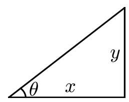
Formula Sheet

Trigonometry



$\sin\theta = \frac{y}{\sqrt{x^2+y^2}}$; $\cos\theta = \frac{x}{\sqrt{x^2+y^2}}$;

Calculus

$\frac{d}{d\theta}\sin\theta = \cos\theta$; $\frac{d}{d\theta}\cos\theta = -\sin\theta$

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

$\frac{d}{dx}x^n = nx^{n-1}$

Vectors

$\mathbf{A} = A_x\mathbf{i} + A_y\mathbf{j} + A_z\mathbf{k}$

$A = \sqrt{A_x^2 + A_y^2 + A_z^2}$

$\mathbf{u}_A = \frac{A_x}{A}\mathbf{i} + \frac{A_y}{A}\mathbf{j} + \frac{A_z}{A}\mathbf{k}$

$\mathbf{u}_A = \cos(\alpha)i + \cos(\beta)j + \cos(\gamma)k$

$\mathbf{u}_A = \sin(\phi)\cos(\theta)i + \sin(\phi)\sin(\theta)j + \cos(\phi)k$

$\mathbf{F}_A = F\mathbf{u}_A$

$\mathbf{r}_{B/A} = (x_B - x_A)\mathbf{i} + (y_B - y_A)\mathbf{j} + (z_B - z_A)\mathbf{k}$

$\mathbf{A}.\mathbf{B} = A_xB_x + A_yB_y + A_zB_z$

$$\mathbf{A}\times\mathbf{B} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

$= (A_yB_z - A_zB_y)\mathbf{i} - (A_xB_z - A_zB_x)\mathbf{j} + (A_xB_y - A_yB_x)\mathbf{k}$

<u>Statics</u>

Moment of a force

Scalar Formulation: $M_o = Fd$

Vector Formulation: $\mathbf{M}_o = \mathbf{r}\times\mathbf{F} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}$

Moment of a force about a specified axis:

$$\mathbf{M}_{aa} = \mathbf{u}_{aa}.(\mathbf{r}\times\mathbf{F}) = \begin{vmatrix} u_x & u_y & u_z \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}$$

Simplification of a force and couple system:

$\mathbf{F}_R = \sum\mathbf{F}$

$(\mathbf{M}_R)_o = \sum\mathbf{M} + \sum\mathbf{M}_o$

Particle equilibrium:

$\sum F_x = 0$; $\sum F_y = 0$; $\sum F_z = 0$.

Rigid body equilibrium in 2D:

$\sum F_x = 0$; $\sum F_y = 0$; $\sum M_o = 0$.

Rigid body equilibrium in 3D:

$\sum F_x = 0$; $\sum F_y = 0$; $\sum F_z = 0$;

$\sum M_x = 0$; $\sum M_y = 0$; $\sum M_z = 0$.

Equilibrium equations: Vector formulation:

$\sum\mathbf{F} = 0$; $\sum\mathbf{M}_o = 0$.

Centroid:

$\bar{x} = \frac{\sum x_iA_i}{\sum A_i}$; $\bar{x} = \frac{\int x dA}{\int dA}$