**Formulas**
**(you need very few of these!!)**

$$x = x_0 + v_0 t + \frac{1}{2} a_x t^2, D = \frac{1}{2} C \rho A v^2, W = \int_{\vec{x}_i}^{\vec{x}_f} \vec{F}(x) \cdot d\vec{x}, \; W = \vec{F} \cdot \vec{x}$$

$$\vec{A} \cdot \vec{B} = |A||B| \cos\theta, \; \vec{a} \times \vec{b} = |a||b| \sin\theta \text{ to both}, \; x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\sin\theta = \frac{o}{h}, \; \cos\theta = \frac{a}{h}, \; \tan\theta = \frac{o}{a}$$

$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2, \; \vec{v} = \vec{v}_0 + \vec{a}t, \; \vec{v}^2 = \vec{v}_0^{\,2} + 2\vec{a}(\vec{r} - \vec{r}_0), \; R = \frac{v^2}{g} \sin(2\theta)$$

$$y = (\tan\theta_0) x - \frac{g x^2}{2(v_0 \cos\theta_0)^2}, \; a_r = \frac{v_t^2}{r}$$

$$\sum \vec{F} = m\vec{a}, f_s = \mu_s N, f_k = \mu_k N, \; F_s = -kx, \; W_s = -\frac{1}{2} k x^2$$

$$U_g = mgh, \; W_s = -\frac{1}{2} k x^2, \; KE = \frac{1}{2} m v^2, \; P = \frac{dW}{dt}$$

$$\sin 30° = 0.5 = \cos 60°, \cos 30° = 0.866 = \sin 60°, \sin 45° = 0.707 = \cos 45°$$

$$\text{use } g = 10 \frac{m}{\sec^2}, \; \tan 45° = 1$$

$$C = 2\pi r, \; A = \pi r^2, \; V = \frac{4}{3} \pi r^3, \; A_{sphere} = 4\pi r^2, \; A_{cylinder} = 2\pi r h$$

$$v = \frac{dx}{dt}, \; a = \frac{dv}{dt}, \; s = \theta R, \; v_t = \omega R, \; a_t = \alpha R, \; T = \frac{2\pi}{\omega},$$

$$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2,\ \omega = \omega_0 + \alpha t$$

$$\vec{p} = m\vec{v},\ v_{1f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1i},\ v_{2f} = \frac{2m_1}{m_1 + m_2} v_{1i},\ \vec{F} = \frac{d\vec{p}}{dt}$$

$$I = \sum m_i R_i^2,\ I_{hoop} = MR^2,\ I_{disk} = \frac{1}{2}MR^2,\ I_{sphere} = \frac{2}{5}MR^2,$$

$$I_{rod} = \frac{1}{12}ML^2,\ \ I_{general} = \gamma MR^2$$

$$x_{cm} = \frac{\sum_i m_i x_i}{\sum_i m_i},\ \vec{\tau} = \vec{r} \times \vec{F} = rF\sin\theta,\ \sum \vec{\tau} = I\vec{\alpha},\ KE = \frac{1}{2}I\omega^2$$

$$L = I\omega,\ \tau = \frac{dL}{dt},\ \vec{F} = \frac{GMm}{r^2}\hat{r},\ U = -\frac{GMm}{r},\ G = 6.67 \times 10^{-11}$$

$$P_1 = P_0 + \rho g(y_0 - y_1),\ P_0 + \frac{1}{2}\rho v^2 + \rho gh = const.,\ Av = const.$$

$$v = \sqrt{\frac{T}{\mu}},\ y = y_m \sin(kx - \omega t),\ v = \frac{\omega}{k} = \frac{\lambda}{T},\ k = \frac{2\pi}{\lambda},\ \omega = 2\pi f = \frac{2\pi}{T}$$

$$\omega = \sqrt{\frac{k}{m}},\ \omega = \sqrt{\frac{g}{L}},\ x = x_m \cos(\omega t + \phi),\ v_x = -\omega x_m \sin(\omega t + \phi)$$

$$a_x = -\omega^2 x_m \cos(\omega t + \phi),\ f_b = |f_1 - f_2|,\ v = \sqrt{\frac{B}{\mu}}$$

$$s = s_m \cos(kx - \omega t),\ \beta = (10\,dB)\log\frac{I}{I_0},\ I = \frac{P_s}{4\pi r^2},\ f_{obs} = f_s \frac{v \pm v_D}{v \mp v_s}$$