Integral Calculus:-

$$\frac{d}{dx} F(x) = f(x)$$

$$\Rightarrow F(x) + C = \int f(x)\,dx$$

$$\frac{d}{dx}(x^2) = 2x$$

$$\frac{d}{dx}(x^2+3) = 2x$$

$$\int 2x\,dx = x^2 + c$$

(c is constant of Integration)

$$\boxed{\int f(x)\,dx = F(x) + C}$$

Indefinite Integral

$$\boxed{\int_a^b f(x)\,dx = F(b) - F(a)}$$

Definite Integral.

1) $\int k f(x)\, dx = k \int f(x)\, dx$

2) $\int [a f(x) \pm b\, g(x)]\, dx = a \int f(x)\, dx \pm b \int f(x)\, dx$] Linearity.

3) $\frac{d}{dx}(x^n) = n x^{n-1} \Rightarrow \int n x^{n-1}\, dx = x^n + C$

$\Rightarrow \int x^{n-1}\, dx = \frac{x^n}{n} + C$ Let $n = k+1$

$\Rightarrow \boxed{\int x^k\, dx = \frac{x^{k+1}}{k+1} + C}$ (When $k \neq -1$)

for $k=0$

$\int x^0\, dx = x + C$

$\Rightarrow \int 1 \cdot dx = x + c$

$$\frac{d}{dx}\left(\log_e x\right) = \frac{1}{x} \quad \therefore \quad \int \frac{1}{x}\,dx = \log_e x + C$$

$$\int \underbrace{f(x)}_{\text{Integrand}} \underbrace{dx}_{\text{Differential}}$$

$$\frac{d}{dx}\left(\sin x\right) = \cos x \quad \Rightarrow \quad \int \cos x\,dx = \sin x + C$$

$$\frac{d}{dx}\left(\cos x\right) = -\sin x \quad \Rightarrow \quad \int \sin x\,dx = -\cos x + C$$

$$\int \left(3x^2 + \sin x\right) dx = 3\int x^2\,dx + \int \sin x\,dx$$

$$= \cancel{3} \cdot \left(\frac{x^3}{\cancel{3}}\right) + \left(-\cos x\right) + C$$

$$= x^3 - \cos x + C$$

$\frac{dy}{dx} = f(x) \rightarrow$ Differential Equation.

$y = \int f(x)\, dx + C$

$F(b) + c - (F(a) + c)$

$= F(b) - F(a) + \cancel{c} - \cancel{c}$

Definite Integration :-

Suppose $\int f(x)\, dx = \underline{F}(x) + c$

$$\boxed{\int_a^b f(x)\, dx = F(b) - F(a)}$$

$$\int_0^2 3x^2\, dx = [x^3]_0^2$$

$$= 2^3 - 0^3$$

$$= 8$$

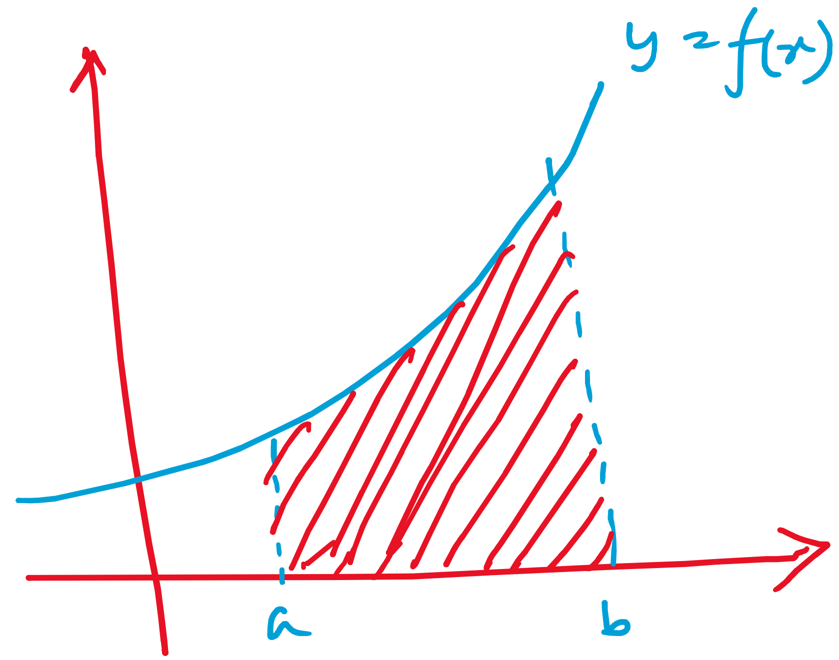
$$\int_0^\pi \sin x\, dx = [-\cos x]_0^\pi = -[\cos x]_0^\pi = -(\cos\pi - \cos 0)$$

