Mathematica 11.3 Integration Test Results

Test results for the 136 problems in "8.4 Trig integral functions.m"

Problem 6: Unable to integrate problem.

$$\int \frac{\text{SinIntegral}[b\,x]}{x}\,dx$$

Optimal (type 5, 43 leaves, 1 step):

$$\frac{1}{2}\,b\,x\,\text{HypergeometricPFQ}[\{1,1,1\},\{2,2,2\},-i\,b\,x]+\frac{1}{2}\,b\,x\,\text{HypergeometricPFQ}[\{1,1,1\},\{2,2,2\},i\,b\,x]$$

Result (type 8, 10 leaves):

$$\int \frac{\text{SinIntegral}[b\,x]}{x}\,dx$$

Problem 39: Unable to integrate problem.

$$\int \frac{\text{Sin}[b\,x]\,\text{SinIntegral}[b\,x]}{x^3}\,dx$$

Optimal (type 4, 96 leaves, 14 steps):

$$b^2\,\text{CosIntegral}[2\,b\,x]-\frac{b\,\text{Cos}[b\,x]\,\text{Sin}[b\,x]}{2\,x}-\frac{\text{Sin}[b\,x]^2}{4\,x^2}-\frac{b\,\text{Sin}[2\,b\,x]}{4\,x}-\frac{b\,\text{Cos}[b\,x]\,\text{SinIntegral}[b\,x]}{2\,x}-\frac{\text{Sin}[b\,x]\,\text{SinIntegral}[b\,x]}{2\,x^2}-\frac{1}{4}\,b^2\,\text{SinIntegral}[b\,x]^2$$

Result (type 8, 14 leaves):

$$\int \frac{\text{Sin}[b\,x]\,\text{SinIntegral}[b\,x]}{x^3}\,dx$$

Problem 41: Unable to integrate problem.

$$\int \frac{\text{Sin}[b\,x]\,\text{SinIntegral}[b\,x]}{x}\,dx$$

Optimal (type 4, 10 leaves, 1 step):

$$\frac{1}{2}\,\text{SinIntegral}[b\,x]^2$$

Result (type 9, 26 leaves):

$$\frac{\text{Sin}[b\,x]\ \text{SinIntegral}[b\,x]^2}{2\,b\,x\,\text{Sinc}[b\,x]}$$

Problem 47: Unable to integrate problem.

$$\int \frac{\text{Cos}[b\,x]\ \text{SinIntegral}[b\,x]}{x^2}\,dx$$

Optimal (type 4, 44 leaves, 7 steps):

$$b\,\text{CosIntegral}[2\,b\,x]-\frac{\text{Sin}[2\,b\,x]}{2\,x}-\frac{\text{Cos}[b\,x]\ \text{SinIntegral}[b\,x]}{x}-\frac{1}{2}\,b\,\text{SinIntegral}[b\,x]^2$$

Result (type 8, 14 leaves):

$$\int \frac{\text{Cos}[b\,x]\ \text{SinIntegral}[b\,x]}{x^2}\,dx$$

Problem 63: Result unnecessarily involves imaginary or complex numbers.

$$\int x\,\text{Sin}[a+b\,x]\ \text{SinIntegral}[c+d\,x]\,dx$$

Optimal (type 4, 371 leaves, 24 steps):

