Useful Equations

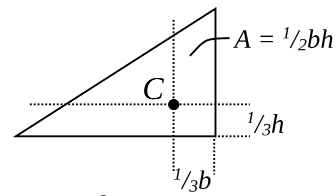
$$\cos\alpha = \frac{A_x}{A} \quad \cos\beta = \frac{A_y}{A} \quad \cos\gamma = \frac{A_z}{A} \qquad \cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

$$F = ks \qquad \sum \vec{F}_i = 0 \qquad \sum \vec{M}_{Oi} = 0 \qquad \hat{u} = \frac{\vec{R}}{|\vec{R}|} \qquad \vec{A}\cdot\vec{B} = |\vec{A}||\vec{B}|\cos\theta = A_xB_x + A_yB_y + A_zB_z$$

$$\vec{F} = \vec{F}_\parallel + \vec{F}_\perp \qquad \vec{M}_O = \vec{R}_{OF} \times \vec{F} = \begin{vmatrix} i & j & k \\ R_x & R_y & R_z \\ F_x & F_y & F_z \end{vmatrix} \qquad M_u = \hat{u}\cdot\left(\vec{R}_{OF} \times \vec{F}\right) = \begin{vmatrix} u_x & u_x & u_x \\ R_x & R_y & R_z \\ F_x & F_y & F_z \end{vmatrix}$$

$$\vec{M}_{Couple} = \vec{d}_\perp \times \vec{F} \qquad |\vec{R}| = \sqrt{R_x^2 + R_y^2 + R_z^2}$$

$$\bar{x} = \frac{\int_L x w(x)\,dx}{\int_L w(x)\,dx}$$



$$\sum_i \vec{F}_i = m\vec{a} \qquad f_s^{Max} = \mu_s N \qquad f_k = \mu_k N \qquad y = (x tan\theta) - \left(\frac{gx^2}{2v_0^2}\right)(1 + tan^2\theta)$$

$$v = \frac{ds}{dt} \qquad a = \frac{dv}{dt} \qquad a\,ds = v\,dv \qquad \rho = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\left|\frac{d^2y}{dx^2}\right|} \qquad ds = \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\;dx$$

$$a_t = \dot{v} \qquad a_n = \frac{v^2}{\rho} \qquad \tan\theta = \frac{dy}{dx}$$

$$\vec{v} = \dot{r}\,\mathbf{u}_r + r\dot{\theta}\,\mathbf{u}_\theta + \dot{z}\,\mathbf{u}_z \qquad \vec{a} = \left(\ddot{r} - r\dot{\theta}^2\right)\mathbf{u}_r + \left(r\ddot{\theta} + 2\dot{r}\dot{\theta}\right)\mathbf{u}_\theta + \ddot{z}\,\mathbf{u}_z \qquad \tan\psi = \frac{r}{dr/d\theta}$$

$$\vec{r}_B = \vec{r}_A + \vec{r}_{B/A} \qquad \vec{v}_B = \vec{v}_A + \vec{v}_{B/A} \qquad \vec{a}_B = \vec{a}_A + \vec{a}_{B/A}$$

$$U = \int_{r_1}^{r_2} \vec{F}\cdot d\vec{r} = \int_{r_1}^{r_2} F\cos\theta\,dr \qquad U = F\,\Delta s\,cos\theta \qquad \frac{1}{2}mv_1^2 + \sum\int_{s_1}^{s_2} F ds = \frac{1}{2}mv_2^2$$

$$T = \tfrac{1}{2}mv^2 \qquad T_1 + U_{Total} = T_2 \qquad T_1 + V_1 + U_{nonconservative} = T_2 + V_2$$

$$V_{spring} = \tfrac{1}{2}ks^2 \qquad V_{gravity} = -\frac{GMm}{r} \qquad V_{gravity} = mgh$$

$$\varepsilon = \frac{Power\ output}{Power\ input} \qquad P = \frac{dU}{dt} = \vec{F}\cdot\vec{v}$$

$$\vec{L} = m\vec{v} \qquad \vec{I} = \int_{t_1}^{t_2} \vec{F}\,dt = \Delta\vec{L} \qquad m\vec{v}_i + \Sigma\int_{t_1}^{t_2} \vec{F}_i\,dt = m\vec{v}_f \qquad m_1\vec{v}_{1i} + m_2\vec{v}_{2i} = m_1\vec{v}_{1f} + m_2\vec{v}_{2f}$$

$$e = -\frac{v_{Bf} - v_{Af}}{v_{Bi} - v_{Ai}} \qquad \begin{pmatrix} v'_{xi} \\ v'_{yi} \end{pmatrix} = \begin{pmatrix} cos\theta & sin\theta \\ -sin\theta & cos\theta \end{pmatrix}\begin{pmatrix} v_x \\ v_y \end{pmatrix} \qquad \begin{pmatrix} v_{xf} \\ v_{yf} \end{pmatrix} = \begin{pmatrix} cos\theta & -sin\theta \\ sin\theta & cos\theta \end{pmatrix}\begin{pmatrix} v'_{xf} \\ v'_{yf} \end{pmatrix}$$

$\vec{H}_0 = \vec{r} \times m\vec{v}$ $\left(\vec{H}_o\right)_1 + \sum \int_{t_1}^{t_2} \vec{M}_0 dt = \left(\vec{H}_o\right)_2$

$\frac{dx^n}{dx} = nx^{n-1}$ $\frac{d}{dx} tanx = \frac{1}{cos^2 x}$ $\frac{d}{dx} sinx = cosx$ $\frac{d}{dx} cosx = -sinx$ $\frac{d}{dx} \ell nx = \frac{1}{x}$

$\frac{df}{d\theta} = \frac{df}{dx}\frac{dx}{d\theta}$