt[4]{-1}\,(a+b)^2 \tan^{-1}\left(\frac{(-1)^{3/4} \sqrt[4]{a} \tanh(c z)}{\sqrt[4]{b}}\right)}{\sqrt{a} - i\sqrt{b}} \right)\right) + \frac{1}{a^{7/4} b^{7/4}} \left(4\left((-1)^{3/4} \left(\sqrt{a} + i\sqrt{b}\right)\left(3 a + 2 i \sqrt{b}\sqrt{a} - 3 b\right) \tan^{-1}\left(\frac{\sqrt[4]{-1}\, \sqrt[4]{a} \tanh(c z)}{\sqrt[4]{b}}\right) + \sqrt[4]{-1} \left(\sqrt{a} - i\sqrt{b}\right)\left(3 a - 2 i \sqrt{b}\sqrt{a} - 3 b\right) \tan^{-1}\left(\frac{(-1)^{3/4} \sqrt[4]{a} \tanh(c z)}{\sqrt[4]{b}}\right) + \frac{8 a^{3/4} b^{3/4} (-2 a + 2 b + 3(a+b)\cosh(2 c z)) \sinh(2 c z)}{4(a-b)\cosh(2 c z) - (a+b)(\cosh(4 c z)+3)} \right)\right) + \frac{8\left(14\left(b^2 - a^2\right) + \left(15 a^2 - 98 b a + 15 b^2\right)\cosh(2 c z)\right)\sinh(2 c z)}{a b (a+b)((a+b)(\cosh(4 c z)+3) - 4(a-b)\cosh(2 c z))} \right)\right) \Big/ \left(65\,536\, c \left(b \coth^2(c z) + a \tanh^2(c z)\right)^2\right)$$

Involving algebraic functions of the direct function and hyperbolic functions

Involving sinh

Involving $\sinh(c z)\,(a + b \coth(c z))^{\beta}$

01.22.21.0395.01

$$\int \sinh(c\,z)\,(a + b\coth(c\,z))^{\beta}\,dz = \frac{1}{\sqrt{2}\,c}\sqrt{\coth(c\,z)+1}\,(a+b\coth(c\,z))^{\beta}\left(\frac{a+b\coth(c\,z)}{a+b}\right)^{-\beta}\sinh(c\,z)\,F_1\!\left(-\frac{1}{2};\frac{3}{2},-\beta;\frac{1}{2};\frac{1}{2}(1-\coth(c\,z)),\frac{b-b\coth(c\,z)}{a+b}\right)$$

01.22.21.0396.01

$$\int \sinh(c\,z)\sqrt{a+b\coth(c\,z)}\,dz = -\left(\cosh(c\,z)\sqrt{\frac{(\cosh(c\,z)+\sinh(c\,z))\,(b\cosh(c\,z)+a\sinh(c\,z))}{b}}\left((a+b)\,i\sqrt{\coth(c\,z)-1}\sqrt{\frac{a+b\coth(c\,z)}{b\coth(c\,z)-b}}\,E\!\left(i\sinh^{-1}\!\left(\frac{\sqrt{\frac{a+b}{b}}}{\sqrt{\coth(c\,z)-1}}\right)\middle|\frac{2b}{a+b}\right)\operatorname{sech}(c\,z)\sqrt{\cosh(2\,c\,z)+\sinh(2\,c\,z)}\,(\cosh(c\,z)-\sinh(c\,z)) + a\,i\sqrt{\coth(c\,z)-1}\sqrt{\frac{a+b\coth(c\,z)}{b\coth(c\,z)-b}}\,F\!\left(i\sinh^{-1}\!\left(\frac{\sqrt{\frac{a+b}{b}}}{\sqrt{\coth(c\,z)-1}}\right)\middle|\frac{2b}{a+b}\right)\sqrt{\cosh(2\,c\,z)+\sinh(2\,c\,z)}\,(\tanh(c\,z)-1)+\sqrt{\frac{a+b}{b}}\,(b+a\tanh(c\,z))\right)\right)\Bigg/\left(\sqrt{\frac{a+b}{b}}\,c\sqrt{a+b\coth(c\,z)}\sqrt{\frac{a+b}{b\coth(c\,z)-b}+1}\right)$$

01.22.21.0397.01

$$\int \frac{\sinh(c\,z)}{\sqrt{a+b\coth(c\,z)}}\,dz = \left(\cosh(c\,z)\left(\sqrt{\frac{b\,(\coth(c\,z)+1)}{b-a}}\sqrt{\frac{a+b\coth(c\,z)}{a+b}}\sqrt{\coth(c\,z)+1}\;F\!\left(\sin^{-1}\!\left(\frac{\sqrt{1-\coth(c\,z)}}{\sqrt{2}}\right)\middle|\frac{2\,b}{a+b}\right)(\tanh(c\,z)-1)\,b^2 - a\sqrt{\frac{a+b\coth(c\,z)}{a-b}}\sqrt{\frac{b-b\coth(c\,z)}{a+b}}\,(a+b)\sqrt{1-\coth(c\,z)}\;E\!\left(\sin^{-1}\!\left(\sqrt{\frac{a+b\coth(c\,z)}{a-b}}\right)\middle|\frac{a-b}{a+b}\right)\operatorname{sech}(c\,z)\,(\cosh(c\,z)+\sinh(c\,z)) + \sqrt{1-\coth(c\,z)}\left(\sqrt{\frac{b\,(\coth(c\,z)+1)}{b-a}}\left(a^2+b\operatorname{csch}(c\,z)\operatorname{sech}(c\,z)\,a-b^2\right) + a\sqrt{\frac{a+b\coth(c\,z)}{a-b}}\;b\sqrt{\frac{b-b\coth(c\,z)}{a+b}}\;F\!\left(\sin^{-1}\!\left(\sqrt{\frac{a+b\coth(c\,z)}{a-b}}\right)\middle|\frac{a-b}{a+b}\right)(\tanh(c\,z)+1)\right)\right)\right) \Big/ \left((a-b)\,(a+b)\,c\sqrt{1-\coth(c\,z)}\sqrt{\frac{b\,(\coth(c\,z)+1)}{b-a}}\sqrt{a+b\coth(c\,z)}\right)$$

Involving $\sinh(c\,z)\left(a+b\coth^2(c\,z)\right)^{\beta}$

01.22.21.0398.01

$$\int \sinh(c\,z)\left(a+b\coth^2(c\,z)\right)^{\beta} dz = \frac{\cosh(c\,z)\left(b\coth^2(c\,z)+a\right)^{\beta}\left(\frac{b\coth^2(c\,z)}{a}+1\right)^{-\beta}\sqrt{-\operatorname{csch}^2(c\,z)}}{c}\,F_1\!\left(\frac{1}{2};\frac{3}{2},-\beta;\frac{3}{2};\coth^2(c\,z),-\frac{b\coth^2(c\,z)}{a}\right)$$

01.22.21.0399.01

$$\int \sinh(c\,z)\sqrt{a+b\coth^2(c\,z)}\,dz = \left(i\sqrt{2}\sqrt{\frac{1}{a}}\;b\cosh(c\,z)\sqrt{b\coth^2(c\,z)+a}\left(E\!\left(i\sinh^{-1}\!\left(\frac{\sqrt{\frac{1}{a}}\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}}{\sqrt{2}}\right)\middle|-\frac{a}{b}\right) - F\!\left(i\sinh^{-1}\!\left(\frac{\sqrt{\frac{1}{a}}\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}}{\sqrt{2}}\right)\middle|-\frac{a}{b}\right)\right)\sqrt{-\frac{(a+b)\sinh^2(c\,z)}{b}}\right)\Big/\left(c\sqrt{\frac{(a+b)\cosh^2(c\,z)}{a}}\sqrt{-a+b+(a+b)\cosh(2\,c\,z)}\right)$$

01.22.21.0400.01

$$\int \frac{\sinh(c z)}{\sqrt{a+b\coth^2(c z)}}\,dz = \left((\cosh(c z)+1)\sqrt{\frac{-a+b+(a+b)\cosh(2 c z)}{(\cosh(c z)+1)^2}}\,\operatorname{csch}(c z)\left(\sqrt{\frac{2a-2\sqrt{a+b}\sqrt{a}+b}{b}}\,(-a+b+(a+b)\cosh(2 c z))\tanh\left(\frac{c z}{2}\right)\operatorname{sech}^2\left(\frac{c z}{2}\right)+4\sqrt{\frac{\left(2a+2\sqrt{a+b}\sqrt{a}+b\right)\tanh^2\left(\frac{c z}{2}\right)+b}{b}}\sqrt{\frac{\left(2a-2\sqrt{a+b}\sqrt{a}+b\right)\tanh^2\left(\frac{c z}{2}\right)+b}{b}}\left(a-\sqrt{a+b}\sqrt{a}+b\right)i\,F\left(i\sinh^{-1}\left(\sqrt{\frac{2a-2\sqrt{a+b}\sqrt{a}+b}{b}}\tanh\left(\frac{c z}{2}\right)\right)\middle|\frac{2a+2\sqrt{a+b}\sqrt{a}+b}{2a-2\sqrt{a+b}\sqrt{a}+b}\right)-2i\left(2a-2\sqrt{a+b}\sqrt{a}+b\right)E\left(i\sinh^{-1}\left(\sqrt{\frac{2a-2\sqrt{a+b}\sqrt{a}+b}{b}}\tanh\left(\frac{c z}{2}\right)\right)\middle|\frac{2a+2\sqrt{a+b}\sqrt{a}+b}{2a-2\sqrt{a+b}\sqrt{a}+b}\right)\sqrt{\frac{\left(2a-2\sqrt{a+b}\sqrt{a}+b\right)\tanh^2\left(\frac{c z}{2}\right)+b}{b}}\sqrt{\frac{\left(2a+2\sqrt{a+b}\sqrt{a}+b\right)\tanh^2\left(\frac{c z}{2}\right)+b}{b}}\right)\right)\Big/\left(2\sqrt{2}\,(a+b)\sqrt{\frac{2a-2\sqrt{a+b}\sqrt{a}+b}{b}}\,c\sqrt{b\coth^2(c z)+a}\sqrt{4a\tanh^2\left(\frac{c z}{2}\right)+b\left(\tanh^2\left(\frac{c z}{2}\right)+1\right)^2}\right)$$

Involving cosh

Involving $\cosh(c z)\,(a+b\coth(c z))^\beta$

01.22.21.0401.01

$$\int \cosh(c z)\,(a+b\coth(c z))^\beta\,dz = -\frac{1}{c(\beta-2)(\beta-1)}\left(\left(b+\frac{a+b}{\coth(c z)-1}\right)^\beta\left((\beta-1)F_1\left(2-\beta;\frac{3}{2},-\beta;3-\beta;-\frac{2}{\coth(c z)-1},\frac{a+b}{b-b\coth(c z)}\right)+(\beta-2)F_1\left(1-\beta;\frac{3}{2},-\beta;2-\beta;-\frac{2}{\coth(c z)-1},\frac{a+b}{b-b\coth(c z)}\right)(\coth(c z)-1)\right)(a+b\coth(c z))^{\beta-1}\left(\frac{a+b\coth(c z)}{\coth(c z)-1}\right)^{1-\beta}\left(\frac{a+b}{b\coth(c z)-b}+1\right)^{-\beta}\sinh(c z)\sqrt{\cosh(2 c z)+\sinh(2 c z)}\right)$$

01.22.21.0402.01

$$\int \cosh(c z)\sqrt{a+b\coth(c z)}\,dz = \left(\cosh(c z)\sqrt{\frac{(\cosh(c z)+\sinh(c z))(b\cosh(c z)+a\sinh(c z))}{b}}\left(\sqrt{2}\,b\,i\sqrt{\coth(c z)-1}\sqrt{\frac{a+b\coth(c z)}{b\coth(c z)-b}}\,F\left(i\sinh^{-1}\left(\frac{\sqrt{2}}{\sqrt{\coth(c z)-1}}\right)\middle|\frac{a+b}{2b}\right)\sqrt{\cosh(2 c z)+\sinh(2 c z)}\,(\tanh(c z)-1)+2(b+a\tanh(c z))\right)\right)\Big/\left(2c\sqrt{a+b\coth(c z)}\sqrt{\frac{a+b}{b\coth(c z)-b}+1}\right)$$

01.22.21.0403.01

$$\int \frac{\cosh(c z)}{\sqrt{a+b\coth(c z)}}\,dz = \left(\cosh(c z)\sqrt{a+b\coth(c z)}\,\sinh(c z)(\cosh(c z)+\sinh(c z))\left(i\,b\sqrt{\coth(c z)-1}\sqrt{\frac{a+b\coth(c z)}{b\coth(c z)-b}}\,E\left(i\sinh^{-1}\left(\frac{\sqrt{\frac{a+b}{b}}}{\sqrt{\coth(c z)-1}}\right)\middle|\frac{2b}{a+b}\right)\sqrt{\cosh(2 c z)+\sinh(2 c z)}\,(\tanh(c z)-1)-\sqrt{\frac{a+b}{b}}\,(b+a\tanh(c z))\right)\right)\Big/\left(b(b-a)\sqrt{\frac{a+b}{b}}\,c\sqrt{\frac{a+b}{b\coth(c z)-b}+1}\sqrt{\frac{(\cosh(c z)+\sinh(c z))(b\cosh(c z)+a\sinh(c z))}{b}}\right)$$

Involving $\cosh(c z)\left(a+b\coth^2(c z)\right)^\beta$

01.22.21.0404.01

$$\int \cosh(c z)\left(b\coth^2(c z)+a\right)^\beta dz = \frac{\left(b\coth^2(c z)+a\right)^{\beta+1}\sinh(c z)}{2(a+b)c(\beta+1)}\sqrt{-\frac{b\operatorname{csch}^2(c z)}{a+b}}\;{}_2F_1\left(\beta+1,\frac{3}{2};\beta+2;\frac{b\coth^2(c z)+a}{a+b}\right)$$

01.22.21.0405.01

$$\int \cosh(c z)\sqrt{a+b\coth^2(c z)}\,dz = \frac{\sinh(c z)}{c\sqrt{b\coth^2(c z)+a}}\left(b\coth^2(c z)+a-\sqrt{a+b}\,\sin^{-1}\left(\frac{\sqrt{b\coth^2(c z)+a}}{\sqrt{a+b}}\right)\sqrt{b\coth^2(c z)+a}\sqrt{-\frac{b\operatorname{csch}^2(c z)}{a+b}}\right)$$

01.22.21.0406.01

$$\int \frac{\cosh(c z)}{\sqrt{a+b\coth^2(c z)}}\,dz = -\frac{(a-b)\operatorname{csch}(c z)}{2(a+b)c\sqrt{b\coth^2(c z)+a}}\sqrt{\frac{(a+b)\cosh(2 c z)}{b-a}+1}\left(\sqrt{\frac{(a+b)\cosh(2 c z)}{b-a}+1}-1\right)$$

Involving tanh

Involving $\tanh(c\,z)\,(a+b\coth(c\,z))^{\beta}$

01.22.21.0407.01

$$\int \tanh(c\,z)\,(a+b\coth(c\,z))^{\beta}\,dz = \frac{1}{2\,a\,(a-b)\,(a+b)\,c\,(\beta+1)} \left((a+b\coth(c\,z))^{\beta+1}\left((a-b)\left(a\,{}_2F_1\left(\beta+1,1;\beta+2;\frac{a+b\coth(c\,z)}{a+b}\right)-2\,(a+b)\,{}_2F_1\left(\beta+1,1;\beta+2;\frac{b\coth(c\,z)}{a}+1\right)\right)+a\,(a+b)\,{}_2F_1\left(\beta+1,1;\beta+2;\frac{a+b\coth(c\,z)}{a-b}\right)\right)\right)$$

01.22.21.0408.01

$$\int \tanh(c\,z)\sqrt{a+b\coth(c\,z)}\,dz = \frac{1}{c}\left(-2\sqrt{a}\,\tanh^{-1}\left(\frac{\sqrt{a+b\coth(c\,z)}}{\sqrt{a}}\right)+\sqrt{a-b}\,\tanh^{-1}\left(\frac{\sqrt{a+b\coth(c\,z)}}{\sqrt{a-b}}\right)+\sqrt{a+b}\,\tanh^{-1}\left(\frac{\sqrt{a+b\coth(c\,z)}}{\sqrt{a+b}}\right)\right)$$

01.22.21.0409.01

$$\int \frac{\tanh(c\,z)}{\sqrt{a+b\coth(c\,z)}}\,dz = \frac{1}{c}\left(-\frac{2\tanh^{-1}\left(\frac{\sqrt{a+b\coth(c\,z)}}{\sqrt{a}}\right)}{\sqrt{a}}+\frac{\tanh^{-1}\left(\frac{\sqrt{a+b\coth(c\,z)}}{\sqrt{a-b}}\right)}{\sqrt{a-b}}+\frac{\tanh^{-1}\left(\frac{\sqrt{a+b\coth(c\,z)}}{\sqrt{a+b}}\right)}{\sqrt{a+b}}\right)$$

Involving $\tanh(c\,z)\left(a+b\coth^2(c\,z)\right)^{\beta}$

01.22.21.0410.01

$$\int \tanh(c\,z)\left(a+b\coth^2(c\,z)\right)^{\beta}dz = \frac{\left(b\coth^2(c\,z)+a\right)^{\beta}}{2\,c}\left(\frac{1}{\beta}\,{}_2F_1\left(-\beta,-\beta;1-\beta;-\frac{a\tanh^2(c\,z)}{b}\right)\left(\frac{a\tanh^2(c\,z)}{b}+1\right)^{-\beta}+\frac{\left(b\coth^2(c\,z)+a\right)}{(a+b)\,(\beta+1)}\,{}_2F_1\left(\beta+1,1;\beta+2;\frac{b\coth^2(c\,z)+a}{a+b}\right)\right)$$

01.22.21.0411.01

$$\int \tanh(c\,z)\sqrt{a+b\coth^2(c\,z)}\,dz = \left(\sqrt{b}\,(a+b)\tanh^{-1}\left(\frac{\sqrt{b\coth^2(c\,z)+a}}{\sqrt{a+b}}\right)\sqrt{b\coth^2(c\,z)+a}\,\sqrt{\frac{a\tanh^2(c\,z)}{b}+1}-\sqrt{a}\,\sqrt{a+b}\,\sinh^{-1}\left(\frac{\sqrt{a}\,\tanh(c\,z)}{\sqrt{b}}\right)(b\coth(c\,z)+a\tanh(c\,z))\right)\Big/\left(\sqrt{b}\,\sqrt{a+b}\,c\,\sqrt{b\coth^2(c\,z)+a}\,\sqrt{\frac{a\tanh^2(c\,z)}{b}+1}\right)$$

01.22.21.0412.01

$$\int \frac{\tanh(c\,z)}{\sqrt{a+b\coth^2(c\,z)}}\,dz = \frac{1}{c}\left(\frac{\tanh^{-1}\left(\frac{\sqrt{b\coth^2(c\,z)+a}}{\sqrt{a+b}}\right)}{\sqrt{a+b}} - \frac{\sqrt{b}\,\sinh^{-1}\left(\frac{\sqrt{a}\,\tanh(c\,z)}{\sqrt{b}}\right)\coth(c\,z)\sqrt{\frac{a\tanh^2(c\,z)}{b}+1}}{\sqrt{a}\,\sqrt{b\coth^2(c\,z)+a}}\right)$$

Involving sinh and tanh

01.22.21.0413.01

$$\int \frac{d\coth^2(c\,z)+e\sinh(c\,z)}{\sqrt{\left(b\tanh^2(c\,z)+a\right)^3}}\,dz = \Bigg(\operatorname{sech}(c\,z)\left(d\coth^2(c\,z)+e\sinh(c\,z)\right) \Bigg((a-b+(a+b)\cosh(2\,c\,z))^{3/2}\Bigg(\sqrt{2}\,d\operatorname{csch}^3(c\,z)\log\left(\sqrt{a-b+(a+b)\cosh(2\,c\,z)}+\sqrt{2}\,\sqrt{(a+b)\sinh^2(c\,z)}\right)\left((a+b)\sinh^2(c\,z)\right)^{3/2}+\frac{2\,(a+b)\,e\sqrt{a-b+(a+b)\cosh(2\,c\,z)}\sqrt{\frac{a-b+(a+b)\cosh(2\,c\,z)}{(\cosh(c\,z)+1)^2}}}{\sqrt{(a-b+(a+b)\cosh(2\,c\,z))\operatorname{sech}^4\left(\frac{c\,z}{2}\right)}}\Bigg)-\frac{1}{a^2}\left((a+b)\,(a-b+(a+b)\cosh(2\,c\,z))\operatorname{csch}(c\,z)\left(2\,b\,e\sinh(c\,z)\,a^2+\left(a^3+b\,a^2-2\,b^2\,a-2\,b^3\right)d+\left(a^3+3\,b\,a^2+4\,b^2\,a+2\,b^3\right)d\cosh(2\,c\,z)\right)\right)\tanh^2(c\,z)\Bigg)\Bigg) \Big/ \left((a+b)^3\,c\,(2\cosh(2\,c\,z)\,d+2\,d-3\,e\sinh(c\,z)+e\sinh(3\,c\,z))\sqrt{\left(b\tanh^2(c\,z)+a\right)^3}\right)$$

Involving functions of the direct function, hyperbolic and a power functions

Involving powers of the direct function, hyperbolic and a power functions

Involving sinh and power

Involving $z^n \sinh(a+b\,z)\coth^{\nu}(c\,z)$

01.22.21.0414.01

$$\int z^n \sinh(a+b\,z)\coth^\nu(c\,z)\,dz = \frac{1}{2}(-1)^\nu\, n!\left(-e^{(c\,\nu-b)\,z-a}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(c\,\nu-b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{c\,\nu-b}{2\,c},\,\ldots,\,\frac{c\,\nu-b}{2\,c},\,\nu;\,\frac{c\,\nu-b}{2\,c}+1,\,\ldots,\,\frac{c\,\nu-b}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{a+(b+c\,\nu)\,z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(b+c\,\nu)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{b+c\,\nu}{2\,c},\,\ldots,\,\frac{b+c\,\nu}{2\,c},\,\nu;\,\frac{b+c\,\nu}{2\,c}+1,\,\ldots,\,\frac{b+c\,\nu}{2\,c}+1;\,e^{2\,c\,z}\right)-\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\left(e^{(2\,c\,s-b)\,z-a}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,s-b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{2\,c\,s-b}{2\,c},\,\ldots,\,\frac{2\,c\,s-b}{2\,c},\,\nu;\,\frac{2\,c\,s-b}{2\,c}+1,\,\ldots,\,\frac{2\,c\,s-b}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{(2\,c\,(\nu-s)-b)\,z-a}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,(\nu-s)-b)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{2\,c\,(\nu-s)-b}{2\,c},\,\ldots,\,\frac{2\,c\,(\nu-s)-b}{2\,c},\,\nu;\,\frac{2\,c\,(\nu-s)-b}{2\,c}+1,\,\ldots,\,\frac{2\,c\,(\nu-s)-b}{2\,c}+1;\,e^{2\,c\,z}\right)\right)+\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\left(e^{a+(b+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{b+2\,c\,s}{2\,c},\,\ldots,\,\frac{b+2\,c\,s}{2\,c},\,\nu;\,\frac{b+2\,c\,s}{2\,c}+1,\,\ldots,\,\frac{b+2\,c\,s}{2\,c}+1;\,e^{2\,c\,z}\right)+e^{a+(b+2\,c\,(\nu-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b+2\,c\,(\nu-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\!\left(\frac{b+2\,c\,(\nu-s)}{2\,c},\,\ldots,\,\frac{b+2\,c\,(\nu-s)}{2\,c},\,\nu;\,\frac{b+2\,c\,(\nu-s)}{2\,c}+1,\,\ldots,\,\frac{b+2\,c\,(\nu-s)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)\right)\,/;\,n\in\mathbb{N}\land\nu\in\mathbb{N}^+$$

01.22.21.0415.01

$$\int z^n \sinh(b\,z)\coth^\nu(c\,z)\,dz = \frac{1}{2}(-1)^\nu \binom{\nu}{\frac{\nu}{2}} n!\,(1-\nu \bmod 2) \left(e^{(b+c\nu)z} \sum_{j=0}^{n} \frac{(-1)^j (b+c\nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{b+c\nu}{2c}, \ldots, \frac{b+c\nu}{2c}, \nu; \frac{b+c\nu}{2c}+1, \ldots, \frac{b+c\nu}{2c}+1; e^{2cz}\right) - e^{(c\nu-b)z} \sum_{j=0}^{n} \frac{(-1)^j (c\nu-b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{c\nu-b}{2c}, \ldots, \frac{c\nu-b}{2c}, \nu; \frac{c\nu-b}{2c}+1, \ldots, \frac{c\nu-b}{2c}+1; e^{2cz}\right)\right) + \frac{1}{2}(-1)^\nu n! \sum_{i=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{i} \left(-e^{(2ci-b)z} \sum_{j=0}^{n} \frac{(-1)^j (2ci-b)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{2ci-b}{2c}, \ldots, \frac{2ci-b}{2c}, \nu; \frac{2ci-b}{2c}+1, \ldots, \frac{2ci-b}{2c}+1; e^{2cz}\right) + e^{(b+2ci)z} \sum_{j=0}^{n} \frac{(-1)^j (b+2ci)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{b+2ci}{2c}, \ldots, \frac{b+2ci}{2c}, \nu; \frac{b+2ci}{2c}+1, \ldots, \frac{b+2ci}{2c}+1; e^{2cz}\right) - e^{(-b-2ci+2c\nu)z} \sum_{j=0}^{n} \frac{(-1)^j (-b-2ci+2c\nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{-b-2ci+2c\nu}{2c}, \ldots, \frac{-b-2ci+2c\nu}{2c}, \nu; \frac{-b-2ci+2c\nu}{2c}+1, \ldots, \frac{-b-2ci+2c\nu}{2c}+1; e^{2cz}\right) + e^{(b-2ci+2c\nu)z} \sum_{j=0}^{n} \frac{(-1)^j (b-2ci+2c\nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{b-2ci+2c\nu}{2c}, \ldots, \frac{b-2ci+2c\nu}{2c}, \nu; \frac{b-2ci+2c\nu}{2c}+1, \ldots, \frac{b-2ci+2c\nu}{2c}+1; e^{2cz}\right)\right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

Involving powers of sinh and power

Involving $z^n \sinh^u(b\,z) \coth^\nu(c\,z)$

01.22.21.0416.01

$$\int z^n \sinh^u(b\,z)\coth^\nu(c\,z)\,dz = (-1)^\nu \binom{u}{\frac{u}{2}} n!\,(1-u \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + e^{2c\nu z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} (c\nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\nu, \ldots, \nu; \nu+1, \ldots, \nu+1; e^{2cz}\right) + e^{2cz} \nu \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+3}F_{j+2}\!\left(1, \ldots, 1, \nu+1; 2, \ldots, 2; e^{2cz}\right) + e^{c\nu z} \binom{\nu}{\frac{\nu}{2}} (1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c\nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{\nu}{2}, \ldots, \frac{\nu}{2}, \nu; \frac{\nu}{2}+1, \ldots, \frac{\nu}{2}+1; e^{2cz}\right) + \right.$$

$$\sum_{s=1}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{2csz}\sum_{j=0}^{n}\frac{(-1)^j\,2^{-j-1}\,(c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(s,\,\ldots,\,s,\,v;\,s+1,\,\ldots,\,s+1;\,e^{2cz}\right)+e^{2c(v-s)z}\right.$$

$$\left.\sum_{j=0}^{n}\frac{(-1)^j\,2^{-j-1}\,(c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(v-s,\,\ldots,\,v-s,\,v;\,-s+v+1,\,\ldots,\,-s+v+1;\,e^{2cz}\right)\right)\left(\frac{i}{2}\right)^u+$$

$$2^{-u}\,n!\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}(-1)^{k+v}\binom{u}{k}\left((-1)^u\,e^{(c\,v-b\,(u-2k))z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(c\,v-b\,(u-2k))^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$${}_{j+2}F_{j+1}\left(\frac{c\,v-b\,(u-2k)}{2c},\,\ldots,\,\frac{c\,v-b\,(u-2k)}{2c},\,v;\,\frac{c\,v-b\,(u-2k)}{2c}+1,\,\ldots,\,\frac{c\,v-b\,(u-2k)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(b\,(u-2k)+c\,v)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(b\,(u-2k)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{b\,(u-2k)+c\,v}{2c},\,\ldots,\,\frac{b\,(u-2k)+c\,v}{2c},\,v;\,\frac{b\,(u-2k)+c\,v}{2c}+1,\,\ldots,\,\frac{b\,(u-2k)+c\,v}{2c}+1;\,e^{2cz}\right)+$$

$$(-1)^u\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(2cs-b\,(u-2k))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2cs-b\,(u-2k))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2cs-b\,(u-2k)}{2c},\right.\right.$$

$$\left.\ldots,\,\frac{2cs-b\,(u-2k)}{2c},\,v;\,\frac{2cs-b\,(u-2k)}{2c}+1,\,\ldots,\,\frac{2cs-b\,(u-2k)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(2c(v-s)-b\,(u-2k))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2c\,(v-s)-b\,(u-2k))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\left(\frac{2c\,(v-s)-b\,(u-2k)}{2c},\,\ldots,\,\frac{2c\,(v-s)-b\,(u-2k)}{2c},\,v;\right.$$

$$\left.\left.\frac{2c\,(v-s)-b\,(u-2k)}{2c}+1,\,\ldots,\,\frac{2c\,(v-s)-b\,(u-2k)}{2c}+1;\,e^{2cz}\right)\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(2cs+b\,(u-2k))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2cs+b\,(u-2k))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2cs+b\,(u-2k)}{2c},\,\ldots,\right.\right.$$

$$\left.\frac{2cs+b\,(u-2k)}{2c},\,v;\,\frac{2cs+b\,(u-2k)}{2c}+1,\,\ldots,\,\frac{2cs+b\,(u-2k)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(b\,(u-2k)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(b\,(u-2k)+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{b\,(u-2k)+2c\,(v-s)}{2c},\right.$$

$$\ldots,\,\frac{b\,(u-2k)+2c\,(v-s)}{2c},\,v;\,\frac{b\,(u-2k)+2c\,(v-s)}{2c}+1,\,\ldots,$$

$$\left.\left.\left.\frac{b\,(u-2k)+2c\,(v-s)}{2c}+1;\,e^{2cz}\right)\right)\right)\,/;\,n\in\mathbb{N}\land u\in\mathbb{N}^+\land v\in\mathbb{N}^+$$

Involving cosh and power

Involving $z^n \cosh(a + b z) \coth^v(c z)$

01.22.21.0417.01

$$\int z^n \cosh(a+b z)\coth^v(c z)\,dz = \frac{1}{2}(-1)^v\, n!\left(e^{(-b+c v) z-a}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(-b+c v)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-b+c v}{2 c},\ldots,\frac{-b+c v}{2 c}, v; \frac{-b+c v}{2 c}+1,\ldots,\frac{-b+c v}{2 c}+1; e^{2 c z}\right)+e^{a+(b+c v) z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(b+c v)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{b+c v}{2 c},\ldots,\frac{b+c v}{2 c}, v; \frac{b+c v}{2 c}+1,\ldots,\frac{b+c v}{2 c}+1; e^{2 c z}\right)+\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(-b+2 c s) z-a}\sum_{j=0}^{n}\frac{(-1)^j(-b+2 c s)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-b+2 c s}{2 c},\ldots,\frac{-b+2 c s}{2 c}, v; \frac{-b+2 c s}{2 c}+1,\ldots,\frac{-b+2 c s}{2 c}+1; e^{2 c z}\right)+e^{(-b+2 c(v-s)) z-a}\sum_{j=0}^{n}\frac{(-1)^j(-b+2 c(v-s))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-b+2 c(v-s)}{2 c},\ldots,\frac{-b+2 c(v-s)}{2 c}, v; \frac{-b+2 c(v-s)}{2 c}+1,\ldots,\frac{-b+2 c(v-s)}{2 c}+1; e^{2 c z}\right)\right)+\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{a+(b+2 c s) z}\sum_{j=0}^{n}\frac{(-1)^j(b+2 c s)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{b+2 c s}{2 c},\ldots,\frac{b+2 c s}{2 c}, v; \frac{b+2 c s}{2 c}+1,\ldots,\frac{b+2 c s}{2 c}+1; e^{2 c z}\right)+e^{a+(b+2 c(v-s)) z}\sum_{j=0}^{n}\frac{(-1)^j(b+2 c(v-s))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{b+2 c(v-s)}{2 c},\ldots,\frac{b+2 c(v-s)}{2 c}, v; \frac{b+2 c(v-s)}{2 c}+1,\ldots,\frac{b+2 c(v-s)}{2 c}+1; e^{2 c z}\right)\right)\right) /; n \in \mathbb{N} \land v \in \mathbb{N}^+$$

01.22.21.0418.01

$$\int z^n \cosh(b\,z) \coth^\nu(c\,z)\,dz = \frac{1}{2}(-1)^\nu \binom{\nu}{\frac{\nu}{2}} n!\,(1-\nu \bmod 2) \left(e^{(c\,\nu-b)\,z} \sum_{j=0}^{n} \frac{(-1)^j (c\,\nu-b)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{c\,\nu-b}{2\,c}, \ldots, \frac{c\,\nu-b}{2\,c}, \nu; \frac{c\,\nu-b}{2\,c}+1, \ldots, \frac{c\,\nu-b}{2\,c}+1; e^{2\,c\,z}\right) + e^{(b+c\,\nu)\,z} \sum_{j=0}^{n} \frac{(-1)^j (b+c\,\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+c\,\nu}{2\,c}, \ldots, \frac{b+c\,\nu}{2\,c}, \nu; \frac{b+c\,\nu}{2\,c}+1, \ldots, \frac{b+c\,\nu}{2\,c}+1; e^{2\,c\,z}\right)\right) + \frac{1}{2}(-1)^\nu n! \sum_{i=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{i} \left(e^{(2\,c\,i-b)\,z} \sum_{j=0}^{n} \frac{(-1)^j (2\,c\,i-b)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{2\,c\,i-b}{2\,c}, \ldots, \frac{2\,c\,i-b}{2\,c}, \nu; \frac{2\,c\,i-b}{2\,c}+1, \ldots, \frac{2\,c\,i-b}{2\,c}+1; e^{2\,c\,z}\right) + e^{(b+2\,c\,i)\,z} \sum_{j=0}^{n} \frac{(-1)^j (b+2\,c\,i)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2\,c\,i}{2\,c}, \ldots, \frac{b+2\,c\,i}{2\,c}, \nu; \frac{b+2\,c\,i}{2\,c}+1, \ldots, \frac{b+2\,c\,i}{2\,c}+1; e^{2\,c\,z}\right) + e^{(-b-2\,c\,i+2\,c\,\nu)\,z} \sum_{j=0}^{n} \frac{(-1)^j (-b-2\,c\,i+2\,c\,\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b-2\,c\,i+2\,c\,\nu}{2\,c}, \ldots, \frac{-b-2\,c\,i+2\,c\,\nu}{2\,c}, \nu; \frac{-b-2\,c\,i+2\,c\,\nu}{2\,c}+1, \ldots, \frac{-b-2\,c\,i+2\,c\,\nu}{2\,c}+1; e^{2\,c\,z}\right) + e^{(b-2\,c\,i+2\,c\,\nu)\,z} \sum_{j=0}^{n} \frac{(-1)^j (b-2\,c\,i+2\,c\,\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b-2\,c\,i+2\,c\,\nu}{2\,c}, \ldots, \frac{b-2\,c\,i+2\,c\,\nu}{2\,c}, \nu; \frac{b-2\,c\,i+2\,c\,\nu}{2\,c}+1, \ldots, \frac{b-2\,c\,i+2\,c\,\nu}{2\,c}+1; e^{2\,c\,z}\right)\right) /;\ n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0419.01

$$\int z^n \cosh(c\,z) \coth^\nu(c\,z)\,dz = \frac{1}{2}(-1)^\nu e^{c\,\nu\,z} \binom{\nu+1}{\frac{\nu+1}{2}} n!\,(1-(\nu+1) \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c\,\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{\nu}{2}, \ldots, \frac{\nu}{2}, \nu; \frac{\nu}{2}+1, \ldots, \frac{\nu}{2}+1; e^{2\,c\,z}\right) + \frac{1}{2}(-1)^\nu e^{c\,\nu\,z} n! \sum_{s=0}^{\left\lfloor \frac{\nu}{2} \right\rfloor} \binom{\nu+1}{s} \left(e^{-c\,(-2\,s+\nu+1)\,z} \sum_{j=0}^{n} \frac{(-1)^j (-c\,(1-2\,s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{1}{2}(2\,s-1), \ldots, \frac{1}{2}(2\,s-1), \nu; \frac{1}{2}(2\,s-1)+1, \ldots, \frac{1}{2}(2\,s-1)+1; e^{2\,c\,z}\right) + e^{c\,(-2\,s+\nu+1)\,z} \sum_{j=0}^{n} \frac{(-1)^j (c\,(-2\,s+2\,\nu+1))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{1}{2}(-2\,s+2\,\nu+1), \ldots, \frac{1}{2}(-2\,s+2\,\nu+1), \nu; \frac{1}{2}(-2\,s+2\,\nu+1)+1, \ldots, \frac{1}{2}(-2\,s+2\,\nu+1)+1; e^{2\,c\,z}\right)\right) /;\ n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

Involving powers of cosh and power

Involving $z^n \cosh^u(b z) \coth^v(c z)$

01.22.21.0420.01

$$\int z^n \cosh^u(b z) \coth^v(c z)\, dz = (-1)^v 2^{-u} \binom{u}{\frac{u}{2}} n! \,(1 - u \bmod 2) \Bigg(\frac{z^{n+1}}{(n+1)!} + e^{2 c v z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} (c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(v, \ldots, v; v+1, \ldots, v+1; e^{2 c z}\right) + e^{2 c z} v \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} c^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+3}F_{j+2}\left(1, \ldots, 1, v+1; 2, \ldots, 2; e^{2 c z}\right) + e^{c v z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{v}{2}, \ldots, \frac{v}{2}, v; \frac{v}{2}+1, \ldots, \frac{v}{2}+1; e^{2 c z}\right) + \sum_{s=1}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{2 c s z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} (c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(s, \ldots, s, v; s+1, \ldots, s+1; e^{2 c z}\right) + e^{2 c (v-s) z} \sum_{j=0}^{n} \frac{(-1)^j 2^{-j-1} (c (v-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(v-s, \ldots, v-s, v; -s+v+1, \ldots, -s+v+1; e^{2 c z}\right) \Bigg) \Bigg) +$$

$$(-1)^v 2^{-u} n! \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{u}{k} \Bigg(e^{(c v - b (u - 2 k)) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c v - b (u - 2 k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{c v - b (u - 2 k)}{2 c}, \ldots, \frac{c v - b (u - 2 k)}{2 c}, v; \frac{c v - b (u - 2 k)}{2 c} + 1, \ldots, \frac{c v - b (u - 2 k)}{2 c} + 1; e^{2 c z}\right) + e^{(b (u - 2 k) + c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b (u - 2 k) + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b (u - 2 k) + c v}{2 c}, \ldots, \frac{b (u - 2 k) + c v}{2 c}, v; \frac{b (u - 2 k) + c v}{2 c} + 1, \ldots, \frac{b (u - 2 k) + c v}{2 c} + 1; e^{2 c z}\right) + \sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(2 c s - b (u - 2 k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s - b (u - 2 k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 c s - b (u - 2 k)}{2 c}, \ldots, \frac{2 c s - b (u - 2 k)}{2 c}, v; \frac{2 c s - b (u - 2 k)}{2 c} + 1, \ldots, \frac{2 c s - b (u - 2 k)}{2 c} + 1; e^{2 c z}\right) + e^{(2 c (v - s) - b (u - 2 k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (v - s) - b (u - 2 k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 c (v - s) - b (u - 2 k)}{2 c}, \ldots, \frac{2 c (v - s) - b (u - 2 k)}{2 c}, v; \frac{2 c (v - s) - b (u - 2 k)}{2 c} + 1, \ldots, \frac{2 c (v - s) - b (u - 2 k)}{2 c} + 1; e^{2 c z}\right) \Bigg) +$$

$$\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\Bigg(e^{(2cs+b(u-2k))z}\sum_{j=0}^{n}\frac{(-1)^j\,(2cs+b(u-2k))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\bigg(\frac{2cs+b(u-2k)}{2c},\ldots,\frac{2cs+b(u-2k)}{2c},\nu;\frac{2cs+b(u-2k)}{2c}+1,\ldots,\frac{2cs+b(u-2k)}{2c}+1;e^{2cz}\bigg)+e^{(b(u-2k)+2c(\nu-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(b(u-2k)+2c(\nu-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\bigg(\frac{b(u-2k)+2c(\nu-s)}{2c},\ldots,\frac{b(u-2k)+2c(\nu-s)}{2c},\nu;\frac{b(u-2k)+2c(\nu-s)}{2c}+1,\ldots,\frac{b(u-2k)+2c(\nu-s)}{2c}+1;e^{2cz}\bigg)\Bigg)\Bigg)\;/;\;n\in\mathbb{N}\land u\in\mathbb{N}^+\land\nu\in\mathbb{N}^+$$

Involving functions of the direct function, hyperbolic and exponential functions

Involving powers of the direct function, hyperbolic and exponential functions

Involving sinh and exp

Involving $e^{pz}\sinh(bz)\coth^{\nu}(cz)$

01.22.21.0421.01

$$\int e^{pz}\sinh(bz)\coth^{\nu}(cz)\,dz=\frac{1}{2}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(cz)\left(\frac{e^{(b+p)z}}{b+p}F_1\left(-\frac{b+p}{2c};-\nu,\nu;1-\frac{b+p}{2c};-e^{-2cz},e^{-2cz}\right)-\frac{e^{(p-b)z}}{p-b}F_1\left(-\frac{p-b}{2c};-\nu,\nu;1-\frac{p-b}{2c};-e^{-2cz},e^{-2cz}\right)\right)$$