$$\frac{\text{Cos}\left[a-c+\left(b-d\right)x\right]}{2\,b\left(b-d\right)}-\frac{\text{Cos}\left[a+c+\left(b+d\right)x\right]}{2\,b\left(b+d\right)}-$$
$$\frac{\text{Cos}\left[a-\frac{b\,c}{d}\right]\text{CosIntegral}\left[\frac{c\,(b-d)}{d}+\left(b-d\right)x\right]}{2\,b^2}+\frac{\text{Cos}\left[a-\frac{b\,c}{d}\right]\text{CosIntegral}\left[\frac{c\,(b+d)}{d}+\left(b+d\right)x\right]}{2\,b^2}+$$
$$\frac{c\,\text{CosIntegral}\left[\frac{c\,(b-d)}{d}+\left(b-d\right)x\right]\text{Sin}\left[a-\frac{b\,c}{d}\right]}{2\,b\,d}-\frac{c\,\text{CosIntegral}\left[\frac{c\,(b+d)}{d}+\left(b+d\right)x\right]\text{Sin}\left[a-\frac{b\,c}{d}\right]}{2\,b\,d}+$$
$$\frac{c\,\text{Cos}\left[a-\frac{b\,c}{d}\right]\text{SinIntegral}\left[\frac{c\,(b-d)}{d}+\left(b-d\right)x\right]}{2\,b\,d}+\frac{\text{Sin}\left[a-\frac{b\,c}{d}\right]\text{SinIntegral}\left[\frac{c\,(b-d)}{d}+\left(b-d\right)x\right]}{2\,b^2}-$$
$$\frac{x\,\text{Cos}[a+b\,x]\ \text{SinIntegral}[c+d\,x]}{b}+\frac{\text{Sin}[a+b\,x]\ \text{SinIntegral}[c+d\,x]}{b^2}-$$
$$\frac{c\,\text{Cos}\left[a-\frac{b\,c}{d}\right]\text{SinIntegral}\left[\frac{c\,(b+d)}{d}+\left(b+d\right)x\right]}{2\,b\,d}-\frac{\text{Sin}\left[a-\frac{b\,c}{d}\right]\text{SinIntegral}\left[\frac{c\,(b+d)}{d}+\left(b+d\right)x\right]}{2\,b^2}$$

Result (type 4, 345 leaves):

$$\frac{1}{4 b^2 d} e^{-i (a+c)} \left(b d \left(-\frac{e^{-i (b+d) x}}{b+d}+\frac{e^{i (2 a+b x-d x)}}{b-d}\right) - i (b c - i d)\, e^{\frac{i (-b c+(2 a+c) d)}{d}} \text{ExpIntegralEi}\left[\frac{i (b-d) (c+d x)}{d}\right] + \right.$$
$$\left. (-i b c + d)\, e^{\frac{i c (b+d)}{d}} \text{ExpIntegralEi}\left[-\frac{i (b+d) (c+d x)}{d}\right]\right) + \frac{1}{4 b^2 d}$$
$$e^{-i (a-c)} \left(b d \left(\frac{e^{-i (b-d) x}}{b-d}-\frac{e^{i (2 a+(b+d) x)}}{b+d}\right) + i (b c + i d)\, e^{\frac{i c (b-d)}{d}} \text{ExpIntegralEi}\left[-\frac{i (b-d) (c+d x)}{d}\right] + \right.$$
$$\left. (i b c + d)\, e^{-\frac{i (b c-2 a d+c d)}{d}} \text{ExpIntegralEi}\left[\frac{i (b+d) (c+d x)}{d}\right]\right) -$$
$$\frac{(b x \text{Cos}[a+b x] - \text{Sin}[a+b x]) \text{SinIntegral}[c+d x]}{b^2}$$

Problem 64: Result unnecessarily involves imaginary or complex numbers.

$$\int \text{Sin}[a+b x] \text{SinIntegral}[c+d x] \, dx$$

Optimal (type 4, 154 leaves, 9 steps):

$$-\frac{\text{CosIntegral}\left[\frac{c (b-d)}{d}+(b-d) x\right] \text{Sin}\left[a-\frac{b c}{d}\right]}{2 b} + \frac{\text{CosIntegral}\left[\frac{c (b+d)}{d}+(b+d) x\right] \text{Sin}\left[a-\frac{b c}{d}\right]}{2 b} - \frac{\text{Cos}\left[a-\frac{b c}{d}\right] \text{SinIntegral}\left[\frac{c (b-d)}{d}+(b-d) x\right]}{2 b} -$$
$$\frac{\text{Cos}[a+b x] \text{SinIntegral}[c+d x]}{b} + \frac{\text{Cos}\left[a-\frac{b c}{d}\right] \text{SinIntegral}\left[\frac{c (b+d)}{d}+(b+d) x\right]}{2 b}$$

