Formula Sheet

$$\vec{r} = \vec{r_0} + \vec{v_0}t + \frac{1}{2}\vec{a}t^2 \qquad \vec{v_f} = \vec{v_0} + \vec{a}t$$

$$v_f^2 = v_0^2 + 2\vec{a} \cdot \Delta\vec{r}$$

$$x = \frac{v_0^2}{g}\sin 2\theta_0 \qquad y = \frac{v_0^2}{2g}\sin^2\theta_0$$

$$y = x\tan\theta_0 - \frac{g}{2v_0^2\cos^2\theta_0}x^2$$

$$\vec{F} = m\vec{a} \qquad F = \frac{mv^2}{r}$$

$$f_k = \mu_k N \qquad f_s \leq \mu_s N$$

$$\vec{W} = m\vec{g} \qquad \vec{F} = -k\vec{x}$$

$$\frac{1}{2}mv^2 = K \qquad W = \vec{F} \cdot \Delta\vec{r}$$

$$\Delta K = W \qquad W = \int \vec{F} \cdot \Delta\vec{r}$$

$$P = \frac{dW}{dt} \qquad \vec{F} = -\frac{\partial U}{\partial x}\hat{i} - \frac{\partial U}{\partial y}\hat{j} - \frac{\partial U}{\partial z}\hat{k}$$

$$U = \frac{1}{2}kx^2 \qquad U = mgh$$

$$\vec{p} = m\vec{v} \qquad \vec{F} = \frac{d\vec{p}}{dt}$$

$$\vec{r}_{cm} = \frac{\sum_i m_i\vec{r}_i}{\sum_i m_i} \qquad v_f - v_i = v_{er}\ln\frac{M_i}{M_f}$$

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

$$\omega^2 = \omega_0^2 + 2\alpha\Delta\theta \qquad W = \tau\Delta\theta$$

$$W = \int \tau\, d\theta \qquad I = \sum_i m_i r_i^2$$

$$I = \int r^2\, dm \qquad \vec{L} = \vec{r} \times \vec{p} = I\vec{\omega}$$

$$\vec{\tau} = \frac{d\vec{L}}{dt} \qquad \vec{\tau} = I\vec{\alpha}$$

$$K = \frac{1}{2} I \omega^2$$

$$m v \hat{i} - M u \hat{i} = -m v' \hat{i} + M u' \hat{i} \qquad u' = \frac{2mv + (m - M)u}{M + m}$$

$$v' = \frac{2Mu + (M - m)v}{M + m}$$

$$I_{solid-sphere} = \frac{2}{5} M R^2 \qquad I_{hollow-sphere} = \frac{2}{3} M R^2$$

Fundamental Constants

$$G = 6.673 \times 10^{-11}\,\mathrm{m^3\,kg^{-1}\,s^{-2}} \qquad c = 2.997 \times 10^{8}\mathrm{m\,s^{-1}}$$

Physical Constants

$$R_e = 6.371 \times 10^{6}\,\mathrm{m} \qquad M_e = 5.972 \times 10^{24}\,\mathrm{kg}$$

$$g = 9.81\,\mathrm{m\,s^{-2}}$$