01.22.21.0422.01

$$\int e^{bz}\sinh(bz)\coth^{\nu}(cz)\,dz=\frac{\left(e^{2bz}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(cz)\right)}{4b}F_1\left(-\frac{b}{c};-\nu,\nu;1-\frac{b}{c};-e^{-2cz},e^{-2cz}\right)-\frac{\coth^{\nu+1}(cz)}{2c(\nu+1)}\,{}_2F_1\left(\frac{\nu+1}{2},1;\frac{\nu+3}{2};\coth^2(cz)\right)$$

01.22.21.0423.01

$$\int e^{-bz}\sinh(bz)\coth^{\nu}(cz)\,dz=\frac{e^{-2bz}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(cz)}{4b}F_1\left(\frac{b}{c};-\nu,\nu;\frac{b}{c}+1;-e^{-2cz},e^{-2cz}\right)+\frac{\coth^{\nu+1}(cz)}{2c(\nu+1)}\,{}_2F_1\left(\frac{\nu+1}{2},1;\frac{\nu+3}{2};\coth^2(cz)\right)$$

Involving powers of sinh and exp

Involving $e^{pz}\sinh^{u}(bz)\coth^{\nu}(cz)$

01.22.21.0424.01

$$\int e^{p z} \sinh^u(b z) \coth^\nu(c z)\, dz = \frac{e^{p z} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) (1 - u \bmod 2)}{p} \left(\frac{i}{2}\right)^u \binom{u}{\frac{u}{2}} F_1\left(-\frac{p}{2 c}; -\nu, \nu; 1 - \frac{p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) + 2^{-u} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{u}{k} \left(\frac{e^{(p + b (u - 2 k)) z} F_1\left(-\frac{p + b (u - 2 k)}{2 c}; -\nu, \nu; 1 - \frac{p + b (u - 2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p + b (u - 2 k)} + \frac{(-1)^u e^{(p - b (u - 2 k)) z} F_1\left(-\frac{p - b (u - 2 k)}{2 c}; -\nu, \nu; 1 - \frac{p - b (u - 2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p - b (u - 2 k)} \right) /; u \in \mathbb{N}^+$$

01.22.21.0425.01

$$\int e^{p z} \sinh^\mu(c z) \coth^\nu(c z)\, dz = \frac{e^{p z} \left(1 - e^{2 c z}\right)^{\nu - \mu} \left(1 + e^{2 c z}\right)^{-\nu} \coth^\nu(c z) \sinh^\mu(c z)}{p - c \mu} F_1\left(\frac{p - c \mu}{2 c}; \nu - \mu, -\nu; \frac{1}{2} \left(\frac{p}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right)$$

Involving cosh and exp

Involving $e^{p z} \cosh(b z) \coth^\nu(c z)$

01.22.21.0426.01

$$\int e^{p z} \cosh(b z) \coth^\nu(c z)\, dz = \frac{1}{2} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \left(\frac{e^{(p - b) z}}{p - b} F_1\left(-\frac{p - b}{2 c}; -\nu, \nu; 1 - \frac{p - b}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) + \frac{e^{(b + p) z}}{b + p} F_1\left(-\frac{b + p}{2 c}; -\nu, \nu; 1 - \frac{b + p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) \right)$$

01.22.21.0427.01

$$\int e^{b z} \cosh(b z) \coth^\nu(c z)\, dz = \frac{\left(e^{2 b z} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z)\right)}{4 b} F_1\left(-\frac{b}{c}; -\nu, \nu; 1 - \frac{b}{c}; -e^{-2 c z}, e^{-2 c z}\right) + \frac{\coth^{\nu + 1}(c z)}{2 c (\nu + 1)} {}_2F_1\left(\frac{\nu + 1}{2}, 1; \frac{\nu + 3}{2}; \coth^2(c z)\right)$$

01.22.21.0428.01

$$\int e^{-b z} \cosh(b z) \coth^\nu(c z)\, dz = \frac{\coth^{\nu + 1}(c z)}{2 c (\nu + 1)} {}_2F_1\left(\frac{\nu + 1}{2}, 1; \frac{\nu + 3}{2}; \coth^2(c z)\right) - \frac{e^{-2 b z} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z)}{4 b} F_1\left(\frac{b}{c}; -\nu, \nu; \frac{b}{c} + 1; -e^{-2 c z}, e^{-2 c z}\right)$$

Involving powers of cosh and exp

Involving $e^{p z} \cosh^u(b z) \coth^\nu(c z)$

01.22.21.0429.01

$$\int e^{pz}\cosh^{u}(b\,z)\coth^{\nu}(c\,z)\,dz = \frac{2^{-u}\,e^{pz}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(c\,z)\,(1-u \bmod 2)}{p}\binom{u}{\frac{u}{2}}F_1\!\left(-\frac{p}{2c};-\nu,\nu;1-\frac{p}{2c};-e^{-2cz},e^{-2cz}\right)+ 2^{-u}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(c\,z)\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{k}\left(\frac{e^{(p+b(u-2k))z}\,F_1\!\left(-\frac{p+b(u-2k)}{2c};-\nu,\nu;1-\frac{p+b(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)}{p+b(u-2k)}+\frac{e^{(p-b(u-2k))z}\,F_1\!\left(-\frac{p-b(u-2k)}{2c};-\nu,\nu;1-\frac{p-b(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)}{p-b(u-2k)}\right)\;/;\;u\in\mathbb{N}^{+}$$

01.22.21.0430.01

$$\int e^{pz}\cosh^{\mu}(c\,z)\coth^{\nu}(c\,z)\,dz = \frac{e^{pz}\left(1-e^{2cz}\right)^{\nu}\left(1+e^{2cz}\right)^{-\mu-\nu}\cosh^{\mu}(c\,z)\coth^{\nu}(c\,z)}{p-c\,\mu}F_1\!\left(\frac{p-c\,\mu}{2c};\nu,-\mu-\nu;\frac{1}{2}\left(\frac{p}{c}-\mu+2\right);e^{2cz},-e^{2cz}\right)$$

Involving tanh and exp

Involving $e^{pz}\tanh(c\,z)\coth^{\nu}(c\,z)$

01.22.21.0431.01

$$\int e^{pz}\tanh(c\,z)\coth^{\nu}(c\,z)\,dz = \frac{e^{pz}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(c\,z)}{p}F_1\!\left(-\frac{p}{2c};1-\nu,\nu-1;1-\frac{p}{2c};-e^{-2cz},e^{-2cz}\right)$$

Involving powers of tanh and exp

Involving $e^{pz}\tanh^{\mu}(c\,z)\coth^{\nu}(c\,z)$

01.22.21.0432.01

$$\int e^{pz}\tanh^{\mu}(c\,z)\coth^{\nu}(c\,z)\,dz = \frac{e^{pz}\left(1-e^{-2cz}\right)^{\nu-\mu}\left(1+e^{-2cz}\right)^{\mu-\nu}\coth^{\nu}(c\,z)\tanh^{\mu}(c\,z)}{p}F_1\!\left(-\frac{p}{2c};\mu-\nu,\nu-\mu;1-\frac{p}{2c};-e^{-2cz},e^{-2cz}\right)$$

Involving functions of the direct function, hyperbolic and trigonometric functions

Involving powers of the direct function, hyperbolic and trigonometric functions

Involving sin and sinh

Involving $\sin(a\,z)\sinh(b\,z)\coth^{\nu}(c\,z)$

01.22.21.0433.01

$$\int \sin(a\,z)\sinh(b\,z)\coth^{\nu}(c\,z)\,dz = \frac{1}{4}\,i\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^{\nu}(c\,z)$$
$$\left(-\frac{e^{(-b-i a)z}F_1\left(-\frac{-b-i a}{2c};-\nu,\nu;1-\frac{-b-i a}{2c};-e^{-2cz},e^{-2cz}\right)}{-b-i a}+\frac{e^{(i a-b)z}F_1\left(-\frac{i a-b}{2c};-\nu,\nu;1-\frac{i a-b}{2c};-e^{-2cz},e^{-2cz}\right)}{i a-b}+\right.$$
$$\left.\frac{e^{(b-i a)z}F_1\left(-\frac{b-i a}{2c};-\nu,\nu;1-\frac{b-i a}{2c};-e^{-2cz},e^{-2cz}\right)}{b-i a}-\frac{e^{(b+i a)z}F_1\left(-\frac{b+i a}{2c};-\nu,\nu;1-\frac{b+i a}{2c};-e^{-2cz},e^{-2cz}\right)}{b+i a}\right)$$

Involving powers of sin and powers of sinh

Involving $\sin^{m}(a\,z)\sinh^{u}(b\,z)\coth^{\nu}(c\,z)$

01.22.21.0434.01

$$\int \sin^m(a z)\sinh^u(b z)\coth^\nu(c z)\,dz = \frac{i^u\, 2^{-m-u}\coth^{\nu+1}(c z)\,(1-m \bmod 2)\,(1-u \bmod 2)}{c(\nu+1)}\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}}\,{}_2F_1\!\left(\frac{\nu+1}{2},1;\frac{\nu+1}{2}+1;\coth^2(c z)\right)+$$
$$\frac{i^{u+1}\,2^{-m-u}\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(c z)\,(1-u \bmod 2)}{a}\binom{u}{\frac{u}{2}}$$
$$\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\frac{(-1)^s}{m-2s}\binom{m}{s}\left(e^{\frac{i m\pi}{2}-i a(m-2s)z}\,F_1\!\left(\frac{i a(m-2s)}{2c};-\nu,\nu;\frac{a i(m-2s)}{2c}+1;-e^{-2cz},e^{-2cz}\right)-\right.$$
$$\left.e^{i a(m-2s)z-\frac{i m\pi}{2}}\,F_1\!\left(-\frac{i a(m-2s)}{2c};-\nu,\nu;1-\frac{i a(m-2s)}{2c};-e^{-2cz},e^{-2cz}\right)\right)+$$
$$\frac{2^{-m-u}\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(c z)\,(1-m \bmod 2)}{b}\binom{m}{\frac{m}{2}}$$
$$\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\frac{(-1)^k}{u-2k}\binom{u}{k}\left(e^{b(u-2k)z}\,F_1\!\left(-\frac{b(u-2k)}{2c};-\nu,\nu;1-\frac{b(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)-\right.$$
$$\left.(-1)^u\,e^{-b(u-2k)z}\,F_1\!\left(\frac{b(u-2k)}{2c};-\nu,\nu;\frac{b(u-2k)}{2c}+1;-e^{-2cz},e^{-2cz}\right)\right)+2^{-m-u}\left(1-e^{-2cz}\right)^\nu$$
$$\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(c z)\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^{k+s}\binom{m}{s}\binom{u}{k}\left(\left(e^{\frac{i\pi m}{2}+(b(u-2k)-i a(m-2s))z}\,F_1\!\left(-\frac{b(u-2k)-i a(m-2s)}{2c};\right.\right.\right.$$
$$\left.\left.-\nu,\nu;1-\frac{b(u-2k)-i a(m-2s)}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/(b(u-2k)-i a(m-2s))+$$
$$\left(e^{(a i(m-2s)+b(u-2k))z-\frac{i m\pi}{2}}\,F_1\!\left(-\frac{a i(m-2s)+b(u-2k)}{2c};-\nu,\nu;1-\frac{a i(m-2s)+b(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/$$
$$(a i(m-2s)+b(u-2k))+\left((-1)^u\,e^{\frac{i\pi m}{2}+(-i a(m-2s)-b(u-2k))z}\,F_1\!\left(-\frac{-i a(m-2s)-b(u-2k)}{2c};\right.\right.$$
$$\left.\left.-\nu,\nu;1-\frac{-i a(m-2s)-b(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/(-i a(m-2s)-b(u-2k))+$$
$$\left((-1)^u\,e^{(i a(m-2s)-b(u-2k))z-\frac{i m\pi}{2}}\,F_1\!\left(-\frac{i a(m-2s)-b(u-2k)}{2c};-\nu,\nu;1-\frac{i a(m-2s)-b(u-2k)}{2c};\right.\right.$$
$$\left.\left.\left.-e^{-2cz},e^{-2cz}\right)\right)\Big/(i a(m-2s)-b(u-2k))\right)\quad /;\ m\in\mathbb{N}^+\land u\in\mathbb{N}^+$$

01.22.21.0435.01

$$\int \sin^m(a z) \sinh^\mu(c z) \coth^\nu(c z)\, dz = 2^{-m} \left(1 - e^{2 c z}\right)^{\nu-\mu} \left(1 + e^{2 c z}\right)^{-\nu} \coth^\nu(c z) \sinh^\mu(c z)$$

$$\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(\frac{e^{\frac{i m \pi}{2} - i a (m-2k) z} F_1\left(\frac{-i a (m-2k) - c\mu}{2c}; \nu-\mu, -\nu; \frac{1}{2}\left(-\frac{i a (m-2k)}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right)}{-i a (m-2k) - c\mu} + \right.$$

$$\left. \frac{e^{i a (m-2k) z - \frac{i m \pi}{2}} F_1\left(\frac{i a (m-2k) - c\mu}{2c}; \nu-\mu, -\nu; \frac{1}{2}\left(\frac{a i (m-2k)}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right)}{i a (m-2k) - c\mu} \right) - \frac{1}{c\mu} 2^{-m} \left(1 - e^{2 c z}\right)^{\nu-\mu}$$

$$\left(1 + e^{2 c z}\right)^{-\nu} F_1\left(-\frac{\mu}{2}; \nu-\mu, -\nu; \frac{2-\mu}{2}; e^{2 c z}, -e^{2 c z}\right) \binom{m}{\frac{m}{2}} \coth^\nu(c z) (1 - m \bmod 2) \sinh^\mu(c z) /; m \in \mathbb{N}^+$$

Involving cos and sinh

Involving cos(a z) sinh(b z) coth^ν(c z)

01.22.21.0436.01

$$\int \cos(a z) \sinh(b z) \coth^\nu(c z)\, dz = \frac{1}{4} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z)$$

$$\left(-\frac{e^{(-b - i a) z} F_1\left(-\frac{-b - i a}{2c}; -\nu, \nu; 1 - \frac{-b - i a}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{-b - i a} + \frac{e^{(b - i a) z} F_1\left(-\frac{b - i a}{2c}; -\nu, \nu; 1 - \frac{b - i a}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{b - i a} + \right.$$

$$\left. \frac{e^{(b + i a) z} F_1\left(-\frac{b + i a}{2c}; -\nu, \nu; 1 - \frac{b + i a}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{b + i a} - \frac{e^{(i a - b) z} F_1\left(-\frac{i a - b}{2c}; -\nu, \nu; 1 - \frac{i a - b}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{i a - b} \right)$$

Involving powers of cos and powers of sinh

Involving cos^m(a z) sinh^u(b z) coth^ν(c z)

01.22.21.0437.01

$$\int \cos^m(a z) \sinh^u(b z) \coth^\nu(c z)\, dz = \frac{i^u 2^{-m-u} \coth^{\nu+1}(c z)(1 - m \bmod 2)(1 - u \bmod 2)}{c(\nu+1)} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} {}_2F_1\left(\frac{\nu+1}{2}, 1; \frac{\nu+1}{2} + 1; \coth^2(c z)\right) +$$

$$\frac{i^{u+1} 2^{-m-u} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z)(1 - u \bmod 2)}{a} \binom{u}{\frac{u}{2}}$$

$$\sum_{s=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \frac{1}{m - 2 s} \binom{m}{s} \left(e^{-i a (m-2 s) z} F_1\left(\frac{i a (m - 2 s)}{2 c}; -\nu, \nu; \frac{a i (m - 2 s)}{2 c} + 1; -e^{-2 c z}, e^{-2 c z}\right) - \right.$$

$$\left. e^{i a (m-2 s) z} F_1\left(-\frac{i a (m - 2 s)}{2 c}; -\nu, \nu; 1 - \frac{i a (m - 2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) +$$

$$\frac{2^{-m-u} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z)(1 - m \bmod 2)}{b} \binom{m}{\frac{m}{2}}$$

$$\sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \frac{(-1)^k}{u - 2 k} \binom{u}{k} \left(e^{b (u-2 k) z} F_1\left(-\frac{b (u - 2 k)}{2 c}; -\nu, \nu; 1 - \frac{b (u - 2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) - \right.$$

$$\left. (-1)^u e^{-b (u-2 k) z} F_1\left(\frac{b (u - 2 k)}{2 c}; -\nu, \nu; \frac{b (u - 2 k)}{2 c} + 1; -e^{-2 c z}, e^{-2 c z}\right)\right) + 2^{-m-u} \left(1 - e^{-2 c z}\right)^\nu$$

$$\left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{s=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{s} \binom{u}{k} \left(\left(e^{(b (u-2 k) - i a (m-2 s)) z} F_1\left(-\frac{b (u - 2 k) - i a (m - 2 s)}{2 c}; -\nu, \right.\right.\right.$$

$$\left.\left. \nu; 1 - \frac{b (u - 2 k) - i a (m - 2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (b (u - 2 k) - i a (m - 2 s)) +$$

$$\left(e^{(a i (m-2 s) + b (u-2 k)) z} F_1\left(-\frac{a i (m - 2 s) + b (u - 2 k)}{2 c}; -\nu, \nu; 1 - \frac{a i (m - 2 s) + b (u - 2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/$$

$$(a i (m - 2 s) + b (u - 2 k)) + \left((-1)^u e^{(-i a (m-2 s) - b (u-2 k)) z} F_1\left(-\frac{-i a (m - 2 s) - b (u - 2 k)}{2 c}; -\nu, \right.\right.$$

$$\left.\left. \nu; 1 - \frac{-i a (m - 2 s) - b (u - 2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (-i a (m - 2 s) - b (u - 2 k)) +$$

$$\left((-1)^u e^{(i a (m-2 s) - b (u-2 k)) z} F_1\left(-\frac{i a (m - 2 s) - b (u - 2 k)}{2 c}; -\nu, \nu; 1 - \frac{i a (m - 2 s) - b (u - 2 k)}{2 c}; \right.\right.$$

$$\left.\left.\left. -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (i a (m - 2 s) - b (u - 2 k))\right) \text{ /; } m \in \mathbb{N}^+ \land u \in \mathbb{N}^+$$

01.22.21.0438.01

$$\int \cos^m(a z)\sinh^\mu(c z)\coth^\nu(c z)\,dz = 2^{-m}\left(1-e^{2cz}\right)^{\nu-\mu}\left(1+e^{2cz}\right)^{-\nu}\coth^\nu(c z)\sinh^\mu(c z)$$
$$\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(\frac{e^{-i a(m-2k)z}F_1\left(\frac{-i a(m-2k)-c\mu}{2c};\nu-\mu,-\nu;\frac{1}{2}\left(-\frac{i a(m-2k)}{c}-\mu+2\right);e^{2cz},-e^{2cz}\right)}{-i a(m-2k)-c\mu}+\right.$$
$$\left.\frac{e^{i a(m-2k)z}F_1\left(\frac{i a(m-2k)-c\mu}{2c};\nu-\mu,-\nu;\frac{1}{2}\left(\frac{a i(m-2k)}{c}-\mu+2\right);e^{2cz},-e^{2cz}\right)}{i a(m-2k)-c\mu}\right)-\frac{1}{c\mu}2^{-m}\left(1-e^{2cz}\right)^{\nu-\mu}$$
$$\left(1+e^{2cz}\right)^{-\nu}\coth^\nu(c z)\binom{m}{\frac{m}{2}}(1-m\bmod 2)\sinh^\mu(c z)F_1\left(-\frac{\mu}{2};\nu-\mu,-\nu;\frac{2-\mu}{2};e^{2cz},-e^{2cz}\right)\;/;\;m\in\mathbb{N}^+$$

Involving sin and cosh

Involving $\sin(a z)\cosh(b z)\coth^\nu(c z)$

01.22.21.0439.01

$$\int \sin(a z)\cosh(b z)\coth^\nu(c z)\,dz = -\frac{1}{4}i\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(c z)$$
$$\left(-\frac{e^{(-b-i a)z}F_1\left(-\frac{-b-i a}{2c};-\nu,\nu;1-\frac{-b-i a}{2c};-e^{-2cz},e^{-2cz}\right)}{-b-i a}+\frac{e^{(i a-b)z}F_1\left(-\frac{i a-b}{2c};-\nu,\nu;1-\frac{i a-b}{2c};-e^{-2cz},e^{-2cz}\right)}{i a-b}+\right.$$
$$\left.\frac{e^{(b+i a)z}F_1\left(-\frac{b+i a}{2c};-\nu,\nu;1-\frac{b+i a}{2c};-e^{-2cz},e^{-2cz}\right)}{b+i a}-\frac{e^{(b-i a)z}F_1\left(-\frac{b-i a}{2c};-\nu,\nu;1-\frac{b-i a}{2c};-e^{-2cz},e^{-2cz}\right)}{b-i a}\right)$$

Involving powers of sin and powers of cosh

Involving $\sin^m(a z)\cosh^u(b z)\coth^\nu(c z)$

01.22.21.0440.01

$$\int \sin^m(a z)\cosh^u(b z)\coth^\nu(c z)\,dz =$$
$$2^{-m-u}\left(1-e^{-2cz}\right)^\nu\coth^\nu(c z)\left(\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^s\left(\left(e^{\frac{i\pi m}{2}+(b(u-2k)-i a(m-2s))z}F_1\left(-\frac{b(u-2k)-i a(m-2s)}{2c};-\nu,\nu;\right.\right.\right.\right.$$
$$\left.\left.1-\frac{b(u-2k)-i a(m-2s)}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/(b(u-2k)-i a(m-2s))+\left(e^{(a i(m-2s)+b(u-2k))z-\frac{i m\pi}{2}}\right.$$
$$\left.F_1\left(-\frac{a i(m-2s)+b(u-2k)}{2c};-\nu,\nu;1-\frac{a i(m-2s)+b(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/$$
$$(a i(m-2s)+b(u-2k))+\left(e^{\frac{i\pi m}{2}+(-i a(m-2s)-b(u-2k))z}F_1\left(-\frac{-i a(m-2s)-b(u-2k)}{2c};-\nu,\right.\right.$$

$$\nu;\, 1-\frac{-i\, a\,(m-2\,s)-b\,(u-2\,k)}{2\,c};\, -e^{-2\,c\,z},\, e^{-2\,c\,z}\Big)\Big)\Big/ (-i\, a\,(m-2\,s)-b\,(u-2\,k)) +$$

$$\Big(e^{(i\, a\,(m-2\,s)-b\,(u-2\,k))\,z-\frac{i\,m\,\pi}{2}}\, F_1\Big(-\frac{i\, a\,(m-2\,s)-b\,(u-2\,k)}{2\,c};\, -\nu,\, \nu;\, 1-\frac{i\, a\,(m-2\,s)-b\,(u-2\,k)}{2\,c};$$

$$-e^{-2\,c\,z},\, e^{-2\,c\,z}\Big)\Big)\Big/ (i\, a\,(m-2\,s)-b\,(u-2\,k))\Big)\binom{m}{s}\binom{u}{k}\Big)\left(1+e^{-2\,c\,z}\right)^{-\nu} +$$

$$\frac{2^{-m-u}\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}}\coth^{\nu+1}(c\,z)\, {}_2F_1\!\left(\frac{\nu+1}{2},\, 1;\, \frac{\nu+1}{2}+1;\, \coth^2(c\,z)\right)(1-m \bmod 2)\,(1-u \bmod 2)}{c\,(\nu+1)} +$$

$$\frac{1}{a}$$

$$\Bigg(\Big(i\, 2^{-m-u}\left(1-e^{-2\,c\,z}\right)^{\nu}\left(1+e^{-2\,c\,z}\right)^{-\nu}\binom{u}{\frac{u}{2}}\coth^{\nu}(c\,z)\,(1-u \bmod 2)\Big)$$

$$\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\frac{1}{m-2\,s}\Big((-1)^s\Big(e^{\frac{i\,m\,\pi}{2}-i\,a\,(m-2\,s)\,z}\, F_1\Big(\frac{i\, a\,(m-2\,s)}{2\,c};\, -\nu,\, \nu;\, \frac{a\, i\,(m-2\,s)}{2\,c}+1;\, -e^{-2\,c\,z},\, e^{-2\,c\,z}\Big)-$$

$$e^{i\,a\,(m-2\,s)\,z-\frac{i\,m\,\pi}{2}}\, F_1\Big(-\frac{i\, a\,(m-2\,s)}{2\,c};\, -\nu,\, \nu;\, 1-\frac{i\, a\,(m-2\,s)}{2\,c};\, -e^{-2\,c\,z},\, e^{-2\,c\,z}\Big)\Big)\binom{m}{s}\Big)\Bigg) +$$

$$\frac{1}{b}\Bigg(\Big(2^{-m-u}\left(1-e^{-2\,c\,z}\right)^{\nu}\left(1+e^{-2\,c\,z}\right)^{-\nu}\binom{m}{\frac{m}{2}}\coth^{\nu}(c\,z)\,(1-m \bmod 2)\Big)\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\frac{1}{u-2\,k}$$

$$\Big(\Big(e^{b\,(u-2\,k)\,z}\, F_1\Big(-\frac{b\,(u-2\,k)}{2\,c};\, -\nu,\, \nu;\, 1-\frac{b\,(u-2\,k)}{2\,c};\, -e^{-2\,c\,z},\, e^{-2\,c\,z}\Big)-$$

$$e^{-b\,(u-2\,k)\,z}\, F_1\Big(\frac{b\,(u-2\,k)}{2\,c};\, -\nu,\, \nu;\, \frac{b\,(u-2\,k)}{2\,c}+1;\, -e^{-2\,c\,z},\, e^{-2\,c\,z}\Big)\Big)\binom{u}{k}\Big)\Bigg)\, /;\, m\in\mathbb{N}^+ \land u\in\mathbb{N}^+$$

01.22.21.0441.01

$$\int \sin^m(a z) \cosh^\mu(c z) \coth^\nu(c z)\, dz = 2^{-m} \left(1 - e^{2 c z}\right)^\nu \left(1 + e^{2 c z}\right)^{-\mu-\nu} \cosh^\mu(c z) \coth^\nu(c z) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(\frac{e^{\frac{i m \pi}{2} - i a (m-2k) z} F_1\left(\frac{-i a (m-2k) - c \mu}{2c}; \nu, -\mu-\nu; \frac{1}{2}\left(-\frac{i a (m-2k)}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right)}{-i a (m-2k) - c\mu} + \frac{e^{i a (m-2k) z - \frac{i m \pi}{2}} F_1\left(\frac{i a (m-2k) - c \mu}{2c}; \nu, -\mu-\nu; \frac{1}{2}\left(\frac{a i (m-2k)}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right)}{i a (m-2k) - c\mu} \right) - \frac{1}{c \mu} 2^{-m} \left(1 - e^{2 c z}\right)^\nu \left(1 + e^{2 c z}\right)^{-\mu-\nu} \binom{m}{\frac{m}{2}} \cosh^\mu(c z) \coth^\nu(c z) (1 - m \bmod 2) F_1\left(-\frac{\mu}{2}; \nu, -\mu-\nu; \frac{2-\mu}{2}; e^{2 c z}, -e^{2 c z}\right) /; m \in \mathbb{N}^+$$

Involving cos and cosh

Involving $\cos(a z) \cosh(b z) \coth^\nu(c z)$

01.22.21.0442.01

$$\int \cos(a z) \cosh(b z) \coth^\nu(c z)\, dz = \frac{1}{4} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \left(\frac{e^{(-b - i a) z} F_1\left(-\frac{-b - i a}{2c}; -\nu, \nu; 1 - \frac{-b - i a}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{-b - i a} + \frac{e^{(i a - b) z} F_1\left(-\frac{i a - b}{2c}; -\nu, \nu; 1 - \frac{i a - b}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{i a - b} + \frac{e^{(b - i a) z} F_1\left(-\frac{b - i a}{2c}; -\nu, \nu; 1 - \frac{b - i a}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{b - i a} + \frac{e^{(b + i a) z} F_1\left(-\frac{b + i a}{2c}; -\nu, \nu; 1 - \frac{b + i a}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{b + i a} \right)$$

Involving powers of cos and powers of cosh

Involving $\cos^m(a z) \cosh^u(b z) \coth^\nu(c z)$

01.22.21.0443.01

$$\int \cos^m(a z)\cosh^u(b z)\coth^\nu(c z)\,dz = \frac{2^{-m-u}\, i\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(c z)\,(1-u \bmod 2)}{a}$$

$$\binom{u}{\frac{u}{2}}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\frac{1}{m-2k}\binom{m}{k}\left(e^{-i a(m-2k)z}F_1\left(\frac{i a(m-2k)}{2c}; -\nu, \nu; \frac{a i (m-2k)}{2c}+1; -e^{-2cz}, e^{-2cz}\right)-\right.$$

$$\left.e^{i a(m-2k)z}F_1\left(-\frac{i a(m-2k)}{2c}; -\nu, \nu; 1-\frac{i a(m-2k)}{2c}; -e^{-2cz}, e^{-2cz}\right)\right)+$$

$$\frac{2^{-m-u}\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(c z)\,(1-m \bmod 2)}{b}\binom{m}{\frac{m}{2}}$$

$$\sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\frac{1}{u-2s}\binom{u}{s}\left(e^{b(u-2s)z}F_1\left(-\frac{b(u-2s)}{2c}; -\nu, \nu; 1-\frac{b(u-2s)}{2c}; -e^{-2cz}, e^{-2cz}\right)-\right.$$

$$\left.e^{-b(u-2s)z}F_1\left(\frac{b(u-2s)}{2c}; -\nu, \nu; \frac{b(u-2s)}{2c}+1; -e^{-2cz}, e^{-2cz}\right)\right)+$$

$$2^{-m-u}\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(c z)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{m}{k}\binom{u}{s}\left(\left(e^{(b(u-2s)-i a(m-2k))z}F_1\left(-\frac{b(u-2s)-i a(m-2k)}{2c};\right.\right.\right.$$

$$\left.\left.-\nu, \nu; 1-\frac{b(u-2s)-i a(m-2k)}{2c}; -e^{-2cz}, e^{-2cz}\right)\right)\Big/(b(u-2s)-i a(m-2k))+$$

$$\left(e^{(a i(m-2k)+b(u-2s))z}F_1\left(-\frac{a i(m-2k)+b(u-2s)}{2c}; -\nu, \nu; 1-\frac{a i(m-2k)+b(u-2s)}{2c}; -e^{-2cz}, e^{-2cz}\right)\right)\Big/$$

$$(a i(m-2k)+b(u-2s))+\left(e^{(-i a(m-2k)-b(u-2s))z}F_1\left(-\frac{-i a(m-2k)-b(u-2s)}{2c}; -\nu,\right.\right.$$

$$\left.\left.\nu; 1-\frac{-i a(m-2k)-b(u-2s)}{2c}; -e^{-2cz}, e^{-2cz}\right)\right)\Big/(-i a(m-2k)-b(u-2s))+$$

$$\left(e^{(i a(m-2k)-b(u-2s))z}F_1\left(-\frac{i a(m-2k)-b(u-2s)}{2c}; -\nu, \nu; 1-\frac{i a(m-2k)-b(u-2s)}{2c}; -e^{-2cz}, e^{-2cz}\right)\right)\Big/$$

$$\left.(i a(m-2k)-b(u-2s))\right)+$$

$$\frac{2^{-m-u}\coth^{\nu+1}(c z)\;(1-m \bmod 2)(1-u \bmod 2)}{c(\nu+1)}\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}}\,{}_2F_1\left(\frac{\nu+1}{2}, 1; \frac{\nu+1}{2}+1; \coth^2(c z)\right)\Big/; m \in$$

$$\mathbb{N}^+ \land u \in$$

$$\mathbb{N}^+$$

01.22.21.0444.01

$$\int \cos^m(a z) \cosh^\mu(c z) \coth^\nu(c z) \, dz = 2^{-m} \left(1 - e^{2 c z}\right)^\nu \left(1 + e^{2 c z}\right)^{-\mu-\nu} \cosh^\mu(c z) \coth^\nu(c z) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(\frac{e^{-i a (m-2k) z}}{-i a (m-2k) - c \mu} F_1\left(\frac{-i a (m-2k) - c\mu}{2c}; \nu, -\mu-\nu; \frac{1}{2}\left(\frac{-i a (m-2k)}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right) + \frac{e^{i a (m-2k) z}}{i a (m-2k) - c\mu} F_1\left(\frac{i a (m-2k) - c\mu}{2c}; \nu, -\mu-\nu; \frac{1}{2}\left(\frac{a i (m-2k)}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right)\right) - \frac{1}{c\mu} 2^{-m} \left(1 - e^{2 c z}\right)^\nu \left(1 + e^{2 c z}\right)^{-\mu-\nu} F_1\left(-\frac{\mu}{2}; \nu, -\mu-\nu; \frac{2-\mu}{2}; e^{2 c z}, -e^{2 c z}\right) \binom{m}{\frac{m}{2}} \cosh^\mu(c z) \coth^\nu(c z) (1 - m \bmod 2) \;/;\; m \in \mathbb{N}^+$$

Involving sin and tanh

Involving $\sin(a z) \tanh(c z) \coth^\nu(c z)$

01.22.21.0445.01

$$\int \sin(a z) \tanh(c z) \coth^\nu(c z) \, dz = -\frac{1}{2a} e^{-i a z} \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \left(F_1\left(\frac{i a}{2c}; 1-\nu, \nu-1; 1 + \frac{i a}{2c}; -e^{-2 c z}, e^{-2 c z}\right) + e^{2 i a z} F_1\left(-\frac{i a}{2c}; 1-\nu, \nu-1; 1 - \frac{i a}{2c}; -e^{-2 c z}, e^{-2 c z}\right)\right)$$

Involving powers of sin and powers of tanh

Involving $\sin^m(a z) \tanh^\mu(c z) \coth^\nu(c z)$

01.22.21.0446.01

$$\int \sin^m(a z) \tanh^\mu(c z) \coth^\nu(c z) \, dz = \frac{2^{-m} i \left(1 - e^{-2 c z}\right)^{\nu-\mu} \left(1 + e^{-2 c z}\right)^{\mu-\nu} \coth^\nu(c z) \tanh^\mu(c z)}{a} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \frac{(-1)^k}{m-2k} \binom{m}{k} \left(e^{\frac{i m \pi}{2} - i a (m-2k) z} F_1\left(\frac{i a (m-2k)}{2c}; \mu-\nu, \nu-\mu; \frac{a i (m-2k)}{2c} + 1; -e^{-2 c z}, e^{-2 c z}\right) - e^{i a (m-2k) z - \frac{i m \pi}{2}} F_1\left(-\frac{i a (m-2k)}{2c}; \mu-\nu, \nu-\mu; 1 - \frac{i a (m-2k)}{2c}; -e^{-2 c z}, e^{-2 c z}\right)\right) - \frac{2^{-m} (1 - m \bmod 2) \coth^{\nu+1}(c z) \tanh^\mu(c z)}{c (\mu - \nu - 1)} \binom{m}{\frac{m}{2}} {}_2F_1\left(\frac{1}{2}(-\mu+\nu+1), 1; \frac{1}{2}(-\mu+\nu+3); \coth^2(c z)\right) \;/;\; m \in \mathbb{N}^+$$

Involving cos and tanh

Involving $\cos(a z) \tanh(c z) \coth^\nu(c z)$

01.22.21.0447.01

$$\int \cos(a z) \tanh(c z) \coth^{\nu}(c z)\, dz = -\frac{1}{2a} i\, e^{-i a z} \left(1 - e^{-2 c z}\right)^{\nu} \left(1 + e^{-2 c z}\right)^{-\nu} \coth^{\nu}(c z) \left(e^{2 i a z} F_1\left(-\frac{i a}{2 c}; 1 - \nu, \nu - 1; 1 - \frac{i a}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) - F_1\left(\frac{i a}{2 c}; 1 - \nu, \nu - 1; 1 + \frac{i a}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right)$$

Involving powers of cos and powers of tanh

Involving $\cos^m(a z) \tanh^{\mu}(c z) \coth^{\nu}(c z)$

01.22.21.0448.01

$$\int \cos^m(a z) \tanh^{\mu}(c z) \coth^{\nu}(c z)\, dz = \frac{2^{-m} i \left(1 - e^{-2 c z}\right)^{\nu - \mu} \left(1 + e^{-2 c z}\right)^{\mu - \nu} \coth^{\nu}(c z) \tanh^{\mu}(c z)}{a} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \frac{1}{m - 2k} \binom{m}{k} \left(e^{-i a (m - 2k) z} F_1\left(\frac{i a (m - 2k)}{2 c}; \mu - \nu, \nu - \mu; \frac{a i (m - 2k)}{2 c} + 1; -e^{-2 c z}, e^{-2 c z}\right) - e^{i a (m - 2k) z} F_1\left(-\frac{i a (m - 2k)}{2 c}; \mu - \nu, \nu - \mu; 1 - \frac{i a (m - 2k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) - \frac{2^{-m} (1 - m \bmod 2) \coth^{\nu + 1}(c z) \tanh^{\mu}(c z)}{c (\mu - \nu - 1)} \binom{m}{\frac{m}{2}} {}_2F_1\left(\frac{1}{2}(-\mu + \nu + 1), 1; \frac{1}{2}(-\mu + \nu + 3); \coth^2(c z)\right) /; m \in \mathbb{N}^+$$

Involving functions of the direct function, hyperbolic, exponential and a power functions

Involving powers of the direct function, hyperbolic, exponential and a power functions