Result (type 4, 168 leaves):

$$\frac{1}{4 b}$$
$$i\, e^{-\frac{i (b c+a d)}{d}} \left(-e^{\frac{2 i b c}{d}} \text{ExpIntegralEi}\left[-\frac{i (b-d) (c+d x)}{d}\right] + e^{2 i a} \text{ExpIntegralEi}\left[\frac{i (b-d) (c+d x)}{d}\right] + \right.$$
$$e^{\frac{2 i b c}{d}} \text{ExpIntegralEi}\left[-\frac{i (b+d) (c+d x)}{d}\right] - e^{2 i a} \text{ExpIntegralEi}\left[\frac{i (b+d) (c+d x)}{d}\right] +$$
$$\left. 4 i\, e^{\frac{i (b c+a d)}{d}} \text{Cos}[a+b x] \text{SinIntegral}[c+d x]\right)$$

Problem 66: Result unnecessarily involves imaginary or complex numbers.

$$\int x \text{Cos}[a+b x] \text{SinIntegral}[c+d x] \, dx$$

Optimal (type 4, 370 leaves, 24 steps):

$$\frac{c\,\text{Cos}\left[a-\frac{b\,c}{d}\right]\,\text{CosIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b\,d}-\frac{c\,\text{Cos}\left[a-\frac{b\,c}{d}\right]\,\text{CosIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b\,d}+\frac{\text{CosIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]\,\text{Sin}\left[a-\frac{b\,c}{d}\right]}{2\,b^2}-\frac{\text{CosIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]\,\text{Sin}\left[a-\frac{b\,c}{d}\right]}{2\,b^2}-\frac{\text{Sin}\left[a-c+(b-d)\,x\right]}{2\,b\,(b-d)}+\frac{\text{Sin}\left[a+c+(b+d)\,x\right]}{2\,b\,(b+d)}+\frac{\text{Cos}\left[a-\frac{b\,c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b^2}-\frac{c\,\text{Sin}\left[a-\frac{b\,c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b\,d}+\frac{\text{Cos}[a+b\,x]\,\text{SinIntegral}[c+d\,x]}{b^2}+\frac{x\,\text{Sin}[a+b\,x]\,\text{SinIntegral}[c+d\,x]}{b}-\frac{\text{Cos}\left[a-\frac{b\,c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b^2}+\frac{c\,\text{Sin}\left[a-\frac{b\,c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b\,d}$$

Result (type 4, 343 leaves) :

$$-\frac{1}{4\,b^2\,d}e^{-i\,(a+c)}\left(-i\,b\,d\left(\frac{e^{-i\,(b+d)\,x}}{b+d}+\frac{e^{i\,(2\,a+(b-d)\,x)}}{b-d}\right)+\left(-b\,c+i\,d\right)\,e^{\frac{i\,(-b\,c+(2\,a+c)\,d)}{d}}\,\text{ExpIntegralEi}\left[\frac{i\,(b-d)\,(c+d\,x)}{d}\right]+\left(b\,c+i\,d\right)\,e^{\frac{i\,c\,(b+d)}{d}}\,\text{ExpIntegralEi}\left[-\frac{i\,(b+d)\,(c+d\,x)}{d}\right]\right)+\frac{1}{4\,b^2\,d}e^{-i\,(a-c)}\left(-i\,b\,d\left(\frac{e^{-i\,(b-d)\,x}}{b-d}+\frac{e^{i\,(2\,a+(b+d)\,x)}}{b+d}\right)+\left(b\,c+i\,d\right)\,e^{\frac{i\,c\,(b-d)}{d}}\,\text{ExpIntegralEi}\left[-\frac{i\,(b-d)\,(c+d\,x)}{d}\right]+\left(-b\,c+i\,d\right)\,e^{2\,i\,a-\frac{i\,c\,(b+d)}{d}}\,\text{ExpIntegralEi}\left[\frac{i\,(b+d)\,(c+d\,x)}{d}\right]\right)+\frac{\left(\text{Cos}[a+b\,x]+b\,x\,\text{Sin}[a+b\,x]\right)\,\text{SinIntegral}[c+d\,x]}{b^2}$$

