ANTIDIFFERENTIATION = INTEGRATION

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

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

$$= \boxed{3x^2 - 6x^5 + C}$$

Derivative

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

$f'(x) = \frac{6x^2}{2} - \frac{30x^{4+1}}{5}$

Power Rule for Integrals

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

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

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

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

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

$y = x^3$

$y = f(x)$

$\frac{dy}{dx} = f'(x)\,dx$

Derivative - Decrease the power

Integration - Increase the power

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

FOIL!

Indefinite Integrals

* $+C$
* no numerical value

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

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

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

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

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

$p^4 \cdot p^{-2/3}$

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

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

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

DEFINITE INTEGRALS

← Answer is a numerical value

limits of integration

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

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

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

$$= 16 - 4 + 2 + \cancel{C} - [-2 - 1 - 1 - \cancel{C}]$$

$$= 18$$

$$\int_{4}^{9} \left(\frac{1}{\sqrt{x}} + 2\sqrt{x}\right) dx$$

$$\int_{4}^{9} \left(x^{-1/2} + 2x^{1/2}\right) dx$$

$$= \frac{2}{1} \cdot x^{1/2} + \frac{2}{3} \cdot 2x^{3/2} \Big|_{4}^{9}$$

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

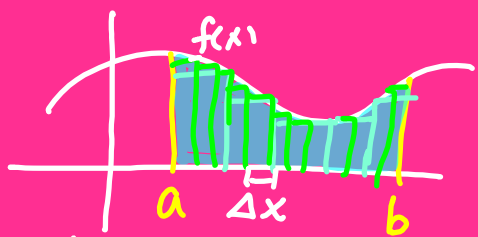
$$= 2\sqrt{9} + \frac{4}{3}\sqrt{9^3} - \left(2\sqrt{4} + \frac{4}{3}\sqrt{4^3}\right)$$

$$= 6 + \frac{4}{\cancel{3}} \cdot \cancel{27}^{9} - 4 - \frac{4}{3} \cdot 8$$

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

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

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

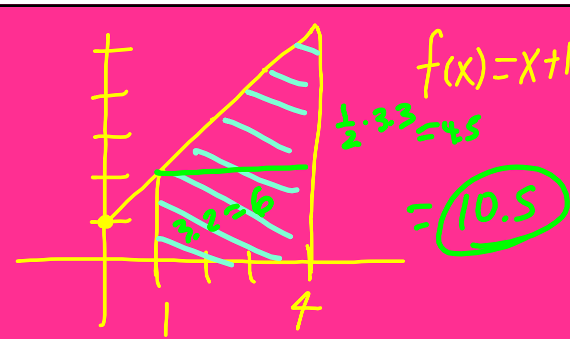


$$\lim_{\Delta x \to 0} \sum_{x=a}^{b} f(x)\,\Delta x$$

length width

$$= \int_a^b f(x)\,dx$$

the area between a function & an axis.



$$\int_1^4 (x+1)\,dx$$

$$= \frac{x^2}{2} + x \Big|_1^4$$

$$= 8 + 4 - \left(\frac{1}{2} + 1\right)$$

$$= 10.5$$

Integration represents the area between a function & an axis.