Involving sinh, exp and power

Involving $z^n e^{p z} \sinh(a + b z) \coth^{\nu}(c z)$

01.22.21.0449.01

$$\int z^n e^{p z} \sinh(a + b z) \coth^\nu(c z) \, dz = \frac{1}{2} (-1)^\nu n! \Bigg(-e^{(-b+p+c\nu) z - a} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-b + p + c\nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b + p + c\nu}{2c}, \ldots, \frac{-b + p + c\nu}{2c}, \nu; \frac{-b + p + c\nu}{2c} + 1, \ldots, \frac{-b + p + c\nu}{2c} + 1; e^{2cz} \right) + e^{a + (b+p+c\nu) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b + p + c\nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b + p + c\nu}{2c}, \ldots, \frac{b + p + c\nu}{2c}, \nu; \frac{b + p + c\nu}{2c} + 1, \ldots, \frac{b + p + c\nu}{2c} + 1; e^{2cz} \right) - \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{(-b+p+2cs) z - a} \sum_{j=0}^{n} \frac{(-1)^j (-b + p + 2cs)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b + p + 2cs}{2c}, \ldots, \frac{-b + p + 2cs}{2c}, \nu; \frac{-b + p + 2cs}{2c} + 1, \ldots, \frac{-b + p + 2cs}{2c} + 1; e^{2cz} \right) + e^{(-b+p+2c(\nu-s)) z - a} \sum_{j=0}^{n} \frac{(-1)^j (-b + p + 2c(\nu - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b + p + 2c(\nu - s)}{2c}, \ldots, \frac{-b + p + 2c(\nu - s)}{2c}, \nu; \frac{-b + p + 2c(\nu - s)}{2c} + 1, \ldots, \frac{-b + p + 2c(\nu - s)}{2c} + 1; e^{2cz} \right) \Bigg) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{a + (b+p+2cs) z} \sum_{j=0}^{n} \frac{(-1)^j (b + p + 2cs)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b + p + 2cs}{2c}, \ldots, \frac{b + p + 2cs}{2c}, \nu; \frac{b + p + 2cs}{2c} + 1, \ldots, \frac{b + p + 2cs}{2c} + 1; e^{2cz} \right) + e^{a + (b+p+2c(\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b + p + 2c(\nu - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b + p + 2c(\nu - s)}{2c}, \ldots, \frac{b + p + 2c(\nu - s)}{2c}, \nu; \frac{b + p + 2c(\nu - s)}{2c} + 1, \ldots, \frac{b + p + 2c(\nu - s)}{2c} + 1; e^{2cz} \right) \Bigg) \Bigg) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0450.01

$$\int z^n e^{p z} \sinh(b z) \coth^\nu(c z)\, dz = \frac{1}{2} (-1)^\nu \binom{\nu}{\frac{\nu}{2}} n!\, (1 - \nu \bmod 2) \left(-e^{(-b+p+c\nu) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+p+c\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+p+c\nu}{2c}, \ldots, \frac{-b+p+c\nu}{2c}, \nu; \frac{-b+p+c\nu}{2c}+1, \ldots, \frac{-b+p+c\nu}{2c}+1; e^{2cz}\right) + e^{(b+p+c\nu) z} \sum_{j=0}^{n} \frac{(-1)^j (b+p+c\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+p+c\nu}{2c}, \ldots, \frac{b+p+c\nu}{2c}, \nu; \frac{b+p+c\nu}{2c}+1, \ldots, \frac{b+p+c\nu}{2c}+1; e^{2cz}\right)\right) + \frac{1}{2} (-1)^\nu n! \sum_{i=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor} \binom{\nu}{i} \left(-e^{(-b+2ci+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2ci+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+2ci+p}{2c}, \ldots, \frac{-b+2ci+p}{2c}, \nu; \frac{-b+2ci+p}{2c}+1, \ldots, \frac{-b+2ci+p}{2c}+1; e^{2cz}\right) + e^{(b+2ci+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2ci+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2ci+p}{2c}, \ldots, \frac{b+2ci+p}{2c}, \nu; \frac{b+2ci+p}{2c}+1, \ldots, \frac{b+2ci+p}{2c}+1; e^{2cz}\right) - e^{(-b-2ci+p+2c\nu) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-2ci+p+2c\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b-2ci+p+2c\nu}{2c}, \ldots, \frac{-b-2ci+p+2c\nu}{2c}, \nu; \frac{-b-2ci+p+2c\nu}{2c}+1, \ldots, \frac{-b-2ci+p+2c\nu}{2c}+1; e^{2cz}\right) + e^{(b-2ci+p+2c\nu) z} \sum_{j=0}^{n} \frac{(-1)^j (b-2ci+p+2c\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b-2ci+p+2c\nu}{2c}, \ldots, \frac{b-2ci+p+2c\nu}{2c}, \nu; \frac{b-2ci+p+2c\nu}{2c}+1, \ldots, \frac{b-2ci+p+2c\nu}{2c}+1; e^{2cz}\right)\right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0451.01

$$\int z^n e^{b z} \sinh(b z) \coth^\nu(c z) \, dz = \frac{1}{2} \left((-1)^\nu n!\right) \left(-\frac{z^{n+1}}{(n+1)!} - e^{2 c \nu z} \sum_{j=0}^{n} \frac{(-1)^j (2 c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(\nu, \ldots, \nu; \nu+1, \ldots, \nu+1; e^{2 c z}) - \nu e^{2 c z} \sum_{j=0}^{n} \frac{(-1)^j (2 c)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+3}F_{j+2}(1, \ldots, 1, \nu+1; 2, \ldots, 2; e^{2 c z}) - e^{c \nu z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{\nu}{2}, \ldots, \frac{\nu}{2}, \nu; \frac{\nu}{2}+1, \ldots, \frac{\nu}{2}+1; e^{2 c z}\right) + e^{(2 b + c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (2 b + c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 b + c \nu}{2 c}, \ldots, \frac{2 b + c \nu}{2 c}, \nu; \frac{2 b + c \nu}{2 c}+1, \ldots, \frac{2 b + c \nu}{2 c}+1; e^{2 c z}\right) - \sum_{s=1}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{2 c s z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(s, \ldots, s, \nu; s+1, \ldots, s+1; e^{2 c z}) + e^{2 c (\nu - s) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(\nu - s, \ldots, \nu - s, \nu; -s+\nu+1, \ldots, -s+\nu+1; e^{2 c z}) \right) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{2 (b + c s) z} \sum_{j=0}^{n} \frac{(-1)^j (2 b + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b + c s}{c}, \ldots, \frac{b + c s}{c}, \nu; \frac{b + c s}{c}+1, \ldots, \frac{b + c s}{c}+1; e^{2 c z}\right) + e^{2 (b + c (\nu - s)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 b + 2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b + c (\nu - s)}{c}, \ldots, \frac{b + c (\nu - s)}{c}, \nu; \frac{b + c (\nu - s)}{c}+1, \ldots, \frac{b + c (\nu - s)}{c}+1; e^{2 c z}\right) \right) \right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0452.01

$$\int z^n e^{-bz}\sinh(bz)\coth^v(cz)\,dz = \frac{1}{2}\left((-1)^v n!\right)\left(\frac{z^{n+1}}{(n+1)!} + e^{2cvz}\sum_{j=0}^{n}\frac{(-1)^j (2cv)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(v,\ldots,v;v+1,\ldots,v+1;e^{2cz}\right) + \right.$$

$$v\,e^{2cz}\sum_{j=0}^{n}\frac{(-1)^j (2c)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+3}F_{j+2}\left(1,\ldots,1,v+1;2,\ldots,2;e^{2cz}\right) + e^{cvz}\binom{v}{\frac{v}{2}}(1-v \bmod 2)$$

$$\sum_{j=0}^{n}\frac{(-1)^j (cv)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{v}{2},\ldots,\frac{v}{2},v;\frac{v}{2}+1,\ldots,\frac{v}{2}+1;e^{2cz}\right) - e^{(cv-2b)z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)$$

$$\sum_{j=0}^{n}\frac{(-1)^j (cv-2b)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{cv-2b}{2c},\ldots,\frac{cv-2b}{2c},v;\frac{cv-2b}{2c}+1,\ldots,\frac{cv-2b}{2c}+1;e^{2cz}\right) +$$

$$\sum_{s=1}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{2csz}\sum_{j=0}^{n}\frac{(-1)^j (2cs)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(s,\ldots,s,v;s+1,\ldots,s+1;e^{2cz}\right) + \right.$$

$$\left. e^{2c(v-s)z}\sum_{j=0}^{n}\frac{(-1)^j (2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(v-s,\ldots,v-s,v;-s+v+1,\ldots,-s+v+1;e^{2cz}\right)\right) -$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{2(cs-b)z}\sum_{j=0}^{n}\frac{(-1)^j (2cs-2b)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{cs-b}{c},\ldots,\frac{cs-b}{c},v;\frac{cs-b}{c}+1,\ldots,\frac{cs-b}{c}+1;e^{2cz}\right) + \right.$$

$$e^{2(c(v-s)-b)z}\sum_{j=0}^{n}\frac{(-1)^j (2c(v-s)-2b)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\left.\left.\left(\frac{c(v-s)-b}{c},\ldots,\frac{c(v-s)-b}{c},v;\frac{c(v-s)-b}{c}+1,\ldots,\frac{c(v-s)-b}{c}+1;e^{2cz}\right)\right)\right)\ /;\ n\in\mathbb{N}\land v\in\mathbb{N}^+$$

Involving powers of sinh, exp and power

Involving $z^n e^{pz}\sinh^u(bz)\coth^v(cz)$

01.22.21.0453.01

$$\int z^n e^{pz}\sinh^u(bz)\coth^v(cz)\,dz =$$

$$(-1)^v\binom{u}{\frac{u}{2}}n!\,(1-u \bmod 2)\left(e^{(p+cv)z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j (p+cv)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+cv}{2c},\right.\right.$$

$$\left.\ldots,\frac{p+cv}{2c},v;\frac{p+cv}{2c}+1,\ldots,\frac{p+cv}{2c}+1;e^{2cz}\right) + \sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(p+2cs)z}\right.$$

$$\sum_{j=0}^{n} \frac{(-1)^j (p+2cs)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{p+2cs}{2c}, \ldots, \frac{p+2cs}{2c}, v; \frac{p+2cs}{2c}+1, \ldots, \frac{p+2cs}{2c}+1; e^{2cz}\right) +$$

$$e^{(p+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (p+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{p+2c(v-s)}{2c}, \ldots, \frac{p+2c(v-s)}{2c}, v;\right.$$

$$\left.\left.\left.\frac{p+2c(v-s)}{2c}+1, \ldots, \frac{p+2c(v-s)}{2c}+1; e^{2cz}\right)\right)\right)\left(\frac{i}{2}\right)^u + (-1)^v 2^{-u} n!$$

$$\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor} (-1)^k \binom{u}{k} \left(e^{(p+b(u-2k)+cv)z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (p+b(u-2k)+cv)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{p+b(u-2k)+cv}{2c},\right.\right.$$

$$\left.\ldots, \frac{p+b(u-2k)+cv}{2c}, v; \frac{p+b(u-2k)+cv}{2c}+1, \ldots, \frac{p+b(u-2k)+cv}{2c}+1; e^{2cz}\right) +$$

$$(-1)^u \left(e^{(p-b(u-2k)+cv)z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (p-b(u-2k)+cv)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{p-b(u-2k)+cv}{2c},\right.\right.$$

$$\left.\ldots, \frac{p-b(u-2k)+cv}{2c}, v; \frac{p-b(u-2k)+cv}{2c}+1, \ldots, \frac{p-b(u-2k)+cv}{2c}+1; e^{2cz}\right) +$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor} \binom{v}{s} \left(e^{(p+2cs-b(u-2k))z} \sum_{j=0}^{n} \frac{(-1)^j (p+2cs-b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{p+2cs-b(u-2k)}{2c},\right.\right.$$

$$\ldots, \frac{p+2cs-b(u-2k)}{2c}, v; \frac{p+2cs-b(u-2k)}{2c}+1, \ldots, \frac{p+2cs-b(u-2k)}{2c}+1;$$

$$\left.e^{2cz}\right) + e^{(p-b(u-2k)+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (p-b(u-2k)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{p-b(u-2k)+2c(v-s)}{2c}, \ldots, \frac{p-b(u-2k)+2c(v-s)}{2c}, v;\right.$$

$$\left.\left.\left.\frac{p-b(u-2k)+2c(v-s)}{2c}+1, \ldots, \frac{p-b(u-2k)+2c(v-s)}{2c}+1; e^{2cz}\right)\right)\right) +$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor} \binom{v}{s} \left(e^{(p+2cs+b(u-2k))z} \sum_{j=0}^{n} \frac{(-1)^j (p+2cs+b(u-2k))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{p+2cs+b(u-2k)}{2c},\right.\right.$$

$$\left.\ldots, \frac{p+2cs+b(u-2k)}{2c}, v; \frac{p+2cs+b(u-2k)}{2c}+1, \ldots, \frac{p+2cs+b(u-2k)}{2c}+1; e^{2cz}\right) +$$

$$e^{(p+b(u-2k)+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (p+b(u-2k)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}$$

$$\left(\frac{p+b(u-2k)+2c(v-s)}{2c}, \ldots, \frac{p+b(u-2k)+2c(v-s)}{2c}, v; \frac{p+b(u-2k)+2c(v-s)}{2c}+1,\right.$$

Involving cosh, exp and power

Involving $z^n e^{p z} \cosh(a + b z) \coth^{\nu}(c z)$

01.22.21.0454.01

$$\int z^n e^{p z} \cosh(a + b z) \coth^{\nu}(c z)\, dz = \frac{1}{2} (-1)^{\nu} n! \left(e^{(-b+p+c\nu) z - a} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-b+p+c\nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b+p+c\nu}{2c}, \ldots, \frac{-b+p+c\nu}{2c}, \nu; \frac{-b+p+c\nu}{2c} + 1, \ldots, \frac{-b+p+c\nu}{2c} + 1; e^{2cz} \right) + e^{a+(b+p+c\nu) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b+p+c\nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b+p+c\nu}{2c}, \ldots, \frac{b+p+c\nu}{2c}, \nu; \frac{b+p+c\nu}{2c} + 1, \ldots, \frac{b+p+c\nu}{2c} + 1; e^{2cz} \right) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{(-b+p+2cs) z - a} \sum_{j=0}^{n} \frac{(-1)^j (-b+p+2cs)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b+p+2cs}{2c}, \ldots, \frac{-b+p+2cs}{2c}, \nu; \frac{-b+p+2cs}{2c} + 1, \ldots, \frac{-b+p+2cs}{2c} + 1; e^{2cz} \right) + e^{(-b+p+2c(\nu-s)) z - a} \sum_{j=0}^{n} \frac{(-1)^j (-b+p+2c(\nu-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b+p+2c(\nu-s)}{2c}, \ldots, \frac{-b+p+2c(\nu-s)}{2c}, \nu; \frac{-b+p+2c(\nu-s)}{2c} + 1, \ldots, \frac{-b+p+2c(\nu-s)}{2c} + 1; e^{2cz} \right) \right) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{a+(b+p+2cs) z} \sum_{j=0}^{n} \frac{(-1)^j (b+p+2cs)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b+p+2cs}{2c}, \ldots, \frac{b+p+2cs}{2c}, \nu; \frac{b+p+2cs}{2c} + 1, \ldots, \frac{b+p+2cs}{2c} + 1; e^{2cz} \right) + e^{a+(b+p+2c(\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b+p+2c(\nu-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b+p+2c(\nu-s)}{2c}, \ldots, \frac{b+p+2c(\nu-s)}{2c}, \nu; \frac{b+p+2c(\nu-s)}{2c} + 1, \ldots, \frac{b+p+2c(\nu-s)}{2c} + 1; e^{2cz} \right) \right) \right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0455.01

$$\int z^n e^{p z} \cosh(b z) \coth^\nu(c z)\, dz = \frac{1}{2} (-1)^\nu \binom{\nu}{\frac{\nu}{2}} n!\, (1 - \nu \bmod 2) \left(e^{(-b+p+c\nu) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+p+c\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+p+c\nu}{2c}, \ldots, \frac{-b+p+c\nu}{2c}, \nu; \frac{-b+p+c\nu}{2c}+1, \ldots, \frac{-b+p+c\nu}{2c}+1; e^{2cz} \right) + e^{(b+p+c\nu) z} \sum_{j=0}^{n} \frac{(-1)^j (b+p+c\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+p+c\nu}{2c}, \ldots, \frac{b+p+c\nu}{2c}, \nu; \frac{b+p+c\nu}{2c}+1, \ldots, \frac{b+p+c\nu}{2c}+1; e^{2cz} \right) \right) +$$

$$\frac{1}{2} (-1)^\nu n! \sum_{i=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{i} \left(e^{(-b+2ci+p) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2ci+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+2ci+p}{2c}, \ldots, \frac{-b+2ci+p}{2c}, \nu; \frac{-b+2ci+p}{2c}+1, \ldots, \frac{-b+2ci+p}{2c}+1; e^{2cz} \right) + e^{(b+2ci+p) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2ci+p)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+2ci+p}{2c}, \ldots, \frac{b+2ci+p}{2c}, \nu; \frac{b+2ci+p}{2c}+1, \ldots, \frac{b+2ci+p}{2c}+1; e^{2cz} \right) + e^{(-b-2ci+p+2c\nu) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-2ci+p+2c\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b-2ci+p+2c\nu}{2c}, \ldots, \frac{-b-2ci+p+2c\nu}{2c}, \nu; \frac{-b-2ci+p+2c\nu}{2c}+1, \ldots, \frac{-b-2ci+p+2c\nu}{2c}+1; e^{2cz} \right) + e^{(b-2ci+p+2c\nu) z} \sum_{j=0}^{n} \frac{(-1)^j (b-2ci+p+2c\nu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b-2ci+p+2c\nu}{2c}, \ldots, \frac{b-2ci+p+2c\nu}{2c}, \nu; \frac{b-2ci+p+2c\nu}{2c}+1, \ldots, \frac{b-2ci+p+2c\nu}{2c}+1; e^{2cz} \right) \right) /;\ n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0456.01

$$\int z^n e^{b z} \cosh(b z) \coth^{\nu}(c z)\, dz = \frac{1}{2} ((-1)^{\nu} n!) \Bigg(\frac{z^{n+1}}{(n+1)!} + e^{2 c \nu z} \sum_{j=0}^{n} \frac{(-1)^j (2 c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(\nu, \ldots, \nu; \nu+1, \ldots, \nu+1; e^{2 c z}) +$$

$$e^{2 c z} \nu \sum_{j=0}^{n} \frac{(-1)^j (2 c)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+3}F_{j+2}(1, \ldots, 1, \nu+1; 2, \ldots, 2; e^{2 c z}) + e^{c \nu z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2)$$

$$\sum_{j=0}^{n} \frac{(-1)^j (c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{\nu}{2}, \ldots, \frac{\nu}{2}, \nu; \frac{\nu}{2}+1, \ldots, \frac{\nu}{2}+1; e^{2 c z}\right) + e^{(2 b + c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2)$$

$$\sum_{j=0}^{n} \frac{(-1)^j (2 b + c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 b + c \nu}{2 c}, \ldots, \frac{2 b + c \nu}{2 c}, \nu; \frac{2 b + c \nu}{2 c}+1, \ldots, \frac{2 b + c \nu}{2 c}+1; e^{2 c z}\right) +$$

$$\sum_{s=1}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{2 c s z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(s, \ldots, s, \nu; s+1, \ldots, s+1; e^{2 c z}) +$$

$$e^{2 c (\nu - s) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(\nu - s, \ldots, \nu - s, \nu; -s+\nu+1, \ldots, -s+\nu+1; e^{2 c z}) \Bigg) +$$

$$\sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{2 (b + c s) z} \sum_{j=0}^{n} \frac{(-1)^j (2 b + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b + c s}{c}, \ldots, \frac{b + c s}{c}, \nu; \frac{b + c s}{c}+1, \ldots, \frac{b + c s}{c}+1; e^{2 c z}\right) +$$

$$e^{2 (b + c (\nu - s)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 b + 2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{b + c (\nu - s)}{c}, \ldots, \frac{b + c (\nu - s)}{c}, \nu; \frac{b + c (\nu - s)}{c}+1, \ldots, \frac{b + c (\nu - s)}{c}+1; e^{2 c z}\right) \Bigg) \Bigg) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0457.01

$$\int z^n e^{-b z} \cosh(b z) \coth^{\nu}(c z)\, dz = \frac{1}{2}\left((-1)^{\nu} n!\right)\left(\frac{z^{n+1}}{(n+1)!} + e^{2 c \nu z} \sum_{j=0}^{n} \frac{(-1)^j (2 c \nu)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\nu, \ldots, \nu; \nu+1, \ldots, \nu+1; e^{2 c z}\right) + e^{2 c z} \nu \sum_{j=0}^{n} \frac{(-1)^j (2 c)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+3}F_{j+2}\left(1, \ldots, 1, \nu+1; 2, \ldots, 2; e^{2 c z}\right) + e^{c \nu z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c \nu)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{\nu}{2}, \ldots, \frac{\nu}{2}, \nu; \frac{\nu}{2}+1, \ldots, \frac{\nu}{2}+1; e^{2 c z}\right) + e^{(c \nu - 2 b) z} \binom{\nu}{\frac{\nu}{2}} (1 - \nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c \nu - 2 b)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{c \nu - 2 b}{2 c}, \ldots, \frac{c \nu - 2 b}{2 c}, \nu; \frac{c \nu - 2 b}{2 c}+1, \ldots, \frac{c \nu - 2 b}{2 c}+1; e^{2 c z}\right) + \sum_{s=1}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{2 c s z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(s, \ldots, s, \nu; s+1, \ldots, s+1; e^{2 c z}\right) + e^{2 c (\nu - s) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (\nu - s))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\nu - s, \ldots, \nu - s, \nu; -s+\nu+1, \ldots, -s+\nu+1; e^{2 c z}\right)\right) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \left(e^{2 (c s - b) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s - 2 b)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{c s - b}{c}, \ldots, \frac{c s - b}{c}, \nu; \frac{c s - b}{c}+1, \ldots, \frac{c s - b}{c}+1; e^{2 c z}\right) + e^{2 (c (\nu - s) - b) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (\nu - s) - 2 b)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{c (\nu - s) - b}{c}, \ldots, \frac{c (\nu - s) - b}{c}, \nu; \frac{c (\nu - s) - b}{c}+1, \ldots, \frac{c (\nu - s) - b}{c}+1; e^{2 c z}\right)\right)\right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

01.22.21.0458.01

$$\int z^n e^{pz}\cosh(cz)\coth^v(cz)\,dz = \frac{1}{2}(-1)^v e^{(p+cv)z}\binom{v+1}{\frac{v+1}{2}} n!\,(1-(v+1)\bmod 2) \sum_{j=0}^{n}\frac{(-1)^j (p+cv)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+cv}{2c},\ldots,\frac{p+cv}{2c}, v; \frac{p+cv}{2c}+1,\ldots,\frac{p+cv}{2c}+1; e^{2cz}\right)+ \frac{1}{2}(-1)^v e^{cvz} n! \sum_{s=0}^{\left\lfloor\frac{v}{2}\right\rfloor}\binom{v+1}{s}\left(e^{(p-c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j (p-c(1-2s))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p-c(1-2s)}{2c},\ldots,\frac{p-c(1-2s)}{2c}, v; \frac{p-c(1-2s)}{2c}+1,\ldots,\frac{p-c(1-2s)}{2c}+1; e^{2cz}\right)+e^{(p+c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j (p+c(-2s+2v+1))^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+c(-2s+2v+1)}{2c},\ldots,\frac{p+c(-2s+2v+1)}{2c}, v; \frac{p+c(-2s+2v+1)}{2c}+1,\ldots,\frac{p+c(-2s+2v+1)}{2c}+1; e^{2cz}\right)\right) /; n\in\mathbb{N}\land v\in\mathbb{N}^+$$

Involving powers of cosh, exp and power

Involving $z^n e^{pz}\cosh^u(bz)\coth^v(cz)$

01.22.21.0459.01

$$\int z^n e^{pz}\cosh^u(bz)\coth^v(cz)\,dz = (-1)^v 2^{-u} e^{(p+cv)z}\binom{u}{\frac{u}{2}}\binom{v}{\frac{v}{2}} n!\,(1-u\bmod 2)(1-v\bmod 2) \sum_{j=0}^{n}\frac{(-1)^j (p+cv)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+cv}{2c},\ldots,\frac{p+cv}{2c}, v; \frac{p+cv}{2c}+1,\ldots,\frac{p+cv}{2c}+1; e^{2cz}\right)+(-1)^v 2^{-u}\binom{v}{\frac{v}{2}} n!\,(1-v\bmod 2)\sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{s}\left(e^{(p-b(u-2s)+cv)z}\sum_{j=0}^{n}\frac{(-1)^j (p-b(u-2s)+cv)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p-b(u-2s)+cv}{2c},\ldots,\frac{p-b(u-2s)+cv}{2c}, v; \frac{p-b(u-2s)+cv}{2c}+1,\ldots,\frac{p-b(u-2s)+cv}{2c}+1; e^{2cz}\right)+ e^{(p+b(u-2s)+cv)z}\sum_{j=0}^{n}\frac{(-1)^j (p+b(u-2s)+cv)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{p+b(u-2s)+cv}{2c},\ldots,\frac{p+b(u-2s)+cv}{2c}, v; \frac{p+b(u-2s)+cv}{2c}+1,\ldots,\frac{p+b(u-2s)+cv}{2c}+1; e^{2cz}\right)\right)+ (-1)^v 2^{-u}\binom{u}{\frac{u}{2}} n!\,(1-u\bmod 2)\sum_{i=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{i}\left(e^{(2ci+p)z}\sum_{j=0}^{n}\frac{(-1)^j (2ci+p)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2ci+p}{2c},\ldots,\frac{2ci+p}{2c}, v; \frac{2ci+p}{2c}+1,\ldots,\frac{2ci+p}{2c}+1; e^{2cz}\right)+e^{(-2ci+p+2cv)z}\sum_{j=0}^{n}\frac{(-1)^j (-2ci+p+2cv)^{-j-1} z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\right.$$

$$\left(\frac{-2ci+p+2cv}{2c}, \ldots, \frac{-2ci+p+2cv}{2c}, v; \frac{-2ci+p+2cv}{2c}+1, \ldots, \frac{-2ci+p+2cv}{2c}+1; e^{2cz}\right)\Bigg) +$$

$$(-1)^v 2^{-u} n! \sum_{i=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{u}{s} \binom{v}{i} \Bigg(e^{(2ci+p+2bs-bu)z} \sum_{j=0}^{n} \frac{(-1)^j (2ci+p+2bs-bu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\Bigg(\frac{2ci+p+2bs-bu}{2c},$$

$$\ldots, \frac{2ci+p+2bs-bu}{2c}, v; \frac{2ci+p+2bs-bu}{2c}+1, \ldots, \frac{2ci+p+2bs-bu}{2c}+1; e^{2cz}\Bigg) +$$

$$e^{(2ci+p-2bs+bu)z} \sum_{j=0}^{n} \frac{(-1)^j (2ci+p-2bs+bu)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\Bigg(\frac{2ci+p-2bs+bu}{2c}, \ldots,$$

$$\frac{2ci+p-2bs+bu}{2c}, v; \frac{2ci+p-2bs+bu}{2c}+1, \ldots, \frac{2ci+p-2bs+bu}{2c}+1; e^{2cz}\Bigg) +$$

$$e^{(-2ci+p+2bs-bu+2cv)z} \sum_{j=0}^{n} \frac{(-1)^j (-2ci+p+2bs-bu+2cv)^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-2ci+p+2bs-bu+2cv}{2c}, \ldots, \frac{-2ci+p+2bs-bu+2cv}{2c}, v;$$

$$\frac{-2ci+p+2bs-bu+2cv}{2c}+1, \ldots, \frac{-2ci+p+2bs-bu+2cv}{2c}+1; e^{2cz}\Bigg) +$$

$$e^{(-2ci+p-2bs+bu+2cv)z} \sum_{j=0}^{n} \frac{(-1)^j (-2ci+p-2bs+bu+2cv)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{-2ci+p-2bs+bu+2cv}{2c}, \ldots, \frac{-2ci+p-2bs+bu+2cv}{2c}, v; \frac{-2ci+p-2bs+bu+2cv}{2c}+$$

$$1, \ldots, \frac{-2ci+p-2bs+bu+2cv}{2c}+1; e^{2cz}\Bigg)\Bigg) /; n \in \mathbb{N} \land u \in \mathbb{N}^+ \land v \in \mathbb{N}^+$$

01.22.21.0460.01

$$\int z^n e^{pz} \cosh^u(cz) \coth^v(cz)\, dz = (-1)^v 2^{-u} e^{(p+cv)z} \binom{u+v}{\frac{u+v}{2}} n! \,(1-(u+v) \bmod 2)$$

$$\sum_{j=0}^{n} \frac{(-1)^j (p+cv)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{cv+p}{2c}, \ldots, \frac{cv+p}{2c}, v; \frac{cv+p}{2c}+1, \ldots, \frac{cv+p}{2c}+1; e^{2cz}\right) +$$

$$(-1)^v 2^{-u} e^{cvz} n! \sum_{s=0}^{\left\lfloor \frac{1}{2}(u+v-1) \right\rfloor} \binom{u+v}{s} \Bigg(e^{(p-c(-2s+u+v))z} \sum_{j=0}^{n} \frac{(-1)^j (p-c(u-2s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}$$

$$\left(\frac{p-c(u-2s)}{2c}, \ldots, \frac{p-c(u-2s)}{2c}, v; \frac{p-c(u-2s)}{2c}+1, \ldots, \frac{p-c(u-2s)}{2c}+1; e^{2cz}\right) + e^{(p+c(-2s+u+v))z}$$

$$\sum_{j=0}^{n} \frac{(-1)^j (p+c(-2s+u+2v))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\Bigg(\frac{p+c(-2s+u+2v)}{2c}, \ldots, \frac{p+c(-2s+u+2v)}{2c},$$

$$v; \frac{p+c(-2s+u+2v)}{2c}+1, \ldots, \frac{p+c(-2s+u+2v)}{2c}+1; e^{2cz}\Bigg)\Bigg) /; n \in \mathbb{N} \land u \in \mathbb{N}^+ \land v \in \mathbb{N}^+$$

Involving functions of the direct function, hyperbolic, exponential and trigonometric functions

Involving powers of the direct function, hyperbolic, exponential and trigonometric functions

Involving sin, sinh and exp

Involving $e^{p z} \sin(a z) \sinh(b z) \coth^{\nu}(c z)$

01.22.21.0461.01

$$\int e^{p z} \sin(a z) \sinh(b z) \coth^{\nu}(c z)\, dz = \frac{1}{4} i \left(1 - e^{-2 c z}\right)^{\nu} \left(1 + e^{-2 c z}\right)^{-\nu} \coth^{\nu}(c z) \left(-\frac{e^{(-b - i a + p) z} F_1\left(-\frac{-b - i a + p}{2 c}; -\nu, \nu; 1 - \frac{-b - i a + p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{-b - i a + p} + \frac{e^{(-b + i a + p) z} F_1\left(-\frac{-b + i a + p}{2 c}; -\nu, \nu; 1 - \frac{-b + i a + p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{-b + i a + p} + \frac{e^{(b - i a + p) z} F_1\left(-\frac{b - i a + p}{2 c}; -\nu, \nu; 1 - \frac{b - i a + p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{b - i a + p} - \frac{e^{(b + i a + p) z} F_1\left(-\frac{b + i a + p}{2 c}; -\nu, \nu; 1 - \frac{b + i a + p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{b + i a + p} \right)$$

Involving powers of sin, powers of sinh and exp

Involving $e^{p z} \sin^{m}(a z) \sinh^{u}(b z) \coth^{\nu}(c z)$

01.22.21.0462.01

$$\int e^{pz}\sin^m(az)\sinh^u(bz)\coth^\nu(cz)\,dz = \frac{1}{p}\left(i^u\,2^{-m-u}\,e^{pz}\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}F_1\left(-\frac{p}{2c};-\nu,\nu;1-\frac{p}{2c};-e^{-2cz},e^{-2cz}\right)\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}}\right.$$

$$\left.\coth^\nu(cz)\,(1-m\bmod 2)\,(1-u\bmod 2)\right)-i^u\,2^{-m-u}\binom{u}{\frac{u}{2}}(u\bmod 2-1)\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}$$

$$\coth^\nu(cz)\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^s\binom{m}{s}\left(\frac{e^{(p+a\,i\,(m-2s))z-\frac{i m\pi}{2}}F_1\left(-\frac{p+a\,i\,(m-2s)}{2c};-\nu,\nu;1-\frac{p+a\,i\,(m-2s)}{2c};-e^{-2cz},e^{-2cz}\right)}{p+a\,i\,(m-2s)}+\right.$$

$$\left.\frac{e^{\frac{i\pi m}{2}+(p-i\,a\,(m-2s))z}F_1\left(-\frac{p-i\,a\,(m-2s)}{2c};-\nu,\nu;1-\frac{p-i\,a\,(m-2s)}{2c};-e^{-2cz},e^{-2cz}\right)}{p-i\,a\,(m-2s)}\right)+2^{-m-u}\binom{m}{\frac{m}{2}}(1-m\bmod 2)$$

$$\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(cz)\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}(-1)^k\binom{u}{k}\left(\frac{e^{(p+b\,(u-2k))z}F_1\left(-\frac{p+b\,(u-2k)}{2c};-\nu,\nu;1-\frac{p+b\,(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)}{p+b\,(u-2k)}+\right.$$

$$\left.\frac{(-1)^u\,e^{(p-b\,(u-2k))z}F_1\left(-\frac{p-b\,(u-2k)}{2c};-\nu,\nu;1-\frac{p-b\,(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)}{p-b\,(u-2k)}\right)+$$

$$2^{-m-u}\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(cz)\sum_{k=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{s=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^{k+s}\binom{m}{s}\binom{u}{k}$$

$$\left(\left(e^{(p+a\,i\,(m-2s)+b\,(u-2k))z-\frac{i m\pi}{2}}F_1\left(-\frac{p+a\,i\,(m-2s)+b\,(u-2k)}{2c};-\nu,\nu;1-\frac{p+a\,i\,(m-2s)+b\,(u-2k)}{2c};\right.\right.\right.$$

$$\left.\left.-e^{-2cz},e^{-2cz}\right)\right)\Big/(p+a\,i\,(m-2s)+b\,(u-2k))+\left(e^{\frac{i\pi m}{2}+(p-i\,a\,(m-2s)+b\,(u-2k))z}\right.$$

$$\left.F_1\left(-\frac{p-i\,a\,(m-2s)+b\,(u-2k)}{2c};-\nu,\nu;1-\frac{p-i\,a\,(m-2s)+b\,(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/$$

$$(p-i\,a\,(m-2s)+b\,(u-2k))+\left((-1)^u\,e^{(p+a\,i\,(m-2s)-b\,(u-2k))z-\frac{i m\pi}{2}}F_1\left(-\frac{p+a\,i\,(m-2s)-b\,(u-2k)}{2c};\right.\right.$$

$$\left.\left.-\nu,\nu;1-\frac{p+a\,i\,(m-2s)-b\,(u-2k)}{2c};-e^{-2cz},e^{-2cz}\right)\right)\Big/(p+a\,i\,(m-2s)-b\,(u-2k))+$$

$$\left((-1)^u\,e^{\frac{i\pi m}{2}+(p-i\,a\,(m-2s)-b\,(u-2k))z}F_1\left(-\frac{p-i\,a\,(m-2s)-b\,(u-2k)}{2c};-\nu,\nu;1-\frac{p-i\,a\,(m-2s)-b\,(u-2k)}{2c};\right.\right.$$

$$\left.\left.\left.-e^{-2cz},e^{-2cz}\right)\right)\Big/(p-i\,a\,(m-2s)-b\,(u-2k))\right)\;/;\;m\in\mathbb{N}^+\land u\in\mathbb{N}^+$$

01.22.21.0463.01

$$\int e^{pz}\sin^m(az)\sinh^\mu(cz)\coth^\nu(cz)\,dz = 2^{-m}\left(1-e^{2cz}\right)^{\nu-\mu}\left(1+e^{2cz}\right)^{-\nu}\coth^\nu(cz)\sinh^\mu(cz)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(\left(e^{\frac{i\pi m}{2}+(p-ia(m-2k))z}F_1\left(\frac{-ia(m-2k)+p-c\mu}{2c};\nu-\mu,-\nu;\frac{1}{2}\left(\frac{p-ia(m-2k)}{c}-\mu+2\right);e^{2cz},-e^{2cz}\right)\right)\Big/(-ia(m-2k)+p-c\mu)+\left(e^{(ai(m-2k)+p)z-\frac{im\pi}{2}}F_1\left(\frac{ai(m-2k)+p-c\mu}{2c};\nu-\mu,-\nu;\frac{1}{2}\left(\frac{ai(m-2k)+p}{c}-\mu+2\right);e^{2cz},-e^{2cz}\right)\right)\Big/(ai(m-2k)+p-c\mu)\right)+\frac{1}{p-c\mu}2^{-m}e^{pz}\left(1-e^{2cz}\right)^{\nu-\mu}\left(1+e^{2cz}\right)^{-\nu}F_1\left(\frac{p-c\mu}{2c};\nu-\mu,-\nu;\frac{1}{2}\left(\frac{p}{c}-\mu+2\right);e^{2cz},-e^{2cz}\right)\binom{m}{\frac{m}{2}}\coth^\nu(cz)(1-m\bmod 2)\sinh^\mu(cz)\;/;\;m\in\mathbb{N}^+$$

Involving cos, sinh and exp

Involving $e^{pz}\cos(az)\sinh(bz)\coth^\nu(cz)$

01.22.21.0464.01

$$\int e^{pz}\cos(az)\sinh(bz)\coth^\nu(cz)\,dz = \frac{1}{4}\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(cz)\left(-\frac{e^{(-b-ia+p)z}F_1\left(-\frac{-b-ia+p}{2c};-\nu,\nu;1-\frac{-b-ia+p}{2c};-e^{-2cz},e^{-2cz}\right)}{-b-ia+p}-\frac{e^{(-b+ia+p)z}F_1\left(-\frac{-b+ia+p}{2c};-\nu,\nu;1-\frac{-b+ia+p}{2c};-e^{-2cz},e^{-2cz}\right)}{-b+ia+p}+\frac{e^{(b-ia+p)z}F_1\left(-\frac{b-ia+p}{2c};-\nu,\nu;1-\frac{b-ia+p}{2c};-e^{-2cz},e^{-2cz}\right)}{b-ia+p}+\frac{e^{(b+ia+p)z}F_1\left(-\frac{b+ia+p}{2c};-\nu,\nu;1-\frac{b+ia+p}{2c};-e^{-2cz},e^{-2cz}\right)}{b+ia+p}\right)$$

Involving powers of cos, powers of sinh and exp

Involving $e^{pz}\cos^m(az)\sinh^u(bz)\coth^\nu(cz)$

01.22.21.0465.01

$$\int e^{p z} \cos^m(a z) \sinh^u(b z) \coth^\nu(c z)\, dz = \frac{1}{p}\left(i^u\, 2^{-m-u} e^{p z} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} F_1\left(-\frac{p}{2 c}; -\nu, \nu; 1-\frac{p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} \coth^\nu(c z)\,(1-m \bmod 2)\,(1-u \bmod 2)\right) - i^u\, 2^{-m-u} \binom{u}{\frac{u}{2}} (u \bmod 2 - 1) \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \sum_{s=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{s} \left(\frac{e^{(p+a i (m-2 s)) z} F_1\left(-\frac{p+a i (m-2 s)}{2 c}; -\nu, \nu; 1-\frac{p+a i (m-2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p+a i (m-2 s)} + \frac{e^{(p-i a (m-2 s)) z} F_1\left(-\frac{p-i a (m-2 s)}{2 c}; -\nu, \nu; 1-\frac{p-i a (m-2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p-i a (m-2 s)}\right) + 2^{-m-u} \binom{m}{\frac{m}{2}} (1-m \bmod 2) \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{u}{k} \left(\frac{e^{(p+b (u-2 k)) z} F_1\left(-\frac{p+b (u-2 k)}{2 c}; -\nu, \nu; 1-\frac{p+b (u-2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p+b (u-2 k)} + \frac{(-1)^u e^{(p-b (u-2 k)) z} F_1\left(-\frac{p-b (u-2 k)}{2 c}; -\nu, \nu; 1-\frac{p-b (u-2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p-b (u-2 k)}\right) +$$

$$2^{-m-u} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \sum_{k=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{s=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{s} \binom{u}{k} \left(\left(e^{(p+a i (m-2 s)+b (u-2 k)) z} F_1\left(-\frac{p+a i (m-2 s)+b (u-2 k)}{2 c}; -\nu, \nu; 1-\frac{p+a i (m-2 s)+b (u-2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (p+a i (m-2 s)+b (u-2 k)) + \left(e^{(p-i a (m-2 s)+b (u-2 k)) z} F_1\left(-\frac{p-i a (m-2 s)+b (u-2 k)}{2 c}; -\nu, \nu; 1-\frac{p-i a (m-2 s)+b (u-2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (p-i a (m-2 s)+b (u-2 k)) + \left((-1)^u e^{(p+a i (m-2 s)-b (u-2 k)) z} F_1\left(-\frac{p+a i (m-2 s)-b (u-2 k)}{2 c}; -\nu, \nu; 1-\frac{p+a i (m-2 s)-b (u-2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (p+a i (m-2 s)-b (u-2 k)) + \left((-1)^u e^{(p-i a (m-2 s)-b (u-2 k)) z} F_1\left(-\frac{p-i a (m-2 s)-b (u-2 k)}{2 c}; -\nu, \nu; 1-\frac{p-i a (m-2 s)-b (u-2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (p-i a (m-2 s)-b (u-2 k))\right) /; m \in \mathbb{N}^+ \land u \in \mathbb{N}^+$$

01.22.21.0466.01

$$\int e^{p z} \cos^m(a z) \sinh^\mu(c z) \coth^\nu(c z)\, dz = 2^{-m} \left(1 - e^{2 c z}\right)^{\nu-\mu} \left(1 + e^{2 c z}\right)^{-\nu} \coth^\nu(c z) \sinh^\mu(c z)$$

$$\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(\left(e^{(p - i a (m-2k)) z} F_1\left(\frac{-i a (m-2k) + p - c\mu}{2c}; \nu-\mu, -\nu; \frac{1}{2}\left(\frac{p - i a (m-2k)}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right)\right)\right/$$

$$(-i a (m-2k) + p - c\mu) + \left(e^{(a i (m-2k) + p) z} F_1\left(\frac{a i (m-2k) + p - c\mu}{2c}; \nu-\mu, -\nu;\right.\right.$$

$$\left.\left.\left.\frac{1}{2}\left(\frac{a i (m-2k) + p}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right)\right) \right/ (a i (m-2k) + p - c\mu)\right) +$$

$$\frac{1}{p - c\mu} 2^{-m} e^{p z} \left(1 - e^{2 c z}\right)^{\nu-\mu} \left(1 + e^{2 c z}\right)^{-\nu} F_1\left(\frac{p - c\mu}{2c}; \nu-\mu, -\nu; \frac{1}{2}\left(\frac{p}{c} - \mu + 2\right); e^{2 c z}, -e^{2 c z}\right)$$

$$\binom{m}{\frac{m}{2}} \coth^\nu(c z) (1 - m \bmod 2) \sinh^\mu(c z) \;/;\; m \in \mathbb{N}^+$$

Involving sin, cosh and exp

Involving $e^{p z} \sin(a z) \cosh(b z) \coth^\nu(c z)$

01.22.21.0467.01

$$\int e^{p z} \sin(a z) \cosh(b z) \coth^\nu(c z)\, dz =$$

$$-\frac{1}{4} i \left(1 - e^{-2 c z}\right)^\nu \left(1 + e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \left(-\frac{e^{(-b - i a + p) z} F_1\left(-\frac{-b - i a + p}{2c}; -\nu, \nu; 1 - \frac{-b - i a + p}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{-b - i a + p} + \right.$$

$$\frac{e^{(-b + i a + p) z} F_1\left(-\frac{-b + i a + p}{2c}; -\nu, \nu; 1 - \frac{-b + i a + p}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{-b + i a + p} +$$

$$\left.\frac{e^{(b + i a + p) z} F_1\left(-\frac{b + i a + p}{2c}; -\nu, \nu; 1 - \frac{b + i a + p}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{b + i a + p} - \frac{e^{(b - i a + p) z} F_1\left(-\frac{b - i a + p}{2c}; -\nu, \nu; 1 - \frac{b - i a + p}{2c}; -e^{-2 c z}, e^{-2 c z}\right)}{b - i a + p}\right)$$