Problem 67: Result unnecessarily involves imaginary or complex numbers.

$$\int \text{Cos}[a+b\,x]\,\text{SinIntegral}[c+d\,x]\,dx$$

Optimal (type 4, 153 leaves, 9 steps) :

$$-\frac{\text{Cos}\left[a-\frac{b\,c}{d}\right]\,\text{CosIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b}+\frac{\text{Cos}\left[a-\frac{b\,c}{d}\right]\,\text{CosIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b}+\frac{\text{Sin}\left[a-\frac{b\,c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b}+\frac{\text{Sin}[a+b\,x]\,\text{SinIntegral}[c+d\,x]}{b}-\frac{\text{Sin}\left[a-\frac{b\,c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b}$$

Result (type 4, 164 leaves) :

$$\frac{1}{4b}e^{-\frac{i(bc+ad)}{d}}\left(-e^{\frac{2ibc}{d}}\text{ExpIntegralEi}\left[-\frac{i(b-d)(c+dx)}{d}\right]-e^{2ia}\text{ExpIntegralEi}\left[\frac{i(b-d)(c+dx)}{d}\right]+e^{\frac{2ibc}{d}}\text{ExpIntegralEi}\left[-\frac{i(b+d)(c+dx)}{d}\right]+e^{2ia}\text{ExpIntegralEi}\left[\frac{i(b+d)(c+dx)}{d}\right]+4e^{\frac{i(bc+ad)}{d}}\text{Sin}[a+bx]\,\text{SinIntegral}[c+dx]\right)$$

Problem 108: Unable to integrate problem.

$$\int\frac{\text{CosIntegral}[bx]\,\text{Sin}[bx]}{x^2}\,dx$$

Optimal (type 4, 44 leaves, 7 steps):

$$\frac{1}{2}b\,\text{CosIntegral}[bx]^2+b\,\text{CosIntegral}[2bx]-\frac{\text{CosIntegral}[bx]\,\text{Sin}[bx]}{x}-\frac{\text{Sin}[2bx]}{2x}$$

Result (type 8, 14 leaves):

$$\int\frac{\text{CosIntegral}[bx]\,\text{Sin}[bx]}{x^2}\,dx$$

Problem 114: Unable to integrate problem.

$$\int\frac{\text{Cos}[bx]\,\text{CosIntegral}[bx]}{x^3}\,dx$$

Optimal (type 4, 97 leaves, 14 steps):

$$-\frac{\text{Cos}[bx]^2}{4x^2}-\frac{\text{Cos}[bx]\,\text{CosIntegral}[bx]}{2x^2}-\frac{1}{4}b^2\,\text{CosIntegral}[bx]^2-b^2\,\text{CosIntegral}[2bx]+\frac{b\,\text{Cos}[bx]\,\text{Sin}[bx]}{2x}+\frac{b\,\text{CosIntegral}[bx]\,\text{Sin}[bx]}{2x}+\frac{b\,\text{Sin}[2bx]}{4x}$$

Result (type 8, 14 leaves):

$$\int\frac{\text{Cos}[bx]\,\text{CosIntegral}[bx]}{x^3}\,dx$$

Problem 131: Result unnecessarily involves imaginary or complex numbers.

