Mathematica 11.3 Integration Test Results

Test results for the 175 problems in "Apostol Problems.m"

Problem 41: Result unnecessarily involves imaginary or complex numbers.

$$\int \frac{t^3}{\sqrt{4+t^3}}\,dt$$

Optimal (type 4, 172 leaves, 2 steps):

$$\frac{2}{5} t \sqrt{4+t^3} - \frac{8 \times 2^{2/3} \sqrt{2+\sqrt{3}}\, \left(2^{2/3}+t\right) \sqrt{\frac{2 \times 2^{1/3} - 2^{2/3} t + t^2}{\left(2^{2/3}\left(1+\sqrt{3}\right)+t\right)^2}}\, \text{EllipticF}\left[\text{ArcSin}\left[\frac{2^{2/3}\left(1-\sqrt{3}\right)+t}{2^{2/3}\left(1+\sqrt{3}\right)+t}\right], -7-4\sqrt{3}\right]}{5 \times 3^{1/4} \sqrt{\frac{2^{2/3}+t}{\left(2^{2/3}\left(1+\sqrt{3}\right)+t\right)^2}}\, \sqrt{4+t^3}}$$

Result (type 4, 122 leaves):

$$\frac{6 t \left(4+t^3\right) - 8 (-2)^{1/6}\, 3^{3/4} \sqrt{-(-1)^{1/6}\left(2 (-1)^{2/3}+2^{1/3} t\right)}\, \sqrt{4+2 (-2)^{1/3} t + (-2)^{2/3} t^2}\, \text{EllipticF}\left[\text{ArcSin}\left[\frac{\sqrt{\left(-i+\sqrt{3}\right)\left(2+2^{1/3} t\right)}}{2 \times 3^{1/4}}\right], (-1)^{1/3}\right]}{15 \sqrt{4+t^3}}$$

Problem 50: Result more than twice size of optimal antiderivative.

$$\int x^4 \left(1+x^5\right)^5 dx$$

Optimal (type 1, 11 leaves, 1 step):

$$\frac{1}{30} \left(1+x^5\right)^6$$

Result (type 1, 43 leaves):

$$\frac{x^5}{5} + \frac{x^{10}}{2} + \frac{2 x^{15}}{3} + \frac{x^{20}}{2} + \frac{x^{25}}{5} + \frac{x^{30}}{30}$$

Problem 51: Result more than twice size of optimal antiderivative.

$$\int (1-x)^{20} x^4 \, dx$$

Optimal (type 1, 56 leaves, 2 steps):

$$-\frac{1}{21}(1-x)^{21}+\frac{2}{11}(1-x)^{22}-\frac{6}{23}(1-x)^{23}+\frac{1}{6}(1-x)^{24}-\frac{1}{25}(1-x)^{25}$$

Result (type 1, 140 leaves):

$$\frac{x^5}{5}-\frac{10 x^6}{3}+\frac{190 x^7}{7}-\frac{285 x^8}{2}+\frac{1615 x^9}{3}-\frac{7752 x^{10}}{5}+\frac{38760 x^{11}}{11}-6460 x^{12}+9690 x^{13}-\frac{83980 x^{14}}{7}+\frac{184756 x^{15}}{15}-\frac{20995 x^{16}}{2}+7410 x^{17}-\frac{12920 x^{18}}{3}+2040 x^{19}-\frac{3876 x^{20}}{5}+\frac{1615 x^{21}}{7}-\frac{570 x^{22}}{11}+\frac{190 x^{23}}{23}-\frac{5 x^{24}}{6}+\frac{x^{25}}{25}$$

Problem 55: Result more than twice size of optimal antiderivative.

$$\int \sqrt{1+3\,\text{Cos}[x]^2}\;\text{Sin}[2x] \, dx$$

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

$$-\frac{2}{9}\left(4-3\,\text{Sin}[x]^2\right)^{3/2}$$

Result (type 3, 49 leaves):

$$\frac{5\sqrt{5}-5\sqrt{5+3\,\text{Cos}[2x]}-3\,\text{Cos}[2x]\sqrt{5+3\,\text{Cos}[2x]}}{9\sqrt{2}}$$

Problem 83: Result more than twice size of optimal antiderivative.

$$\int \text{ArcSec}[x] \, dx$$

Optimal (type 3, 19 leaves, 4 steps):

$$x\,\text{ArcSec}[x]-\text{ArcTanh}\left[\sqrt{1-\frac{1}{x^2}}\right]$$

Result (type 3, 64 leaves):

$$x \operatorname{ArcSec}[x] - \frac{\sqrt{-1+x^2}\left(-\operatorname{Log}\left[1-\frac{x}{\sqrt{-1+x^2}}\right]+\operatorname{Log}\left[1+\frac{x}{\sqrt{-1+x^2}}\right]\right)}{2\sqrt{1-\frac{1}{x^2}}\; x}$$