$$= -(-1 - 1) = 2$$

Geometrical Interpretation of Definite Integral :-

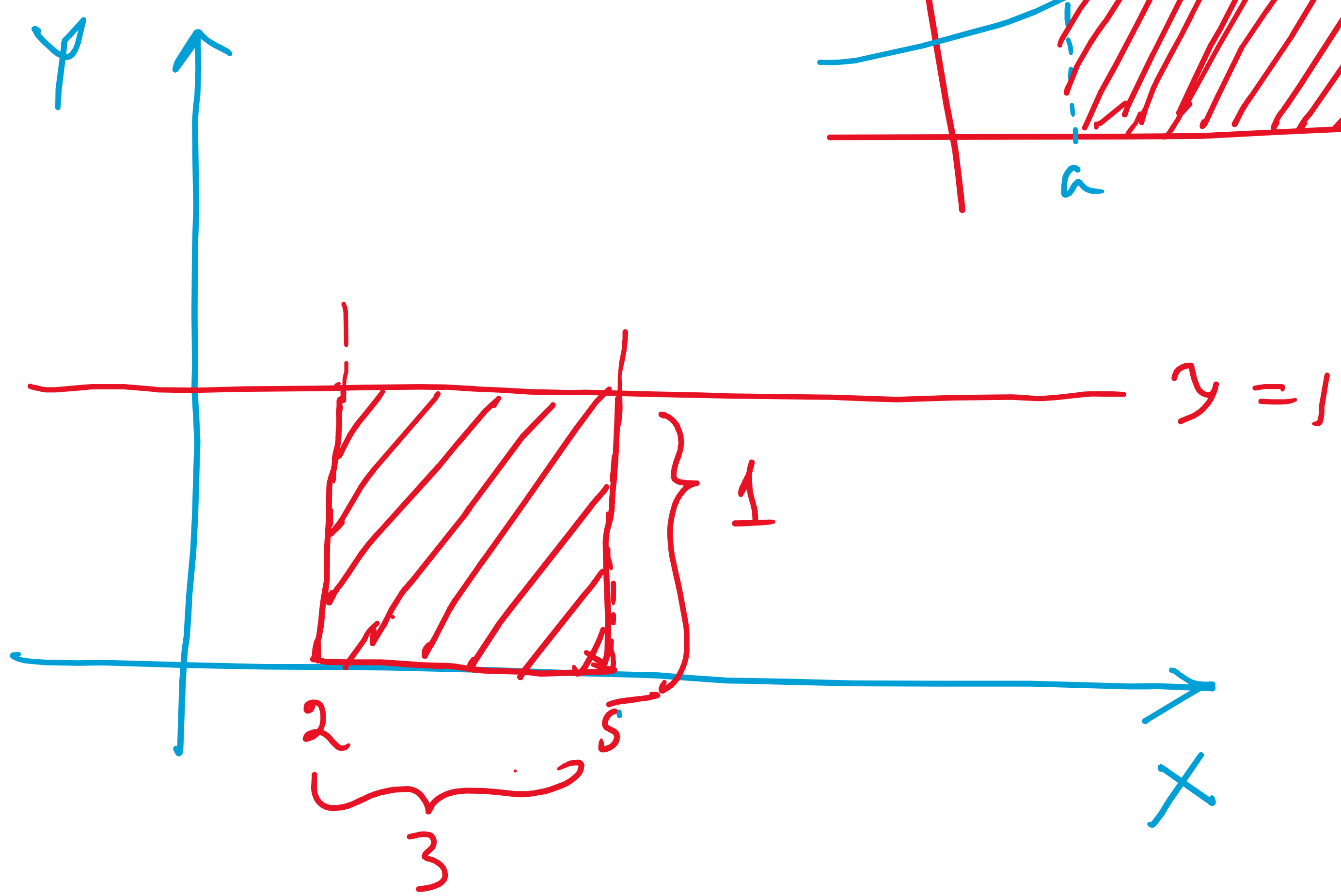
$S \Rightarrow \int$ Sum.