$$\int x\,\text{CosIntegral}[c+dx]\,\text{Sin}[a+bx]\,dx$$

Optimal (type 4, 371 leaves, 24 steps):

$$-\frac{c\,\text{Cos}\left[a-\frac{b c}{d}\right]\,\text{CosIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b\,d}-\frac{x\,\text{Cos}[a+b\,x]\,\text{CosIntegral}[c+d\,x]}{b}-\frac{c\,\text{Cos}\left[a-\frac{b c}{d}\right]\,\text{CosIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b\,d}-\frac{\text{CosIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]\,\text{Sin}\left[a-\frac{b c}{d}\right]}{2\,b^2}-\frac{\text{CosIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]\,\text{Sin}\left[a-\frac{b c}{d}\right]}{2\,b^2}+\frac{\text{CosIntegral}[c+d\,x]\,\text{Sin}[a+b\,x]}{b^2}+\frac{\text{Sin}[a-c+(b-d)\,x]}{2\,b\,(b-d)}+\frac{\text{Sin}[a+c+(b+d)\,x]}{2\,b\,(b+d)}-\frac{\text{Cos}\left[a-\frac{b c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b^2}+\frac{c\,\text{Sin}\left[a-\frac{b c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b\,d}-\frac{\text{Cos}\left[a-\frac{b c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b^2}+\frac{c\,\text{Sin}\left[a-\frac{b c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b\,d}$$

Result (type 4, 332 leaves):

$$-\frac{1}{4\,b^2\,d}e^{-i\,(a+c)}\left(-i\,b\,d\left(\frac{e^{-i\,(b+d)\,x}}{b+d}+\frac{e^{i\,(2\,c-b\,x+d\,x)}}{b-d}\right)+(b\,c+i\,d)\,e^{\frac{i\,c\,(b+d)}{d}}\,\text{ExpIntegralEi}\left[-\frac{i\,(b-d)\,(c+d\,x)}{d}\right]+(b\,c+i\,d)\,e^{\frac{i\,c\,(b+d)}{d}}\,\text{ExpIntegralEi}\left[-\frac{i\,(b+d)\,(c+d\,x)}{d}\right]\right)-\frac{1}{4\,b^2\,d}e^{i\,(a-c)}\left(i\,b\,d\left(\frac{e^{i\,(b-d)\,x}}{b-d}+\frac{e^{i\,(2\,c+(b+d)\,x)}}{b+d}\right)+(b\,c-i\,d)\,e^{-\frac{i\,c\,(b-d)}{d}}\,\text{ExpIntegralEi}\left[\frac{i\,(b-d)\,(c+d\,x)}{d}\right]+(b\,c-i\,d)\,e^{-\frac{i\,c\,(b-d)}{d}}\,\text{ExpIntegralEi}\left[\frac{i\,(b+d)\,(c+d\,x)}{d}\right]\right)-\frac{\text{CosIntegral}[c+d\,x]\,(b\,x\,\text{Cos}[a+b\,x]-\text{Sin}[a+b\,x])}{b^2}$$

Problem 132: Result unnecessarily involves imaginary or complex numbers.

$$\int\text{CosIntegral}[c+d\,x]\,\text{Sin}[a+b\,x]\,dx$$

Optimal (type 4, 154 leaves, 9 steps):

$$\frac{\text{Cos}\left[a-\frac{b c}{d}\right]\,\text{CosIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b}-\frac{\text{Cos}[a+b\,x]\,\text{CosIntegral}[c+d\,x]}{b}+\frac{\text{Cos}\left[a-\frac{b c}{d}\right]\,\text{CosIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b}-\frac{\text{Sin}\left[a-\frac{b c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b-d)}{d}+(b-d)\,x\right]}{2\,b}-\frac{\text{Sin}\left[a-\frac{b c}{d}\right]\,\text{SinIntegral}\left[\frac{c\,(b+d)}{d}+(b+d)\,x\right]}{2\,b}$$