Problem 84: Result more than twice size of optimal antiderivative.

$$\int \operatorname{ArcCsc}[x]\, dx$$

Optimal (type 3, 17 leaves, 4 steps):

$$x \operatorname{ArcCsc}[x] + \operatorname{ArcTanh}\left[\sqrt{1-\frac{1}{x^2}}\right]$$

Result (type 3, 64 leaves):

$$x \operatorname{ArcCsc}[x] + \frac{\sqrt{-1+x^2}\left(-\operatorname{Log}\left[1-\frac{x}{\sqrt{-1+x^2}}\right]+\operatorname{Log}\left[1+\frac{x}{\sqrt{-1+x^2}}\right]\right)}{2\sqrt{1-\frac{1}{x^2}}\; x}$$

Problem 113: Result unnecessarily involves imaginary or complex numbers.

$$\int \frac{1}{\operatorname{Cos}[x] + \operatorname{Sin}[x]}\, dx$$

Optimal (type 3, 21 leaves, 2 steps):

$$-\frac{\operatorname{ArcTanh}\left[\frac{\operatorname{Cos}[x]-\operatorname{Sin}[x]}{\sqrt{2}}\right]}{\sqrt{2}}$$

Result (type 3, 24 leaves):

$$(-1-i)\,(-1)^{3/4} \operatorname{ArcTanh}\left[\frac{-1+\operatorname{Tan}\left[\frac{x}{2}\right]}{\sqrt{2}}\right]$$

Problem 154: Result more than twice size of optimal antiderivative.

$$\int \frac{1}{\sqrt{x+x^2}}\, dx$$

Optimal (type 3, 14 leaves, 2 steps):

$$2\,\text{ArcTanh}\left[\frac{x}{\sqrt{x+x^2}}\right]$$

Result (type 3, 29 leaves):

$$\frac{2\sqrt{x}\,\sqrt{1+x}\,\text{ArcSinh}\left[\sqrt{x}\right]}{\sqrt{x\,(1+x)}}$$

Problem 175: Result unnecessarily involves imaginary or complex numbers.

$$\int \frac{1}{\sqrt{1+t^3}}\,dt$$

Optimal (type 4, 103 leaves, 1 step):

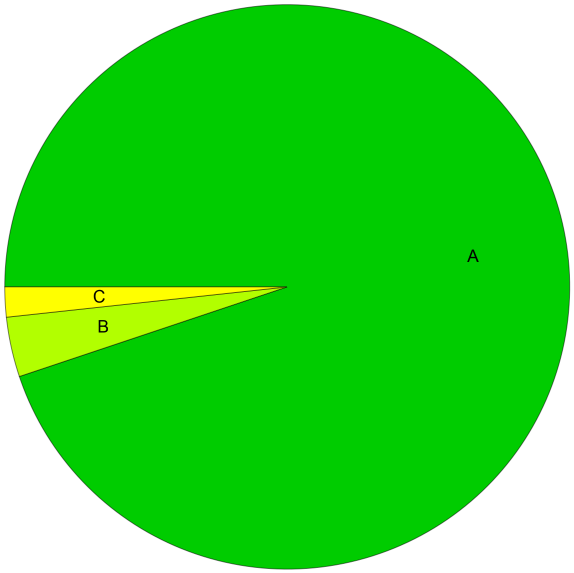
$$\frac{2\sqrt{2+\sqrt{3}}\,(1+t)\sqrt{\frac{1-t+t^2}{\left(1+\sqrt{3}+t\right)^2}}\,\text{EllipticF}\left[\text{ArcSin}\left[\frac{1-\sqrt{3}+t}{1+\sqrt{3}+t}\right],-7-4\sqrt{3}\right]}{3^{1/4}\sqrt{\frac{1+t}{\left(1+\sqrt{3}+t\right)^2}}\,\sqrt{1+t^3}}$$

Result (type 4, 88 leaves):

$$\frac{1}{3^{1/4}\sqrt{1+t^3}}2\,(-1)^{1/6}\sqrt{-(-1)^{1/6}\left((-1)^{2/3}+t\right)}\,\sqrt{1+(-1)^{1/3}t+(-1)^{2/3}t^2}\,\text{EllipticF}\left[\text{ArcSin}\left[\frac{\sqrt{-(-1)^{5/6}(1+t)}}{3^{1/4}}\right],(-1)^{1/3}\right]$$

Summary of Integration Test Results

175 integration problems



A - 166 optimal antiderivatives

B - 6 more than twice size of optimal antiderivatives

C - 3 unnecessarily complex antiderivatives

D - 0 unable to integrate problems

E - 0 integration timeouts