Mathematica 11.3 Integration Test Results

Test results for the 113 problems in "Moses Problems.m"

Problem 31: Result more than twice size of optimal antiderivative.

$$\int \frac{x^7}{1+x^{12}}\,dx$$

Optimal (type 3, 49 leaves, 7 steps):

$$-\frac{\text{ArcTan}\left[\frac{1-2x^4}{\sqrt{3}}\right]}{4\sqrt{3}}-\frac{1}{12}\text{Log}\left[1+x^4\right]+\frac{1}{24}\text{Log}\left[1-x^4+x^8\right]$$

Result (type 3, 260 leaves):

$$\frac{1}{24}\left(2\sqrt{3}\,\text{ArcTan}\left[\frac{1+\sqrt{3}-2\sqrt{2}\,x}{1-\sqrt{3}}\right]-2\sqrt{3}\,\text{ArcTan}\left[\frac{1-\sqrt{3}+2\sqrt{2}\,x}{1+\sqrt{3}}\right]+\right.$$
$$2\sqrt{3}\,\text{ArcTan}\left[\frac{-1+\sqrt{3}+2\sqrt{2}\,x}{1+\sqrt{3}}\right]-2\sqrt{3}\,\text{ArcTan}\left[\frac{1+\sqrt{3}+2\sqrt{2}\,x}{-1+\sqrt{3}}\right]-2\,\text{Log}\left[1-\sqrt{2}\,x+x^2\right]-2\,\text{Log}\left[1+\sqrt{2}\,x+x^2\right]+$$
$$\left.\text{Log}\left[2+\sqrt{2}\,x-\sqrt{6}\,x+2x^2\right]+\text{Log}\left[2+\sqrt{2}\left(-1+\sqrt{3}\right)x+2x^2\right]+\text{Log}\left[2-\left(\sqrt{2}+\sqrt{6}\right)x+2x^2\right]+\text{Log}\left[2+\left(\sqrt{2}+\sqrt{6}\right)x+2x^2\right]\right)$$

Problem 40: Result unnecessarily involves complex numbers and more than twice size of optimal antiderivative.

$$\int \frac{\sqrt{A^2+B^2-B^2y^2}}{1-y^2}\,dy$$

Optimal (type 3, 51 leaves, 5 steps):

$$B\,\text{ArcTan}\left[\frac{B\,y}{\sqrt{A^2+B^2-B^2y^2}}\right]+A\,\text{ArcTanh}\left[\frac{A\,y}{\sqrt{A^2+B^2-B^2y^2}}\right]$$

Result (type 3, 134 leaves):

$$-\frac{1}{2} A \operatorname{Log}[1-y]+\frac{1}{2} A \operatorname{Log}[1+y]+i B \operatorname{Log}\left[-2 i B y+2 \sqrt{A^2+B^2-B^2 y^2}\right]+$$
$$\frac{1}{2} A \operatorname{Log}\left[A^2+B^2-B^2 y+A \sqrt{A^2+B^2-B^2 y^2}\right]-\frac{1}{2} A \operatorname{Log}\left[A^2+B^2+B^2 y+A \sqrt{A^2+B^2-B^2 y^2}\right]$$

Problem 42: Result more than twice size of optimal antiderivative.

$$\int \operatorname{Csc}[x] \sqrt{A^2+B^2 \operatorname{Sin}[x]^2}\, dx$$

Optimal (type 3, 49 leaves, 6 steps):

$$-B \operatorname{ArcTan}\left[\frac{B \operatorname{Cos}[x]}{\sqrt{A^2+B^2 \operatorname{Sin}[x]^2}}\right]-A \operatorname{ArcTanh}\left[\frac{A \operatorname{Cos}[x]}{\sqrt{A^2+B^2 \operatorname{Sin}[x]^2}}\right]$$

Result (type 3, 99 leaves):

$$-\sqrt{A^2} \operatorname{ArcTanh}\left[\frac{\sqrt{2} \sqrt{A^2} \operatorname{Cos}[x]}{\sqrt{2 A^2+B^2-B^2 \operatorname{Cos}[2 x]}}\right]+\sqrt{-B^2} \operatorname{Log}\left[\sqrt{2} \sqrt{-B^2} \operatorname{Cos}[x]+\sqrt{2 A^2+B^2-B^2 \operatorname{Cos}[2 x]}\right]$$

Problem 69: Result unnecessarily involves complex numbers and more than twice size of optimal antiderivative.