Involving powers of sin, powers of cosh and exp

Involving $e^{p z} \sin^m(a z) \cosh^u(b z) \coth^\nu(c z)$

01.22.21.0468.01

$$\int e^{p z} \sin^m(a z) \cosh^u(b z) \coth^\nu(c z)\, dz = \frac{1}{p}\left(2^{-m-u} e^{p z} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} F_1\left(-\frac{p}{2 c}; -\nu, \nu; 1-\frac{p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} \coth^\nu(c z) (1 - m \bmod 2)(1 - u \bmod 2)\right) + 2^{-m-u} i^{-m} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} \binom{u}{\frac{u}{2}} \coth^\nu(c z) (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(\frac{(-1)^m e^{(p - i a (m-2k)) z} F_1\left(-\frac{p - i a (m-2k)}{2 c}; -\nu, \nu; 1-\frac{p - i a (m-2k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p - i a (m-2k)} + \frac{e^{(a i (m-2k)+p) z} F_1\left(-\frac{a i (m-2k)+p}{2 c}; -\nu, \nu; 1-\frac{a i (m-2k)+p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{a i (m-2k)+p}\right) - 2^{-m-u} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} \binom{m}{\frac{m}{2}} \coth^\nu(c z) (m \bmod 2 - 1) \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{u}{s} \left(\frac{e^{(p+b(u-2s)) z} F_1\left(-\frac{p+b(u-2s)}{2 c}; -\nu, \nu; 1-\frac{p+b(u-2s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p+b(u-2s)} + \frac{e^{(p-b(u-2s)) z} F_1\left(-\frac{p-b(u-2s)}{2 c}; -\nu, \nu; 1-\frac{p-b(u-2s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p-b(u-2s)}\right) + i^{-m} 2^{-m-u} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \sum_{s=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \binom{u}{s} \left(\left((-1)^m e^{(-i a (m-2k)+p+b(u-2s)) z} F_1\left(-\frac{-i a (m-2k)+p+b(u-2s)}{2 c}; -\nu, \nu; 1-\frac{-i a (m-2k)+p+b(u-2s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (-i a (m-2k)+p+b(u-2s)) + \left(e^{(a i (m-2k)+p+b(u-2s)) z} F_1\left(-\frac{a i (m-2k)+p+b(u-2s)}{2 c}; -\nu, \nu; 1-\frac{a i (m-2k)+p+b(u-2s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (a i (m-2k)+p+b(u-2s)) + \left((-1)^m e^{(-i a (m-2k)+p-b(u-2s)) z} F_1\left(-\frac{-i a (m-2k)+p-b(u-2s)}{2 c}; -\nu, \nu; 1-\frac{-i a (m-2k)+p-b(u-2s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (-i a (m-2k)+p-b(u-2s)) + \left(e^{(a i (m-2k)+p-b(u-2s)) z} F_1\left(-\frac{a i (m-2k)+p-b(u-2s)}{2 c}; -\nu, \nu; 1-\frac{a i (m-2k)+p-b(u-2s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (a i (m-2k)+p-b(u-2s))\right) \;/;\; m \in \mathbb{N}^+ \land u \in \mathbb{N}^+$$

01.22.21.0469.01

$$\int e^{p z}\sin^m(a z)\cosh^\mu(c z)\coth^\nu(c z)\,dz = 2^{-m}\left(1-e^{2 c z}\right)^\nu\left(1+e^{2 c z}\right)^{-\mu-\nu}\coth^\nu(c z)\cosh^\mu(c z)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(\left(e^{\frac{i\pi m}{2}+(p-i a(m-2k))z}F_1\left(\frac{-i a(m-2k)+p-c\mu}{2c};\nu,-\mu-\nu;\frac{1}{2}\left(\frac{p-i a(m-2k)}{c}-\mu+2\right);e^{2 c z},-e^{2 c z}\right)\right)\Big/(-i a(m-2k)+p-c\mu)+\left(e^{(a i(m-2k)+p)z-\frac{i m\pi}{2}}F_1\left(\frac{a i(m-2k)+p-c\mu}{2c};\nu,-\mu-\nu;\frac{1}{2}\left(\frac{a i(m-2k)+p}{c}-\mu+2\right);e^{2 c z},-e^{2 c z}\right)\right)\Big/(a i(m-2k)+p-c\mu)\right)+\frac{1}{p-c\mu}2^{-m}e^{p z}\left(1-e^{2 c z}\right)^\nu\left(1+e^{2 c z}\right)^{-\mu-\nu}\binom{m}{\frac{m}{2}}\cosh^\mu(c z)\coth^\nu(c z)F_1\left(\frac{p-c\mu}{2c};\nu,-\mu-\nu;\frac{1}{2}\left(\frac{p}{c}-\mu+2\right);e^{2 c z},-e^{2 c z}\right)(1-m\bmod 2)\;/;\;m\in\mathbb{N}^+$$

Involving cos, cosh and exp

Involving $e^{p z}\cos(a z)\cosh(b z)\coth^\nu(c z)$

01.22.21.0470.01

$$\int e^{p z}\cos(a z)\cosh(b z)\coth^\nu(c z)\,dz = \frac{1}{4}\left(1-e^{-2 c z}\right)^\nu\left(1+e^{-2 c z}\right)^{-\nu}\coth^\nu(c z)\left(\frac{e^{(-b-i a+p)z}F_1\left(-\frac{-b-i a+p}{2c};-\nu,\nu;1-\frac{-b-i a+p}{2c};-e^{-2 c z},e^{-2 c z}\right)}{-b-i a+p}+\frac{e^{(-b+i a+p)z}F_1\left(-\frac{-b+i a+p}{2c};-\nu,\nu;1-\frac{-b+i a+p}{2c};-e^{-2 c z},e^{-2 c z}\right)}{-b+i a+p}+\frac{e^{(b-i a+p)z}F_1\left(-\frac{b-i a+p}{2c};-\nu,\nu;1-\frac{b-i a+p}{2c};-e^{-2 c z},e^{-2 c z}\right)}{b-i a+p}+\frac{e^{(b+i a+p)z}F_1\left(-\frac{b+i a+p}{2c};-\nu,\nu;1-\frac{b+i a+p}{2c};-e^{-2 c z},e^{-2 c z}\right)}{b+i a+p}\right)$$

Involving powers of cos, powers of cosh and exp

Involving $e^{p z}\cos^m(a z)\cosh^u(b z)\coth^\nu(c z)$

01.22.21.0471.01

$$\int e^{p z} \cos^m(a z) \cosh^u(b z) \coth^\nu(c z)\, dz = 2^{-m-u} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} \binom{u}{\frac{u}{2}} \coth^\nu(c z) (1-u \bmod 2) \sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor} \binom{m}{k} \left(\frac{e^{(p-i a (m-2 k)) z} F_1\left(-\frac{p-i a (m-2 k)}{2 c}; -\nu, \nu; 1-\frac{p-i a (m-2 k)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p-i a (m-2 k)} + \frac{e^{(a i (m-2 k)+p) z} F_1\left(-\frac{a i (m-2 k)+p}{2 c}; -\nu, \nu; 1-\frac{a i (m-2 k)+p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{a i (m-2 k)+p}\right) + 2^{-m-u} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} \binom{m}{\frac{m}{2}} \coth^\nu(c z) (1-m \bmod 2) \sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor} \binom{u}{s} \left(\frac{e^{(p+b (u-2 s)) z} F_1\left(-\frac{p+b (u-2 s)}{2 c}; -\nu, \nu; 1-\frac{p+b (u-2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p+b (u-2 s)} + \frac{e^{(p-b (u-2 s)) z} F_1\left(-\frac{p-b (u-2 s)}{2 c}; -\nu, \nu; 1-\frac{p-b (u-2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)}{p-b (u-2 s)}\right) +$$

$$2^{-m-u} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} \coth^\nu(c z) \sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor} \sum_{s=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor} \binom{m}{k} \binom{u}{s} \Bigg(\left(e^{(-i a (m-2 k)+p+b (u-2 s)) z} F_1\left(-\frac{-i a (m-2 k)+p+b (u-2 s)}{2 c}; -\nu, \nu; 1-\frac{-i a (m-2 k)+p+b (u-2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (-i a (m-2 k)+p+b (u-2 s)) + \left(e^{(a i (m-2 k)+p+b (u-2 s)) z} F_1\left(-\frac{a i (m-2 k)+p+b (u-2 s)}{2 c}; -\nu, \nu; 1-\frac{a i (m-2 k)+p+b (u-2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (a i (m-2 k)+p+b (u-2 s)) + \left(e^{(-i a (m-2 k)+p-b (u-2 s)) z} F_1\left(-\frac{-i a (m-2 k)+p-b (u-2 s)}{2 c}; -\nu, \nu; 1-\frac{-i a (m-2 k)+p-b (u-2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (-i a (m-2 k)+p-b (u-2 s)) + \left(e^{(a i (m-2 k)+p-b (u-2 s)) z} F_1\left(-\frac{a i (m-2 k)+p-b (u-2 s)}{2 c}; -\nu, \nu; 1-\frac{a i (m-2 k)+p-b (u-2 s)}{2 c}; -e^{-2 c z}, e^{-2 c z}\right)\right) \Big/ (a i (m-2 k)+p-b (u-2 s))\Bigg) +$$

$$\frac{1}{p} 2^{-m-u} e^{p z} \left(1-e^{-2 c z}\right)^\nu \left(1+e^{-2 c z}\right)^{-\nu} F_1\left(-\frac{p}{2 c}; -\nu, \nu; 1-\frac{p}{2 c}; -e^{-2 c z}, e^{-2 c z}\right) \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} \coth^\nu(c z) (1-m \bmod 2) (1-u \bmod 2) /; m \in \mathbb{N}^+ \land u \in \mathbb{N}^+$$

01.22.21.0472.01

$$\int e^{pz}\cos^m(az)\cosh^\mu(cz)\coth^\nu(cz)\,dz = 2^{-m}\left(1-e^{2cz}\right)^\nu\left(1+e^{2cz}\right)^{-\mu-\nu}\coth^\nu(cz)\cosh^\mu(cz)$$
$$\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(\left(e^{(p-i a(m-2k))z}F_1\left(\frac{-i a(m-2k)+p-c\mu}{2c};\nu,-\mu-\nu;\frac{1}{2}\left(\frac{p-i a(m-2k)}{c}-\mu+2\right);e^{2cz},-e^{2cz}\right)\right)\right/$$
$$(-i a(m-2k)+p-c\mu)+\left(e^{(a i(m-2k)+p)z}F_1\left(\frac{a i(m-2k)+p-c\mu}{2c};\nu,-\mu-\nu;\right.\right.$$
$$\left.\left.\left.\frac{1}{2}\left(\frac{a i(m-2k)+p}{c}-\mu+2\right);e^{2cz},-e^{2cz}\right)\right)\right/(a i(m-2k)+p-c\mu)\right)+$$
$$\frac{1}{p-c\mu}2^{-m}e^{pz}\left(1-e^{2cz}\right)^\nu\left(1+e^{2cz}\right)^{-\mu-\nu}\binom{m}{\frac{m}{2}}\cosh^\mu(cz)\coth^\nu(cz)F_1\left(\frac{p-c\mu}{2c};\nu,-\mu-\nu;\right.$$
$$\left.\frac{1}{2}\left(\frac{p}{c}-\mu+2\right);e^{2cz},-e^{2cz}\right)(1-m\bmod 2)\;/;\;m\in\mathbb{N}^+$$

Involving sin, tanh and exp

Involving $e^{pz}\sin(az)\tanh(cz)\coth^\nu(cz)$

01.22.21.0473.01

$$\int e^{pz}\sin(az)\tanh(cz)\coth^\nu(cz)\,dz =$$
$$\frac{1}{2}\left(1-e^{-2cz}\right)^\nu\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(cz)\left(\frac{e^{\frac{i\pi}{2}+(-i a+p)z}F_1\left(-\frac{-i a+p}{2c};1-\nu,\nu-1;1-\frac{-i a+p}{2c};-e^{-2cz},e^{-2cz}\right)}{-i a+p}+\right.$$
$$\left.\frac{e^{-\frac{1}{2}(i\pi)+(i a+p)z}F_1\left(-\frac{i a+p}{2c};1-\nu,\nu-1;1-\frac{i a+p}{2c};-e^{-2cz},e^{-2cz}\right)}{i a+p}\right)$$

Involving powers of sin, powers of tanh and exp

Involving $e^{pz}\sin^m(az)\tanh^\mu(cz)\coth^\nu(cz)$

01.22.21.0474.01

$$\int e^{pz}\sin^m(az)\tanh^\mu(cz)\coth^\nu(cz)\,dz = \frac{1}{p}2^{-m}e^{pz}\left(1-e^{-2cz}\right)^{\nu-\mu}\left(1+e^{-2cz}\right)^{\mu-\nu}\binom{m}{\frac{m}{2}}\coth^\nu(cz)\tanh^\mu(cz)\,F_1\left(-\frac{p}{2c};\mu-\nu,\nu-\mu;1-\frac{p}{2c};-e^{-2cz},e^{-2cz}\right)(1-m\bmod 2)+2^{-m}\left(1-e^{-2cz}\right)^{\nu-\mu}\left(1+e^{-2cz}\right)^{\mu-\nu}\coth^\nu(cz)\tanh^\mu(cz)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(\frac{e^{\frac{i\pi m}{2}+(p-i a(m-2k))z}F_1\left(-\frac{p-i a(m-2k)}{2c};\mu-\nu,\nu-\mu;1-\frac{p-i a(m-2k)}{2c};-e^{-2cz},e^{-2cz}\right)}{p-i a(m-2k)}+\frac{e^{(a i(m-2k)+p)z-\frac{i m\pi}{2}}F_1\left(-\frac{a i(m-2k)+p}{2c};\mu-\nu,\nu-\mu;1-\frac{a i(m-2k)+p}{2c};-e^{-2cz},e^{-2cz}\right)}{a i(m-2k)+p}\right)\;/;\;m\in\mathbb{N}^+$$

Involving cos, tanh and exp

Involving $e^{pz}\cos(az)\tanh(cz)\coth^\nu(cz)$

01.22.21.0475.01

$$\int e^{pz}\cos(az)\tanh(cz)\coth^\nu(cz)\,dz = \frac{1}{2}\left(1-e^{-2cz}\right)^{\nu}\left(1+e^{-2cz}\right)^{-\nu}\coth^\nu(cz)\left(\frac{e^{(-i a+p)z}F_1\left(-\frac{-i a+p}{2c};1-\nu,\nu-1;1-\frac{-i a+p}{2c};-e^{-2cz},e^{-2cz}\right)}{-i a+p}+\frac{e^{(i a+p)z}F_1\left(-\frac{i a+p}{2c};1-\nu,\nu-1;1-\frac{i a+p}{2c};-e^{-2cz},e^{-2cz}\right)}{i a+p}\right)$$

Involving powers of cos, powers of tanh and exp

Involving $e^{pz}\cos^m(az)\tanh^\mu(cz)\coth^\nu(cz)$

01.22.21.0476.01

$$\int e^{pz}\cos^m(az)\tanh^\mu(cz)\coth^\nu(cz)\,dz = \frac{1}{p}2^{-m}e^{pz}\left(1-e^{-2cz}\right)^{\nu-\mu}\left(1+e^{-2cz}\right)^{\mu-\nu}\binom{m}{\frac{m}{2}}\coth^\nu(cz)\tanh^\mu(cz)\,F_1\left(-\frac{p}{2c};\mu-\nu,\nu-\mu;1-\frac{p}{2c};-e^{-2cz},e^{-2cz}\right)(1-m\bmod 2)+2^{-m}\left(1-e^{-2cz}\right)^{\nu-\mu}\left(1+e^{-2cz}\right)^{\mu-\nu}\coth^\nu(cz)\tanh^\mu(cz)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\left(\frac{e^{(p-i a(m-2k))z}F_1\left(-\frac{p-i a(m-2k)}{2c};\mu-\nu,\nu-\mu;1-\frac{p-i a(m-2k)}{2c};-e^{-2cz},e^{-2cz}\right)}{p-i a(m-2k)}+\frac{e^{(a i(m-2k)+p)z}F_1\left(-\frac{a i(m-2k)+p}{2c};\mu-\nu,\nu-\mu;1-\frac{a i(m-2k)+p}{2c};-e^{-2cz},e^{-2cz}\right)}{a i(m-2k)+p}\right)\;/;\;m\in\mathbb{N}^+$$

Involving functions of the direct function, hyperbolic, trigonometric and a power functions

Involving powers of the direct function, hyperbolic, trigonometric and a power functions

Involving sin, sinh and power

Involving $z^n \sin(a z) \sinh(b z) \coth^{\nu}(c z)$

01.22.21.0477.01

$$\int z^n \sin(a z) \sinh(b z) \coth^{\nu}(c z)\, dz = \frac{1}{4} i (-1)^{\nu} n! \Bigg(-e^{(-b-i a+c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-b-i a+c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a-b+c \nu}{2 c}, \ldots, \frac{-i a-b+c \nu}{2 c}, \nu; \frac{-i a-b+c \nu}{2 c}+1, \ldots, \frac{-i a-b+c \nu}{2 c}+1; e^{2 c z}\right) + e^{(-b+i a+c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-b+i a+c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a-b+c \nu}{2 c}, \ldots, \frac{i a-b+c \nu}{2 c}, \nu; \frac{i a-b+c \nu}{2 c}+1, \ldots, \frac{i a-b+c \nu}{2 c}+1; e^{2 c z}\right) + e^{(b-i a+c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b-i a+c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a+b+c \nu}{2 c}, \ldots, \frac{-i a+b+c \nu}{2 c}, \nu; \frac{-i a+b+c \nu}{2 c}+1, \ldots, \frac{-i a+b+c \nu}{2 c}+1; e^{2 c z}\right) - e^{(b+i a+c \nu) z} \binom{\nu}{\frac{\nu}{2}} (1-\nu \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b+i a+c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a+b+c \nu}{2 c}, \ldots, \frac{i a+b+c \nu}{2 c}, \nu; \frac{i a+b+c \nu}{2 c}+1, \ldots, \frac{i a+b+c \nu}{2 c}+1; e^{2 c z}\right) - \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{(-b-i a+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-i a+2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a-b+2 c s}{2 c}, \ldots, \frac{-i a-b+2 c s}{2 c}, \nu; \frac{-i a-b+2 c s}{2 c}+1, \ldots, \frac{-i a-b+2 c s}{2 c}+1; e^{2 c z}\right) + e^{(-b-i a+2 c (\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-i a+2 c (\nu-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a-b+2 c (\nu-s)}{2 c}, \ldots, \frac{-i a-b+2 c (\nu-s)}{2 c}, \nu; \frac{-i a-b+2 c (\nu-s)}{2 c}+1, \ldots, \frac{-i a-b+2 c (\nu-s)}{2 c}+1; e^{2 c z}\right) \Bigg) + \sum_{s=0}^{\left\lfloor \frac{\nu-1}{2} \right\rfloor} \binom{\nu}{s} \Bigg(e^{(-b+i a+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+i a+2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a-b+2 c s}{2 c}, \ldots, \frac{i a-b+2 c s}{2 c}, \nu; \frac{i a-b+2 c s}{2 c}+1, \ldots, \frac{i a-b+2 c s}{2 c}+1; e^{2 c z}\right) + e^{(-b+i a+2 c (\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+i a+2 c (\nu-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a-b+2 c (\nu-s)}{2 c}, \ldots,\right.$$

$$\left.\left.\frac{i a-b+2 c (v-s)}{2 c}, v; \frac{i a-b+2 c (v-s)}{2 c}+1, \ldots, \frac{i a-b+2 c (v-s)}{2 c}+1; e^{2 c z}\right)\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(b-i a+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a+2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a+b+2 c s}{2 c}, \ldots, \frac{-i a+b+2 c s}{2 c},\right.\right.$$

$$\left.v; \frac{-i a+b+2 c s}{2 c}+1, \ldots, \frac{-i a+b+2 c s}{2 c}+1; e^{2 c z}\right)+$$

$$e^{(b-i a+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a+2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a+b+2 c (v-s)}{2 c}, \ldots,\right.$$

$$\left.\left.\frac{-i a+b+2 c (v-s)}{2 c}, v; \frac{-i a+b+2 c (v-s)}{2 c}+1, \ldots, \frac{-i a+b+2 c (v-s)}{2 c}+1; e^{2 c z}\right)\right)-$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(b+i a+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a+2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a+b+2 c s}{2 c}, \ldots, \frac{i a+b+2 c s}{2 c},\right.\right.$$

$$\left.v; \frac{i a+b+2 c s}{2 c}+1, \ldots, \frac{i a+b+2 c s}{2 c}+1; e^{2 c z}\right)+$$

$$e^{(b+i a+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a+2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a+b+2 c (v-s)}{2 c}, \ldots,\right.$$

$$\left.\left.\left.\frac{i a+b+2 c (v-s)}{2 c}, v; \frac{i a+b+2 c (v-s)}{2 c}+1, \ldots, \frac{i a+b+2 c (v-s)}{2 c}+1; e^{2 c z}\right)\right)\right) /; n \in \mathbb{N} \land v \in \mathbb{N}^+$$

Involving powers of sin, powers of sinh and power

Involving $z^n \sin^m(a z) \sinh^u(b z) \coth^v(c z)$

01.22.21.0478.01

$$\int z^n \sin^m(a z) \sinh^u(b z) \coth^v(c z)\, dz = (-1)^v n!\, i^u\, 2^{-m-u} \binom{u}{\frac{u}{2}} \binom{m}{\frac{m}{2}} (1-u \bmod 2)$$

$$(1-m \bmod 2)\left(\frac{z^{n+1}}{(n+1)!}+e^{2 c v z} \sum_{j=0}^{n} \frac{(-1)^j (2 c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(v, \ldots, v; v+1, \ldots, v+1; e^{2 c z}\right)+\right.$$

$$e^{2 c z} v \sum_{j=0}^{n} \frac{(-1)^j (2 c)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+3}F_{j+2}\left(1, \ldots, 1, v+1; 2, \ldots, 2; e^{2 c z}\right)+$$

$$e^{c v z} \binom{v}{\frac{v}{2}} (1-v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{v}{2}, \ldots, \frac{v}{2}, v; \frac{v}{2}+1, \ldots, \frac{v}{2}+1; e^{2 c z}\right)+$$

$$\sum_{s=1}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{2csz}\sum_{j=0}^{n}\frac{(-1)^j(2cs)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(s,\,\ldots,\,s,\,v;\,s+1,\,\ldots,\,s+1;\,e^{2cz}\right)+\right.$$

$$\left.\left.e^{2c(v-s)z}\sum_{j=0}^{n}\frac{(-1)^j(2c(v-s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(v-s,\,\ldots,\,v-s,\,v;\,-s+v+1,\,\ldots,\,-s+v+1;\,e^{2cz}\right)\right)\right)+$$

$$(-1)^v\,i^u\,2^{-m-u}\binom{u}{\frac{u}{2}}n!\,(1-u\bmod 2)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\left(e^{\frac{i m\pi}{2}}\left(e^{(cv-ia(m-2k))z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\right.\right.$$

$$\sum_{j=0}^{n}\frac{(-1)^j(cv-ia(m-2k))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{cv-ia(m-2k)}{2c},\,\ldots,\right.$$

$$\left.\frac{cv-ia(m-2k)}{2c},\,v;\,\frac{cv-ia(m-2k)}{2c}+1,\,\ldots,\,\frac{cv-ia(m-2k)}{2c}+1;\,e^{2cz}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(2cs-ia(m-2k))z}\sum_{j=0}^{n}\frac{(-1)^j(2cs-ia(m-2k))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{2cs-ia(m-2k)}{2c},\right.\right.$$

$$\left.\ldots,\,\frac{2cs-ia(m-2k)}{2c},\,v;\,\frac{2cs-ia(m-2k)}{2c}+1,\,\ldots,\,\frac{2cs-ia(m-2k)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(2c(v-s)-ia(m-2k))z}\sum_{j=0}^{n}\frac{(-1)^j(2c(v-s)-ia(m-2k))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\left(\frac{2c(v-s)-ia(m-2k)}{2c},\,\ldots,\,\frac{2c(v-s)-ia(m-2k)}{2c},\,v;\right.$$

$$\left.\left.\left.\frac{2c(v-s)-ia(m-2k)}{2c}+1,\,\ldots,\,\frac{2c(v-s)-ia(m-2k)}{2c}+1;\,e^{2cz}\right)\right)\right)+$$

$$e^{-\frac{1}{2}i m\pi}\left(e^{(ai(m-2k)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(ai(m-2k)+cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia(m-2k)+cv}{2c},\right.\right.$$

$$\left.\ldots,\,\frac{ia(m-2k)+cv}{2c},\,v;\,\frac{ia(m-2k)+cv}{2c}+1,\,\ldots,\,\frac{ia(m-2k)+cv}{2c}+1;\,e^{2cz}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(ai(m-2k)+2cs)z}\sum_{j=0}^{n}\frac{(-1)^j(ai(m-2k)+2cs)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia(m-2k)+2cs}{2c},\right.\right.$$

$$\left.\ldots,\,\frac{ia(m-2k)+2cs}{2c},\,v;\,\frac{ia(m-2k)+2cs}{2c}+1,\,\ldots,\,\frac{ia(m-2k)+2cs}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(ai(m-2k)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j(ai(m-2k)+2c(v-s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\left(\frac{ia(m-2k)+2c(v-s)}{2c},\,\ldots,\,\frac{ia(m-2k)+2c(v-s)}{2c},\,v;\,\frac{ia(m-2k)+2c(v-s)}{2c}+1,\right.$$

$$\ldots,\ \frac{i\,a\,(m-2\,k)+2\,c\,(v-s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg)+(-1)^v\,i^u\,2^{-m-u}\binom{m}{\frac{m}{2}}n!$$

$$(1-m \bmod 2)\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}(-1)^i\binom{u}{i}\Bigg(e^{\frac{i\pi u}{2}}\Bigg(e^{(c\,v-b\,(u-2\,i))\,z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(c\,v-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{c\,v-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{c\,v-b\,(u-2\,i)}{2\,c},\ v;\ \frac{c\,v-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{c\,v-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(2\,c\,s-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,s-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{2\,c\,s-b\,(u-2\,i)}{2\,c},\ \ldots,$$

$$\frac{2\,c\,s-b\,(u-2\,i)}{2\,c},\ v;\ \frac{2\,c\,s-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c\,s-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c\,(v-s)-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,(v-s)-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{2\,c\,(v-s)-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{2\,c\,(v-s)-b\,(u-2\,i)}{2\,c},\ v;$$

$$\frac{2\,c\,(v-s)-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c\,(v-s)-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)+$$

$$e^{-\frac{1}{2}\,i\,\pi\,u}\Bigg(e^{(b\,(u-2\,i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(b\,(u-2\,i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{b\,(u-2\,i)+c\,v}{2\,c},$$

$$\ldots,\ \frac{b\,(u-2\,i)+c\,v}{2\,c},\ v;\ \frac{b\,(u-2\,i)+c\,v}{2\,c}+1,\ \ldots,\ \frac{b\,(u-2\,i)+c\,v}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(2\,c\,s+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,s+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}\Bigg(\frac{2\,c\,s+b\,(u-2\,i)}{2\,c},\ \ldots,$$

$$\frac{2\,c\,s+b\,(u-2\,i)}{2\,c},\ v;\ \frac{2\,c\,s+b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\ {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\ \ldots,\ \frac{b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\ v;$$

$$\frac{b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\ \ldots,\ \frac{b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg)+$$

$$(-1)^{v}\, i^{u}\, 2^{-m-u}\, n! \sum_{i=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^{i+k} \binom{m}{k} \binom{u}{i} \Bigg(e^{\frac{1}{2} i \pi (m+u)} \Bigg(e^{(-i a (m-2k)-b(u-2i)+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2)$$

$$\sum_{j=0}^{n} \frac{(-1)^{j} (-i a (m-2k) - b(u-2i) + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Bigg(\frac{-i a (m-2k) - b(u-2i) + c v}{2c},$$

$$\ldots, \frac{-i a (m-2k) - b(u-2i) + c v}{2c}, v; \frac{-i a (m-2k) - b(u-2i) + c v}{2c} + 1, \ldots,$$

$$\frac{-i a (m-2k) - b(u-2i) + c v}{2c} + 1; e^{2cz} \Bigg) + \sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(-i a (m-2k)+2 c s-b(u-2i)) z}$$

$$\sum_{j=0}^{n} \frac{(-1)^{j} (-i a (m-2k) + 2 c s - b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\Bigg(\frac{-i a (m-2k) + 2 c s - b(u-2i)}{2c},$$

$$\ldots, \frac{-i a (m-2k) + 2 c s - b(u-2i)}{2c}, v; \frac{-i a (m-2k) + 2 c s - b(u-2i)}{2c} + 1,$$

$$\ldots, \frac{-i a (m-2k) + 2 c s - b(u-2i)}{2c} + 1; e^{2cz} \Bigg) +$$

$$e^{(-i a (m-2k)-b(u-2i)+2c(v-s)) z} \sum_{j=0}^{n} \frac{(-1)^{j} (-i a (m-2k) - b(u-2i) + 2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i a (m-2k) - b(u-2i) + 2c(v-s)}{2c}, \ldots,$$

$$\frac{-i a (m-2k) - b(u-2i) + 2c(v-s)}{2c}, v; \frac{-i a (m-2k) - b(u-2i) + 2c(v-s)}{2c} + 1,$$

$$\ldots, \frac{-i a (m-2k) - b(u-2i) + 2c(v-s)}{2c} + 1; e^{2cz} \Bigg) \Bigg) \Bigg) +$$

$$e^{\frac{1}{2} i \pi (u-m)} \Bigg(e^{(a i (m-2k)-b(u-2i)+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^{j} (a i (m-2k) - b(u-2i) + c v)^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{i a (m-2k) - b(u-2i) + c v}{2c}, \ldots, \frac{i a (m-2k) - b(u-2i) + c v}{2c}, v;$$

$$\frac{i a (m-2k) - b(u-2i) + c v}{2c} + 1, \ldots, \frac{i a (m-2k) - b(u-2i) + c v}{2c} + 1; e^{2cz} \Bigg) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(a i (m-2k)+2 c s-b(u-2i)) z} \sum_{j=0}^{n} \frac{(-1)^{j} (a i (m-2k) + 2 c s - b(u-2i))^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{i a (m-2k) + 2 c s - b(u-2i)}{2c}, \ldots, \frac{i a (m-2k) + 2 c s - b(u-2i)}{2c}, v;$$

$$\frac{i a (m-2k) + 2 c s - b(u-2i)}{2c} + 1, \ldots, \frac{i a (m-2k) + 2 c s - b(u-2i)}{2c} + 1; e^{2cz} \Bigg) +$$

$$e^{(a\,i\,(m-2k)-b\,(u-2i)+2c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)-b\,(u-2i)+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c},\,\ldots,\,\frac{i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c},\,v;\,\frac{i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c}+1,\,\ldots,\,\frac{i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c}+1;\,e^{2cz}\right)\Bigg)\Bigg)+$$

$$e^{\frac{1}{2}i\pi(m-u)}\Bigg(e^{(-i\,a\,(m-2k)+b\,(u-2i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)+b\,(u-2i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c},\,\ldots,\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c},\,v;\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c}+1,\,\ldots,\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c}+1;\,e^{2cz}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(-i\,a\,(m-2k)+2c\,s+b\,(u-2i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)+2c\,s+b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)+2c\,s+b\,(u-2i)}{2c},\,\ldots,\,\frac{-i\,a\,(m-2k)+2c\,s+b\,(u-2i)}{2c},\,v;\,\frac{-i\,a\,(m-2k)+2c\,s+b\,(u-2i)}{2c}+1,\,\ldots,\,\frac{-i\,a\,(m-2k)+2c\,s+b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c},\,\ldots,\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c},\,v;\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c}+1,\,\ldots,\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c}+1;\,e^{2cz}\right)\Bigg)\Bigg)+$$

$$e^{-\frac{1}{2}i\pi(m+u)}\Bigg(e^{(a\,i\,(m-2k)+b\,(u-2i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)+b\,(u-2i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c},\,\ldots,\,\frac{i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c},\,v;\right.$$

$$\frac{i\, a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}+1,\,\ldots,\,\frac{i\, a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(a\,i\,(m-2\,k)+2\,c\,s+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+2\,c\,s+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c},\,v;$$

$$\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{(a\,i\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,v;$$

$$\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;$$

$$e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg)\Bigg)\,/;\,n\in\mathbb{N}\land m\in\mathbb{N}^+\land u\in\mathbb{N}^+\land v\in\mathbb{N}^+$$

Involving cos, sinh and power

Involving $z^n\cos(a\,z)\sinh(b\,z)\coth^v(c\,z)$

01.22.21.0479.01

$$\int z^n\cos(a\,z)\sinh(b\,z)\coth^v(c\,z)\,dz=$$

$$\frac{1}{4}(-1)^{v-1}\,n!\Bigg(e^{(-b-i\,a+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(-b-i\,a+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{-i\,a-b+c\,v}{2\,c},\,\ldots,$$

$$\frac{-i\,a-b+c\,v}{2\,c},\,v;\,\frac{-i\,a-b+c\,v}{2\,c}+1,\,\ldots,\,\frac{-i\,a-b+c\,v}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+e^{(-b+i\,a+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(-b+i\,a+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{i\,a-b+c\,v}{2\,c},\,\ldots,\,\frac{i\,a-b+c\,v}{2\,c},\,v;\,\frac{i\,a-b+c\,v}{2\,c}+1,\,\ldots,$$

$$\frac{i\,a-b+c\,v}{2\,c}+1;\,e^{2\,c\,z}\Bigg)-e^{(b-i\,a+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(b-i\,a+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i\,a+b+c\,v}{2\,c},\,\ldots,\,\frac{-i\,a+b+c\,v}{2\,c},\,v;\,\frac{-i\,a+b+c\,v}{2\,c}+1,\,\ldots,\,\frac{-i\,a+b+c\,v}{2\,c}+1;\,e^{2\,c\,z}\Bigg)-$$

$$e^{(b+i\,a+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(b+i\,a+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$
{}_{j+2}F_{j+1}\left(\frac{i a+b+c v}{2 c}, \ldots, \frac{i a+b+c v}{2 c}, v; \frac{i a+b+c v}{2 c}+1, \ldots, \frac{i a+b+c v}{2 c}+1; e^{2 c z}\right)+
$$

$$
\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(-b+i a+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+i a+2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a-b+2 c s}{2 c}, \ldots, \frac{i a-b+2 c s}{2 c}, v; \frac{i a-b+2 c s}{2 c}+1, \ldots, \frac{i a-b+2 c s}{2 c}+1; e^{2 c z}\right)+ e^{(-b+i a+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+i a+2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a-b+2 c (v-s)}{2 c}, \ldots, \frac{i a-b+2 c (v-s)}{2 c}, v; \frac{i a-b+2 c (v-s)}{2 c}+1, \ldots, \frac{i a-b+2 c (v-s)}{2 c}+1; e^{2 c z}\right)\right)+
$$

$$
\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(-b-i a+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-i a+2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a-b+2 c s}{2 c}, \ldots, \frac{-i a-b+2 c s}{2 c}, v; \frac{-i a-b+2 c s}{2 c}+1, \ldots, \frac{-i a-b+2 c s}{2 c}+1; e^{2 c z}\right)+ e^{(-b-i a+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-i a+2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a-b+2 c (v-s)}{2 c}, \ldots, \frac{-i a-b+2 c (v-s)}{2 c}, v; \frac{-i a-b+2 c (v-s)}{2 c}+1, \ldots, \frac{-i a-b+2 c (v-s)}{2 c}+1; e^{2 c z}\right)\right)-
$$

$$
\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(b-i a+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a+2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a+b+2 c s}{2 c}, \ldots, \frac{-i a+b+2 c s}{2 c}, v; \frac{-i a+b+2 c s}{2 c}+1, \ldots, \frac{-i a+b+2 c s}{2 c}+1; e^{2 c z}\right)+ e^{(b-i a+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a+2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a+b+2 c (v-s)}{2 c}, \ldots, \frac{-i a+b+2 c (v-s)}{2 c}, v; \frac{-i a+b+2 c (v-s)}{2 c}+1, \ldots, \frac{-i a+b+2 c (v-s)}{2 c}+1; e^{2 c z}\right)\right)-
$$

$$
\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(b+i a+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a+2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a+b+2 c s}{2 c}, \ldots, \frac{i a+b+2 c s}{2 c}, v; \frac{i a+b+2 c s}{2 c}+1, \ldots, \frac{i a+b+2 c s}{2 c}+1; e^{2 c z}\right)+ e^{(b+i a+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a+2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a+b+2 c (v-s)}{2 c}, \ldots, \frac{i a+b+2 c (v-s)}{2 c}, v; \frac{i a+b+2 c (v-s)}{2 c}+1, \ldots, \frac{i a+b+2 c (v-s)}{2 c}+1; e^{2 c z}\right)\right)\Bigg) /; n \in \mathbb{N} \land v \in \mathbb{Z} \land v > 0
$$

Involving powers of cos, powers of sinh and power

Involving $z^n \cos^m(a z) \sinh^u(b z) \coth^v(c z)$

01.22.21.0480.01

$$\int z^n \cos^m(a z) \sinh^u(b z) \coth^v(c z)\, dz = (-1)^v n!\, i^u 2^{-m-u} \binom{u}{\frac{u}{2}} \binom{m}{\frac{m}{2}} (1 - u \bmod 2)$$

$$(1 - m \bmod 2)\left(\frac{z^{n+1}}{(n+1)!} + e^{2 c v z} \sum_{j=0}^{n} \frac{(-1)^j (2 c v)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(v, \ldots, v; v+1, \ldots, v+1; e^{2 c z}\right) +\right.$$

$$e^{2 c z} v \sum_{j=0}^{n} \frac{(-1)^j (2 c)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+3}F_{j+2}\left(1, \ldots, 1, v+1; 2, \ldots, 2; e^{2 c z}\right) +$$

$$e^{c v z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c v)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{v}{2}, \ldots, \frac{v}{2}, v; \frac{v}{2}+1, \ldots, \frac{v}{2}+1; e^{2 c z}\right) +$$

$$\sum_{s=1}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{2 c s z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(s, \ldots, s, v; s+1, \ldots, s+1; e^{2 c z}\right) +\right.$$

$$\left.\left. e^{2 c (v-s) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(v-s, \ldots, v-s, v; -s+v+1, \ldots, -s+v+1; e^{2 c z}\right)\right)\right) + (-1)^v$$

$$i^u 2^{-m-u} \binom{u}{\frac{u}{2}} n!\, (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(e^{(c v - i a (m-2k)) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c v - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\right.$$

$$\left(\frac{c v - i a (m-2k)}{2 c}, \ldots, \frac{c v - i a (m-2k)}{2 c}, v; \frac{c v - i a (m-2k)}{2 c} + 1, \ldots, \frac{c v - i a (m-2k)}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(a i (m-2k) + c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k) + c v)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}$$

$$\left(\frac{i a (m-2k) + c v}{2 c}, \ldots, \frac{i a (m-2k) + c v}{2 c}, v; \frac{i a (m-2k) + c v}{2 c} + 1, \ldots, \frac{i a (m-2k) + c v}{2 c} + 1; e^{2 c z}\right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(2 c s - i a (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{2 c s - i a (m-2k)}{2 c}, \ldots,\right.\right.$$

$$\left.\frac{2 c s - i a (m-2k)}{2 c}, v; \frac{2 c s - i a (m-2k)}{2 c} + 1, \ldots, \frac{2 c s - i a (m-2k)}{2 c} + 1; e^{2 c z}\right) +$$

$$e^{(2 c (v-s) - i a (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (v-s) - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}$$

$$\left(\frac{2 c (v-s) - i a (m-2k)}{2 c}, \ldots, \frac{2 c (v-s) - i a (m-2k)}{2 c}, v;\right.$$

$$\frac{2c(v-s)-i\,a(m-2k)}{2c}+1,\ \ldots,\ \frac{2c(v-s)-i\,a(m-2k)}{2c}+1;\ e^{2cz}\Bigg)\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(a\,i(m-2k)+2cs)z}\sum_{j=0}^{n}\frac{(-1)^j(a\,i(m-2k)+2cs)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{i\,a(m-2k)+2cs}{2c},$$

$$\ldots,\ \frac{i\,a(m-2k)+2cs}{2c},\ v;\ \frac{i\,a(m-2k)+2cs}{2c}+1,\ \ldots,\ \frac{i\,a(m-2k)+2cs}{2c}+1;\ e^{2cz}\Bigg)+$$

$$e^{(a\,i(m-2k)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j(a\,i(m-2k)+2c(v-s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{i\,a(m-2k)+2c(v-s)}{2c},\ \ldots,\ \frac{i\,a(m-2k)+2c(v-s)}{2c},\ v;\ \frac{i\,a(m-2k)+2c(v-s)}{2c}+1,$$

$$\ldots,\ \frac{i\,a(m-2k)+2c(v-s)}{2c}+1;\ e^{2cz}\Bigg)\Bigg)\Bigg)+(-1)^v\,i^u\,2^{-m-u}\binom{m}{\frac{m}{2}}n!$$

$$(1-m\bmod 2)\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}(-1)^i\binom{u}{i}\Bigg(e^{\frac{i\pi u}{2}}\Bigg(e^{(cv-b(u-2i))z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(cv-b(u-2i))^{-j-1}z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{cv-b(u-2i)}{2c},\ \ldots,\ \frac{cv-b(u-2i)}{2c},\ v;\ \frac{cv-b(u-2i)}{2c}+1,\ \ldots,\ \frac{cv-b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(2cs-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j(2cs-b(u-2i))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{2cs-b(u-2i)}{2c},\ \ldots,$$

$$\frac{2cs-b(u-2i)}{2c},\ v;\ \frac{2cs-b(u-2i)}{2c}+1,\ \ldots,\ \frac{2cs-b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)+$$

$$e^{(2c(v-s)-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j(2c(v-s)-b(u-2i))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{2c(v-s)-b(u-2i)}{2c},\ \ldots,\ \frac{2c(v-s)-b(u-2i)}{2c},\ v;$$

$$\frac{2c(v-s)-b(u-2i)}{2c}+1,\ \ldots,\ \frac{2c(v-s)-b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)\Bigg)\Bigg)+$$

$$e^{-\frac{1}{2}i\pi u}\Bigg(e^{(b(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(b(u-2i)+cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{b(u-2i)+cv}{2c},$$

$$\ldots,\ \frac{b(u-2i)+cv}{2c},\ v;\ \frac{b(u-2i)+cv}{2c}+1,\ \ldots,\ \frac{b(u-2i)+cv}{2c}+1;\ e^{2cz}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(2cs+b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j(2cs+b(u-2i))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{2cs+b(u-2i)}{2c},\ \ldots,$$

$$\frac{2 c s+b (u-2 i)}{2 c}, v; \frac{2 c s+b (u-2 i)}{2 c}+1, \ldots, \frac{2 c s+b (u-2 i)}{2 c}+1; e^{2 c z}\Bigg)+$$

$$e^{(b (u-2 i)+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b (u-2 i)+2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{b (u-2 i)+2 c (v-s)}{2 c}, \ldots, \frac{b (u-2 i)+2 c (v-s)}{2 c}, v;$$

$$\frac{b (u-2 i)+2 c (v-s)}{2 c}+1, \ldots, \frac{b (u-2 i)+2 c (v-s)}{2 c}+1; e^{2 c z}\Bigg)\Bigg)\Bigg)\Bigg)+$$

$$(-1)^v i^u 2^{-m-u} n! \sum_{i=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^i \binom{m}{k} \binom{u}{i} \Bigg(e^{\frac{i \pi u}{2}} \Bigg(e^{(-i a (m-2 k)-b (u-2 i)+c v) z} \binom{v}{\frac{v}{2}} (1-v \bmod 2)$$

$$\sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2 k)-b (u-2 i)+c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\Bigg(\frac{-i a (m-2 k)-b (u-2 i)+c v}{2 c},$$

$$\ldots, \frac{-i a (m-2 k)-b (u-2 i)+c v}{2 c}, v; \frac{-i a (m-2 k)-b (u-2 i)+c v}{2 c}+1, \ldots,$$

$$\frac{-i a (m-2 k)-b (u-2 i)+c v}{2 c}+1; e^{2 c z}\Bigg)+\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(-i a (m-2 k)+2 c s-b (u-2 i)) z}$$

$$\sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2 k)+2 c s-b (u-2 i))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\Bigg(\frac{-i a (m-2 k)+2 c s-b (u-2 i)}{2 c},$$

$$\ldots, \frac{-i a (m-2 k)+2 c s-b (u-2 i)}{2 c}, v; \frac{-i a (m-2 k)+2 c s-b (u-2 i)}{2 c}+1,$$

$$\ldots, \frac{-i a (m-2 k)+2 c s-b (u-2 i)}{2 c}+1; e^{2 c z}\Bigg)+$$

$$e^{(-i a (m-2 k)-b (u-2 i)+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2 k)-b (u-2 i)+2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i a (m-2 k)-b (u-2 i)+2 c (v-s)}{2 c}, \ldots,$$

$$\frac{-i a (m-2 k)-b (u-2 i)+2 c (v-s)}{2 c}, v; \frac{-i a (m-2 k)-b (u-2 i)+2 c (v-s)}{2 c}+1,$$

$$\ldots, \frac{-i a (m-2 k)-b (u-2 i)+2 c (v-s)}{2 c}+1; e^{2 c z}\Bigg)\Bigg)\Bigg)+$$

$$e^{\frac{i \pi u}{2}} \Bigg(e^{(a i (m-2 k)-b (u-2 i)+c v) z} \binom{v}{\frac{v}{2}} (1-v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2 k)-b (u-2 i)+c v)^{-j-1} z^{n-j}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)+c\,v}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)+c\,v}{2\,c},\,v;\ \frac{i\,a\,(m-2\,k)-b\,(u-2\,i)+c\,v}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)+c\,v}{2\,c}+1;\,e^{2\,c\,z}\right)+ $$

$$ \sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(a\,i\,(m-2\,k)+2\,c\,s-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+2\,c\,s-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\right. $$

$$ {}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2\,k)+2\,c\,s-b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+2\,c\,s-b\,(u-2\,i)}{2\,c},\,v;\ \frac{i\,a\,(m-2\,k)+2\,c\,s-b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+2\,c\,s-b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\right)+ $$

$$ e^{(a\,i\,(m-2\,k)-b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)-b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!} $$

$$ \left.{}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,v;\ \frac{i\,a\,(m-2\,k)-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\,e^{2\,c\,z}\right)\right)\Bigg)+ $$

$$ e^{-\frac{1}{2}\,i\,\pi\,u}\left(e^{(-i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\right. $$

$$ {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c},\,\ldots,\,\frac{-i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c},\,v;\ \frac{-i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}+1;\,e^{2\,c\,z}\right)+ $$

$$ \sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(-i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\right. $$

$$ {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{-i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c},\,v;\ \frac{-i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\right)+ $$

$$ e^{(-i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!} $$

$$ {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,\ldots,\right. $$

$$\frac{-i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,v;\,\frac{-i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)\Bigg)\Bigg)+$$

$$e^{-\frac{1}{2}\,i\,\pi\,u}\Bigg(e^{(a\,i\,(m-2\,k)+b\,(u-2\,i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+b\,(u-2\,i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c},\,v;\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(a\,i\,(m-2\,k)+2\,c\,s+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+2\,c\,s+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c},\,v;\,\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+$$

$$e^{(a\,i\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,v;\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\,e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg)\,/;\,n\in\mathbb{N}\land m\in\mathbb{N}^+\land u\in\mathbb{N}^+\land v\in\mathbb{N}^+$$

