ANTIDIFFERENTIATION = INTEGRATION

Derivative = Differentiation

Given the derivative, find the original func = Antidifferentiation

$$\frac{6x^3}{3}$$

$$f'(x) = 6x^2 + 8x - 3x^0$$

$$f(x) = 2x^3 + 4x^2 - 3x + C$$

Power for Integrals

integral sign $\rightarrow$ $\int x^n \, dx = \frac{x^{n+1}}{n+1} + C$

$$\int \left(8x^5 - \frac{1}{2x^6} + \sqrt[3]{x^2} - 5\right) dx$$

$$= \int \left(8x^5 - \frac{1}{2}x^{-6} + x^{2/3} - 5\right) dx$$

$$= \frac{8x^6}{6} - \frac{1}{2}\cdot\frac{x^{-5}}{-5} + \frac{3}{5}\cdot x^{5/3} - 5x + C$$

$$= \boxed{\frac{4}{3}x^6 + \frac{1}{10x^5} + \frac{3}{5}x^{5/3} - 5x + C}$$

$$y = x^5$$

$$\cancel{\frac{\Delta y}{\Delta x}} \quad \frac{dy}{dx} = 5x^4 \, dx$$

$$\int (x^2-3)(x^5+8x)\,dx \leftarrow \text{FOIL}$$

$$\int \left(x^7+8x^3-3x^5-24x\right)dx$$

$$= \frac{x^8}{8} + \frac{8x^4}{4} - \frac{3x^6}{6} - \frac{24x^2}{2} + C$$

$$= \boxed{\frac{1}{8}x^8 + 2x^4 - \frac{1}{2}x^6 - 12x^2 + C}$$

$$\int \frac{3p^4-2p^2+9}{p^{2/3}}\,dp$$

$$\int (3p^4-2p^2+9)\cdot p^{-2/3}\,dp$$

$$\int \left(3p^{10/3} - 2p^{4/3} + 9p^{-2/3}\right)dp$$

$$= \frac{3}{13}\cdot 3p^{13/3} - \frac{3}{7}\cdot 2p^{7/3} + 3\cdot 9p^{1/3} + C$$

$$= \boxed{\frac{9}{13}p^{13/3} - \frac{6}{7}p^{7/3} + 27p^{1/3} + C}$$

Definite Integrals — Answer is a numerical value

Indefinite Integrals
expression with $+C$

limits of intg.

$$\int_{-1}^{2}(2x-5)\,dx$$

$$= \frac{\cancel{2}x^2}{\cancel{2}} - \frac{5x^1}{1} + C \Big|_{-1}^{2}$$

$$= x^2 - 5x + C \Big|_{-1}^{2}$$

$$= 4 - 10 + \cancel{C} + [-1 - 5 - \cancel{C}]$$

$$= \boxed{-12}$$

$$\int_4^9 \left(\frac{1}{\sqrt{x}} + 2\sqrt{x}\right) dx$$

$$\int_4^9 \left(x^{-1/2} + 2x^{1/2}\right) dx$$

$$= \frac{2}{1}x^{1/2} + \frac{2}{3}\cdot 2x^{3/2} \Big|_4^9$$

$$= \underset{9^{1/2}}{2x^{1/2}} + \frac{4}{3}\underset{\sqrt[2]{9^3}}{x^{3/2}} \Big|_4^9 \qquad 4^{1/2} \qquad \sqrt[2]{4^3}$$

$$= 2\cdot 3 + \frac{4}{\cancel{3}}\cdot \overset{9}{\cancel{27}} - \left[2\cdot 2 + \frac{4}{3}\cdot 8\right]$$

$$= 6 + 36 - 4 - \frac{32}{3}$$

$$= 38 - \frac{32}{3}$$

$$= \frac{114}{3} - 32/3 = \frac{82}{3}$$

$$\int_{-3}^{2} \frac{x^4 - 3x^3}{x^2}\,dx$$

$$\int_{-3}^{2} (x^4 - 3x^3) \cdot x^{-2}\,dx$$

$$\int_{-3}^{2} (x^2 - 3x)\,dx$$

$$= \frac{x^3}{3} - \frac{3x^2}{2} \Big|_{-3}^{2}$$

$$= \frac{8}{3} - 6 + \left[+9 + \frac{27}{2} \right]$$

$$= 3 + 8/3 + \frac{27}{2}$$

$$= \frac{18}{6} + \frac{16}{6} + \frac{81}{6} = \frac{115}{6}$$