Antidifferentiation = Integration

$y = x^4$

$\frac{dy}{dx} = 4x^3$ dx

$\int (6x - 30x^4)\,dx$

Integral sign

$= \frac{6x^2}{2} - \frac{30x^5}{5} + C$

$= 3x^2 - 6x^5 + C$

Derivatives Decrease power

Integration Increase power

Derivative

$f(x) = 3x^2 - 6x^5 + 7$

$f'(x) = 6x^1 - 30x^4$

$\frac{6x^2}{2} - \frac{30x^5}{5} + C$

Power Rule for Integrals

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

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

$$\int \left(8x^5 - \frac{1}{2}x^{-6} + x^{2/3} - 5x^0\right) dx$$

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

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

Indefinite Integrals

* +C
* no numerical valu

$$\int (x^2-3)(x^5+8x)\,dx$$

FOIL

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

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

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

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

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

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

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

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

DEFINITE INTEGRALS ← Answer is a numerical value

limits of integration

$$\int_{-1}^{2} (6x^2 - 2x + 1)\,dx$$

$$= \frac{6x^3}{3} - \frac{2x^2}{2} + x + C \Big|_{-1}^{2}$$

$$= 2x^3 - x^2 + x + C \Big|_{-1}^{2}$$

$$= 16 - 4 + 2 + C + (+2 + 1 + 1 + C)$$

$$= \boxed{18}$$

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

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

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

$$= 2\sqrt{x} + \frac{4}{3}\sqrt{x^3} \Big|_4^9$$

$$= 2\sqrt{9} + \frac{4}{3}\sqrt{9^3} + \left[-2\sqrt{4} - \frac{4}{3}\sqrt{4^3}\right]$$

$9^3 = 27$, $4^3 = 2^3$

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

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

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

$$= \boxed{82/3}$$

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