Involving sin, cosh and power

Involving $z^n \sin(a\,z)\cosh(b\,z)\coth^v(c\,z)$

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$$\int z^n\sin(a\,z)\cosh(b\,z)\coth^v(c\,z)\,dz ==$$

$$\frac{1}{4}(-1)^v\binom{v}{\frac{v}{2}}n!\,(1-v \bmod 2)\Bigg(e^{\frac{i\pi}{2}+(-b-i\,a+c\,v)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b-i\,a+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{-i\,a-b+c\,v}{2\,c},\,\ldots,\,\frac{-i\,a-b+c\,v}{2\,c},$$

$$v;\,\frac{-i\,a-b+c\,v}{2\,c}+1,\,\ldots,\,\frac{-i\,a-b+c\,v}{2\,c}+1;\,e^{2\,c\,z}\Bigg)+e^{-\frac{1}{2}(i\,\pi)+(-b+i\,a+c\,v)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b+i\,a+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$
{}_{j+2}F_{j+1}\left(\frac{i a-b+c v}{2 c}, \ldots, \frac{i a-b+c v}{2 c}, v; \frac{i a-b+c v}{2 c}+1, \ldots, \frac{i a-b+c v}{2 c}+1; e^{2 c z}\right)+
$$

$$
e^{-\frac{1}{2}(i \pi)+(b+i a+c v) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a+c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a+b+c v}{2 c}, \ldots, \frac{i a+b+c v}{2 c}, v;\right.
$$

$$
\left.\frac{i a+b+c v}{2 c}+1, \ldots, \frac{i a+b+c v}{2 c}+1; e^{2 c z}\right)+e^{\frac{i \pi}{2}+(b-i a+c v) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a+c v)^{-j-1} z^{n-j}}{(n-j)!}
$$

$$
\left.{}_{j+2}F_{j+1}\left(\frac{-i a+b+c v}{2 c}, \ldots, \frac{-i a+b+c v}{2 c}, v; \frac{-i a+b+c v}{2 c}+1, \ldots, \frac{-i a+b+c v}{2 c}+1; e^{2 c z}\right)\right)+
$$

$$
\frac{1}{4}(-1)^v n! \sum_{i=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{i}\left(e^{\frac{i \pi}{2}+(-b+2 c i-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c i-i a)^{-j-1} z^{n-j}}{(n-j)!}\right.
$$

$$
{}_{j+2}F_{j+1}\left(\frac{-i a-b+2 c i}{2 c}, \ldots, \frac{-i a-b+2 c i}{2 c}, v; \frac{-i a-b+2 c i}{2 c}+1, \ldots, \frac{-i a-b+2 c i}{2 c}+1; e^{2 c z}\right)+
$$

$$
e^{\frac{i \pi}{2}+(b+2 c i-i a) z} \sum_{j=0}^{n} \frac{(-1)^j (b+2 c i-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a+b+2 c i}{2 c}, \ldots, \frac{-i a+b+2 c i}{2 c},\right.
$$

$$
\left.v; \frac{-i a+b+2 c i}{2 c}+1, \ldots, \frac{-i a+b+2 c i}{2 c}+1; e^{2 c z}\right)+e^{-\frac{1}{2}(i \pi)+(b+2 c i+i a) z}
$$

$$
\sum_{j=0}^{n} \frac{(-1)^j (b+2 c i+i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a+b+2 c i}{2 c}, \ldots, \frac{i a+b+2 c i}{2 c}, v; \frac{i a+b+2 c i}{2 c}+1,\right.
$$

$$
\left.\ldots, \frac{i a+b+2 c i}{2 c}+1; e^{2 c z}\right)+e^{-\frac{1}{2}(i \pi)+(-b+2 c i+i a) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2 c i+i a)^{-j-1} z^{n-j}}{(n-j)!}
$$

$$
{}_{j+2}F_{j+1}\left(\frac{i a+2 c i-b}{2 c}, \ldots, \frac{i a+2 c i-b}{2 c}, v; \frac{i a+2 c i-b}{2 c}+1, \ldots, \frac{i a+2 c i-b}{2 c}+1; e^{2 c z}\right)+
$$

$$
e^{\frac{i \pi}{2}+(-b-2 c i-i a+2 c v) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-2 c i-i a+2 c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a-b-2 c i+2 c v}{2 c}, \ldots,\right.
$$

$$
\left.\frac{-i a-b-2 c i+2 c v}{2 c}, v; \frac{-i a-b-2 c i+2 c v}{2 c}+1, \ldots, \frac{-i a-b-2 c i+2 c v}{2 c}+1; e^{2 c z}\right)+
$$

$$
e^{-\frac{1}{2}(i \pi)+(-b-2 c i+i a+2 c v) z} \sum_{j=0}^{n} \frac{(-1)^j (-b-2 c i+i a+2 c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a-b-2 c i+2 c v}{2 c},\right.
$$

$$
\left.\ldots, \frac{i a-b-2 c i+2 c v}{2 c}, v; \frac{i a-b-2 c i+2 c v}{2 c}+1, \ldots, \frac{i a-b-2 c i+2 c v}{2 c}+1; e^{2 c z}\right)+
$$

$$
e^{\frac{i \pi}{2}+(b-2 c i-i a+2 c v) z} \sum_{j=0}^{n} \frac{(-1)^j (b-2 c i-i a+2 c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a+b-2 c i+2 c v}{2 c}, \ldots,\right.
$$

$$
\left.\frac{-i a+b-2 c i+2 c v}{2 c}, v; \frac{-i a+b-2 c i+2 c v}{2 c}+1, \ldots, \frac{-i a+b-2 c i+2 c v}{2 c}+1; e^{2 c z}\right)+
$$

$$e^{-\frac{1}{2}(i\pi)+(b-2ci+ia+2cv)z}\sum_{j=0}^{n}\frac{(-1)^j(b-2ci+ia+2cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia+b-2ci+2cv}{2c},\ldots,\frac{ia+b-2ci+2cv}{2c},v;\frac{ia+b-2ci+2cv}{2c}+1,\ldots,\frac{ia+b-2ci+2cv}{2c}+1;e^{2cz}\right)\Bigg)\Bigg)/;n\in\mathbb{N}\bigwedge v\in\mathbb{N}^+$$

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$$\int z^n\sin(az)\cosh(cz)\coth^v(cz)\,dz=\frac{1}{4}(-1)^v\,i\,e^{czv}\binom{v+1}{\frac{v+1}{2}}n!\,(1-(v+1)\bmod 2)\Bigg(e^{-iaz}\sum_{j=0}^{n}\frac{(-1)^j(-ia+cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{cv-ia}{2c},\ldots,\frac{cv-ia}{2c},v;\frac{cv-ia}{2c}+1,\ldots,\frac{cv-ia}{2c}+1;e^{2cz}\right)-e^{iaz}\sum_{j=0}^{n}\frac{(-1)^j(ia+cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia+cv}{2c},\ldots,\frac{ia+cv}{2c},v;\frac{ia+cv}{2c}+1,\ldots,\frac{ia+cv}{2c}+1;e^{2cz}\right)\Bigg)+\frac{1}{4}(-1)^v\,i\,e^{czv}\,n!\sum_{s=0}^{\left\lfloor\frac{v}{2}\right\rfloor}\binom{v+1}{s}\Bigg(e^{(-ia-c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j(-ia-c(1-2s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-ia-c(1-2s)}{2c},\ldots,\frac{-ia-c(1-2s)}{2c},v;\frac{-ia-c(1-2s)}{2c}+1,\ldots,\frac{-ia-c(1-2s)}{2c}+1;e^{2cz}\right)-e^{(ia-c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j(ia-c(1-2s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia-c(1-2s)}{2c},\ldots,\frac{ia-c(1-2s)}{2c},v;\frac{ia-c(1-2s)}{2c}+1,\ldots,\frac{ia-c(1-2s)}{2c}+1;e^{2cz}\right)+e^{(-ia+c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j(-ia+c(-2s+2v+1))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{c(-2s+2v+1)-ia}{2c},\ldots,\frac{c(-2s+2v+1)-ia}{2c},v;\frac{c(-2s+2v+1)-ia}{2c}+1,\ldots,\frac{c(-2s+2v+1)-ia}{2c}+1;e^{2cz}\right)-e^{(ia+c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j(ia+c(-2s+2v+1))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{ia+c(-2s+2v+1)}{2c},\ldots,\frac{ia+c(-2s+2v+1)}{2c},v;\frac{ia+c(-2s+2v+1)}{2c}+1,\ldots,\frac{ia+c(-2s+2v+1)}{2c}+1;e^{2cz}\right)\Bigg)/;n\in\mathbb{N}\bigwedge v\in\mathbb{N}^+$$

Involving powers of sin, powers of cosh and power

Involving $z^n\sin^m(az)\cosh^u(bz)\coth^v(cz)$

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$$\int z^n \sin^m(a z) \cosh^u(b z) \coth^v(c z)\, dz = (-1)^v\, n!\, 2^{-m-u} \binom{u}{\frac{u}{2}} \binom{m}{\frac{m}{2}} (1 - u \bmod 2)$$

$$(1 - m \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + e^{2 c v z} \sum_{j=0}^{n} \frac{(-1)^j (2 c v)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(v, \ldots, v; v+1, \ldots, v+1; e^{2 c z}\right) + \right.$$

$$e^{2 c z} v \sum_{j=0}^{n} \frac{(-1)^j (2 c)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+3}F_{j+2}\left(1, \ldots, 1, v+1; 2, \ldots, 2; e^{2 c z}\right) +$$

$$e^{c v z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c v)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{v}{2}, \ldots, \frac{v}{2}, v; \frac{v}{2}+1, \ldots, \frac{v}{2}+1; e^{2 c z}\right) +$$

$$\sum_{s=1}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{2 c s z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(s, \ldots, s, v; s+1, \ldots, s+1; e^{2 c z}\right) + \right.$$

$$\left.\left. e^{2 c (v-s) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(v-s, \ldots, v-s, v; -s+v+1, \ldots, -s+v+1; e^{2 c z}\right) \right) \right) +$$

$$(-1)^v 2^{-m-u} \binom{u}{\frac{u}{2}} n!\, (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(e^{\frac{i m \pi}{2}} \left(e^{(c v - i a (m-2k)) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \right.\right.$$

$$\sum_{j=0}^{n} \frac{(-1)^j (c v - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{c v - i a (m-2k)}{2 c}, \ldots, \right.$$

$$\left. \frac{c v - i a (m-2k)}{2 c}, v; \frac{c v - i a (m-2k)}{2 c} + 1, \ldots, \frac{c v - i a (m-2k)}{2 c} + 1; e^{2 c z} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(2 c s - i a (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{2 c s - i a (m-2k)}{2 c}, \right.\right.$$

$$\left. \ldots, \frac{2 c s - i a (m-2k)}{2 c}, v; \frac{2 c s - i a (m-2k)}{2 c} + 1, \ldots, \frac{2 c s - i a (m-2k)}{2 c} + 1; e^{2 c z} \right) +$$

$$e^{(2 c (v-s) - i a (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (v-s) - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}$$

$$\left(\frac{2 c (v-s) - i a (m-2k)}{2 c}, \ldots, \frac{2 c (v-s) - i a (m-2k)}{2 c}, v; \right.$$

$$\left.\left.\left. \frac{2 c (v-s) - i a (m-2k)}{2 c} + 1, \ldots, \frac{2 c (v-s) - i a (m-2k)}{2 c} + 1; e^{2 c z} \right) \right) \right) +$$

$$e^{-\frac{1}{2} i m \pi} \left(e^{(a i (m-2k) + c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k) + c v)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{i a (m-2k) + c v}{2 c}, \right.\right.$$

$$\ldots,\ \frac{i\,a\,(m-2\,k)+c\,v}{2\,c},\ v;\ \frac{i\,a\,(m-2\,k)+c\,v}{2\,c}+1,\ \ldots,\ \frac{i\,a\,(m-2\,k)+c\,v}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(a\,i\,(m-2\,k)+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+2\,c\,s}{2\,c},$$

$$\ldots,\ \frac{i\,a\,(m-2\,k)+2\,c\,s}{2\,c},\ v;\ \frac{i\,a\,(m-2\,k)+2\,c\,s}{2\,c}+1,\ \ldots,\ \frac{i\,a\,(m-2\,k)+2\,c\,s}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(a\,i\,(m-2\,k)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{i\,a\,(m-2\,k)+2\,c\,(v-s)}{2\,c},\ \ldots,\ \frac{i\,a\,(m-2\,k)+2\,c\,(v-s)}{2\,c},\ v;$$

$$\frac{i\,a\,(m-2\,k)+2\,c\,(v-s)}{2\,c}+1,\ \ldots,\ \frac{i\,a\,(m-2\,k)+2\,c\,(v-s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg)+$$

$$(-1)^v\,2^{-m-u}\binom{m}{\frac{m}{2}}n!\,(1-m\bmod 2)\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{i}\Bigg(e^{(c\,v-b\,(u-2\,i))\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(c\,v-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{c\,v-b\,(u-2\,i)}{2\,c},\ \ldots,\ \frac{c\,v-b\,(u-2\,i)}{2\,c},\ v;\ \frac{c\,v-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{c\,v-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(b\,(u-2\,i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(b\,(u-2\,i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{b\,(u-2\,i)+c\,v}{2\,c},\ \ldots,\ \frac{b\,(u-2\,i)+c\,v}{2\,c},\ v;\ \frac{b\,(u-2\,i)+c\,v}{2\,c}+1,\ \ldots,\ \frac{b\,(u-2\,i)+c\,v}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(2\,c\,s-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,s-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{2\,c\,s-b\,(u-2\,i)}{2\,c},\ \ldots,$$

$$\frac{2\,c\,s-b\,(u-2\,i)}{2\,c},\ v;\ \frac{2\,c\,s-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c\,s-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(2\,c\,(v-s)-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,(v-s)-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{2\,c\,(v-s)-b\,(u-2\,i)}{2\,c},\ \ldots,$$

$$\frac{2\,c\,(v-s)-b\,(u-2\,i)}{2\,c},\ v;\ \frac{2\,c\,(v-s)-b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c\,(v-s)-b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(2\,c\,s+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(2\,c\,s+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{2\,c\,s+b\,(u-2\,i)}{2\,c},\ \ldots,$$

$$\frac{2\,c\,s+b\,(u-2\,i)}{2\,c},\ v;\ \frac{2\,c\,s+b\,(u-2\,i)}{2\,c}+1,\ \ldots,\ \frac{2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(b(u-2i)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(b(u-2i)+2c(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\!\left(\frac{b(u-2i)+2c(v-s)}{2c},\,\ldots,\right.$$

$$\left.\left.\left.\frac{b(u-2i)+2c(v-s)}{2c},\,v;\,\frac{b(u-2i)+2c(v-s)}{2c}+1,\,\ldots,\,\frac{b(u-2i)+2c(v-s)}{2c}+1;\,e^{2cz}\right)\right)\right)+$$

$$(-1)^v\,2^{-m-u}\,n!\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\binom{u}{i}\left(e^{\frac{i\pi m}{2}}\left(e^{(-i a(m-2k)-b(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\right.\right.$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(-i a(m-2k)-b(u-2i)+cv)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\!\left(\frac{-i a(m-2k)-b(u-2i)+cv}{2c},\right.$$

$$\ldots,\,\frac{-i a(m-2k)-b(u-2i)+cv}{2c},\,v;\,\frac{-i a(m-2k)-b(u-2i)+cv}{2c}+1,\,\ldots,$$

$$\left.\frac{-i a(m-2k)-b(u-2i)+cv}{2c}+1;\,e^{2cz}\right)+\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(-i a(m-2k)+2cs-b(u-2i))z}\right.$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(-i a(m-2k)+2cs-b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\!\left(\frac{-i a(m-2k)+2cs-b(u-2i)}{2c},\right.$$

$$\ldots,\,\frac{-i a(m-2k)+2cs-b(u-2i)}{2c},\,v;\,\frac{-i a(m-2k)+2cs-b(u-2i)}{2c}+1,$$

$$\left.\ldots,\,\frac{-i a(m-2k)+2cs-b(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(-i a(m-2k)-b(u-2i)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i a(m-2k)-b(u-2i)+2c(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\!\left(\frac{-i a(m-2k)-b(u-2i)+2c(v-s)}{2c},\,\ldots,\right.$$

$$\frac{-i a(m-2k)-b(u-2i)+2c(v-s)}{2c},\,v;\,\frac{-i a(m-2k)-b(u-2i)+2c(v-s)}{2c}+1,$$

$$\left.\left.\left.\ldots,\,\frac{-i a(m-2k)-b(u-2i)+2c(v-s)}{2c}+1;\,e^{2cz}\right)\right)\right)+$$

$$e^{-\frac{1}{2}i\pi m}\left(e^{(a i(m-2k)-b(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(a i(m-2k)-b(u-2i)+cv)^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$${}_{j+2}F_{j+1}\!\left(\frac{i a(m-2k)-b(u-2i)+cv}{2c},\,\ldots,\,\frac{i a(m-2k)-b(u-2i)+cv}{2c},\,v;\right.$$

$$\left.\frac{i a(m-2k)-b(u-2i)+cv}{2c}+1,\,\ldots,\,\frac{i a(m-2k)-b(u-2i)+cv}{2c}+1;\,e^{2cz}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(a\,i\,(m-2k)+2cs-b\,(u-2i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)+2cs-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$$\,_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c},\,\ldots,\,\frac{i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c},\,v;\right.$$

$$\left.\frac{i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c}+1,\,\ldots,\,\frac{i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(a\,i\,(m-2k)-b\,(u-2i)+2c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)-b\,(u-2i)+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c},\,\ldots,\right.$$

$$\frac{i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c},\,v;\,\frac{i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c}+1,$$

$$\left.\left.\left.\ldots,\,\frac{i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c}+1;\,e^{2cz}\right)\right)\right)+$$

$$e^{\frac{i\pi m}{2}}\left(e^{(-i\,a\,(m-2k)+b\,(u-2i)+cv)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)+b\,(u-2i)+cv)^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$$\,_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)+b\,(u-2i)+cv}{2c},\,\ldots,\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+cv}{2c},\,v;\right.$$

$$\left.\frac{-i\,a\,(m-2k)+b\,(u-2i)+cv}{2c}+1,\,\ldots,\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+cv}{2c}+1;\,e^{2cz}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(-i\,a\,(m-2k)+2cs+b\,(u-2i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)+2cs+b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$$\,_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)+2cs+b\,(u-2i)}{2c},\,\ldots,\right.$$

$$\frac{-i\,a\,(m-2k)+2cs+b\,(u-2i)}{2c},\,v;\,\frac{-i\,a\,(m-2k)+2cs+b\,(u-2i)}{2c}+1,$$

$$\left.\ldots,\,\frac{-i\,a\,(m-2k)+2cs+b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$\,_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c},\,\ldots,\right.$$

$$\frac{-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c},\,v;\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c}+1,$$

$$\ldots, \frac{-i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\, e^{2\,c\,z}\Bigg)\Bigg)\Bigg) +$$

$$e^{-\frac{1}{2}\,i\,\pi\,m}\Bigg(e^{(a\,i\,(m-2\,k)+b\,(u-2\,i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+b\,(u-2\,i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}, \ldots, \frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}, v;$$

$$\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}+1, \ldots, \frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+c\,v}{2\,c}+1;\, e^{2\,c\,z}\Bigg) +$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(a\,i\,(m-2\,k)+2\,c\,s+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+2\,c\,s+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}, \ldots, \frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}, v;$$

$$\frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}+1, \ldots, \frac{i\,a\,(m-2\,k)+2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\, e^{2\,c\,z}\Bigg) +$$

$$e^{(a\,i\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}, \ldots, \frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}, v;$$

$$\frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1, \ldots, \frac{i\,a\,(m-2\,k)+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;$$

$$e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg) /;\, n \in \mathbb{N} \land m \in \mathbb{N}^+ \land u \in \mathbb{N}^+ \land v \in \mathbb{N}^+$$

Involving cos, cosh and power

Involving $z^n \cos(a\,z) \cosh(b\,z) \coth^v(c\,z)$

01.22.21.0484.01

$$\int z^n \cos(a\,z)\cosh(b\,z)\coth^v(c\,z)\,dz = $$

$$\frac{1}{4}(-1)^v\binom{v}{\frac{v}{2}}n!\,(1-v \bmod 2)\Bigg(e^{(-b-i\,a+c\,v)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b-i\,a+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{-i\,a-b+c\,v}{2\,c}, \ldots, \frac{-i\,a-b+c\,v}{2\,c}, v;$$

$$\frac{-i\,a-b+c\,v}{2\,c}+1, \ldots, \frac{-i\,a-b+c\,v}{2\,c}+1;\, e^{2\,c\,z}\Bigg) + e^{(-b+i\,a+c\,v)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b+i\,a+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a-b+c\,v}{2\,c}, \ldots, \frac{i\,a-b+c\,v}{2\,c}, v;\, \frac{i\,a-b+c\,v}{2\,c}+1, \ldots, \frac{i\,a-b+c\,v}{2\,c}+1;\, e^{2\,c\,z}\Bigg) +$$

$$e^{(b+i a+c v) z} \sum_{j=0}^{n} \frac{(-1)^{j} (b+i a+c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a+b+c v}{2 c}, \ldots, \frac{i a+b+c v}{2 c}, v; \frac{i a+b+c v}{2 c}+1, \ldots, \frac{i a+b+c v}{2 c}+1; e^{2 c z}\right)+e^{(b-i a+c v) z} \sum_{j=0}^{n} \frac{(-1)^{j} (b-i a+c v)^{-j-1} z^{n-j}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{-i a+b+c v}{2 c}, \ldots, \frac{-i a+b+c v}{2 c}, v; \frac{-i a+b+c v}{2 c}+1, \ldots, \frac{-i a+b+c v}{2 c}+1; e^{2 c z}\right)\Bigg)+$$

$$\frac{1}{4} (-1)^{v} n! \sum_{i=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor} \binom{v}{i} \Bigg(e^{(-b+2 c i-i a) z} \sum_{j=0}^{n} \frac{(-1)^{j} (-b+2 c i-i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a-b+2 c i}{2 c}, \ldots, \frac{-i a-b+2 c i}{2 c}, v; \frac{-i a-b+2 c i}{2 c}+1, \ldots, \frac{-i a-b+2 c i}{2 c}+1; e^{2 c z}\right)+e^{(b+2 c i-i a) z} \sum_{j=0}^{n} \frac{(-1)^{j} (b+2 c i-i a)^{-j-1} z^{n-j}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{-i a+b+2 c i}{2 c}, \ldots, \frac{-i a+b+2 c i}{2 c}, v; \frac{-i a+b+2 c i}{2 c}+1, \ldots, \frac{-i a+b+2 c i}{2 c}+1; e^{2 c z}\right)+$$

$$e^{(b+2 c i+i a) z} \sum_{j=0}^{n} \frac{(-1)^{j} (b+2 c i+i a)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a+b+2 c i}{2 c}, \ldots, \frac{i a+b+2 c i}{2 c}, v; \frac{i a+b+2 c i}{2 c}+1, \ldots, \frac{i a+b+2 c i}{2 c}+1; e^{2 c z}\right)+e^{(-b+2 c i+i a) z} \sum_{j=0}^{n} \frac{(-1)^{j} (-b+2 c i+i a)^{-j-1} z^{n-j}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{i a+2 c i-b}{2 c}, \ldots, \frac{i a+2 c i-b}{2 c}, v; \frac{i a+2 c i-b}{2 c}+1, \ldots, \frac{i a+2 c i-b}{2 c}+1; e^{2 c z}\right)+$$

$$e^{(-b-2 c i-i a+2 c v) z} \sum_{j=0}^{n} \frac{(-1)^{j} (-b-2 c i-i a+2 c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a-b-2 c i+2 c v}{2 c}, \ldots, \frac{-i a-b-2 c i+2 c v}{2 c}, v; \frac{-i a-b-2 c i+2 c v}{2 c}+1, \ldots, \frac{-i a-b-2 c i+2 c v}{2 c}+1; e^{2 c z}\right)+$$

$$e^{(-b-2 c i+i a+2 c v) z} \sum_{j=0}^{n} \frac{(-1)^{j} (-b-2 c i+i a+2 c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a-b-2 c i+2 c v}{2 c}, \ldots, \frac{i a-b-2 c i+2 c v}{2 c}, v; \frac{i a-b-2 c i+2 c v}{2 c}+1, \ldots, \frac{i a-b-2 c i+2 c v}{2 c}+1; e^{2 c z}\right)+$$

$$e^{(b-2 c i-i a+2 c v) z} \sum_{j=0}^{n} \frac{(-1)^{j} (b-2 c i-i a+2 c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-i a+b-2 c i+2 c v}{2 c}, \ldots, \frac{-i a+b-2 c i+2 c v}{2 c}, v; \frac{-i a+b-2 c i+2 c v}{2 c}+1, \ldots, \frac{-i a+b-2 c i+2 c v}{2 c}+1; e^{2 c z}\right)+$$

$$e^{(b-2 c i+i a+2 c v) z} \sum_{j=0}^{n} \frac{(-1)^{j} (b-2 c i+i a+2 c v)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{i a+b-2 c i+2 c v}{2 c}, \ldots, \frac{i a+b-2 c i+2 c v}{2 c}, v; \frac{i a+b-2 c i+2 c v}{2 c}+1, \ldots, \frac{i a+b-2 c i+2 c v}{2 c}+1; e^{2 c z}\right)\Bigg) /; n \in \mathbb{N} \land v \in \mathbb{Z} \land v > 0$$

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$$\int z^n \cos(a z) \cosh(c z) \coth^\nu(c z) \, dz = \frac{1}{4} (-1)^\nu e^{c z \nu} \binom{\nu+1}{\frac{\nu+1}{2}} n! \, (1 - (\nu+1) \bmod 2) \left(e^{-i a z} \sum_{j=0}^{n} \frac{(-1)^j (-i a + c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{c \nu - i a}{2 c}, \ldots, \frac{c \nu - i a}{2 c}, \nu; \frac{c \nu - i a}{2 c} + 1, \ldots, \frac{c \nu - i a}{2 c} + 1; e^{2 c z}\right) + e^{i a z} \sum_{j=0}^{n} \frac{(-1)^j (i a + c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{i a + c \nu}{2 c}, \ldots, \frac{i a + c \nu}{2 c}, \nu; \frac{i a + c \nu}{2 c} + 1, \ldots, \frac{i a + c \nu}{2 c} + 1; e^{2 c z}\right)\right) + \frac{1}{4} (-1)^\nu e^{c z \nu} n! \sum_{s=0}^{\lfloor \frac{\nu}{2} \rfloor} \binom{\nu+1}{s} \left(e^{(-i a - c(-2 s + \nu + 1)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a - c(1 - 2 s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{-i a - c(1-2 s)}{2 c}, \ldots, \frac{-i a - c(1-2 s)}{2 c}, \nu; \frac{-i a - c(1-2 s)}{2 c} + 1, \ldots, \frac{-i a - c(1-2 s)}{2 c} + 1; e^{2 c z}\right) + e^{(i a - c(-2 s + \nu + 1)) z} \sum_{j=0}^{n} \frac{(-1)^j (i a - c(1 - 2 s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{i a - c(1-2 s)}{2 c}, \ldots, \frac{i a - c(1-2 s)}{2 c}, \nu; \frac{i a - c(1-2 s)}{2 c} + 1, \ldots, \frac{i a - c(1-2 s)}{2 c} + 1; e^{2 c z}\right) + e^{(-i a + c(-2 s + \nu + 1)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a + c(-2 s + 2 \nu + 1))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{c(-2 s + 2 \nu + 1) - i a}{2 c}, \ldots, \frac{c(-2 s + 2 \nu + 1) - i a}{2 c}, \nu; \frac{c(-2 s + 2 \nu + 1) - i a}{2 c} + 1, \ldots, \frac{c(-2 s + 2 \nu + 1) - i a}{2 c} + 1; e^{2 c z}\right) + e^{(i a + c(-2 s + \nu + 1)) z} \sum_{j=0}^{n} \frac{(-1)^j (i a + c(-2 s + 2 \nu + 1))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\frac{i a + c(-2 s + 2 \nu + 1)}{2 c}, \ldots, \frac{i a + c(-2 s + 2 \nu + 1)}{2 c}, \nu; \frac{i a + c(-2 s + 2 \nu + 1)}{2 c} + 1, \ldots, \frac{i a + c(-2 s + 2 \nu + 1)}{2 c} + 1; e^{2 c z}\right)\right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

Involving powers of cos, powers of cosh and power

Involving $z^n \cos^m(a z) \cosh^u(b z) \coth^\nu(c z)$

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$$\int z^n \cos^m(a z) \cosh^u(b z) \coth^\nu(c z) \, dz = (-1)^\nu 2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} n! \, (1 - m \bmod 2) \, (1 - u \bmod 2) \left(\frac{z^{n+1}}{(n+1)!} + e^{2 c \nu z} \sum_{j=0}^{n} \frac{(-1)^j (2 c \nu)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\!\left(\nu, \ldots, \nu; \nu + 1, \ldots, \nu + 1; e^{2 c z}\right) + e^{2 c z} \nu \sum_{j=0}^{n} \frac{(-1)^j (2 c)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+3}F_{j+2}\!\left(1, \ldots, 1, \nu + 1; 2, \ldots, 2; e^{2 c z}\right) + \right.$$

$$e^{c v z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{v}{2}, \ldots, \frac{v}{2}, v; \frac{v}{2}+1, \ldots, \frac{v}{2}+1; e^{2 c z}\right) +$$

$$\sum_{s=1}^{\left\lfloor\frac{v-1}{2}\right\rfloor} \binom{v}{s} \left(e^{2 c s z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(s, \ldots, s, v; s+1, \ldots, s+1; e^{2 c z}) + \right.$$

$$\left.\left. e^{2 c (v-s) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}(v-s, \ldots, v-s, v; -s+v+1, \ldots, -s+v+1; e^{2 c z}) \right)\right) + (-1)^v$$

$$2^{-m-u} \binom{u}{\frac{u}{2}} n! \, (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor} \binom{m}{k} \left(e^{(c v - i a (m-2k)) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (c v - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1} \right.$$

$$\left(\frac{c v - i a (m-2k)}{2 c}, \ldots, \frac{c v - i a (m-2k)}{2 c}, v; \frac{c v - i a (m-2k)}{2 c} + 1, \ldots, \frac{c v - i a (m-2k)}{2 c} + 1; e^{2 c z} \right) +$$

$$e^{(a i (m-2k) + c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k) + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{i a (m-2k) + c v}{2 c}, \ldots, \frac{i a (m-2k) + c v}{2 c}, v; \frac{i a (m-2k) + c v}{2 c} + 1, \ldots, \frac{i a (m-2k) + c v}{2 c} + 1; e^{2 c z} \right) +$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor} \binom{v}{s} \left(e^{(2 c s - i a (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c s - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{2 c s - i a (m-2k)}{2 c}, \ldots, \right.\right.$$

$$\left. \frac{2 c s - i a (m-2k)}{2 c}, v; \frac{2 c s - i a (m-2k)}{2 c} + 1, \ldots, \frac{2 c s - i a (m-2k)}{2 c} + 1; e^{2 c z} \right) +$$

$$e^{(2 c (v-s) - i a (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j (2 c (v-s) - i a (m-2k))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{2 c (v-s) - i a (m-2k)}{2 c}, \ldots, \frac{2 c (v-s) - i a (m-2k)}{2 c}, v; \right.$$

$$\left.\left. \frac{2 c (v-s) - i a (m-2k)}{2 c} + 1, \ldots, \frac{2 c (v-s) - i a (m-2k)}{2 c} + 1; e^{2 c z} \right)\right) +$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor} \binom{v}{s} \left(e^{(a i (m-2k) + 2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k) + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a (m-2k) + 2 c s}{2 c}, \right.\right.$$

$$\left. \ldots, \frac{i a (m-2k) + 2 c s}{2 c}, v; \frac{i a (m-2k) + 2 c s}{2 c} + 1, \ldots, \frac{i a (m-2k) + 2 c s}{2 c} + 1; e^{2 c z} \right) +$$

$$e^{(a i (m-2k) + 2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k) + 2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{i a (m-2k) + 2 c (v-s)}{2 c}, \ldots, \frac{i a (m-2k) + 2 c (v-s)}{2 c}, v; \right.$$

$$\frac{i\, a\, (m-2\, k)+2\, c\, (v-s)}{2\, c}+1,\, \ldots,\, \frac{i\, a\, (m-2\, k)+2\, c\, (v-s)}{2\, c}+1;\, e^{2\, c\, z}\Bigg)\Bigg)\Bigg)\Bigg)+$$

$$(-1)^v\, 2^{-m-u} \binom{m}{\frac{m}{2}} n!\, (1-m \bmod 2) \sum_{i=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{u}{i} \Bigg(e^{(c\, v-b\, (u-2\, i))\, z} \binom{v}{\frac{v}{2}} (1-v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j\, (c\, v-b\, (u-2\, i))^{-j-1}\, z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{c\, v-b\, (u-2\, i)}{2\, c},\, \ldots,\, \frac{c\, v-b\, (u-2\, i)}{2\, c},\, v;\, \frac{c\, v-b\, (u-2\, i)}{2\, c}+1,\, \ldots,\, \frac{c\, v-b\, (u-2\, i)}{2\, c}+1;\, e^{2\, c\, z}\Bigg)+$$

$$e^{(b\, (u-2\, i)+c\, v)\, z} \binom{v}{\frac{v}{2}} (1-v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j\, (b\, (u-2\, i)+c\, v)^{-j-1}\, z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{b\, (u-2\, i)+c\, v}{2\, c},\, \ldots,\, \frac{b\, (u-2\, i)+c\, v}{2\, c},\, v;\, \frac{b\, (u-2\, i)+c\, v}{2\, c}+1,\, \ldots,\, \frac{b\, (u-2\, i)+c\, v}{2\, c}+1;\, e^{2\, c\, z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(2\, c\, s-b\, (u-2\, i))\, z} \sum_{j=0}^{n} \frac{(-1)^j\, (2\, c\, s-b\, (u-2\, i))^{-j-1}\, z^{n-j}}{(n-j)!}\; {}_{j+2}F_{j+1}\Bigg(\frac{2\, c\, s-b\, (u-2\, i)}{2\, c},\, \ldots,$$

$$\frac{2\, c\, s-b\, (u-2\, i)}{2\, c},\, v;\, \frac{2\, c\, s-b\, (u-2\, i)}{2\, c}+1,\, \ldots,\, \frac{2\, c\, s-b\, (u-2\, i)}{2\, c}+1;\, e^{2\, c\, z}\Bigg)+$$

$$e^{(2\, c\, (v-s)-b\, (u-2\, i))\, z} \sum_{j=0}^{n} \frac{(-1)^j\, (2\, c\, (v-s)-b\, (u-2\, i))^{-j-1}\, z^{n-j}}{(n-j)!}\; {}_{j+2}F_{j+1}\Bigg(\frac{2\, c\, (v-s)-b\, (u-2\, i)}{2\, c},\, \ldots,$$

$$\frac{2\, c\, (v-s)-b\, (u-2\, i)}{2\, c},\, v;\, \frac{2\, c\, (v-s)-b\, (u-2\, i)}{2\, c}+1,\, \ldots,\, \frac{2\, c\, (v-s)-b\, (u-2\, i)}{2\, c}+1;\, e^{2\, c\, z}\Bigg)\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(2\, c\, s+b\, (u-2\, i))\, z} \sum_{j=0}^{n} \frac{(-1)^j\, (2\, c\, s+b\, (u-2\, i))^{-j-1}\, z^{n-j}}{(n-j)!}\; {}_{j+2}F_{j+1}\Bigg(\frac{2\, c\, s+b\, (u-2\, i)}{2\, c},\, \ldots,$$

$$\frac{2\, c\, s+b\, (u-2\, i)}{2\, c},\, v;\, \frac{2\, c\, s+b\, (u-2\, i)}{2\, c}+1,\, \ldots,\, \frac{2\, c\, s+b\, (u-2\, i)}{2\, c}+1;\, e^{2\, c\, z}\Bigg)+e^{(b\, (u-2\, i)+2\, c\, (v-s))\, z}$$

$$\sum_{j=0}^{n} \frac{(-1)^j\, (b\, (u-2\, i)+2\, c\, (v-s))^{-j-1}\, z^{n-j}}{(n-j)!}\; {}_{j+2}F_{j+1}\Bigg(\frac{b\, (u-2\, i)+2\, c\, (v-s)}{2\, c},\, \ldots,\, \frac{b\, (u-2\, i)+2\, c\, (v-s)}{2\, c},$$

$$v;\, \frac{b\, (u-2\, i)+2\, c\, (v-s)}{2\, c}+1,\, \ldots,\, \frac{b\, (u-2\, i)+2\, c\, (v-s)}{2\, c}+1;\, e^{2\, c\, z}\Bigg)\Bigg)\Bigg)+(-1)^v\, 2^{-m-u}\, n!$$

$$\sum_{i=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \binom{u}{i} \Bigg(e^{(-i\, a\, (m-2\, k)-b\, (u-2\, i)+c\, v)\, z} \binom{v}{\frac{v}{2}} (1-v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j\, (-i\, a\, (m-2\, k)-b\, (u-2\, i)+c\, v)^{-j-1}\, z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{-i\, a\, (m-2\, k)-b\, (u-2\, i)+c\, v}{2\, c},\, \ldots,\, \frac{-i\, a\, (m-2\, k)-b\, (u-2\, i)+c\, v}{2\, c},\, v;$$

$$\frac{-i\, a\, (m-2\, k)-b\, (u-2\, i)+c\, v}{2\, c}+1,\, \ldots,\, \frac{-i\, a\, (m-2\, k)-b\, (u-2\, i)+c\, v}{2\, c}+1;\, e^{2\, c\, z}\Bigg)+$$

$$e^{(a\,i\,(m-2k)-b\,(u-2i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)-b\,(u-2i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)-b\,(u-2i)+c\,v}{2c},\,\ldots,\,\frac{i\,a\,(m-2k)-b\,(u-2i)+c\,v}{2c},\,v;\right.$$

$$\left.\frac{i\,a\,(m-2k)-b\,(u-2i)+c\,v}{2c}+1,\,\ldots,\,\frac{i\,a\,(m-2k)-b\,(u-2i)+c\,v}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(-i\,a\,(m-2k)+b\,(u-2i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)+b\,(u-2i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c},\,\ldots,\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c},\,v;\right.$$

$$\left.\frac{-i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c}+1,\,\ldots,\,\frac{-i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(a\,i\,(m-2k)+b\,(u-2i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)+b\,(u-2i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c},\,\ldots,\,\frac{i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c},\,v;\right.$$

$$\left.\frac{i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c}+1,\,\ldots,\,\frac{i\,a\,(m-2k)+b\,(u-2i)+c\,v}{2c}+1;\,e^{2cz}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(-i\,a\,(m-2k)+2cs-b\,(u-2i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)+2cs-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$${}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c},\,\ldots,\,\frac{-i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c},\,v;\right.$$

$$\left.\frac{-i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c}+1,\,\ldots,\,\frac{-i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(-i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c},\,\ldots,\right.$$

$$\frac{-i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c},\,v;\,\frac{-i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c}+1,$$

$$\left.\left.\ldots,\,\frac{-i\,a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c}+1;\,e^{2cz}\right)\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(a\,i\,(m-2k)+2cs-b\,(u-2i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)+2cs-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$${}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c},\,\ldots,\,\frac{i\,a\,(m-2k)+2cs-b\,(u-2i)}{2c},\,v;\right.$$

$$\frac{i\, a\,(m-2k)+2cs-b\,(u-2i)}{2c}+1,\, \ldots,\, \frac{i\, a\,(m-2k)+2cs-b\,(u-2i)}{2c}+1;\, e^{2cz}\Bigg)+$$

$$e^{(a\, i\,(m-2k)-b\,(u-2i)+2c\,(v-s))\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(a\, i\,(m-2k)-b\,(u-2i)+2c\,(v-s))^{-j-1}\, z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{i\, a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c},\, \ldots,$$

$$\frac{i\, a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c},\, v;\, \frac{i\, a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c}+1,$$

$$\ldots,\, \frac{i\, a\,(m-2k)-b\,(u-2i)+2c\,(v-s)}{2c}+1;\, e^{2cz}\Bigg)\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2}\right\rfloor} \binom{v}{s} \Bigg(e^{(-i\, a\,(m-2k)+2cs+b\,(u-2i))\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(-i\, a\,(m-2k)+2cs+b\,(u-2i))^{-j-1}\, z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i\, a\,(m-2k)+2cs+b\,(u-2i)}{2c},\, \ldots,\, \frac{-i\, a\,(m-2k)+2cs+b\,(u-2i)}{2c},\, v;$$

$$\frac{-i\, a\,(m-2k)+2cs+b\,(u-2i)}{2c}+1,\, \ldots,\, \frac{-i\, a\,(m-2k)+2cs+b\,(u-2i)}{2c}+1;\, e^{2cz}\Bigg)+$$

$$e^{(-i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s))\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(-i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s))^{-j-1}\, z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c},\, \ldots,$$

$$\frac{-i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c},\, v;\, \frac{-i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c}+1,$$

$$\ldots,\, \frac{-i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c}+1;\, e^{2cz}\Bigg)\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2}\right\rfloor} \binom{v}{s} \Bigg(e^{(a\, i\,(m-2k)+2cs+b\,(u-2i))\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(a\, i\,(m-2k)+2cs+b\,(u-2i))^{-j-1}\, z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{i\, a\,(m-2k)+2cs+b\,(u-2i)}{2c},\, \ldots,\, \frac{i\, a\,(m-2k)+2cs+b\,(u-2i)}{2c},\, v;$$

$$\frac{i\, a\,(m-2k)+2cs+b\,(u-2i)}{2c}+1,\, \ldots,\, \frac{i\, a\,(m-2k)+2cs+b\,(u-2i)}{2c}+1;\, e^{2cz}\Bigg)+$$

$$e^{(a\, i\,(m-2k)+b\,(u-2i)+2c\,(v-s))\,z} \sum_{j=0}^{n} \frac{(-1)^j\,(a\, i\,(m-2k)+b\,(u-2i)+2c\,(v-s))^{-j-1}\, z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c},\, \ldots,\, \frac{i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c},$$

$$v;\, \frac{i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c}+1,\, \ldots,$$

$$\frac{i\, a\,(m-2k)+b\,(u-2i)+2c\,(v-s)}{2c}+1;\, e^{2cz}\Bigg)\Bigg)$$

Involving functions of the direct function, hyperbolic, exponential, trigonometric and a power functions