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



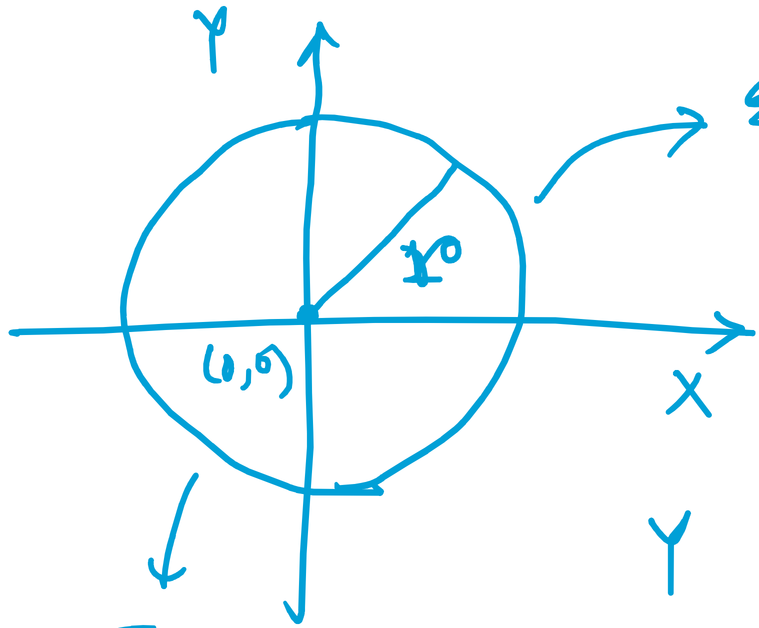
$$\int 1 \cdot dx = x + C$$

$$\int_2^5 1 \cdot dx = [x]_2^5 = 5 - 2 = 3$$



$$\boxed{y = 1}$$

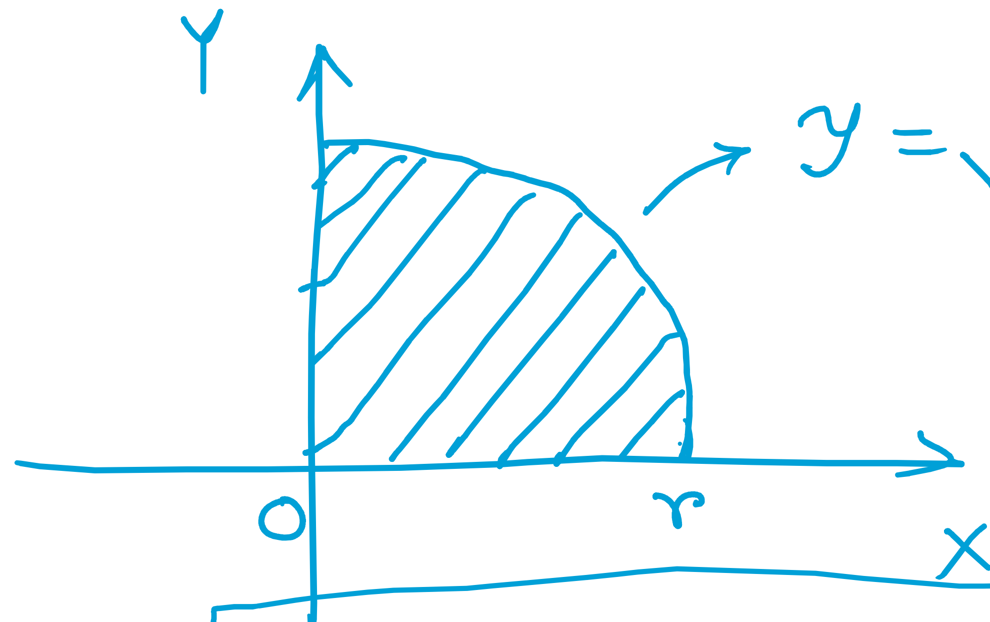
$\int_a^b f(x)\,dx \rightarrow$ It is the measure of the area under the curve $y = f(x)$ between $x = a$ & $x = b$.



