WARMUP

Use the Chain Rule to calculate $f'(x)$.

1) $f(x) = (x^2+3)^{10}$

$f'(x) = 10(x^2+3)^9 \cdot 2x$

$= 20x(x^2+3)^9$

so $\int 20x(x^2+3)^9 dx = (x^2+3)^{10} + C$

2) $f(x) = (5x-1)^{15}$

$f'(x) = 15(5x-1)^{14} \cdot 5$

$= 75(5x-1)^{14}$

3) $f(x) = \sqrt{3x+10}$

$f(x) = (3x+10)^{1/2}$

$f'(x) = \frac{1}{2}(3x+10)^{-\frac{1}{2}} \cdot 3$

$= \frac{3}{2\sqrt{3x+10}}$

Section 7.1 Integration by Substitution

$\int x^n dx = \frac{x^{n+1}}{n+1} + C$

$\int (3x+1)^9 \, dx = \int u^9 \cdot \frac{1}{3} du$

Let $u = 3x+1$

$\cancel{dx} \cdot \frac{du}{\cancel{dx}} = 3 \cdot dx$

$\frac{1}{3} \cdot du = \frac{1}{3} \cdot 3 \, dx$

$\frac{1}{3} du = dx$

$= \frac{1}{3} \int u^9 du$

$= \frac{1}{3} \cdot \frac{u^{10}}{10} + C$

$= \frac{(3x+1)^{10}}{30} + C$

ex: $\int (5x-1)^{14} \, dx = \int u^{14} \cdot \frac{1}{5} du$

$u = 5x-1$

$\frac{du}{dx} = 5$

$du = 5 \, dx$

$= \frac{1}{5} \int u^{14} du$

$\frac{1}{5}du = dx$ $\quad = \frac{1}{5} \cdot \frac{u^{15}}{15} + C$

$= \frac{(5x-1)^{15}}{75} + C$

ex: $\int x^3(5x^4-3)^{10}\,dx = \int (5x^4-3)^{10} \cdot x^3\,dx$

$u = 5x^4 - 3$

$du = 20x^3\,dx$

$\frac{1}{20}du = x^3\,dx$

$= \int u^{10} \cdot \frac{1}{20}du$

$= \frac{1}{20}\int u^{10}\,du$

$= \frac{1}{20} \cdot \frac{u^{11}}{11} + C$

$= \frac{(5x^4-3)^{11}}{220} + C$

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ex: $\int x^6(5-x^7)^{13}\,dx$

$u = 5 - x^7$

$du = -7x^6\,dx$

$-\frac{1}{7}du = x^6\,dx$

$\int u^{13} \cdot \left(-\frac{1}{7}\right)du$

$= -\frac{1}{7}\int u^{13}\,du$

$= -\frac{1}{7} \cdot \frac{u^{14}}{14} = \frac{-(5-x^7)^{14}}{98} + C$