

DISK METHOD: $dV = \pi \times \text{radius}^2 \times \text{thickness}$

SHELL METHOD: $dV = 2\pi \times \text{radius} \times \text{height} \times \text{thickness}$

CENTROID OF PLANE REGION:

$$\bar{x} = \frac{\int_a^b x(y_t - y_b) dx}{\int_a^b (y_t - y_b) dx} \quad \bar{y} = \frac{\int_c^d y(x_r - x_l) dy}{\int_c^d (x_r - x_l) dy}$$

CENTROID OF SOLID OF REVOLUTION:

$$\bar{x} = \frac{\int_a^b xy^2 dx}{\int_a^b y^2 dx} \quad \bar{y} = \frac{\int_c^d yx^2 dy}{\int_c^d x^2 dy}$$

MOMENT OF INERTIA OF PLANE REGION:

$$I_x = k \int_c^d y^2 (x_r - x_l) dy \quad I_y = k \int_a^b x^2 (y_t - y_b) dx$$

MOMENT OF INERTIA OF SOLID OF REVOLUTION

(with respect to axis of revolution):

$$I_x = 2\pi k \int_c^d y^3 (x_r - x_l) dy \quad I_y = 2\pi k \int_a^b x^3 (y_t - y_b) dx$$

RADIUS OF GYRATION:

$$R_x = \sqrt{\frac{I_x}{m}} \quad R_y = \sqrt{\frac{I_y}{m}}$$

where $m = k \times \text{area}$ or $m = k \times \text{volume}$

$$\text{AVERAGE VALUE} \quad \frac{\int_a^b y dx}{(b-a)}$$

$$\text{ARC LENGTH} \quad s = \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2} dx$$

$$\text{SURFACE AREA OF A SOLID} \quad S = 2\pi \int_a^b y \sqrt{1 + \left(\frac{dy}{dx}\right)^2} dx$$

$$\sin^2 x + \cos^2 x = 1$$

$$\tan^2 x + 1 = \sec^2 x$$

$$1 + \cot^2 x = \csc^2 x$$

$$\cos^2 x = \frac{1}{2}(1 + \cos 2x)$$

$$\sin^2 x = \frac{1}{2}(1 - \cos 2x)$$

$$\sin 2x = 2 \sin x \cos x$$

$$\int \tan x \, dx = -\ln |\cos x| + C \quad \int \cot x \, dx = \ln |\sin x| + C$$

$$\int \sec x \, dx = \ln |\sec x + \tan x| + C \quad \int \csc x \, dx = \ln |\csc x - \cot x| + C$$

$$\int \sec^2 x \, dx = \tan x + C \quad \int \sec x \tan x \, dx = \sec x + C$$

$$\int \csc^2 x \, dx = -\cot x + C \quad \int \csc x \cot x \, dx = -\csc x + C$$

$$\int u \, dv = uv - \int v \, du$$

$$\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1} \frac{x}{a} + C \quad \int \frac{dx}{a^2+x^2} = \frac{1}{a} \tan^{-1} \frac{x}{a} + C$$

$$\begin{array}{lll} \sqrt{a^2-x^2} & \text{Sub} & x = a \sin \theta \\ \sqrt{a^2+x^2} & \text{Sub} & x = a \tan \theta \\ \sqrt{x^2-a^2} & \text{Sub} & x = a \sec \theta \end{array}$$

$$\frac{a}{1-r} = a + ar + ar^2 + ar^3 + \dots, \text{ valid for } -1 < r < 1$$

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \dots$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$$

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \dots, \text{ valid for } -1 < x \leq 1$$

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \frac{n(n-1)(n-2)}{3!}x^3 + \dots, \text{ for } |x| < 1 \text{ and all real } n$$

$$f(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \frac{f'''(a)}{3!}(x-a)^3 + \dots$$