U Substitution Circuit Training

Start with the instructed box by putting a 1 in that box. Work out the problem and then find the box with that answer in it. Put a 2 in that box and continue until you have completed the circuit.

Answer: $4\ln|2x^5+1|+C$

\# 1 $\int\left(-16x^3+7x^{\frac{2}{5}}+3\right)dx$

$-16(\frac{1}{4}x^4)+7(\frac{5}{7}x^{7/5})+3x+C$

$-4x^4+5x^{7/5}+3x+C$

Answer: $\frac{1}{3}(2x^5-1)^6+C$

$u=x^3+4$

$du=3x^2dx$

\# 8 $\int\frac{3x^2}{(x^3+4)^4}dx$

$\int\frac{1}{(x^3+4)^4}\cdot 3x^2dx=\int u^{-4}du$

$-\frac{1}{3}u^{-3}+C=-\frac{1}{3}(x^3+4)^{-3}+C$

$=\frac{-1}{3(x^3+4)^3}+C$

Answer: $\frac{1}{6}(2x^3+5)^6+C$

$u=2x^4+5$

\# 6 $\int 8x^3(2x^4+5)^3dx$

$du=8x^3dx$

$\int u^3du$

$\frac{1}{4}u^4+C\Rightarrow\frac{1}{4}(2x^4+5)^4+C$

Answer: $-4x^4+5x^{\frac{7}{5}}+3x+C$

\# 2 $\int\left(8x^3+\frac{2}{x^3}\right)dx$

$\int(8x^3+2x^{-3})dx$

$8(\frac{1}{4}x^4)+2(-\frac{1}{2}x^{-2})+C$

$2x^4-x^{-2}+C\Rightarrow 2x^4-\frac{1}{x^2}+C$

Answer: $\frac{3}{7}(3x^2-1)^{\frac{7}{3}}+C$

$u=5x^4-4$

\# 12 $\int 20x^3e^{5x^4-4}dx$

$du=20x^3dx$

$\int e^u du$

$e^u+C\Rightarrow e^{5x^4-4}+C$

Answer: $\ln|3x^2+4|+C$

$u=2x^5+1$

\# 15 $\int\frac{40x^4}{2x^5+1}dx$

$du=10x^4dx$

$4du=40x^4dx$

$\int\frac{1}{2x^5+1}\cdot 40x^4dx$

$\int\frac{1}{u}\cdot 4du\Rightarrow 4\int\frac{1}{u}du=4\ln|u|+C$

$4\ln|2x^5+1|+C$

Answer: $\frac{1}{8}(2x+5)^4+C$

$u=2x^3+5$

\# 5 $\int(2x^3+5)^5 6x^2dx$

$du=6x^2dx$

$\int u^5du$

$\frac{1}{6}u^6+C\Rightarrow\frac{1}{6}(2x^3+5)^6+C$

Answer: $\frac{-1}{3(x^3+4)^3}+C$

$u=x^3-4$

\# 9 $\int 3x^2\sqrt{x^3-4}dx$

$du=3x^2dx$

$\int 3x^2(x^3-4)^{1/2}dx=\int u^{1/2}du$

$\frac{2}{3}u^{3/2}+C$

$\frac{2}{3}(u^3-4)^{3/2}+C$

Answer: $2x^4 - \frac{1}{x^2} + C$

\# 3 $\int \left(\frac{5}{x} + 3e^x\right) dx$

$\int (5 \cdot \frac{1}{x} + 3e^x) dx$

$5 \ln|x| + 3e^x + C$

Answer: $\frac{1}{4}(2x^4 + 5)^4 + C$

\# 7 $\int 20x^4(2x^5 - 1)^5 dx$

$u = 2x^5 - 1$

$du = 10x^4 dx$

$2du = 20x^4 dx$

$\int u^5 \cdot 2du$

$2 \int u^5 du$

$2\left(\frac{1}{6}u^6\right) + C$

$\frac{1}{3}u^6 + C \Rightarrow \frac{1}{3}(2x^5 - 1)^6 + C$

Answer: $\frac{2}{3}(x^3 - 4)^{\frac{3}{2}} + C$

* \# 10 $\int 3e^{3x}(e^{3x} + 1)^5 dx$

$u = e^{3x} + 1$

$du = 3e^{3x} dx$

(chain rule)

$\int u^5 du$

$\frac{1}{6}u^6 + C \Rightarrow \frac{1}{6}(e^{3x} + 1)^6 + C$

Answer: $\frac{1}{6}(e^{3x} + 1)^6 + C$

\# 11 $\int (3x^2 - 1)^{\frac{4}{3}} \cdot 6x dx$

$u = 3x^2 - 1$

$du = 6x dx$

$\int u^{4/3} du$

$\frac{3}{7}u^{7/3} + C \Rightarrow \frac{3}{7}(3x^2 - 1)^{7/3} + C$

Answer: $3e^{4x^3 - 5} + C$

\# 14 $\int \frac{6x}{3x^2 + 4} dx$

$u = 3x^2 + 4$

$du = 6x dx$

$\int \frac{1}{3x^2 + 4} 6x dx = \int \frac{1}{u} du$

$\ln|u| + C$

$\ln|3x^2 + 4| + C$

Answer: $5 \ln|x| + 3e^x + C$

\# 4 $\int (2x + 5)^3 dx$

$u = 2x + 5$

$du = 2x$

$\frac{1}{2}du = dx$

$\int u^3 \cdot \frac{1}{2} du$

$\frac{1}{2} \int u^3 du$

$\frac{1}{2}\left(\frac{1}{4}u^4\right) + C = \frac{1}{8}u^4 + C$

$\frac{1}{8}(2x + 5)^4 + C$

Answer: $e^{5x^4 - 4} + C$

\# 13 $\int 36x^2 e^{4x^3 - 5} dx$

$u = 4x^3 - 5$

$du = 12x^2 dx$

$3du = 36x^2 dx$

$\int e^u \cdot 3du$

$3 \int e^u du$

$3e^u + C \Rightarrow 3e^{4x^3 - 5} + C$