Involving powers of the direct function, hyperbolic, exponential, trigonometric and a power functions

Involving sin, sinh, exp and power

Involving $z^n e^{pz} \sin(a z) \sinh(b z) \coth^v(c z)$

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$$\int z^n e^{pz} \sin(a z) \sinh(b z) \coth^v(c z)\, dz = \frac{1}{4} i (-1)^v n! \Bigg(-e^{(-b-i a+p+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-b - i a + p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b - i a + p + c v}{2c}, \ldots, \frac{-b - i a + p + c v}{2c}, v; \frac{-b - i a + p + c v}{2c} + 1, \ldots, \frac{-b - i a + p + c v}{2c} + 1; e^{2cz} \right) + e^{(-b+i a+p+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-b + i a + p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b + i a + p + c v}{2c}, \ldots, \frac{-b + i a + p + c v}{2c}, v; \frac{-b + i a + p + c v}{2c} + 1, \ldots, \frac{-b + i a + p + c v}{2c} + 1; e^{2cz} \right) + e^{(b-i a+p+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b - i a + p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b - i a + p + c v}{2c}, \ldots, \frac{b - i a + p + c v}{2c}, v; \frac{b - i a + p + c v}{2c} + 1, \ldots, \frac{b - i a + p + c v}{2c} + 1; e^{2cz} \right) - e^{(b+i a+p+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (b + i a + p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{b + i a + p + c v}{2c}, \ldots, \frac{b + i a + p + c v}{2c}, v; \frac{b + i a + p + c v}{2c} + 1, \ldots, \frac{b + i a + p + c v}{2c} + 1; e^{2cz} \right) - \sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(-b-i a+p+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-b - i a + p + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b - i a + p + 2 c s}{2c}, \ldots, \frac{-b - i a + p + 2 c s}{2c}, v; \frac{-b - i a + p + 2 c s}{2c} + 1, \ldots, \frac{-b - i a + p + 2 c s}{2c} + 1; e^{2cz} \right) + e^{(-b-i a+p+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-b - i a + p + 2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-b - i a + p + 2 c (v-s)}{2c}, \ldots, \frac{-b - i a + p + 2 c (v-s)}{2c}, v; \frac{-b - i a + p + 2 c (v-s)}{2c} + 1, \ldots, \frac{-b - i a + p + 2 c (v-s)}{2c} + 1; e^{2cz} \right) \Bigg) +$$

$$\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\left(e^{(-b+i a+p+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+i a+p+2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+i a+p+2 c s}{2 c}, \ldots, \frac{-b+i a+p+2 c s}{2 c}, \nu; \frac{-b+i a+p+2 c s}{2 c}+1, \ldots, \frac{-b+i a+p+2 c s}{2 c}+1; e^{2 c z}\right)+ e^{(-b+i a+p+2 c(\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-b+i a+p+2 c(\nu-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{-b+i a+p+2 c(\nu-s)}{2 c}, \ldots, \frac{-b+i a+p+2 c(\nu-s)}{2 c}, \nu; \frac{-b+i a+p+2 c(\nu-s)}{2 c}+1, \ldots, \frac{-b+i a+p+2 c(\nu-s)}{2 c}+1; e^{2 c z}\right)\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\left(e^{(b-i a+p+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a+p+2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b-i a+p+2 c s}{2 c}, \ldots, \frac{b-i a+p+2 c s}{2 c}, \nu; \frac{b-i a+p+2 c s}{2 c}+1, \ldots, \frac{b-i a+p+2 c s}{2 c}+1; e^{2 c z}\right)+ e^{(b-i a+p+2 c(\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b-i a+p+2 c(\nu-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b-i a+p+2 c(\nu-s)}{2 c}, \ldots, \frac{b-i a+p+2 c(\nu-s)}{2 c}, \nu; \frac{b-i a+p+2 c(\nu-s)}{2 c}+1, \ldots, \frac{b-i a+p+2 c(\nu-s)}{2 c}+1; e^{2 c z}\right)\right)-$$

$$\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\left(e^{(b+i a+p+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a+p+2 c s)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+i a+p+2 c s}{2 c}, \ldots, \frac{b+i a+p+2 c s}{2 c}, \nu; \frac{b+i a+p+2 c s}{2 c}+1, \ldots, \frac{b+i a+p+2 c s}{2 c}+1; e^{2 c z}\right)+ e^{(b+i a+p+2 c(\nu-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (b+i a+p+2 c(\nu-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{b+i a+p+2 c(\nu-s)}{2 c}, \ldots, \frac{b+i a+p+2 c(\nu-s)}{2 c}, \nu; \frac{b+i a+p+2 c(\nu-s)}{2 c}+1, \ldots, \frac{b+i a+p+2 c(\nu-s)}{2 c}+1; e^{2 c z}\right)\right)\right) /; n \in \mathbb{N} \land \nu \in \mathbb{N}^+$$

Involving powers of sin, powers of sinh, exp and power

Involving $z^n e^{p z} \sin^m(a z) \sinh^\mu(b z) \coth^\nu(c z)$

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$$\int z^n e^{p z} \sin^m(a z) \sinh^u(b z) \coth^v(c z)\, dz = (-1)^v n!\, i^u 2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} (1 - m \bmod 2)(1 - u \bmod 2) \left(e^{(p+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p+c v}{2 c}, \ldots, \frac{p+c v}{2 c}, v; \frac{p+c v}{2 c} + 1, \ldots, \frac{p+c v}{2 c} + 1; e^{2 c z}\right) + \sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(p+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (p + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p+2 c s}{2 c}, \ldots, \frac{p+2 c s}{2 c}, v; \frac{p+2 c s}{2 c} + 1, \ldots, \frac{p+2 c s}{2 c} + 1; e^{2 c z}\right) + e^{(p+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (p + 2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p+2 c (v-s)}{2 c}, \ldots, \frac{p+2 c (v-s)}{2 c}, v; \frac{p+2 c (v-s)}{2 c} + 1, \ldots, \frac{p+2 c (v-s)}{2 c} + 1; e^{2 c z}\right)\right)\right) +$$

$$(-1)^v n!\, i^u 2^{-m-u} \binom{u}{\frac{u}{2}} (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(e^{\frac{i m \pi}{2}} \left(e^{(-i a (m-2k) + p + c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k) + p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a (m-2k) + p + c v}{2 c}, \ldots, \frac{-i a (m-2k) + p + c v}{2 c}, v; \frac{-i a (m-2k) + p + c v}{2 c} + 1, \ldots, \frac{-i a (m-2k) + p + c v}{2 c} + 1; e^{2 c z}\right) + \sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(-i a (m-2k) + p + 2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k) + p + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a (m-2k) + p + 2 c s}{2 c}, \ldots, \frac{-i a (m-2k) + p + 2 c s}{2 c}, v; \frac{-i a (m-2k) + p + 2 c s}{2 c} + 1, \ldots, \frac{-i a (m-2k) + p + 2 c s}{2 c} + 1; e^{2 c z}\right) + e^{(-i a (m-2k) + p + 2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k) + p + 2 c (v-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a (m-2k) + p + 2 c (v-s)}{2 c}, \ldots, \frac{-i a (m-2k) + p + 2 c (v-s)}{2 c}, v; \frac{-i a (m-2k) + p + 2 c (v-s)}{2 c} + 1, \ldots, \frac{-i a (m-2k) + p + 2 c (v-s)}{2 c} + 1; e^{2 c z}\right)\right)\right) +$$

$$e^{-\frac{1}{2} i m \pi} \left(e^{(a i (m-2k)+p+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p+c v)^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$$_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p+c v}{2c}, \ldots, \frac{i a (m-2k)+p+c v}{2c}, v; \right.$$

$$\left. \frac{i a (m-2k)+p+c v}{2c} + 1, \ldots, \frac{i a (m-2k)+p+c v}{2c} + 1; e^{2cz} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(a i (m-2k)+p+2cs) z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p+2cs)^{-j-1} z^{n-j}}{(n-j)!} \, _{j+2}F_{j+1}\left(\frac{i a (m-2k)+p+2cs}{2c}, \right. \right.$$

$$\ldots, \frac{i a (m-2k)+p+2cs}{2c}, v; \frac{i a (m-2k)+p+2cs}{2c} + 1, \ldots, \frac{i a (m-2k)+p+2cs}{2c} +$$

$$\left. 1; e^{2cz} \right) + e^{(a i (m-2k)+p+2c(v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p+2c(v-s)}{2c}, \ldots, \frac{i a (m-2k)+p+2c(v-s)}{2c}, v; \right.$$

$$\left. \left. \left. \frac{i a (m-2k)+p+2c(v-s)}{2c} + 1, \ldots, \frac{i a (m-2k)+p+2c(v-s)}{2c} + 1; e^{2cz} \right) \right) \right) +$$

$$(-1)^v n! \, i^u 2^{-m-u} \binom{m}{\frac{m}{2}} (1 - m \bmod 2) \sum_{i=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} (-1)^i \binom{u}{i} \left(e^{\frac{i \pi u}{2}} \left(e^{(p-b(u-2i)+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \right. \right.$$

$$\sum_{j=0}^{n} \frac{(-1)^j (p-b(u-2i)+c v)^{-j-1} z^{n-j}}{(n-j)!} \, _{j+2}F_{j+1}\left(\frac{p-b(u-2i)+c v}{2c}, \ldots, \right.$$

$$\left. \frac{p-b(u-2i)+c v}{2c}, v; \frac{p-b(u-2i)+c v}{2c} + 1, \ldots, \frac{p-b(u-2i)+c v}{2c} + 1; e^{2cz} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(p+2cs-b(u-2i)) z} \sum_{j=0}^{n} \frac{(-1)^j (p+2cs-b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \, _{j+2}F_{j+1}\left(\frac{p+2cs-b(u-2i)}{2c}, \ldots, \right. \right.$$

$$\left. \frac{p+2cs-b(u-2i)}{2c}, v; \frac{p+2cs-b(u-2i)}{2c} + 1, \ldots, \frac{p+2cs-b(u-2i)}{2c} + 1; e^{2cz} \right) +$$

$$e^{(p-b(u-2i)+2c(v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (p-b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!} \, _{j+2}F_{j+1}$$

$$\left(\frac{p-b(u-2i)+2c(v-s)}{2c}, \ldots, \frac{p-b(u-2i)+2c(v-s)}{2c}, v; \right.$$

$$\left. \left. \left. \frac{p-b(u-2i)+2c(v-s)}{2c} + 1, \ldots, \frac{p-b(u-2i)+2c(v-s)}{2c} + 1; e^{2cz} \right) \right) \right) +$$

$$e^{-\frac{1}{2} i \pi u} \left(e^{(p+b(u-2i)+cv)z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (p+b(u-2i)+cv)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p+b(u-2i)+cv}{2c}, \right. \right.$$

$$\left. \ldots, \frac{p+b(u-2i)+cv}{2c}, v; \frac{p+b(u-2i)+cv}{2c}+1, \ldots, \frac{p+b(u-2i)+cv}{2c}+1; e^{2cz} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(p+2cs+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (p+2cs+b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p+2cs+b(u-2i)}{2c}, \ldots, \right. \right.$$

$$\left. \frac{p+2cs+b(u-2i)}{2c}, v; \frac{p+2cs+b(u-2i)}{2c}+1, \ldots, \frac{p+2cs+b(u-2i)}{2c}+1; e^{2cz} \right) +$$

$$e^{(p+b(u-2i)+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (p+b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{p+b(u-2i)+2c(v-s)}{2c}, \ldots, \frac{p+b(u-2i)+2c(v-s)}{2c}, v; \right.$$

$$\left. \left. \left. \left. \frac{p+b(u-2i)+2c(v-s)}{2c}+1, \ldots, \frac{p+b(u-2i)+2c(v-s)}{2c}+1; e^{2cz} \right) \right) \right) \right) +$$

$$(-1)^v n! \, i^u \, 2^{-m-u} \sum_{i=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^{i+k} \binom{m}{k} \binom{u}{i} \left(e^{\frac{1}{2} i \pi (m+u)} \left(e^{(-ia(m-2k)+p-b(u-2i)+cv)z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \right. \right.$$

$$\sum_{j=0}^{n} \frac{(-1)^j (-ia(m-2k)+p-b(u-2i)+cv)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}$$

$$\left(\frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}, \ldots, \frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}, v; \right.$$

$$\left. \frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}+1, \ldots, \frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}+1; e^{2cz} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(-ia(m-2k)+p+2cs-b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (-ia(m-2k)+p+2cs-b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$${}_{j+2}F_{j+1}\left(\frac{-ia(m-2k)+p+2cs-b(u-2i)}{2c}, \ldots, \right.$$

$$\frac{-ia(m-2k)+p+2cs-b(u-2i)}{2c}, v; \frac{-ia(m-2k)+p+2cs-b(u-2i)}{2c}+1,$$

$$\left. \ldots, \frac{-ia(m-2k)+p+2cs-b(u-2i)}{2c}+1; e^{2cz} \right) +$$

$$e^{(-ia(m-2k)+p-b(u-2i)+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (-ia(m-2k)+p-b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{-ia(m-2k)+p-b(u-2i)+2c(v-s)}{2c}, \right.$$

$$\ldots, \frac{-i\, a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}, v;$$

$$\frac{-i\, a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1, \ldots,$$

$$\left.\left.\left.\frac{-i\, a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1; e^{2\,c\,z}\right)\right)\right)+e^{\frac{1}{2}\,i\,\pi\,(u-m)}$$

$$\left(e^{(a\,i\,(m-2\,k)+p-b\,(u-2\,i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p-b\,(u-2\,i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$$_{j+2}F_{j+1}\left(\frac{i\, a\,(m-2\,k)+p-b\,(u-2\,i)+c\,v}{2\,c}, \ldots, \frac{i\, a\,(m-2\,k)+p-b\,(u-2\,i)+c\,v}{2\,c}, v;\right.$$

$$\left.\frac{i\, a\,(m-2\,k)+p-b\,(u-2\,i)+c\,v}{2\,c}+1, \ldots, \frac{i\, a\,(m-2\,k)+p-b\,(u-2\,i)+c\,v}{2\,c}+1; e^{2\,c\,z}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(a\,i\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$$_{j+2}F_{j+1}\left(\frac{i\, a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c}, \ldots,\right.$$

$$\frac{i\, a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c}, v; \frac{i\, a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c}+1,$$

$$\left.\ldots, \frac{i\, a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c}+1; e^{2\,c\,z}\right)+$$

$$e^{(a\,i\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\left(\frac{i\, a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}, \ldots,\right.$$

$$\frac{i\, a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}, v; \frac{i\, a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+$$

$$\left.\left.\left.1, \ldots, \frac{i\, a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1; e^{2\,c\,z}\right)\right)\right)+e^{\frac{1}{2}\,i\,\pi\,(m-u)}$$

$$\left(e^{(-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\right.$$

$$_{j+2}F_{j+1}\left(\frac{-i\, a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c}, \ldots, \frac{-i\, a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c}, v;\right.$$

$$\left.\frac{-i\, a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c}+1, \ldots, \frac{-i\, a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c}+1; e^{2\,c\,z}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(-i a(m-2k)+p+2cs+b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j(-i a(m-2k)+p+2cs+b(u-2i))^{-j-1}z^{n-j}}{(n-j)!}\right.$$

$$_{j+2}F_{j+1}\left(\frac{-i a(m-2k)+p+2cs+b(u-2i)}{2c},\ldots,\right.$$

$$\frac{-i a(m-2k)+p+2cs+b(u-2i)}{2c},v;\frac{-i a(m-2k)+p+2cs+b(u-2i)}{2c}+1,$$

$$\left.\ldots,\frac{-i a(m-2k)+p+2cs+b(u-2i)}{2c}+1;e^{2cz}\right)+$$

$$e^{(-i a(m-2k)+p+b(u-2i)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j(-i a(m-2k)+p+b(u-2i)+2c(v-s))^{-j-1}z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\left(\frac{-i a(m-2k)+p+b(u-2i)+2c(v-s)}{2c},\right.$$

$$\ldots,\frac{-i a(m-2k)+p+b(u-2i)+2c(v-s)}{2c},v;$$

$$\frac{-i a(m-2k)+p+b(u-2i)+2c(v-s)}{2c}+1,\ldots,$$

$$\left.\left.\left.\frac{-i a(m-2k)+p+b(u-2i)+2c(v-s)}{2c}+1;e^{2cz}\right)\right)\right)+e^{-\frac{1}{2}i\pi(m+u)}$$

$$\left(e^{(a i(m-2k)+p+b(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(a i(m-2k)+p+b(u-2i)+cv)^{-j-1}z^{n-j}}{(n-j)!}\right.$$

$$_{j+2}F_{j+1}\left(\frac{i a(m-2k)+p+b(u-2i)+cv}{2c},\ldots,\frac{i a(m-2k)+p+b(u-2i)+cv}{2c},v;\right.$$

$$\left.\frac{i a(m-2k)+p+b(u-2i)+cv}{2c}+1,\ldots,\frac{i a(m-2k)+p+b(u-2i)+cv}{2c}+1;e^{2cz}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(a i(m-2k)+p+2cs+b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j(a i(m-2k)+p+2cs+b(u-2i))^{-j-1}z^{n-j}}{(n-j)!}\right.$$

$$_{j+2}F_{j+1}\left(\frac{i a(m-2k)+p+2cs+b(u-2i)}{2c},\ldots,\right.$$

$$\frac{i a(m-2k)+p+2cs+b(u-2i)}{2c},v;\frac{i a(m-2k)+p+2cs+b(u-2i)}{2c}+1,$$

$$\left.\ldots,\frac{i a(m-2k)+p+2cs+b(u-2i)}{2c}+1;e^{2cz}\right)+$$

$$e^{(a i(m-2k)+p+b(u-2i)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j(a i(m-2k)+p+b(u-2i)+2c(v-s))^{-j-1}z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\left(\frac{i a(m-2k)+p+b(u-2i)+2c(v-s)}{2c},\ldots,\right.$$

$$\frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\ v;\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\ \ldots,\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg)\ /;\ n\in\mathbb{N}\land m\in\mathbb{N}^+\land u\in\mathbb{N}^+\land v\in\mathbb{N}^+$$

Involving cos, sinh, exp and power

Involving $z^n\, e^{p\,z} \cos(a\,z) \sinh(b\,z) \coth^{\nu}(c\,z)$

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$$\int z^n\, e^{p\,z} \cos(a\,z) \sinh(b\,z) \coth^{\nu}(c\,z)\, dz =$$

$$\frac{1}{4}(-1)^{\nu}\, n!\Bigg(-e^{(-b-i\,a+p+c\,\nu)\,z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(-b-i\,a+p+c\,\nu)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-b-i\,a+p+c\,\nu}{2\,c},\ \ldots,\ \frac{-b-i\,a+p+c\,\nu}{2\,c},\ \nu;\ \frac{-b-i\,a+p+c\,\nu}{2\,c}+1,\ \ldots,\ \frac{-b-i\,a+p+c\,\nu}{2\,c}+1;\ e^{2\,c\,z}\right)-$$

$$e^{(-b+i\,a+p+c\,\nu)\,z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(-b+i\,a+p+c\,\nu)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-b+i\,a+p+c\,\nu}{2\,c},\ \ldots,\ \frac{-b+i\,a+p+c\,\nu}{2\,c},\ \nu;\ \frac{-b+i\,a+p+c\,\nu}{2\,c}+1,\ \ldots,\ \frac{-b+i\,a+p+c\,\nu}{2\,c}+1;\ e^{2\,c\,z}\right)+$$

$$e^{(b-i\,a+p+c\,\nu)\,z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(b-i\,a+p+c\,\nu)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{b-i\,a+p+c\,\nu}{2\,c},\ \ldots,\ \frac{b-i\,a+p+c\,\nu}{2\,c},\ \nu;\ \frac{b-i\,a+p+c\,\nu}{2\,c}+1,\ \ldots,\ \frac{b-i\,a+p+c\,\nu}{2\,c}+1;\ e^{2\,c\,z}\right)+$$

$$e^{(b+i\,a+p+c\,\nu)\,z}\binom{\nu}{\frac{\nu}{2}}(1-\nu \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(b+i\,a+p+c\,\nu)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{b+i\,a+p+c\,\nu}{2\,c},\ \ldots,\ \frac{b+i\,a+p+c\,\nu}{2\,c},\ \nu;\ \frac{b+i\,a+p+c\,\nu}{2\,c}+1,\ \ldots,\ \frac{b+i\,a+p+c\,\nu}{2\,c}+1;\ e^{2\,c\,z}\right)-$$

$$\sum_{s=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{s}\Bigg(e^{(-b-i\,a+p+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b-i\,a+p+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-b-i\,a+p+2\,c\,s}{2\,c},\ \ldots,\ \frac{-b-i\,a+p+2\,c\,s}{2\,c},\ \nu;\ \frac{-b-i\,a+p+2\,c\,s}{2\,c}+1,\ \ldots,\ \frac{-b-i\,a+p+2\,c\,s}{2\,c}+1;\ e^{2\,c\,z}\right)+$$

$$e^{(-b-i\,a+p+2\,c\,(\nu-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b-i\,a+p+2\,c\,(\nu-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-b-i\,a+p+2\,c\,(\nu-s)}{2\,c},\ \ldots,\right.$$

$$\frac{-b-i\,a+p+2\,c\,(v-s)}{2\,c}, v; \frac{-b-i\,a+p+2\,c\,(v-s)}{2\,c}+1, \ldots, \frac{-b-i\,a+p+2\,c\,(v-s)}{2\,c}+1; e^{2\,c\,z}\Bigg)\Bigg) -$$

$$\sum_{s=0}^{\lfloor\frac{v-1}{2}\rfloor}\binom{v}{s}\Bigg(e^{(-b+i\,a+p+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b+i\,a+p+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{-b+i\,a+p+2\,c\,(v-s)}{2\,c}, \ldots,$$

$$\frac{-b+i\,a+p+2\,c\,(v-s)}{2\,c}, v; \frac{-b+i\,a+p+2\,c\,(v-s)}{2\,c}+1, \ldots, \frac{-b+i\,a+p+2\,c\,(v-s)}{2\,c}+1; e^{2\,c\,z}\Bigg)+$$

$$e^{(-b+i\,a+p+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-b+i\,a+p+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{-b+i\,a+p+2\,c\,s}{2\,c}, \ldots,$$

$$\frac{-b+i\,a+p+2\,c\,s}{2\,c}, v; \frac{-b+i\,a+p+2\,c\,s}{2\,c}+1, \ldots, \frac{-b+i\,a+p+2\,c\,s}{2\,c}+1; e^{2\,c\,z}\Bigg)\Bigg)+$$

$$\sum_{s=0}^{\lfloor\frac{v-1}{2}\rfloor}\binom{v}{s}\Bigg(e^{(b-i\,a+p+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b-i\,a+p+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{b-i\,a+p+2\,c\,s}{2\,c}, \ldots,$$

$$\frac{b-i\,a+p+2\,c\,s}{2\,c}, v; \frac{b-i\,a+p+2\,c\,s}{2\,c}+1, \ldots, \frac{b-i\,a+p+2\,c\,s}{2\,c}+1; e^{2\,c\,z}\Bigg)+$$

$$e^{(b-i\,a+p+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b-i\,a+p+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{b-i\,a+p+2\,c\,(v-s)}{2\,c}, \ldots,$$

$$\frac{b-i\,a+p+2\,c\,(v-s)}{2\,c}, v; \frac{b-i\,a+p+2\,c\,(v-s)}{2\,c}+1, \ldots, \frac{b-i\,a+p+2\,c\,(v-s)}{2\,c}+1; e^{2\,c\,z}\Bigg)\Bigg)+$$

$$\sum_{s=0}^{\lfloor\frac{v-1}{2}\rfloor}\binom{v}{s}\Bigg(e^{(b+i\,a+p+2\,c\,s)\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(b+i\,a+p+2\,c\,s)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{b+i\,a+p+2\,c\,s}{2\,c}, \ldots,$$

$$\frac{b+i\,a+p+2\,c\,s}{2\,c}, v; \frac{b+i\,a+p+2\,c\,s}{2\,c}+1, \ldots, \frac{b+i\,a+p+2\,c\,s}{2\,c}+1; e^{2\,c\,z}\Bigg)+e^{(b+i\,a+p+2\,c\,(v-s))\,z}$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(b+i\,a+p+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{b+i\,a+p+2\,c\,(v-s)}{2\,c}, \ldots, \frac{b+i\,a+p+2\,c\,(v-s)}{2\,c},$$

$$v; \frac{b+i\,a+p+2\,c\,(v-s)}{2\,c}+1, \ldots, \frac{b+i\,a+p+2\,c\,(v-s)}{2\,c}+1; e^{2\,c\,z}\Bigg)\Bigg)\Bigg) /; n\in\mathbb{N}\bigwedge v\in\mathbb{N}^+$$

Involving powers of cos, powers of sinh, exp and power

Involving $z^n\, e^{p\,z}\cos^m(a\,z)\sinh^u(b\,z)\coth^v(c\,z)$

01.22.21.0490.01

$$\int z^n e^{pz}\cos^m(az)\sinh^u(bz)\coth^v(cz)\,dz = (-1)^v n!\, i^u 2^{-m-u}\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}}(1-m \bmod 2)(1-u \bmod 2)\Bigg(e^{(p+cv)z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j (p+cv)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{p+cv}{2c},\ldots,\frac{p+cv}{2c},v;\frac{p+cv}{2c}+1,\ldots,\frac{p+cv}{2c}+1;e^{2cz}\right)+\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(p+2cs)z}\sum_{j=0}^{n}\frac{(-1)^j (p+2cs)^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{p+2cs}{2c},\ldots,\frac{p+2cs}{2c},v;\frac{p+2cs}{2c}+1,\ldots,\frac{p+2cs}{2c}+1;e^{2cz}\right)+e^{(p+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j (p+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{p+2c(v-s)}{2c},\ldots,\frac{p+2c(v-s)}{2c},v;\frac{p+2c(v-s)}{2c}+1,\ldots,\frac{p+2c(v-s)}{2c}+1;e^{2cz}\right)\Bigg)\Bigg)+$$

$$(-1)^v n!\, i^u 2^{-m-u}\binom{u}{\frac{u}{2}}(1-u \bmod 2)\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\Bigg(e^{(-ia(m-2k)+p+cv)z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(-ia(m-2k)+p+cv)^{-j-1}z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{-ia(m-2k)+p+cv}{2c},\ldots,\frac{-ia(m-2k)+p+cv}{2c},v;\frac{-ia(m-2k)+p+cv}{2c}+1,\ldots,\frac{-ia(m-2k)+p+cv}{2c}+1;e^{2cz}\right)+e^{(ai(m-2k)+p+cv)z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(ai(m-2k)+p+cv)^{-j-1}z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{ia(m-2k)+p+cv}{2c},\ldots,\frac{ia(m-2k)+p+cv}{2c},v;\frac{ia(m-2k)+p+cv}{2c}+1,\ldots,\frac{ia(m-2k)+p+cv}{2c}+1;e^{2cz}\right)+\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(-ia(m-2k)+p+2cs)z}\sum_{j=0}^{n}\frac{(-1)^j(-ia(m-2k)+p+2cs)^{-j-1}z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{-ia(m-2k)+p+2cs}{2c},\ldots,\frac{-ia(m-2k)+p+2cs}{2c},v;\frac{-ia(m-2k)+p+2cs}{2c}+1,\ldots,\frac{-ia(m-2k)+p+2cs}{2c}+1;e^{2cz}\right)+e^{(-ia(m-2k)+p+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j(-ia(m-2k)+p+2c(v-s))^{-j-1}z^{n-j}}{(n-j)!}\, {}_{j+2}F_{j+1}\left(\frac{-ia(m-2k)+p+2c(v-s)}{2c},\ldots,\frac{-ia(m-2k)+p+2c(v-s)}{2c},v;\frac{-ia(m-2k)+p+2c(v-s)}{2c}+1,\ldots,\frac{-ia(m-2k)+p+2c(v-s)}{2c}+1;e^{2cz}\right)\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(a\,i\,(m-2k)+p+2cs)z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)+p+2cs)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2k)+p+2cs}{2c},\,\ldots,$$

$$\frac{i\,a\,(m-2k)+p+2cs}{2c},\,v;\;\frac{i\,a\,(m-2k)+p+2cs}{2c}+1,\,\ldots,\;\frac{i\,a\,(m-2k)+p+2cs}{2c}+1;\,e^{2cz}\Bigg)+$$

$$e^{(a\,i\,(m-2k)+p+2c\,(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)+p+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{i\,a\,(m-2k)+p+2c\,(v-s)}{2c},\,\ldots,\;\frac{i\,a\,(m-2k)+p+2c\,(v-s)}{2c},\,v;$$

$$\frac{i\,a\,(m-2k)+p+2c\,(v-s)}{2c}+1,\,\ldots,\;\frac{i\,a\,(m-2k)+p+2c\,(v-s)}{2c}+1;\,e^{2cz}\Bigg)\Bigg)\Bigg)+$$

$$(-1)^v\,n!\,i^u\,2^{-m-u}\binom{m}{\frac{m}{2}}(1-m\bmod 2)\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}(-1)^i\binom{u}{i}\Bigg(e^{\frac{i\pi u}{2}}\Bigg(e^{(p-b\,(u-2i)+c\,v)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(p-b\,(u-2i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Bigg(\frac{p-b\,(u-2i)+c\,v}{2c},\,\ldots,$$

$$\frac{p-b\,(u-2i)+c\,v}{2c},\,v;\;\frac{p-b\,(u-2i)+c\,v}{2c}+1,\,\ldots,\;\frac{p-b\,(u-2i)+c\,v}{2c}+1;\,e^{2cz}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(p+2cs-b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(p+2cs-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Bigg(\frac{p+2cs-b\,(u-2i)}{2c},\,\ldots,$$

$$\frac{p+2cs-b\,(u-2i)}{2c},\,v;\;\frac{p+2cs-b\,(u-2i)}{2c}+1,\,\ldots,\;\frac{p+2cs-b\,(u-2i)}{2c}+1;\,e^{2cz}\Bigg)+$$

$$e^{(p-b\,(u-2i)+2c\,(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(p-b\,(u-2i)+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{p-b\,(u-2i)+2c\,(v-s)}{2c},\,\ldots,\;\frac{p-b\,(u-2i)+2c\,(v-s)}{2c},\,v;$$

$$\frac{p-b\,(u-2i)+2c\,(v-s)}{2c}+1,\,\ldots,\;\frac{p-b\,(u-2i)+2c\,(v-s)}{2c}+1;\,e^{2cz}\Bigg)\Bigg)\Bigg)+$$

$$e^{-\frac{1}{2}i\pi u}\Bigg(e^{(p+b\,(u-2i)+c\,v)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(p+b\,(u-2i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Bigg(\frac{p+b\,(u-2i)+c\,v}{2c},$$

$$\ldots,\;\frac{p+b\,(u-2i)+c\,v}{2c},\,v;\;\frac{p+b\,(u-2i)+c\,v}{2c}+1,\,\ldots,\;\frac{p+b\,(u-2i)+c\,v}{2c}+1;\,e^{2cz}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(p+2cs+b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(p+2cs+b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\Bigg(\frac{p+2cs+b\,(u-2i)}{2c},\,\ldots,$$

$$\frac{p+2cs+b(u-2i)}{2c}, v; \frac{p+2cs+b(u-2i)}{2c}+1, \ldots, \frac{p+2cs+b(u-2i)}{2c}+1; e^{2cz}\Bigg) +$$

$$e^{(p+b(u-2i)+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (p+b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{p+b(u-2i)+2c(v-s)}{2c}, \ldots, \frac{p+b(u-2i)+2c(v-s)}{2c}, v;$$

$$\frac{p+b(u-2i)+2c(v-s)}{2c}+1, \ldots, \frac{p+b(u-2i)+2c(v-s)}{2c}+1; e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg) +$$

$$(-1)^v n! \, i^u 2^{-m-u} \sum_{i=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^i \binom{m}{k} \binom{u}{i} \Bigg(e^{\frac{i\pi u}{2}} \Bigg(e^{(-ia(m-2k)+p-b(u-2i)+cv)z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2)$$

$$\sum_{j=0}^{n} \frac{(-1)^j (-ia(m-2k)+p-b(u-2i)+cv)^{-j-1} z^{n-j}}{(n-j)!} {}_{j+2}F_{j+1}$$

$$\Bigg(\frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}, \ldots, \frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}, v;$$

$$\frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}+1, \ldots, \frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}+1; e^{2cz}\Bigg) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(-ia(m-2k)+p+2cs-b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (-ia(m-2k)+p+2cs-b(u-2i))^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-ia(m-2k)+p+2cs-b(u-2i)}{2c}, \ldots,$$

$$\frac{-ia(m-2k)+p+2cs-b(u-2i)}{2c}, v; \frac{-ia(m-2k)+p+2cs-b(u-2i)}{2c}+1,$$

$$\ldots, \frac{-ia(m-2k)+p+2cs-b(u-2i)}{2c}+1; e^{2cz}\Bigg) +$$

$$e^{(-ia(m-2k)+p-b(u-2i)+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (-ia(m-2k)+p-b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-ia(m-2k)+p-b(u-2i)+2c(v-s)}{2c},$$

$$\ldots, \frac{-ia(m-2k)+p-b(u-2i)+2c(v-s)}{2c}, v;$$

$$\frac{-ia(m-2k)+p-b(u-2i)+2c(v-s)}{2c}+1, \ldots,$$

$$\frac{-ia(m-2k)+p-b(u-2i)+2c(v-s)}{2c}+1; e^{2cz}\Bigg)\Bigg)\Bigg) +$$

$$e^{\frac{i \pi u}{2}} \left(e^{(a i (m-2k)+p-b(u-2i)+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p-b(u-2i)+c v)^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$$_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p-b(u-2i)+c v}{2c}, \ldots, \frac{i a (m-2k)+p-b(u-2i)+c v}{2c}, v; \right.$$

$$\left. \frac{i a (m-2k)+p-b(u-2i)+c v}{2c}+1, \ldots, \frac{i a (m-2k)+p-b(u-2i)+c v}{2c}+1; e^{2cz} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(a i (m-2k)+p+2cs-b(u-2i)) z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p+2cs-b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$$_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p+2cs-b(u-2i)}{2c}, \ldots, \right.$$

$$\frac{i a (m-2k)+p+2cs-b(u-2i)}{2c}, v; \frac{i a (m-2k)+p+2cs-b(u-2i)}{2c}+1,$$

$$\left. \ldots, \frac{i a (m-2k)+p+2cs-b(u-2i)}{2c}+1; e^{2cz} \right) +$$

$$e^{(a i (m-2k)+p-b(u-2i)+2c(v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p-b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p-b(u-2i)+2c(v-s)}{2c}, \ldots, \right.$$

$$\frac{i a (m-2k)+p-b(u-2i)+2c(v-s)}{2c}, v; \frac{i a (m-2k)+p-b(u-2i)+2c(v-s)}{2c}+$$

$$\left.\left.\left. 1, \ldots, \frac{i a (m-2k)+p-b(u-2i)+2c(v-s)}{2c}+1; e^{2cz} \right) \right) \right) +$$

$$e^{-\frac{1}{2} i \pi u} \left(e^{(-i a (m-2k)+p+b(u-2i)+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k)+p+b(u-2i)+c v)^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$$_{j+2}F_{j+1}\left(\frac{-i a (m-2k)+p+b(u-2i)+c v}{2c}, \ldots, \frac{-i a (m-2k)+p+b(u-2i)+c v}{2c}, v; \right.$$

$$\left. \frac{-i a (m-2k)+p+b(u-2i)+c v}{2c}+1, \ldots, \frac{-i a (m-2k)+p+b(u-2i)+c v}{2c}+1; e^{2cz} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(-i a (m-2k)+p+2cs+b(u-2i)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k)+p+2cs+b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$$_{j+2}F_{j+1}\left(\frac{-i a (m-2k)+p+2cs+b(u-2i)}{2c}, \ldots, \right.$$

$$\frac{-i a (m-2k)+p+2cs+b(u-2i)}{2c}, v; \frac{-i a (m-2k)+p+2cs+b(u-2i)}{2c}+1,$$

$$\ldots, \frac{-i\, a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\, e^{2\,c\,z}\Bigg)+$$

$$e^{(-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},$$

$$\ldots, \frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}, v;$$

$$\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\ \ldots,$$

$$\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\, e^{2\,c\,z}\Bigg)\Bigg)\Bigg)+$$

$$e^{-\frac{1}{2}\,i\,\pi\,u}\Bigg(e^{(a\,i\,(m-2\,k)+p+b\,(u-2\,i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v \bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p+b\,(u-2\,i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c},\ \ldots,\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c}, v;$$

$$\frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c}+1,\ \ldots,\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c}+1;\, e^{2\,c\,z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(a\,i\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c},\ \ldots,$$

$$\frac{i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c}, v;\ \frac{i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c}+1,$$

$$\ldots, \frac{i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\, e^{2\,c\,z}\Bigg)+$$

$$e^{(a\,i\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\ \ldots,$$

$$\frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}, v;\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+$$

$$1,\ \ldots,\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+$$

$$1;\, e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg)\ /;\ n\in\mathbb{N}\land m\in\mathbb{N}^+\land u\in\mathbb{N}^+\land v\in\mathbb{N}^+$$