$$\int -\frac{\sqrt{A^2+B^2 \left(1-y^2\right)}}{1-y^2}\, dy$$

Optimal (type 3, 53 leaves, 6 steps):

$$-B \operatorname{ArcTan}\left[\frac{B y}{\sqrt{A^2+B^2-B^2 y^2}}\right]-A \operatorname{ArcTanh}\left[\frac{A y}{\sqrt{A^2+B^2-B^2 y^2}}\right]$$

Result (type 3, 127 leaves):

$$\frac{1}{2} \left(A \operatorname{Log}[1-y]-A \operatorname{Log}[1+y]-2 i B \operatorname{Log}\left[2 \left(-i B y+\sqrt{A^2+B^2-B^2 y^2}\right)\right]-\right.$$
$$\left.A \operatorname{Log}\left[A^2+B^2-B^2 y+A \sqrt{A^2+B^2-B^2 y^2}\right]+A \operatorname{Log}\left[A^2+B^2 (1+y)+A \sqrt{A^2+B^2-B^2 y^2}\right]\right)$$

Problem 70: Result more than twice size of optimal antiderivative.

$$\int \frac{\left(-A^2-B^2\right) \operatorname{Cos}[z]^2}{B \left(1-\frac{\left(A^2+B^2\right) \operatorname{Sin}[z]^2}{B^2}\right)}\, dz$$

Optimal (type 3, 16 leaves, 5 steps):

$$-B\,z-A\,\mathrm{ArcTanh}\left[\frac{A\,\mathrm{Tan}[z]}{B}\right]$$

Result (type 3, 35 leaves):

$$-\frac{B\left(A^2+B^2\right)\left(B\,z+A\,\mathrm{ArcTanh}\left[\frac{A\,\mathrm{Tan}[z]}{B}\right]\right)}{A^2\,B+B^3}$$

Problem 71: Result more than twice size of optimal antiderivative.

$$\int -\frac{A^2+B^2}{B\left(1+w^2\right)^2\left(1-\frac{\left(A^2+B^2\right)w^2}{B^2\left(1+w^2\right)}\right)}\,dw$$

Optimal (type 3, 16 leaves, 6 steps):

$$-B\,\mathrm{ArcTan}[w]-A\,\mathrm{ArcTanh}\left[\frac{A\,w}{B}\right]$$

Result (type 3, 35 leaves):

$$-\frac{B\left(A^2+B^2\right)\left(B\,\mathrm{ArcTan}[w]+A\,\mathrm{ArcTanh}\left[\frac{A\,w}{B}\right]\right)}{A^2\,B+B^3}$$

Problem 72: Result more than twice size of optimal antiderivative.

$$\int -\frac{B\left(A^2+B^2\right)}{\left(1+w^2\right)\left(B^2-A^2\,w^2\right)}\,dw$$

Optimal (type 3, 16 leaves, 4 steps):

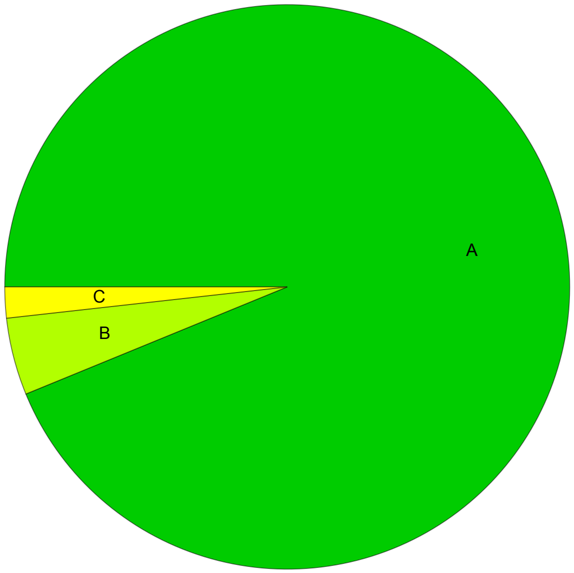
$$-B\,\mathrm{ArcTan}[w]-A\,\mathrm{ArcTanh}\left[\frac{A\,w}{B}\right]$$

Result (type 3, 35 leaves):

$$-\frac{B\left(A^2+B^2\right)\left(B\,\mathrm{ArcTan}[w]+A\,\mathrm{ArcTanh}\left[\frac{A\,w}{B}\right]\right)}{A^2\,B+B^3}$$

Summary of Integration Test Results

113 integration problems



A - 106 optimal antiderivatives

B - 5 more than twice size of optimal antiderivatives

C - 2 unnecessarily complex antiderivatives

D - 0 unable to integrate problems

E - 0 integration timeouts