Result (type 4, 144 leaves):

$$\frac{1}{4 b}\left(-4 \operatorname{Cos}[a+b x] \operatorname{CosIntegral}[c+d x]+\left(\operatorname{ExpIntegralEi}\left[-\frac{i (b-d)(c+d x)}{d}\right]+\operatorname{ExpIntegralEi}\left[-\frac{i (b+d)(c+d x)}{d}\right]\right)\left(\operatorname{Cos}\left[a-\frac{b c}{d}\right]-i \operatorname{Sin}\left[a-\frac{b c}{d}\right]\right)+\left(\operatorname{ExpIntegralEi}\left[\frac{i (b-d)(c+d x)}{d}\right]+\operatorname{ExpIntegralEi}\left[\frac{i (b+d)(c+d x)}{d}\right]\right)\left(\operatorname{Cos}\left[a-\frac{b c}{d}\right]+i \operatorname{Sin}\left[a-\frac{b c}{d}\right]\right)\right)$$

Problem 134: Result unnecessarily involves imaginary or complex numbers.

$$\int x \operatorname{Cos}[a+b x] \operatorname{CosIntegral}[c+d x] \, dx$$

Optimal (type 4, 370 leaves, 24 steps):

$$\frac{\operatorname{Cos}[a-c+(b-d) x]}{2 b (b-d)}+\frac{\operatorname{Cos}[a+c+(b+d) x]}{2 b (b+d)}-\frac{\operatorname{Cos}\left[a-\frac{b c}{d}\right] \operatorname{CosIntegral}\left[\frac{c (b-d)}{d}+(b-d) x\right]}{2 b^2}+\frac{\operatorname{Cos}[a+b x] \operatorname{CosIntegral}[c+d x]}{b^2}-\frac{\operatorname{Cos}\left[a-\frac{b c}{d}\right] \operatorname{CosIntegral}\left[\frac{c (b+d)}{d}+(b+d) x\right]}{2 b^2}+\frac{c \operatorname{CosIntegral}\left[\frac{c (b-d)}{d}+(b-d) x\right] \operatorname{Sin}\left[a-\frac{b c}{d}\right]}{2 b d}+\frac{c \operatorname{CosIntegral}\left[\frac{c (b+d)}{d}+(b+d) x\right] \operatorname{Sin}\left[a-\frac{b c}{d}\right]}{2 b d}+\frac{x \operatorname{CosIntegral}[c+d x] \operatorname{Sin}[a+b x]}{b}+\frac{c \operatorname{Cos}\left[a-\frac{b c}{d}\right] \operatorname{SinIntegral}\left[\frac{c (b-d)}{d}+(b-d) x\right]}{2 b d}+\frac{\operatorname{Sin}\left[a-\frac{b c}{d}\right] \operatorname{SinIntegral}\left[\frac{c (b-d)}{d}+(b-d) x\right]}{2 b^2}+\frac{c \operatorname{Cos}\left[a-\frac{b c}{d}\right] \operatorname{SinIntegral}\left[\frac{c (b+d)}{d}+(b+d) x\right]}{2 b d}+\frac{\operatorname{Sin}\left[a-\frac{b c}{d}\right] \operatorname{SinIntegral}\left[\frac{c (b+d)}{d}+(b+d) x\right]}{2 b^2}$$

Result (type 4, 347 leaves):

$$\frac{1}{4 b^2 d} i e^{-i (a+c)} \left(-i b d \left(\frac{e^{-i (b+d) x}}{b+d}+\frac{e^{i (2 a+(b-d) x)}}{b-d}\right)+(-b c+i d) e^{\frac{i (-b c+(2 a+c) d)}{d}} \text{ExpIntegralEi}\left[\frac{i (b-d) (c+d x)}{d}\right]+\right.$$
$$\left.(b c+i d) e^{\frac{i c (b+d)}{d}} \text{ExpIntegralEi}\left[-\frac{i (b+d) (c+d x)}{d}\right]\right)+\frac{1}{4 b^2 d} i e^{-i (a-c)}$$
$$\left(-i b d \left(\frac{e^{-i (b-d) x}}{b-d}+\frac{e^{i (2 a+(b+d) x)}}{b+d}\right)+(b c+i d) e^{\frac{i c (b-d)}{d}} \text{ExpIntegralEi}\left[-\frac{i (b-d) (c+d x)}{d}\right]+\right.$$
$$\left.(-b c+i d) e^{2 i a-\frac{i c (b+d)}{d}} \text{ExpIntegralEi}\left[\frac{i (b+d) (c+d x)}{d}\right]\right)+$$
$$\frac{\text{CosIntegral}[c+d x] (\text{Cos}[a+b x]+b x \text{Sin}[a+b x])}{b^2}$$