Involving sin, cosh, exp and power

Involving $z^n e^{pz} \sin(az) \cosh(bz) \coth^\nu(cz)$

01.22.21.0491.01

$$\int z^n e^{pz} \sin(az)\cosh(bz)\coth^\nu(cz)\,dz = \frac{1}{4}(-1)^\nu \binom{\nu}{\frac{\nu}{2}} n!\,(1-\nu \bmod 2)\Bigg(e^{\frac{i\pi}{2}+(-b-ia+p+c\nu)z}\sum_{j=0}^{n}\frac{(-1)^j(-b-ia+p+c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{-ia-b+p+c\nu}{2c},\ldots,\frac{-ia-b+p+c\nu}{2c},\nu;\frac{-ia-b+p+c\nu}{2c}+1,\ldots,\frac{-ia-b+p+c\nu}{2c}+1;e^{2cz}\Big)+$$
$$e^{-\frac{1}{2}(i\pi)+(-b+ia+p+c\nu)z}\sum_{j=0}^{n}\frac{(-1)^j(-b+ia+p+c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{ia-b+p+c\nu}{2c},\ldots,\frac{ia-b+p+c\nu}{2c},\nu;\frac{ia-b+p+c\nu}{2c}+1,\ldots,\frac{ia-b+p+c\nu}{2c}+1;e^{2cz}\Big)+$$
$$e^{\frac{i\pi}{2}+(b-ia+p+c\nu)z}\sum_{j=0}^{n}\frac{(-1)^j(b-ia+p+c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{-ia+b+p+c\nu}{2c},\ldots,\frac{-ia+b+p+c\nu}{2c},\nu;\frac{-ia+b+p+c\nu}{2c}+1,\ldots,\frac{-ia+b+p+c\nu}{2c}+1;e^{2cz}\Big)+$$
$$e^{-\frac{1}{2}(i\pi)+(b+ia+p+c\nu)z}\sum_{j=0}^{n}\frac{(-1)^j(b+ia+p+c\nu)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{ia+b+p+c\nu}{2c},\ldots,\frac{ia+b+p+c\nu}{2c},\nu;\frac{ia+b+p+c\nu}{2c}+1,\ldots,\frac{ia+b+p+c\nu}{2c}+1;e^{2cz}\Big)\Bigg)+$$
$$\frac{1}{4}(-1)^\nu n!\sum_{i=0}^{\left\lfloor\frac{\nu-1}{2}\right\rfloor}\binom{\nu}{i}\Bigg(e^{\frac{i\pi}{2}+(-b+2ci-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-b+2ci-ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{-ia-b+2ci+p}{2c},\ldots,\frac{-ia-b+2ci+p}{2c},\nu;\frac{-ia-b+2ci+p}{2c}+1,\ldots,\frac{-ia-b+2ci+p}{2c}+1;e^{2cz}\Big)+$$
$$e^{\frac{i\pi}{2}+(b+2ci-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(b+2ci-ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{-ia+b+2ci+p}{2c},\ldots,\frac{-ia+b+2ci+p}{2c},\nu;\frac{-ia+b+2ci+p}{2c}+1,\ldots,\frac{-ia+b+2ci+p}{2c}+1;e^{2cz}\Big)+$$
$$e^{-\frac{1}{2}(i\pi)+(b+2ci+ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(b+2ci+ia+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{ia+b+2ci+p}{2c},\ldots,\frac{ia+b+2ci+p}{2c},\nu;\frac{ia+b+2ci+p}{2c}+1,\ldots,\frac{ia+b+2ci+p}{2c}+1;e^{2cz}\Big)+$$

$$e^{-\frac{1}{2}(i\pi)+(-b+2ci+i a+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-b+2ci+i a+p)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{i a+2ci+p-b}{2c},\ldots,\frac{i a+2ci+p-b}{2c},v;\frac{i a+2ci+p-b}{2c}+1,\ldots,\frac{i a+2ci+p-b}{2c}+1;e^{2cz}\right)+$$

$$e^{\frac{i\pi}{2}+(-b-2ci-i a+p+2cv)z}\sum_{j=0}^{n}\frac{(-1)^j(-b-2ci-i a+p+2cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-i a-b-2ci+p+2cv}{2c},\ldots,\frac{-i a-b-2ci+p+2cv}{2c},v;\frac{-i a-b-2ci+p+2cv}{2c}+1,\ldots,\frac{-i a-b-2ci+p+2cv}{2c}+1;e^{2cz}\right)+$$

$$e^{-\frac{1}{2}(i\pi)+(-b-2ci+i a+p+2cv)z}\sum_{j=0}^{n}\frac{(-1)^j(-b-2ci+i a+p+2cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{i a-b-2ci+p+2cv}{2c},\ldots,\frac{i a-b-2ci+p+2cv}{2c},v;\frac{i a-b-2ci+p+2cv}{2c}+1,\ldots,\frac{i a-b-2ci+p+2cv}{2c}+1;e^{2cz}\right)+$$

$$e^{\frac{i\pi}{2}+(b-2ci-i a+p+2cv)z}\sum_{j=0}^{n}\frac{(-1)^j(b-2ci-i a+p+2cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{-i a+b-2ci+p+2cv}{2c},\ldots,\frac{-i a+b-2ci+p+2cv}{2c},v;\frac{-i a+b-2ci+p+2cv}{2c}+1,\ldots,\frac{-i a+b-2ci+p+2cv}{2c}+1;e^{2cz}\right)+e^{-\frac{1}{2}(i\pi)+(b-2ci+i a+p+2cv)z}$$

$$\sum_{j=0}^{n}\frac{(-1)^j(b-2ci+i a+p+2cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\left(\frac{i a+b-2ci+p+2cv}{2c},\ldots,\frac{i a+b-2ci+p+2cv}{2c},v;\frac{i a+b-2ci+p+2cv}{2c}+1,\ldots,\frac{i a+b-2ci+p+2cv}{2c}+1;e^{2cz}\right)\Bigg)\Bigg)\,/;\,n\in\mathbb{N}\bigwedge v\in\mathbb{N}^+$$

01.22.21.0492.01

$$\int z^n e^{pz}\sin(az)\cosh(cz)\coth^v(cz)\,dz = \frac{1}{4}(-1)^v i\,e^{czv}\binom{v+1}{\frac{v+1}{2}} n!\,(1-(v+1)\bmod 2)\Bigg(e^{(-ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(-ia+p+cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{cv+p-ia}{2c},\ldots,\frac{cv+p-ia}{2c},v;\frac{cv+p-ia}{2c}+1,\ldots,\frac{cv+p-ia}{2c}+1;e^{2cz}\Big)-e^{(ia+p)z}\sum_{j=0}^{n}\frac{(-1)^j(ia+p+cv)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{cv+p+ia}{2c},\ldots,\frac{cv+p+ia}{2c},v;\frac{cv+p+ia}{2c}+1,\ldots,\frac{cv+p+ia}{2c}+1;e^{2cz}\Big)\Bigg)+\frac{1}{4}(-1)^v i\,e^{czv}n!\sum_{s=0}^{\lfloor\frac{v}{2}\rfloor}\binom{v+1}{s}\Bigg(-e^{(ia+p-c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j(ia+p-c(1-2s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{p+ia-c(-2s+1)}{2c},\ldots,\frac{p+ia-c(-2s+1)}{2c},v;\frac{p+ia-c(-2s+1)}{2c}+1,\ldots,\frac{p+ia-c(-2s+1)}{2c}+1;e^{2cz}\Big)+e^{(-ia+p-c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j(-ia+p-c(1-2s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{p-ia-c(-2s+1)}{2c},\ldots,\frac{p-ia-c(-2s+1)}{2c},v;\frac{p-ia-c(-2s+1)}{2c}+1,\ldots,\frac{p-ia-c(-2s+1)}{2c}+1;e^{2cz}\Big)-e^{(ia+p+c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j(ia+p+c(-2s+2v+1))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{p+ia+c(-2s+1+2v)}{2c},\ldots,\frac{p+ia+c(-2s+1+2v)}{2c},v;\frac{p+ia+c(-2s+1+2v)}{2c}+1,\ldots,\frac{p+ia+c(-2s+1+2v)}{2c}+1;e^{2cz}\Big)+e^{(-ia+p+c(-2s+v+1))z}\sum_{j=0}^{n}\frac{(-1)^j(-ia+p+c(-2s+2v+1))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Big(\frac{p-ia+c(-2s+1+2v)}{2c},\ldots,\frac{p-ia+c(-2s+1+2v)}{2c},v;\frac{p-ia+c(-2s+1+2v)}{2c}+1,\ldots,\frac{p-ia+c(-2s+1+2v)}{2c}+1;e^{2cz}\Big)\Bigg)\ /;\ n\in\mathbb{N}\land v\in\mathbb{N}^+$$

Involving powers of sin, powers of cosh, exp and power

Involving $z^n e^{pz}\sin^m(az)\cosh^u(bz)\coth^v(cz)$

01.22.21.0493.01

$$\int z^n e^{pz}\sin^m(az)\cosh^u(bz)\coth^v(cz)\,dz = (-1)^v 2^{-m-u}\binom{m}{\frac{m}{2}}\binom{u}{\frac{u}{2}} n!\,(1-m\bmod 2)(1-u\bmod 2)\Bigg(e^{(p+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(p+cv)^{-j-1}z^{n-j}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{p+c\,v}{2\,c}, \ldots, \frac{p+c\,v}{2\,c}, v; \frac{p+c\,v}{2\,c}+1, \ldots, \frac{p+c\,v}{2\,c}+1; e^{2\,c\,z}\right) + \sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(p+2\,c\,s)\,z} $$

$$ \sum_{j=0}^{n} \frac{(-1)^j \, (p+2\,c\,s)^{-j-1} \, z^{n-j}}{(n-j)!} \; {}_{j+2}F_{j+1}\left(\frac{p+2\,c\,s}{2\,c}, \ldots, \frac{p+2\,c\,s}{2\,c}, v; \frac{p+2\,c\,s}{2\,c}+1, \ldots, \frac{p+2\,c\,s}{2\,c}+1; e^{2\,c\,z}\right) + $$

$$ e^{(p+2\,c\,(v-s))\,z} \sum_{j=0}^{n} \frac{(-1)^j \, (p+2\,c\,(v-s))^{-j-1} \, z^{n-j}}{(n-j)!} \; {}_{j+2}F_{j+1}\left(\frac{p+2\,c\,(v-s)}{2\,c}, \ldots, \right. $$

$$ \left. \frac{p+2\,c\,(v-s)}{2\,c}, v; \frac{p+2\,c\,(v-s)}{2\,c}+1, \ldots, \frac{p+2\,c\,(v-s)}{2\,c}+1; e^{2\,c\,z}\right)\Bigg)\Bigg) + $$

$$ (-1)^v \, 2^{-m-u} \binom{u}{\frac{u}{2}} n! \, (1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \Bigg(e^{\frac{i\,m\,\pi}{2}} \Bigg(e^{(-i\,a\,(m-2\,k)+p+c\,v)\,z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) $$

$$ \sum_{j=0}^{n} \frac{(-1)^j \, (-i\,a\,(m-2\,k)+p+c\,v)^{-j-1} \, z^{n-j}}{(n-j)!} \; {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)+p+c\,v}{2\,c}, \ldots, \right. $$

$$ \left. \frac{-i\,a\,(m-2\,k)+p+c\,v}{2\,c}, v; \frac{-i\,a\,(m-2\,k)+p+c\,v}{2\,c}+1, \ldots, \frac{-i\,a\,(m-2\,k)+p+c\,v}{2\,c}+1; e^{2\,c\,z}\right) + $$

$$ \sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(-i\,a\,(m-2\,k)+p+2\,c\,s)\,z} \sum_{j=0}^{n} \frac{(-1)^j \, (-i\,a\,(m-2\,k)+p+2\,c\,s)^{-j-1} \, z^{n-j}}{(n-j)!} $$

$$ {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)+p+2\,c\,s}{2\,c}, \ldots, \frac{-i\,a\,(m-2\,k)+p+2\,c\,s}{2\,c}, v; \right. $$

$$ \left. \frac{-i\,a\,(m-2\,k)+p+2\,c\,s}{2\,c}+1, \ldots, \frac{-i\,a\,(m-2\,k)+p+2\,c\,s}{2\,c}+1; e^{2\,c\,z}\right) + $$

$$ e^{(-i\,a\,(m-2\,k)+p+2\,c\,(v-s))\,z} \sum_{j=0}^{n} \frac{(-1)^j \, (-i\,a\,(m-2\,k)+p+2\,c\,(v-s))^{-j-1} \, z^{n-j}}{(n-j)!} $$

$$ {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}, \ldots, \frac{-i\,a\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}, v; \right. $$

$$ \left. \frac{-i\,a\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}+1, \ldots, \frac{-i\,a\,(m-2\,k)+p+2\,c\,(v-s)}{2\,c}+1; e^{2\,c\,z}\right)\Bigg)\Bigg) + $$

$$ e^{-\frac{1}{2}\,i\,m\,\pi} \Bigg(e^{(a\,i\,(m-2\,k)+p+c\,v)\,z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j \, (a\,i\,(m-2\,k)+p+c\,v)^{-j-1} \, z^{n-j}}{(n-j)!} $$

$$ {}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2\,k)+p+c\,v}{2\,c}, \ldots, \frac{i\,a\,(m-2\,k)+p+c\,v}{2\,c}, v; \right. $$

$$ \left. \frac{i\,a\,(m-2\,k)+p+c\,v}{2\,c}+1, \ldots, \frac{i\,a\,(m-2\,k)+p+c\,v}{2\,c}+1; e^{2\,c\,z}\right) + $$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(a\,i\,(m-2k)+p+2cs)z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)+p+2cs)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)+p+2cs}{2c},\right.\right.$$

$$\ldots,\;\frac{i\,a\,(m-2k)+p+2cs}{2c},\,v;\;\frac{i\,a\,(m-2k)+p+2cs}{2c}+1,\;\ldots,\;\frac{i\,a\,(m-2k)+p+2cs}{2c}+$$

$$\left.1;\,e^{2cz}\right)+e^{(a\,i\,(m-2k)+p+2c\,(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2k)+p+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2k)+p+2c\,(v-s)}{2c},\;\ldots,\;\frac{i\,a\,(m-2k)+p+2c\,(v-s)}{2c},\,v;\right.$$

$$\left.\left.\left.\left.\frac{i\,a\,(m-2k)+p+2c\,(v-s)}{2c}+1,\;\ldots,\;\frac{i\,a\,(m-2k)+p+2c\,(v-s)}{2c}+1;\,e^{2cz}\right)\right)\right)\right)+$$

$$(-1)^v\,2^{-m-u}\binom{m}{\frac{m}{2}}n!\,(1-m\bmod 2)\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\binom{u}{i}\left(e^{(p-b\,(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\right.$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(p-b\,(u-2i)+cv)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{p-b\,(u-2i)+cv}{2c},\;\ldots,\right.$$

$$\left.\frac{p-b\,(u-2i)+cv}{2c},\,v;\;\frac{p-b\,(u-2i)+cv}{2c}+1,\;\ldots,\;\frac{p-b\,(u-2i)+cv}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(p+b\,(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(p+b\,(u-2i)+cv)^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{p+b\,(u-2i)+cv}{2c},\right.$$

$$\left.\ldots,\;\frac{p+b\,(u-2i)+cv}{2c},\,v;\;\frac{p+b\,(u-2i)+cv}{2c}+1,\;\ldots,\;\frac{p+b\,(u-2i)+cv}{2c}+1;\,e^{2cz}\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(p+2cs-b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(p+2cs-b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{p+2cs-b\,(u-2i)}{2c},\right.\right.$$

$$\left.\ldots,\;\frac{p+2cs-b\,(u-2i)}{2c},\,v;\;\frac{p+2cs-b\,(u-2i)}{2c}+1,\;\ldots,\;\frac{p+2cs-b\,(u-2i)}{2c}+1;\,e^{2cz}\right)+$$

$$e^{(p-b\,(u-2i)+2c\,(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(p-b\,(u-2i)+2c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}$$

$$\left(\frac{p-b\,(u-2i)+2c\,(v-s)}{2c},\;\ldots,\;\frac{p-b\,(u-2i)+2c\,(v-s)}{2c},\,v;\right.$$

$$\left.\left.\frac{p-b\,(u-2i)+2c\,(v-s)}{2c}+1,\;\ldots,\;\frac{p-b\,(u-2i)+2c\,(v-s)}{2c}+1;\,e^{2cz}\right)\right)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\left(e^{(p+2cs+b\,(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(p+2cs+b\,(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}\;{}_{j+2}F_{j+1}\left(\frac{p+2cs+b\,(u-2i)}{2c},\right.\right.$$

$$\ldots,\ \frac{p+2cs+b(u-2i)}{2c},\ v;\ \frac{p+2cs+b(u-2i)}{2c}+1,\ \ldots,\ \frac{p+2cs+b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)+$$

$$e^{(p+b(u-2i)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(p+b(u-2i)+2c(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{p+b(u-2i)+2c(v-s)}{2c},\ \ldots,\ \frac{p+b(u-2i)+2c(v-s)}{2c},\ v;$$

$$\frac{p+b(u-2i)+2c(v-s)}{2c}+1,\ \ldots,\ \frac{p+b(u-2i)+2c(v-s)}{2c}+1;\ e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg)+$$

$$(-1)^v\,2^{-m-u}\,n!\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}(-1)^k\binom{m}{k}\binom{u}{i}\Bigg(e^{\frac{i\pi m}{2}}\Bigg(e^{(-i a(m-2k)+p-b(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)$$

$$\sum_{j=0}^{n}\frac{(-1)^j\,(-i a(m-2k)+p-b(u-2i)+cv)^{-j-1}\,z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{-i a(m-2k)+p-b(u-2i)+cv}{2c},\ \ldots,\ \frac{-i a(m-2k)+p-b(u-2i)+cv}{2c},\ v;$$

$$\frac{-i a(m-2k)+p-b(u-2i)+cv}{2c}+1,\ \ldots,\ \frac{-i a(m-2k)+p-b(u-2i)+cv}{2c}+1;\ e^{2cz}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(-i a(m-2k)+p+2cs-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i a(m-2k)+p+2cs-b(u-2i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i a(m-2k)+p+2cs-b(u-2i)}{2c},\ \ldots,$$

$$\frac{-i a(m-2k)+p+2cs-b(u-2i)}{2c},\ v;\ \frac{-i a(m-2k)+p+2cs-b(u-2i)}{2c}+1,$$

$$\ldots,\ \frac{-i a(m-2k)+p+2cs-b(u-2i)}{2c}+1;\ e^{2cz}\Bigg)+$$

$$e^{(-i a(m-2k)+p-b(u-2i)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i a(m-2k)+p-b(u-2i)+2c(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-i a(m-2k)+p-b(u-2i)+2c(v-s)}{2c},$$

$$\ldots,\ \frac{-i a(m-2k)+p-b(u-2i)+2c(v-s)}{2c},\ v;$$

$$\frac{-i a(m-2k)+p-b(u-2i)+2c(v-s)}{2c}+1,\ \ldots,$$

$$\frac{-i a(m-2k)+p-b(u-2i)+2c(v-s)}{2c}+1;\ e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg)+$$

$$e^{-\frac{1}{2} i \pi m} \left(e^{(a i (m-2k)+p-b(u-2i)+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p-b(u-2i)+c v)^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$$ {}_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p-b(u-2i)+c v}{2c}, \ldots, \frac{i a (m-2k)+p-b(u-2i)+c v}{2c}, v; \right.$$

$$\left. \frac{i a (m-2k)+p-b(u-2i)+c v}{2c} + 1, \ldots, \frac{i a (m-2k)+p-b(u-2i)+c v}{2c} + 1; e^{2cz} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(a i (m-2k)+p+2cs-b(u-2i)) z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p+2cs-b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$$ {}_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p+2cs-b(u-2i)}{2c}, \ldots, \right.$$

$$\frac{i a (m-2k)+p+2cs-b(u-2i)}{2c}, v; \frac{i a (m-2k)+p+2cs-b(u-2i)}{2c} + 1,$$

$$\left. \ldots, \frac{i a (m-2k)+p+2cs-b(u-2i)}{2c} + 1; e^{2cz} \right) +$$

$$e^{(a i (m-2k)+p-b(u-2i)+2c(v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p-b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p-b(u-2i)+2c(v-s)}{2c}, \ldots, \right.$$

$$\frac{i a (m-2k)+p-b(u-2i)+2c(v-s)}{2c}, v; \frac{i a (m-2k)+p-b(u-2i)+2c(v-s)}{2c} +$$

$$\left.\left.\left. 1, \ldots, \frac{i a (m-2k)+p-b(u-2i)+2c(v-s)}{2c} + 1; e^{2cz} \right) \right) \right) +$$

$$e^{\frac{i \pi m}{2}} \left(e^{(-i a (m-2k)+p+b(u-2i)+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k)+p+b(u-2i)+c v)^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$$ {}_{j+2}F_{j+1}\left(\frac{-i a (m-2k)+p+b(u-2i)+c v}{2c}, \ldots, \frac{-i a (m-2k)+p+b(u-2i)+c v}{2c}, v; \right.$$

$$\left. \frac{-i a (m-2k)+p+b(u-2i)+c v}{2c} + 1, \ldots, \frac{-i a (m-2k)+p+b(u-2i)+c v}{2c} + 1; e^{2cz} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(-i a (m-2k)+p+2cs+b(u-2i)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k)+p+2cs+b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \right.$$

$$ {}_{j+2}F_{j+1}\left(\frac{-i a (m-2k)+p+2cs+b(u-2i)}{2c}, \ldots, \right.$$

$$\frac{-i a (m-2k)+p+2cs+b(u-2i)}{2c}, v; \frac{-i a (m-2k)+p+2cs+b(u-2i)}{2c} + 1,$$

$$\ldots,\ \frac{-i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},$$

$$\ldots,\ \frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\ v;$$

$$\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\ \ldots,$$

$$\frac{-i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)+$$

$$e^{-\frac{1}{2}\,i\,\pi\,m}\Bigg(e^{(a\,i\,(m-2\,k)+p+b\,(u-2\,i)+c\,v)\,z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p+b\,(u-2\,i)+c\,v)^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c},\ \ldots,\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c},\ v;$$

$$\frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c}+1,\ \ldots,\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+c\,v}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(a\,i\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c},\ \ldots,$$

$$\frac{i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c},\ v;\ \frac{i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c}+1,$$

$$\ldots,\ \frac{i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\ e^{2\,c\,z}\Bigg)+$$

$$e^{(a\,i\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!}$$

$$_{j+2}F_{j+1}\Bigg(\frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\ \ldots,$$

$$\frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\ v;\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+$$

$$1,\ \ldots,\ \frac{i\,a\,(m-2\,k)+p+b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+$$

$$1;\ e^{2\,c\,z}\Bigg)\Bigg)\Bigg)\Bigg)\ /;\ n\in\mathbb{N}\land m\in\mathbb{N}^+\land u\in\mathbb{N}^+\land v\in\mathbb{N}^+$$

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$$\int z^n e^{pz} \sin^m(az)\cosh^u(cz)\coth^v(cz)\,dz = (-1)^v 2^{-m-u} n!\, e^{(p+cv)z} \binom{m}{\frac{m}{2}} \binom{u+v}{\frac{u+v}{2}} (1 - m \bmod 2)(1-(u+v) \bmod 2)$$
$$\sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (p+cv)^{-j-1}}{(n-j)!} {}_{j+2}F_{j+1}\left(\frac{cv+p}{2c}, \ldots, \frac{cv+p}{2c}, v; \frac{cv+p}{2c}+1, \ldots, \frac{cv+p}{2c}+1; e^{2cz}\right) +$$
$$(-1)^v 2^{-m-u} n!\, e^{czv} \binom{u+v}{\frac{u+v}{2}} (1-(u+v) \bmod 2)$$
$$\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \left(e^{(ai(m-2k)+p)z - \frac{im\pi}{2}} \sum_{j=0}^{n} \frac{1}{(n-j)!} (-1)^j z^{n-j} (ai(m-2k)+p+cv)^{-j-1} {}_{j+2}F_{j+1}\left(\frac{ai(m-2k)+p+cv}{2c}, \ldots, \right.\right.$$
$$\left.\frac{ai(m-2k)+p+cv}{2c}, v; \frac{ai(m-2k)+p+cv}{2c}+1, \ldots, \frac{ai(m-2k)+p+cv}{2c}+1; e^{2cz}\right) +$$
$$e^{\frac{i\pi m}{2}+(p-ia(m-2k))z} \sum_{j=0}^{n} \frac{1}{(n-j)!} (-1)^j z^{n-j} (-ia(m-2k)+p+cv)^{-j-1} {}_{j+2}F_{j+1}\left(\frac{-ia(m-2k)+p+cv}{2c}, \right.$$
$$\left.\left. \ldots, \frac{-ia(m-2k)+p+cv}{2c}, v; \frac{-ia(m-2k)+p+cv}{2c}+1, \ldots, \frac{-ia(m-2k)+p+cv}{2c}+1; e^{2cz}\right)\right) -$$
$$(-1)^v 2^{-m-u} n!\, e^{czv} \binom{m}{\frac{m}{2}} (m \bmod 2 - 1) \sum_{s=0}^{\left\lfloor \frac{u+v-1}{2} \right\rfloor} \binom{u+v}{s} \left(e^{(p+c(u+v-2s))z} \sum_{j=0}^{n} \frac{1}{(n-j)!} (-1)^j z^{n-j} (p+c(u+2v-2s))^{-j-1} \right.$$
$${}_{j+2}F_{j+1}\left(\frac{p+c(u+2v-2s)}{2c}, \ldots, \frac{p+c(u+2v-2s)}{2c}, v; \frac{p+c(u+2v-2s)}{2c}+1, \ldots,\right.$$
$$\left.\frac{p+c(u+2v-2s)}{2c}+1; e^{2cz}\right) + e^{(p-c(u+v-2s))z} \sum_{j=0}^{n} \frac{1}{(n-j)!} (-1)^j z^{n-j} (p-c(u-2s))^{-j-1}$$
$$\left. {}_{j+2}F_{j+1}\left(\frac{p-c(u-2s)}{2c}, \ldots, \frac{p-c(u-2s)}{2c}, v; \frac{p-c(u-2s)}{2c}+1, \ldots, \frac{p-c(u-2s)}{2c}+1; e^{2cz}\right)\right) +$$
$$(-1)^v 2^{-m-u} n!\, e^{czv} \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \sum_{s=0}^{\left\lfloor \frac{u+v-1}{2} \right\rfloor} (-1)^k \binom{m}{k} \binom{u+v}{s} \left(e^{(ai(m-2k)+p-c(u+v-2s))z - \frac{im\pi}{2}} \sum_{j=0}^{n} \frac{1}{(n-j)!} (-1)^j z^{n-j} (ai(m-2k) + \right.$$
$$p-c(u-2s))^{-j-1} {}_{j+2}F_{j+1}\left(\frac{ai(m-2k)+p-c(u-2s)}{2c}, \ldots, \frac{ai(m-2k)+p-c(u-2s)}{2c},\right.$$
$$\left. v; \frac{ai(m-2k)+p-c(u-2s)}{2c}+1, \ldots, \frac{ai(m-2k)+p-c(u-2s)}{2c}+1; e^{2cz}\right) +$$
$$e^{\frac{i\pi m}{2}+(-ia(m-2k)+p+c(u+v-2s))z} \sum_{j=0}^{n} \frac{1}{(n-j)!} (-1)^j z^{n-j} (-i\,a(m-2k)+p+c(u+2v-2s))^{-j-1}$$
$${}_{j+2}F_{j+1}\left(\frac{-i\,a(m-2k)+p+c(u+2v-2s)}{2c}, \ldots, \frac{-i\,a(m-2k)+p+c(u+2v-2s)}{2c}, v;\right.$$
$$\left.\frac{-i\,a(m-2k)+p+c(u+2v-2s)}{2c}+1, \ldots, \frac{-i\,a(m-2k)+p+c(u+2v-2s)}{2c}+1; e^{2cz}\right) +$$

$$e^{\frac{i\pi m}{2}+(-i a (m-2k)+p-c(u+v-2s))z}\sum_{j=0}^{n}\frac{1}{(n-j)!}(-1)^j z^{n-j}(-i a\,(m-2k)+p-c(u-2s))^{-j-1}$$
$$_{j+2}F_{j+1}\Bigg(\frac{-i a\,(m-2k)+p-c(u-2s)}{2c},\ldots,\frac{-i a\,(m-2k)+p-c(u-2s)}{2c},v;$$
$$\frac{-i a\,(m-2k)+p-c(u-2s)}{2c}+1,\ldots,\frac{-i a\,(m-2k)+p-c(u-2s)}{2c}+1;e^{2cz}\Bigg)+$$
$$e^{(a i (m-2k)+p+c(u+v-2s))z-\frac{i m\pi}{2}}\sum_{j=0}^{n}\frac{1}{(n-j)!}(-1)^j z^{n-j}(a i(m-2k)+p+c(u+2v-2s))^{-j-1}$$
$$_{j+2}F_{j+1}\Bigg(\frac{a i(m-2k)+p+c(u+2v-2s)}{2c},\ldots,\frac{a i(m-2k)+p+c(u+2v-2s)}{2c},v;$$
$$\frac{a i(m-2k)+p+c(u+2v-2s)}{2c}+1,\ldots,\frac{a i(m-2k)+p+c(u+2v-2s)}{2c}+1;$$
$$e^{2cz}\Bigg)\Bigg)\Bigg)\,/;\,n\in\mathbb{N}\bigwedge m\in\mathbb{N}^+\bigwedge u\in\mathbb{N}^+\bigwedge v\in\mathbb{N}^+$$

Involving cos, cosh, exp and power

Involving $z^n\, e^{p z}\cos(a z)\cosh(b z)\coth^v(c z)$

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$$\int z^n e^{p z}\cos(a z)\cosh(b z)\coth^v(c z)\,dz =$$
$$\frac{1}{4}(-1)^v\binom{v}{\frac{v}{2}}n!\,(1-v \bmod 2)\Bigg(e^{(-b-i a+p+c v)z}\sum_{j=0}^{n}\frac{(-1)^j(-b-i a+p+c v)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$
$$\Bigg(\frac{-i a-b+p+c v}{2c},\ldots,\frac{-i a-b+p+c v}{2c},v;\frac{-i a-b+p+c v}{2c}+1,\ldots,\frac{-i a-b+p+c v}{2c}+1;e^{2cz}\Bigg)+$$
$$e^{(-b+i a+p+c v)z}\sum_{j=0}^{n}\frac{(-1)^j(-b+i a+p+c v)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{i a-b+p+c v}{2c},\ldots,\frac{i a-b+p+c v}{2c},v;$$
$$\frac{i a-b+p+c v}{2c}+1,\ldots,\frac{i a-b+p+c v}{2c}+1;e^{2cz}\Bigg)+e^{(b-i a+p+c v)z}\sum_{j=0}^{n}\frac{(-1)^j(b-i a+p+c v)^{-j-1}z^{n-j}}{(n-j)!}$$
$$_{j+2}F_{j+1}\Bigg(\frac{-i a+b+p+c v}{2c},\ldots,\frac{-i a+b+p+c v}{2c},v;\frac{-i a+b+p+c v}{2c}+1,\ldots,\frac{-i a+b+p+c v}{2c}+1;e^{2cz}\Bigg)+$$
$$e^{(b+i a+p+c v)z}\sum_{j=0}^{n}\frac{(-1)^j(b+i a+p+c v)^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}\Bigg(\frac{i a+b+p+c v}{2c},\ldots,\frac{i a+b+p+c v}{2c},$$
$$v;\frac{i a+b+p+c v}{2c}+1,\ldots,\frac{i a+b+p+c v}{2c}+1;e^{2cz}\Bigg)\Bigg)+$$

$$\frac{1}{4}(-1)^v n! \sum_{i=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor} \binom{v}{i} \left(e^{(-b+2ci-ia+p)z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2ci-ia+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-ia-b+2ci+p}{2c}, \ldots, \frac{-ia-b+2ci+p}{2c}, v; \frac{-ia-b+2ci+p}{2c}+1, \ldots, \frac{-ia-b+2ci+p}{2c}+1; e^{2cz} \right) + \right.$$

$$e^{(b+2ci-ia+p)z} \sum_{j=0}^{n} \frac{(-1)^j (b+2ci-ia+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-ia+b+2ci+p}{2c}, \ldots, \frac{-ia+b+2ci+p}{2c}, v; \frac{-ia+b+2ci+p}{2c}+1, \ldots, \frac{-ia+b+2ci+p}{2c}+1; e^{2cz} \right) +$$

$$e^{(b+2ci+ia+p)z} \sum_{j=0}^{n} \frac{(-1)^j (b+2ci+ia+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{ia+b+2ci+p}{2c}, \ldots, \frac{ia+b+2ci+p}{2c}, v; \frac{ia+b+2ci+p}{2c}+1, \ldots, \frac{ia+b+2ci+p}{2c}+1; e^{2cz} \right) +$$

$$e^{(-b+2ci+ia+p)z} \sum_{j=0}^{n} \frac{(-1)^j (-b+2ci+ia+p)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{ia+2ci+p-b}{2c}, \ldots, \frac{ia+2ci+p-b}{2c}, v; \frac{ia+2ci+p-b}{2c}+1, \ldots, \frac{ia+2ci+p-b}{2c}+1; e^{2cz} \right) +$$

$$e^{(-b-2ci-ia+p+2cv)z} \sum_{j=0}^{n} \frac{(-1)^j (-b-2ci-ia+p+2cv)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-ia-b-2ci+p+2cv}{2c}, \ldots, \frac{-ia-b-2ci+p+2cv}{2c}, v; \frac{-ia-b-2ci+p+2cv}{2c}+1, \ldots, \frac{-ia-b-2ci+p+2cv}{2c}+1; e^{2cz} \right) +$$

$$e^{(-b-2ci+ia+p+2cv)z} \sum_{j=0}^{n} \frac{(-1)^j (-b-2ci+ia+p+2cv)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{ia-b-2ci+p+2cv}{2c}, \ldots, \frac{ia-b-2ci+p+2cv}{2c}, v; \frac{ia-b-2ci+p+2cv}{2c}+1, \ldots, \frac{ia-b-2ci+p+2cv}{2c}+1; e^{2cz} \right) +$$

$$e^{(b-2ci-ia+p+2cv)z} \sum_{j=0}^{n} \frac{(-1)^j (b-2ci-ia+p+2cv)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-ia+b-2ci+p+2cv}{2c}, \ldots, \frac{-ia+b-2ci+p+2cv}{2c}, v; \frac{-ia+b-2ci+p+2cv}{2c}+1, \ldots, \frac{-ia+b-2ci+p+2cv}{2c}+1; e^{2cz} \right) + e^{(b-2ci+ia+p+2cv)z}$$

$$\left. \sum_{j=0}^{n} \frac{(-1)^j (b-2ci+ia+p+2cv)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{ia+b-2ci+p+2cv}{2c}, \ldots, \frac{ia+b-2ci+p+2cv}{2c}, v; \frac{ia+b-2ci+p+2cv}{2c}+1, \ldots, \frac{ia+b-2ci+p+2cv}{2c}+1; e^{2cz} \right) \right) /; n \in \mathbb{N} \land v \in \mathbb{N}^+$$

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$$\int z^n e^{p z} \cos(a z) \cosh(c z) \coth^v(c z) \, dz = \frac{1}{4} (-1)^v e^{c v z} \binom{v+1}{\frac{v+1}{2}} n! \, (1 - (v+1) \bmod 2) \Bigg(e^{(-i a + p) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a + p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\bigg(\frac{-i a + p + c v}{2 c}, \ldots, \frac{-i a + p + c v}{2 c}, v; \frac{-i a + p + c v}{2 c} + 1, \ldots, \frac{-i a + p + c v}{2 c} + 1; e^{2 c z} \bigg) + e^{(i a + p) z} \sum_{j=0}^{n} \frac{(-1)^j (i a + p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\bigg(\frac{i a + p + c v}{2 c}, \ldots, \frac{i a + p + c v}{2 c}, v; \frac{i a + p + c v}{2 c} + 1, \ldots, \frac{i a + p + c v}{2 c} + 1; e^{2 c z} \bigg) \Bigg) + \frac{1}{4} (-1)^v e^{c v z} n! \sum_{s=0}^{\left\lfloor \frac{v}{2} \right\rfloor} \binom{v+1}{s} \Bigg(e^{(-i a + p - c(-2 s + v + 1)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a + p - c(1 - 2 s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\bigg(\frac{-i a + p - c(1 - 2 s)}{2 c}, \ldots, \frac{-i a + p - c(1 - 2 s)}{2 c}, v; \frac{-i a + p - c(1 - 2 s)}{2 c} + 1, \ldots, \frac{-i a + p - c(1 - 2 s)}{2 c} + 1; e^{2 c z} \bigg) + e^{(i a + p - c(-2 s + v + 1)) z} \sum_{j=0}^{n} \frac{(-1)^j (i a + p - c(1 - 2 s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\bigg(\frac{i a + p - c(1 - 2 s)}{2 c}, \ldots, \frac{i a + p - c(1 - 2 s)}{2 c}, v; \frac{i a + p - c(1 - 2 s)}{2 c} + 1, \ldots, \frac{i a + p - c(1 - 2 s)}{2 c} + 1; e^{2 c z} \bigg) + e^{(-i a + p + c(-2 s + v + 1)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a + p + c(-2 s + 2 v + 1))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\bigg(\frac{-i a + p + c(-2 s + 2 v + 1)}{2 c}, \ldots, \frac{-i a + p + c(-2 s + 2 v + 1)}{2 c}, v; \frac{-i a + p + c(-2 s + 2 v + 1)}{2 c} + 1, \ldots, \frac{-i a + p + c(-2 s + 2 v + 1)}{2 c} + 1; e^{2 c z} \bigg) + e^{(i a + p + c(-2 s + v + 1)) z} \sum_{j=0}^{n} \frac{(-1)^j (i a + p + c(-2 s + 2 v + 1))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\bigg(\frac{i a + p + c(-2 s + 2 v + 1)}{2 c}, \ldots, \frac{i a + p + c(-2 s + 2 v + 1)}{2 c}, v; \frac{i a + p + c(-2 s + 2 v + 1)}{2 c} + 1, \ldots, \frac{i a + p + c(-2 s + 2 v + 1)}{2 c} + 1; e^{2 c z} \bigg) \Bigg) /; n \in \mathbb{N} \land v \in \mathbb{N}^+$$