Equation of ~~unit radius~~ circle centred at $(0,0)$ and radius 'r'

$$\boxed{x^2 + y^2 = r^2}$$

πr^2

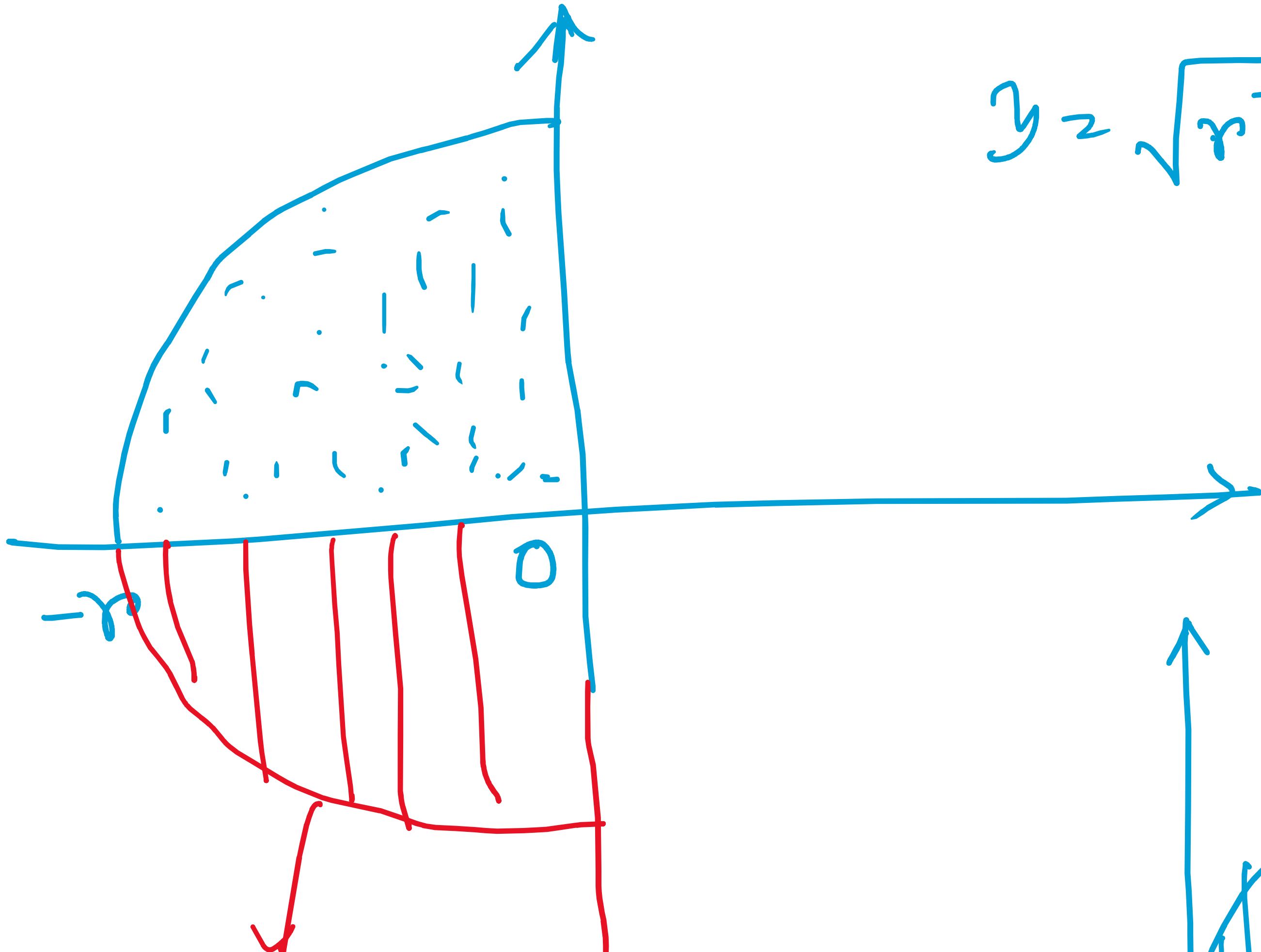


$$y = \sqrt{r^2 - x^2}$$

$$\int_0^r \sqrt{r^2 - x^2}\, dx$$

$$= \frac{\pi}{4} r^2$$

$$\boxed{\int_0^a \sqrt{a^2 - x^2}\, dx = \frac{\pi}{4} a^2}$$



$y = -\sqrt{r^2 - x^2}$

$y = \sqrt{r^2 - x^2}$

$$\int_{-r}^{0} \sqrt{r^2 - x^2}\, dx = \frac{\pi}{4} r^2$$

$$\int_{2}^{5} (-1)\, dx = \underline{-3}$$