Problem 135: Result unnecessarily involves imaginary or complex numbers.

$$\int \text{Cos}[a+b x] \text{CosIntegral}[c+d x] \, dx$$

Optimal (type 4, 153 leaves, 9 steps):

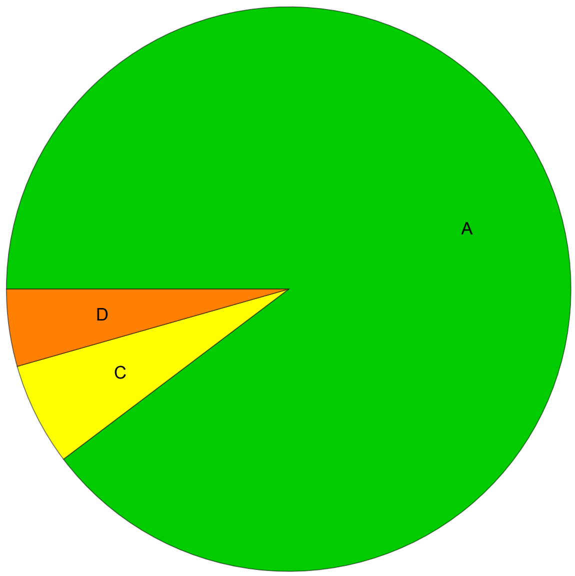
$$-\frac{\text{CosIntegral}\left[\frac{c (b-d)}{d}+(b-d) x\right] \text{Sin}\left[a-\frac{b c}{d}\right]}{2 b}-$$
$$\frac{\text{CosIntegral}\left[\frac{c (b+d)}{d}+(b+d) x\right] \text{Sin}\left[a-\frac{b c}{d}\right]}{2 b}+\frac{\text{CosIntegral}[c+d x] \text{Sin}[a+b x]}{b}-$$
$$\frac{\text{Cos}\left[a-\frac{b c}{d}\right] \text{SinIntegral}\left[\frac{c (b-d)}{d}+(b-d) x\right]}{2 b}-\frac{\text{Cos}\left[a-\frac{b c}{d}\right] \text{SinIntegral}\left[\frac{c (b+d)}{d}+(b+d) x\right]}{2 b}$$

Result (type 4, 153 leaves):

$$\frac{1}{4 b}$$
$$\left(i e^{-\frac{i (b c+a d)}{d}} \left(-e^{\frac{2 i b c}{d}} \text{ExpIntegralEi}\left[-\frac{i (b-d) (c+d x)}{d}\right]+e^{2 i a} \text{ExpIntegralEi}\left[\frac{i (b-d) (c+d x)}{d}\right]-\right.\right.$$
$$\left.e^{\frac{2 i b c}{d}} \text{ExpIntegralEi}\left[-\frac{i (b+d) (c+d x)}{d}\right]+e^{2 i a} \text{ExpIntegralEi}\left[\frac{i (b+d) (c+d x)}{d}\right]\right)+$$
$$\left.4 \text{CosIntegral}[c+d x] \text{Sin}[a+b x]\right)$$

Summary of Integration Test Results

136 integration problems



A - 122 optimal antiderivatives

B - 0 more than twice size of optimal antiderivatives

C - 8 unnecessarily complex antiderivatives

D - 6 unable to integrate problems

E - 0 integration timeouts