Involving powers of cos, powers of cosh, exp and power

Involving $z^n e^{p z} \cos^m(a z) \cosh^u(b z) \coth^v(c z)$

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$$\int z^n e^{p z} \cos^m(a z) \cosh^u(b z) \coth^v(c z)\, dz = (-1)^v 2^{-m-u} \binom{m}{\frac{m}{2}} \binom{u}{\frac{u}{2}} n!\,(1 - m \bmod 2)\,(1 - u \bmod 2) \Bigg(e^{(p+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p + c v}{2 c}, \ldots, \frac{p + c v}{2 c}, v; \frac{p + c v}{2 c} + 1, \ldots, \frac{p + c v}{2 c} + 1; e^{2 c z}\right) + \sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(p+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (p + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p + 2 c s}{2 c}, \ldots, \frac{p + 2 c s}{2 c}, v; \frac{p + 2 c s}{2 c} + 1, \ldots, \frac{p + 2 c s}{2 c} + 1; e^{2 c z}\right) + e^{(p+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (p + 2 c (v - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{p + 2 c (v - s)}{2 c}, \ldots, \frac{p + 2 c (v - s)}{2 c}, v; \frac{p + 2 c (v - s)}{2 c} + 1, \ldots, \frac{p + 2 c (v - s)}{2 c} + 1; e^{2 c z}\right)\Bigg)\Bigg) +$$

$$(-1)^v 2^{-m-u} \binom{u}{\frac{u}{2}} n!\,(1 - u \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \Bigg(e^{(-i a (m-2 k)+p+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (-i a (m - 2 k) + p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a (m - 2 k) + p + c v}{2 c}, \ldots, \frac{-i a (m - 2 k) + p + c v}{2 c}, v; \frac{-i a (m - 2 k) + p + c v}{2 c} + 1, \ldots, \frac{-i a (m - 2 k) + p + c v}{2 c} + 1; e^{2 c z}\right) + e^{(a i (m-2 k)+p+c v) z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (a i (m - 2 k) + p + c v)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a (m - 2 k) + p + c v}{2 c}, \ldots, \frac{i a (m - 2 k) + p + c v}{2 c}, v; \frac{i a (m - 2 k) + p + c v}{2 c} + 1, \ldots, \frac{i a (m - 2 k) + p + c v}{2 c} + 1; e^{2 c z}\right) + \sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Bigg(e^{(-i a (m-2 k)+p+2 c s) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m - 2 k) + p + 2 c s)^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a (m - 2 k) + p + 2 c s}{2 c}, \ldots, \frac{-i a (m - 2 k) + p + 2 c s}{2 c}, v; \frac{-i a (m - 2 k) + p + 2 c s}{2 c} + 1, \ldots, \frac{-i a (m - 2 k) + p + 2 c s}{2 c} + 1; e^{2 c z}\right) + e^{(-i a (m-2 k)+p+2 c (v-s)) z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m - 2 k) + p + 2 c (v - s))^{-j-1} z^{n-j}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{-i a (m - 2 k) + p + 2 c (v - s)}{2 c}, \ldots, \frac{-i a (m - 2 k) + p + 2 c (v - s)}{2 c}, v; \frac{-i a (m - 2 k) + p + 2 c (v - s)}{2 c} + 1, \ldots, \frac{-i a (m - 2 k) + p + 2 c (v - s)}{2 c} + 1; e^{2 c z}\right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(a\,i\,(m-2k)+p+2cs)z} \sum_{j=0}^{n} \frac{(-1)^j (a\,i\,(m-2k)+p+2cs)^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\!\left(\frac{i\,a\,(m-2k)+p+2cs}{2c}, \ldots, \frac{i\,a\,(m-2k)+p+2cs}{2c}, v; \frac{i\,a\,(m-2k)+p+2cs}{2c}+1, \ldots, \frac{i\,a\,(m-2k)+p+2cs}{2c}+1; e^{2cz} \right) + e^{(a\,i\,(m-2k)+p+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (a\,i\,(m-2k)+p+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\!\left(\frac{i\,a\,(m-2k)+p+2c(v-s)}{2c}, \ldots, \frac{i\,a\,(m-2k)+p+2c(v-s)}{2c}, v; \frac{i\,a\,(m-2k)+p+2c(v-s)}{2c}+1, \ldots, \frac{i\,a\,(m-2k)+p+2c(v-s)}{2c}+1; e^{2cz} \right) \right) \Bigg) +$$

$$(-1)^v 2^{-m-u} \binom{m}{\frac{m}{2}} n!\,(1 - m \bmod 2) \sum_{i=0}^{\left\lfloor \frac{u-1}{2} \right\rfloor} \binom{u}{i} \left(e^{(p-b(u-2i)+cv)z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (p-b(u-2i)+cv)^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\!\left(\frac{p-b(u-2i)+cv}{2c}, \ldots, \frac{p-b(u-2i)+cv}{2c}, v; \frac{p-b(u-2i)+cv}{2c}+1, \ldots, \frac{p-b(u-2i)+cv}{2c}+1; e^{2cz} \right) + e^{(p+b(u-2i)+cv)z} \binom{v}{\frac{v}{2}} (1 - v \bmod 2) \sum_{j=0}^{n} \frac{(-1)^j (p+b(u-2i)+cv)^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\!\left(\frac{p+b(u-2i)+cv}{2c}, \ldots, \frac{p+b(u-2i)+cv}{2c}, v; \frac{p+b(u-2i)+cv}{2c}+1, \ldots, \frac{p+b(u-2i)+cv}{2c}+1; e^{2cz} \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(p+2cs-b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (p+2cs-b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\!\left(\frac{p+2cs-b(u-2i)}{2c}, \ldots, \frac{p+2cs-b(u-2i)}{2c}, v; \frac{p+2cs-b(u-2i)}{2c}+1, \ldots, \frac{p+2cs-b(u-2i)}{2c}+1; e^{2cz} \right) + e^{(p-b(u-2i)+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (p-b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\!\left(\frac{p-b(u-2i)+2c(v-s)}{2c}, \ldots, \frac{p-b(u-2i)+2c(v-s)}{2c}, v; \frac{p-b(u-2i)+2c(v-s)}{2c}+1, \ldots, \frac{p-b(u-2i)+2c(v-s)}{2c}+1; e^{2cz} \right) \right) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \left(e^{(p+2cs+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (p+2cs+b(u-2i))^{-j-1} z^{n-j}}{(n-j)!} \,_{j+2}F_{j+1}\!\left(\frac{p+2cs+b(u-2i)}{2c}, \right.\right.$$

$$\ldots, \frac{p+2cs+b(u-2i)}{2c}, v; \frac{p+2cs+b(u-2i)}{2c}+1, \ldots, \frac{p+2cs+b(u-2i)}{2c}+1; e^{2cz}\Bigg)+$$

$$e^{(p+b(u-2i)+2c(v-s))z}\sum_{j=0}^{n}\frac{(-1)^j(p+b(u-2i)+2c(v-s))^{-j-1}z^{n-j}}{(n-j)!}\,{}_{j+2}F_{j+1}$$

$$\Bigg(\frac{p+b(u-2i)+2c(v-s)}{2c}, \ldots, \frac{p+b(u-2i)+2c(v-s)}{2c}, v; \frac{p+b(u-2i)+2c(v-s)}{2c}+1,$$

$$\ldots, \frac{p+b(u-2i)+2c(v-s)}{2c}+1; e^{2cz}\Bigg)\Bigg)\Bigg)\Bigg)+(-1)^v\,2^{-m-u}\,n!$$

$$\sum_{i=0}^{\left\lfloor\frac{u-1}{2}\right\rfloor}\sum_{k=0}^{\left\lfloor\frac{m-1}{2}\right\rfloor}\binom{m}{k}\binom{u}{i}\Bigg(e^{(-ia(m-2k)+p-b(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(-ia(m-2k)+p-b(u-2i)+cv)^{-j-1}z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}, \ldots, \frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}, v;$$

$$\frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}+1, \ldots, \frac{-ia(m-2k)+p-b(u-2i)+cv}{2c}+1; e^{2cz}\Bigg)+$$

$$e^{(ai(m-2k)+p-b(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(ai(m-2k)+p-b(u-2i)+cv)^{-j-1}z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{ia(m-2k)+p-b(u-2i)+cv}{2c}, \ldots, \frac{ia(m-2k)+p-b(u-2i)+cv}{2c}, v;$$

$$\frac{ia(m-2k)+p-b(u-2i)+cv}{2c}+1, \ldots, \frac{ia(m-2k)+p-b(u-2i)+cv}{2c}+1; e^{2cz}\Bigg)+$$

$$e^{(-ia(m-2k)+p+b(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(-ia(m-2k)+p+b(u-2i)+cv)^{-j-1}z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{-ia(m-2k)+p+b(u-2i)+cv}{2c}, \ldots, \frac{-ia(m-2k)+p+b(u-2i)+cv}{2c}, v;$$

$$\frac{-ia(m-2k)+p+b(u-2i)+cv}{2c}+1, \ldots, \frac{-ia(m-2k)+p+b(u-2i)+cv}{2c}+1; e^{2cz}\Bigg)+$$

$$e^{(ai(m-2k)+p+b(u-2i)+cv)z}\binom{v}{\frac{v}{2}}(1-v\bmod 2)\sum_{j=0}^{n}\frac{(-1)^j(ai(m-2k)+p+b(u-2i)+cv)^{-j-1}z^{n-j}}{(n-j)!}$$

$${}_{j+2}F_{j+1}\Bigg(\frac{ia(m-2k)+p+b(u-2i)+cv}{2c}, \ldots, \frac{ia(m-2k)+p+b(u-2i)+cv}{2c}, v;$$

$$\frac{ia(m-2k)+p+b(u-2i)+cv}{2c}+1, \ldots, \frac{ia(m-2k)+p+b(u-2i)+cv}{2c}+1; e^{2cz}\Bigg)+$$

$$\sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(-ia(m-2k)+p+2cs-b(u-2i))z}\sum_{j=0}^{n}\frac{(-1)^j(-ia(m-2k)+p+2cs-b(u-2i))^{-j-1}z^{n-j}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c},\,v;\,\frac{-i\,a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\right)+ $$

$$ e^{(-i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!} $$

$$ {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,v;\,\frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\,e^{2\,c\,z}\right)\Bigg)+ $$

$$ \sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(a\,i\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!} $$

$$ {}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c},\,v;\,\frac{i\,a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+p+2\,c\,s-b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\right)+ $$

$$ e^{(a\,i\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(a\,i\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s))^{-j-1}\,z^{n-j}}{(n-j)!} $$

$$ {}_{j+2}F_{j+1}\left(\frac{i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,\ldots,\,\frac{i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c},\,v;\,\frac{i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1,\,\ldots,\,\frac{i\,a\,(m-2\,k)+p-b\,(u-2\,i)+2\,c\,(v-s)}{2\,c}+1;\,e^{2\,c\,z}\right)\Bigg)+ $$

$$ \sum_{s=0}^{\left\lfloor\frac{v-1}{2}\right\rfloor}\binom{v}{s}\Bigg(e^{(-i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i))\,z}\sum_{j=0}^{n}\frac{(-1)^j\,(-i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i))^{-j-1}\,z^{n-j}}{(n-j)!} $$

$$ {}_{j+2}F_{j+1}\left(\frac{-i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c},\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c},\,v;\,\frac{-i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c}+1,\,\ldots,\,\frac{-i\,a\,(m-2\,k)+p+2\,c\,s+b\,(u-2\,i)}{2\,c}+1;\,e^{2\,c\,z}\right)+ $$

$$e^{(-i a (m-2k)+p+b(u-2i)+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (-i a (m-2k)+p+b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}$$
$$ {}_{j+2}F_{j+1}\Big(\frac{-i a (m-2k)+p+b(u-2i)+2c(v-s)}{2c}, \ldots, \frac{-i a (m-2k)+p+b(u-2i)+2c(v-s)}{2c}, v; \frac{-i a (m-2k)+p+b(u-2i)+2c(v-s)}{2c}+1, \ldots, \frac{-i a (m-2k)+p+b(u-2i)+2c(v-s)}{2c}+1; e^{2cz}\Big)\Big) +$$

$$\sum_{s=0}^{\left\lfloor \frac{v-1}{2} \right\rfloor} \binom{v}{s} \Big(e^{(a i (m-2k)+p+2cs+b(u-2i))z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p+2cs+b(u-2i))^{-j-1} z^{n-j}}{(n-j)!}$$
$$ {}_{j+2}F_{j+1}\Big(\frac{i a (m-2k)+p+2cs+b(u-2i)}{2c}, \ldots, \frac{i a (m-2k)+p+2cs+b(u-2i)}{2c}, v; \frac{i a (m-2k)+p+2cs+b(u-2i)}{2c}+1, \ldots, \frac{i a (m-2k)+p+2cs+b(u-2i)}{2c}+1; e^{2cz}\Big) +$$
$$e^{(a i (m-2k)+p+b(u-2i)+2c(v-s))z} \sum_{j=0}^{n} \frac{(-1)^j (a i (m-2k)+p+b(u-2i)+2c(v-s))^{-j-1} z^{n-j}}{(n-j)!}$$
$$ {}_{j+2}F_{j+1}\Big(\frac{i a (m-2k)+p+b(u-2i)+2c(v-s)}{2c}, \ldots, \frac{i a (m-2k)+p+b(u-2i)+2c(v-s)}{2c}, v; \frac{i a (m-2k)+p+b(u-2i)+2c(v-s)}{2c}+1, \ldots, \frac{i a (m-2k)+p+b(u-2i)+2c(v-s)}{2c}+1; e^{2cz}\Big)\Big)\Big) /; n \in \mathbb{N} \land m \in \mathbb{N}^+ \land u \in \mathbb{N}^+ \land v \in \mathbb{N}^+$$

01.22.21.0498.01

$$\int z^n e^{pz} \cos^m(az) \cosh^u(cz) \coth^v(cz)\, dz = (-1)^v 2^{-m-u} e^{(p+cv)z} \binom{m}{\frac{m}{2}} \binom{u+v}{\frac{u+v}{2}} n! (1 - m \bmod 2)(1-(u+v) \bmod 2)$$
$$\sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (p+cv)^{-j-1}}{(n-j)!} {}_{j+2}F_{j+1}\Big(\frac{p+cv}{2c}, \ldots, \frac{p+cv}{2c}, v; \frac{p+cv}{2c}+1, \ldots, \frac{p+cv}{2c}+1; e^{2cz}\Big) -$$
$$(-1)^v 2^{-m-u} n! e^{czv} \binom{m}{\frac{m}{2}} (m \bmod 2 - 1) \sum_{s=0}^{\left\lfloor \frac{1}{2}(u+v-1) \right\rfloor} \binom{u+v}{s} \Big(e^{(p-c(-2s+u+v))z} \sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (p+cv-c(-2s+u+v))^{-j-1}}{(n-j)!}$$
$$ {}_{j+2}F_{j+1}\Big(\frac{p-c(u-2s)}{2c}, \ldots, \frac{p-c(u-2s)}{2c}, v; \frac{p-c(u-2s)}{2c}+1, \ldots, \frac{p-c(u-2s)}{2c}+1; e^{2cz}\Big) +$$
$$e^{(p+c(-2s+u+v))z} \sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (p+cv+c(-2s+u+v))^{-j-1}}{(n-j)!} {}_{j+2}F_{j+1}\Big(\frac{p+c(-2s+u+2v)}{2c}, \ldots,$$
$$\frac{p+c(-2s+u+2v)}{2c}, v; \frac{p+c(-2s+u+2v)}{2c}+1, \ldots, \frac{p+c(-2s+u+2v)}{2c}+1; e^{2cz}\Big)\Big) +$$

$$(-1)^v 2^{-m-u} e^{c z v} \binom{u+v}{\frac{u+v}{2}} n! \,(1-(u+v) \bmod 2) \sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \binom{m}{k} \left(e^{(p-i a (m-2k)) z} \sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (-i a (m-2k)+p+c v)^{-j-1}}{(n-j)!} \right.$$

$$ {}_{j+2}F_{j+1}\left(\frac{-i a (m-2k)+p+c v}{2c}, \ldots, \frac{-i a (m-2k)+p+c v}{2c}, v; \right.$$

$$\left. \frac{-i a (m-2k)+p+c v}{2c}+1, \ldots, \frac{-i a (m-2k)+p+c v}{2c}+1; e^{2cz} \right) + e^{(a i (m-2k)+p) z}$$

$$\sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (a i (m-2k)+p+c v)^{-j-1}}{(n-j)!} \, {}_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p+c v}{2c}, \ldots, \frac{i a (m-2k)+p+c v}{2c}, \right.$$

$$\left.\left. v; \frac{i a (m-2k)+p+c v}{2c}+1, \ldots, \frac{i a (m-2k)+p+c v}{2c}+1; e^{2cz} \right)\right) + (-1)^v 2^{-m-u} e^{c z v} n!$$

$$\sum_{k=0}^{\left\lfloor \frac{m-1}{2} \right\rfloor} \sum_{s=0}^{\left\lfloor \frac{1}{2}(u+v-1) \right\rfloor} \binom{m}{k} \binom{u+v}{s} \left(e^{(-i a (m-2k)+p-c(-2s+u+v)) z} \sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (-i a (m-2k)+p+c v-c(-2s+u+v))^{-j-1}}{(n-j)!} \right.$$

$$ {}_{j+2}F_{j+1}\left(\frac{-i a (m-2k)+p-c(u-2s)}{2c}, \ldots, \frac{-i a (m-2k)+p-c(u-2s)}{2c}, v; \right.$$

$$\left. \frac{-i a (m-2k)+p-c(u-2s)}{2c}+1, \ldots, \frac{-i a (m-2k)+p-c(u-2s)}{2c}+1; e^{2cz} \right) +$$

$$e^{(a i (m-2k)+p-c(-2s+u+v)) z} \sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (a i (m-2k)+p+c v-c(-2s+u+v))^{-j-1}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p-c(u-2s)}{2c}, \ldots, \frac{i a (m-2k)+p-c(u-2s)}{2c}, v; \right.$$

$$\left. \frac{i a (m-2k)+p-c(u-2s)}{2c}+1, \ldots, \frac{i a (m-2k)+p-c(u-2s)}{2c}+1; e^{2cz} \right) +$$

$$e^{(-i a (m-2k)+p+c(-2s+u+v)) z} \sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (-i a (m-2k)+p+c v+c(-2s+u+v))^{-j-1}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{-i a (m-2k)+p+c(-2s+u+2v)}{2c}, \ldots, \frac{-i a (m-2k)+p+c(-2s+u+2v)}{2c}, v; \right.$$

$$\left. \frac{-i a (m-2k)+p+c(-2s+u+2v)}{2c}+1, \ldots, \frac{-i a (m-2k)+p+c(-2s+u+2v)}{2c}+1; e^{2cz} \right) +$$

$$e^{(a i (m-2k)+p+c(-2s+u+v)) z} \sum_{j=0}^{n} \frac{(-1)^j z^{n-j} (a i (m-2k)+p+c v+c(-2s+u+v))^{-j-1}}{(n-j)!}$$

$$ {}_{j+2}F_{j+1}\left(\frac{i a (m-2k)+p+c(-2s+u+2v)}{2c}, \ldots, \frac{i a (m-2k)+p+c(-2s+u+2v)}{2c}, \right.$$

$$v; \frac{i a (m-2k)+p+c(-2s+u+2v)}{2c}+1, \ldots,$$

$$\left.\left. \frac{i a (m-2k)+p+c(-2s+u+2v)}{2c}+1; e^{2cz} \right)\right) /; n \in \mathbb{N} \bigwedge m \in \mathbb{N}^+ \bigwedge u \in \mathbb{N}^+ \bigwedge v \in \mathbb{N}^+$$

Definite integration

For the direct function itself

01.22.21.0009.01

$$\int_a^b \coth(t)\,dt = \log(\sinh(b)) - \log(\sinh(a))$$

Involving the direct function

01.22.21.0010.01

$$\int_0^\infty t\,e^{-t}\coth(t)\,dt = \frac{1}{4}\left(\pi^2 - 4\right)$$

01.22.21.0011.01

$$\int_0^\infty t^2\,e^{-t}\coth(t)\,dt = \frac{7\,\zeta(3)}{2} - 2$$

Involving related functions

01.22.21.0012.01

$$\int_0^{\frac{\pi}{4}} \log(\coth(t))\,dt = \frac{1}{12}\left(-3\log^2\left(\coth\left(\frac{\pi}{4}\right)\right) + 6\log\left(\coth\left(\frac{\pi}{4}\right)+1\right)\log\left(\coth\left(\frac{\pi}{4}\right)\right) + \pi^2 + 6\,\mathrm{Li}_2\left(1 - \coth\left(\frac{\pi}{4}\right)\right) - 6\,\mathrm{Li}_2\left(-\tanh\left(\frac{\pi}{4}\right)\right)\right)$$

Summation

Finite summation

01.22.23.0001.01

$$\sum_{k=0}^{n-1} \coth^2\left(\frac{i\,\pi\,k}{n} + z\right) = \coth^2(n\,z)\,n^2 - n^2 + n\ /;\ n \in \mathbb{N}^+$$

Representations through more general functions

Through hypergeometric functions

01.22.26.0008.01

$$\coth(z) = \frac{2}{z}\,{}_3F_2\left(1, -\frac{i\,z}{\pi}, \frac{i\,z}{\pi}; 1 - \frac{i\,z}{\pi}, \frac{i\,z}{\pi} + 1; 1\right) - \frac{1}{z}$$

Brychkov Yu.A. (2005)

Through other functions

Involving Jacobi functions

01.22.26.0001.01

$$\coth(z) = i\,\mathrm{cs}(i\,z \mid 0)$$

01.22.26.0002.01

$$\coth(z) = \mathrm{ns}(z \mid 1)$$

01.22.26.0003.01

$$\coth(z) = i\,\mathrm{sc}\left(\frac{\pi}{2} - i\,z \,\middle|\, 0\right)$$

01.22.26.0004.01

$$\coth(z) = -\mathrm{sn}\left(\frac{\pi\,i}{2} - z \,\middle|\, 1\right)$$

Involving Mathieu functions

01.22.26.0005.01

$$\coth\left(\sqrt{a}\;z\right) = i\,\frac{\mathrm{Ce}(a,\,0,\,i\,z)}{\mathrm{Se}(a,\,0,\,i\,z)}$$

01.22.26.0006.01

$$\coth\left(\sqrt{a}\;z\right) = -i\,\frac{\mathrm{Se}_z(a,\,0,\,i\,z)}{\mathrm{Ce}_z(a,\,0,\,i\,z)}$$

Involving some elliptic-type functions

01.22.26.0007.01

$$\coth(z) = \frac{\sqrt{z^2}}{z}\sqrt{\frac{2}{3}}\sqrt{1 - \wp\left(i\sqrt{\frac{2}{3}}\;z;\,3,\,1\right)}\;/;\;i\,z \notin \left(-\frac{\pi}{2},\,\frac{\pi}{2}\right)$$

Representations through equivalent functions

With inverse function

01.22.27.0001.01

$$\coth\left(\coth^{-1}(z)\right) = z$$

01.22.27.0002.01

$$\coth\left(n\coth^{-1}(z)\right) = \frac{(z-1)^n + (z+1)^n}{(z+1)^n - (z-1)^n}\;/;\;n \in \mathbb{N}^+$$

01.22.27.0003.02

$$\coth^{-1}(\coth(z)) = z\;/;\;-\frac{\pi}{2} < \mathrm{Im}(z) < \frac{\pi}{2} \bigvee \left(\mathrm{Im}(z) = -\frac{\pi}{2} \bigwedge \mathrm{Re}(z) > 0\right) \bigvee \left(\mathrm{Im}(z) = \frac{\pi}{2} \bigwedge \mathrm{Re}(z) \le 0\right)$$

01.22.27.0083.01

$$\coth^{-1}(\coth(z)) = z + \pi\,i\;/;\;-\frac{3\,\pi}{2} < \mathrm{Im}(z) < -\frac{\pi}{2} \bigvee \mathrm{Im}(z) = -\frac{3\,\pi}{2} \bigwedge \mathrm{Re}(z) > 0 \bigvee \mathrm{Im}(z) = -\frac{\pi}{2} \bigwedge \mathrm{Re}(z) \le 0$$

01.22.27.0084.01

$$\coth^{-1}(\coth(z)) = z - \pi\,i\;/;\;\frac{\pi}{2} < \mathrm{Im}(z) < \frac{3\,\pi}{2} \bigvee \mathrm{Im}(z) = \frac{\pi}{2} \bigwedge \mathrm{Re}(z) > 0 \bigvee \mathrm{Im}(z) = \frac{3\,\pi}{2} \bigwedge \mathrm{Re}(z) \le 0$$

01.22.27.0085.01

$$\coth^{-1}(\coth(z)) = z - \pi\,i\,k\;/;$$
$$\left(k\,\pi - \frac{\pi}{2} < \mathrm{Im}(z) < \pi\,k + \frac{\pi}{2} \bigvee \mathrm{Im}(z) = k\,\pi - \frac{\pi}{2} \bigwedge \mathrm{Re}(z) > 0 \bigvee \mathrm{Im}(z) = \pi\,k + \frac{\pi}{2} \bigwedge \mathrm{Re}(z) \le 0\right) \bigwedge k \in \mathbb{Z}$$

01.22.27.0004.01

$$\coth^{-1}(\coth(z)) = z - i\,\pi \left\lfloor \frac{\operatorname{Im}(z)}{\pi} + \frac{1}{2} \right\rfloor + \frac{\pi\, i}{2} \left(1 + (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} - \frac{1}{2} \right\rfloor + \left\lfloor \frac{1}{2} - \frac{\operatorname{Im}(z)}{\pi} \right\rfloor}\right) \theta(-\operatorname{Re}(z)) \;/;\; \frac{i\, z}{\pi} - \frac{1}{2} \notin \mathbb{Z}$$

01.22.27.0086.01

$$\coth^{-1}(\coth(z)) = \begin{cases} z - \pi\, i \left\lfloor \frac{2 \operatorname{Im}(z) - \pi}{2 \pi} \right\rfloor & \frac{2 \operatorname{Im}(z) + \pi}{2 \pi} \in \mathbb{Z} \bigwedge \operatorname{Re}(z) \leq 0 \\ z - \pi\, i \left\lfloor \frac{2 \operatorname{Im}(z) + \pi}{2 \pi} \right\rfloor & \text{True} \end{cases}$$

With related functions

Involving exp

01.22.27.0005.01

$$\coth(z) = \frac{e^z + e^{-z}}{e^z - e^{-z}}$$

01.22.27.0006.01

$$\coth(z) = \frac{2}{e^{2 z} - 1} + 1$$

Involving sin

01.22.27.0007.01

$$\coth(z) = \frac{i \sin\left(\frac{\pi}{2} - i\, z\right)}{\sin(i\, z)}$$

01.22.27.0008.01

$$\coth(z) = \frac{i \sin\left(\frac{\pi}{2} + i\, z\right)}{\sin(i\, z)}$$

01.22.27.0009.01

$$\coth(z) = \frac{i \sqrt{1 - \sin^2(i\, z)}}{\sin(i\, z)} \;/;\; |\operatorname{Im}(z)| < \frac{\pi}{2}$$

01.22.27.0010.01

$$\coth(z) = \frac{i \sqrt{1 - \sin^2(i\, z)}}{\sin(i\, z)} (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} + \frac{1}{2} \right\rfloor} \left(1 - \left(1 + (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} + \frac{1}{2} \right\rfloor + \left\lfloor -\frac{\operatorname{Im}(z)}{\pi} - \frac{1}{2} \right\rfloor}\right) \theta(\operatorname{Re}(z))\right)$$

01.22.27.0011.01

$$\coth^2(z) = \frac{\sin^2(i\, z) - 1}{\sin^2(i\, z)}$$

Involving cos

01.22.27.0012.01

$$\coth(z) = \frac{i \cos(i\, z)}{\cos\left(\frac{\pi}{2} - i\, z\right)}$$

01.22.27.0013.01

$$\coth(z) = -\frac{i \cos(i\, z)}{\cos\left(\frac{\pi}{2} + i\, z\right)}$$

01.22.27.0014.01

$$\coth(z) = \frac{\sqrt{z^2}}{z} \frac{\cos(i z)}{\sqrt{\cos^2(i z) - 1}} /; |\mathrm{Im}(z)| < \frac{\pi}{2}$$

01.22.27.0015.01

$$\coth(z) = \frac{\sqrt{-z^2}}{z} \frac{\cos(i z)}{\sqrt{1 - \cos^2(i z)}} /; |\mathrm{Im}(z)| < \pi$$

01.22.27.0016.01

$$\coth(z) = -\frac{i \cos(i z)}{\sqrt{1 - \cos^2(i z)}} /; 0 < \mathrm{Im}(z) < \pi$$

01.22.27.0017.01

$$\coth(z) = \frac{i \cos(i z)}{\sqrt{1 - \cos^2(i z)}} \left((-1)^{\left\lfloor -\frac{\mathrm{Im}(z)}{\pi} \right\rfloor} \left(1 - \left(1 + (-1)^{\left\lfloor \frac{\mathrm{Im}(z)}{\pi} \right\rfloor + \left\lfloor -\frac{\mathrm{Im}(z)}{\pi} \right\rfloor}\right) \theta(-\mathrm{Re}(z))\right)\right)$$

01.22.27.0018.01

$$\coth^2(z) = \frac{\cos^2(i z)}{\cos^2(i z) - 1}$$

Involving tan

01.22.27.0019.01

$$\coth(z) = i \tan\left(\frac{\pi}{2} - i z\right)$$

01.22.27.0020.01

$$\coth(z) = -i \tan\left(i z + \frac{\pi}{2}\right)$$

01.22.27.0021.01

$$\coth(z) = \frac{i}{\tan(i z)}$$

Involving cot

01.22.27.0022.01

$$\coth(z) = i \cot(i z)$$

01.22.27.0023.01

$$\coth(i z) = -i \cot(z)$$

Involving csc

01.22.27.0024.01

$$\coth(z) = \frac{i \csc(i z)}{\csc\left(\frac{\pi}{2} - i z\right)}$$

01.22.27.0025.01

$$\coth(z) = \frac{i \csc(i z)}{\csc\left(\frac{\pi}{2} + i z\right)}$$

01.22.27.0026.01

$$\coth(z) = i\, e^{z} \csc(i\, z) - 1$$

01.22.27.0027.01

$$\coth(z) = i\, e^{-z} \csc(i\, z) + 1$$

01.22.27.0028.01

$$\coth(z) = \frac{i \csc(i\, z)}{\csc\left(\frac{\pi}{2} - i\, z\right)}$$

01.22.27.0029.01

$$\coth(z) = \frac{\sqrt{z^2}}{z} \sqrt{1 - \csc^2(i\, z)} \;/;\; \operatorname{Re}(z) \neq 0$$

01.22.27.0030.01

$$\coth(z) = -i \sqrt{\csc^2(i\, z) - 1} \;/;\; 0 < \operatorname{Im}(z) < \frac{\pi}{2}$$

01.22.27.0031.01

$$\coth(z) = -z \sqrt{-\frac{1}{z^2}} \sqrt{\csc^2(i\, z) - 1} \;/;\; |\operatorname{Im}(z)| < \frac{\pi}{2}$$

01.22.27.0032.01

$$\coth(z) = i \sqrt{\csc^2(i\, z) - 1}\, (-1)^{\left\lfloor -\frac{2 \operatorname{Im}(z)}{\pi} \right\rfloor} \left(1 - \left(1 + (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} - \frac{1}{2} \right\rfloor + \left\lfloor \frac{1}{2} - \frac{\operatorname{Im}(z)}{\pi} \right\rfloor}\right) \theta(-\operatorname{Re}(z))\right) \left(1 - \left(1 + (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} \right\rfloor + \left\lfloor -\frac{\operatorname{Im}(z)}{\pi} \right\rfloor}\right) \theta(\operatorname{Re}(z))\right)$$

01.22.27.0033.01

$$\coth^2(z) = 1 - \csc^2(i\, z)$$

Involving sec

01.22.27.0034.01

$$\coth(z) = \frac{i \sec\left(\frac{\pi}{2} - i\, z\right)}{\sec(i\, z)}$$

01.22.27.0035.01

$$\coth(z) = -\frac{i \sec\left(\frac{\pi}{2} + i\, z\right)}{\sec(i\, z)}$$

01.22.27.0036.01

$$\coth(z) = i\, e^{z} \sec\left(\frac{\pi}{2} - i\, z\right) - 1$$

01.22.27.0037.01

$$\coth(z) = i\, e^{-z} \sec\left(\frac{\pi}{2} - i\, z\right) + 1$$

01.22.27.0038.01

$$\coth(z) = \frac{\sqrt{z^2}}{z} \frac{1}{\sqrt{1 - \sec^2(i\, z)}} \;/;\; \operatorname{Re}(z) \neq 0$$

01.22.27.0039.01

$$\coth(z) = -\frac{i}{\sqrt{\sec^2(i z) - 1}} \;/;\; 0 < \operatorname{Im}(z) < \frac{\pi}{2}$$

01.22.27.0040.01

$$\coth(z) = \frac{\sqrt{-z^2}}{z} \frac{1}{\sqrt{\sec^2(i z) - 1}} \;/;\; |\operatorname{Im}(z)| < \frac{\pi}{2}$$

01.22.27.0041.01

$$\coth(z) = \frac{i}{\sqrt{\sec^2(i z) - 1}} \left((-1)^{\left\lfloor -\frac{2 \operatorname{Im}(z)}{\pi} \right\rfloor} \left(1 - \left(1 + (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} \right\rfloor + \left\lfloor -\frac{\operatorname{Im}(z)}{\pi} \right\rfloor}\right) \theta(-\operatorname{Re}(z))\right) \left(1 - \left(1 + (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} - \frac{1}{2} \right\rfloor + \left\lfloor \frac{1}{2} - \frac{\operatorname{Im}(z)}{\pi} \right\rfloor}\right) \theta(\operatorname{Re}(z))\right)\right)$$

01.22.27.0042.01

$$\coth^2(z) = \frac{1}{1 - \sec^2(i z)}$$

01.22.27.0043.01

$$\coth^2(z) = 1 - \sec^2\left(\frac{\pi}{2} - i z\right)$$

Involving sinh

01.22.27.0044.01

$$\coth(z) = -\frac{i \sinh\left(\frac{i \pi}{2} - z\right)}{\sinh(z)}$$

01.22.27.0045.01

$$\coth(z) = -\frac{i \sinh\left(\frac{i \pi}{2} + z\right)}{\sinh(z)}$$

01.22.27.0046.01

$$\coth(z) = \frac{\sqrt{\sinh^2(z) + 1}}{\sinh(z)} \;/;\; |\operatorname{Im}(z)| < \frac{\pi}{2}$$

01.22.27.0047.01

$$\coth(z) = \frac{\sqrt{\sinh^2(z) + 1}}{\sinh(z)} (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} + \frac{1}{2} \right\rfloor} \left(1 - \left(1 + (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} + \frac{1}{2} \right\rfloor + \left\lfloor -\frac{\operatorname{Im}(z)}{\pi} - \frac{1}{2} \right\rfloor}\right) \theta(\operatorname{Re}(z))\right)$$

01.22.27.0048.01

$$\coth^2(z) = \frac{\sinh^2(z) + 1}{\sinh^2(z)}$$

Involving cosh

01.22.27.0049.01

$$\coth(z) = -\frac{i \cosh(z)}{\cosh\left(\frac{\pi i}{2} - z\right)}$$

01.22.27.0050.01

$$\coth(z) = \frac{i\cosh(z)}{\cosh\left(\frac{\pi i}{2}+z\right)}$$

01.22.27.0051.01

$$\coth(z) = \frac{\sqrt{z^2}}{z}\,\frac{\cosh(z)}{\sqrt{\cosh^2(z)-1}} \;/;\; |\mathrm{Im}(z)| < \frac{\pi}{2}$$

01.22.27.0052.01

$$\coth(z) = \frac{\sqrt{-z^2}}{z}\,\frac{\cosh(z)}{\sqrt{1-\cosh^2(z)}} \;/;\; |\mathrm{Im}(z)| < \pi$$

01.22.27.0053.01

$$\coth(z) = -\frac{i\cosh(z)}{\sqrt{1-\cosh^2(z)}} \;/;\; 0 < \mathrm{Im}(z) < \pi$$

01.22.27.0054.01

$$\coth(z) = -\frac{i\cosh(z)}{\sqrt{1-\cosh^2(z)}}\left((-1)^{\left\lfloor \frac{\mathrm{Im}(z)}{\pi}\right\rfloor}\left(1-\left(1+(-1)^{\left\lfloor \frac{\mathrm{Im}(z)}{\pi}\right\rfloor+\left\lfloor -\frac{\mathrm{Im}(z)}{\pi}\right\rfloor}\right)\theta(\mathrm{Re}(z))\right)\right)$$

01.22.27.0055.01

$$\coth^2(z) = \frac{\cosh^2(z)}{\cosh^2(z)-1}$$

Involving tanh

01.22.27.0056.01

$$\coth(z) = -\tanh\left(\frac{\pi i}{2}-z\right)$$

01.22.27.0057.01

$$\coth(z) = \tanh\left(\frac{\pi i}{2}+z\right)$$

01.22.27.0058.01

$$\coth(z) = \tanh\left(z-\frac{\pi i}{2}\right)$$

01.22.27.0059.01

$$\coth(z) = \frac{1}{\tanh(z)}$$

01.22.27.0060.01

$$\coth(z) = \frac{\tanh^2\left(\frac{z}{2}\right)+1}{2\tanh\left(\frac{z}{2}\right)}$$

01.22.27.0061.01

$$\coth\left(\frac{\pi i}{2}+z\right) = \tanh(z)$$

01.22.27.0062.01

$$\coth\left(\frac{\pi i}{2}-z\right)=-\tanh(z)$$

01.22.27.0063.01

$$\coth(z)=\frac{2}{\tanh(2z)}-\tanh(z)$$

Involving csch

01.22.27.0064.01

$$\coth(z)=-\frac{i\,\text{csch}(z)}{\text{csch}\left(\frac{\pi i}{2}-z\right)}$$

01.22.27.0065.01

$$\coth(z)=-\frac{i\,\text{csch}(z)}{\text{csch}\left(\frac{\pi i}{2}+z\right)}$$

01.22.27.0066.01

$$\coth(z)=e^z\,\text{csch}(z)-1$$

01.22.27.0067.01

$$\coth(z)=e^{-z}\,\text{csch}(z)+1$$

01.22.27.0068.01

$$\coth(z)=\frac{\sqrt{z^2}}{z}\sqrt{1+\text{csch}^2(z)}\;/;\;\text{Re}(z)\neq 0$$

01.22.27.0069.01

$$\coth^2(z)=\text{csch}^2(z)+1$$

Involving sech

01.22.27.0070.01

$$\coth(z)=-\frac{i\,\text{sech}\left(\frac{\pi i}{2}-z\right)}{\text{sech}(z)}$$

01.22.27.0071.01

$$\coth(z)=\frac{i\,\text{sech}\left(\frac{\pi i}{2}+z\right)}{\text{sech}(z)}$$

01.22.27.0072.01

$$\coth(z)=-i\,e^z\,\text{sech}\left(\frac{\pi i}{2}-z\right)-1$$

01.22.27.0073.01

$$\coth(z)=1-i\,e^{-z}\,\text{sech}\left(\frac{\pi i}{2}-z\right)$$

01.22.27.0074.01

$$\coth(z)=\frac{\sqrt{z^2}}{z}\,\frac{1}{\sqrt{1-\text{sech}^2(z)}}\;/;\;\text{Re}(z)\neq 0$$

01.22.27.0075.01

$$\coth(z) = -\frac{i}{\sqrt{\operatorname{sech}^2(z) - 1}} \;/;\; 0 < \operatorname{Im}(z) < \frac{\pi}{2}$$

01.22.27.0076.01

$$\coth(z) = \frac{\sqrt{-z^2}}{z} \frac{1}{\sqrt{\operatorname{sech}^2(z) - 1}} \;/;\; |\operatorname{Im}(z)| < \frac{\pi}{2}$$

01.22.27.0077.01

$$\coth(z) = \frac{i}{\sqrt{\operatorname{sech}^2(z) - 1}} (-1)^{\left\lfloor -\frac{2\operatorname{Im}(z)}{\pi} \right\rfloor} \left(1 - \left(1 + (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} - \frac{1}{2} \right\rfloor + \left\lfloor \frac{1}{2} - \frac{\operatorname{Im}(z)}{\pi} \right\rfloor}\right) \theta(\operatorname{Re}(z))\right) \left(1 - \left(1 + (-1)^{\left\lfloor \frac{\operatorname{Im}(z)}{\pi} \right\rfloor + \left\lfloor -\frac{\operatorname{Im}(z)}{\pi} \right\rfloor}\right) \theta(-\operatorname{Re}(z))\right)$$

01.22.27.0078.01

$$\coth^2(z) = \frac{1}{1 - \operatorname{sech}^2(z)}$$

01.22.27.0079.01

$$\coth^2(z) = 1 - \operatorname{sech}^2\left(\frac{\pi i}{2} - z\right)$$

Involving trigonometric and hyperbolic functions

01.22.27.0080.01

$$\coth(z) = \frac{\cosh(z)}{\sinh(z)}$$

01.22.27.0081.01

$$\coth(z) + \tanh(z) = 2\coth(2z)$$

01.22.27.0082.01

$$\coth(z) - \tanh(z) = 2\operatorname{csch}(2z)$$

Inequalities

01.22.29.0001.01

$$|\coth(x)| > 1 \;/;\; x \in \mathbb{R}$$

Zeros

01.22.30.0001.01

$$\coth(z) = 0 \;/;\; z = \pi i \left(k + \frac{1}{2}\right) \bigwedge k \in \mathbb{Z}$$

Theorems

Magnetic moment

The mean magnetic moment per dipole $\overline{\boldsymbol{\mu}}$ of a classical dipole $\boldsymbol{\mu}$ in a magnetic field $\mathbf{H}$ is given by

$$\overline{\boldsymbol{\mu}} = \mathbf{H} / |\mathbf{H}| \; |\boldsymbol{\mu}| \left(\coth(k_B\, T\, |\boldsymbol{\mu}|\, |\mathbf{H}|) - (k_B\, T\, |\boldsymbol{\mu}|\, |\mathbf{H}|)^{-1}\right) |\mathbf{H}|$$

where k_B is the Boltzmann constant and T is the absolute temperature.
The mean magnetic moment per dipole $\overline{\boldsymbol{\mu}}$ of a quantum-mechanical dipole $\boldsymbol{\mu}$ generated by angular momentum j and g–factor g in a magnetic field $\mathbf{H}$ is given by

$$\overline{\boldsymbol{\mu}} = \mathbf{H} / |\mathbf{H}| \, |\boldsymbol{\mu}| \left(\left(1 + \frac{1}{2 j}\right) \coth\left(\left(1 + \frac{1}{2 j}\right) k_B \, T \, g \, \mu_B \, j\right) - \frac{1}{2 j} \coth\left(\frac{1}{2 j} \, k_B \, T \, g \, \mu_B \, j\right)\right)$$

where μ_B is the Bohr magneton.

History

– L'Abbe Sauri (1774)

The function coth is encountered often in mathematics and the natural sciences.

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