Equations

$\rho = M/V$

$\mathrm{v}_{xf} = \mathrm{v}_{xi} + a_x(t_f - t_i)$ $\qquad$ $\mathrm{v}_{yf} = \mathrm{v}_{yi} + a_y(t_f - t_i)$

$x_f = x_i + \frac{1}{2}(\mathrm{v}_{xi} + \mathrm{v}_{xf})(t_f - t_i)$ $\qquad$ $y_f = y_i + \frac{1}{2}(\mathrm{v}_{yi} + \mathrm{v}_{yf})(t_f - t_i)$

$x_f = x_i + \mathrm{v}_{xi}(t_f - t_i) + \frac{1}{2}a_x(t_f - t_i)^2$ $\qquad$ $y_f = y_i + \mathrm{v}_{yi}(t_f - t_i) + \frac{1}{2}a_y(t_f - t_i)^2$

$\mathrm{v}_{xf}^2 = \mathrm{v}_{xi}^2 + 2a_x(x_f - x_i)$ $\qquad$ $\mathrm{v}_{yf}^2 = \mathrm{v}_{yi}^2 + 2a_y(y_f - y_i)$

$\cos\theta = x/h$ $\qquad$ $\sin\theta = y/h$ $\qquad$ $\tan\theta = y/x$ $\qquad$ $h = \sqrt{x^2 + y^2}$

$\Delta x = x_f - x_i$ $\qquad$ $\mathrm{v}_{x,avg} = \dfrac{x_f - x_i}{t_f - t_i}$ $\qquad$ $\mathbf{a}_{avg} = \dfrac{\mathbf{v}_f - \mathbf{v}_i}{t_f - t_i}$

$\mathrm{v}_x = \lim_{\Delta t \to 0} \dfrac{\Delta x}{\Delta t} = \dfrac{dx}{dt}$ $\qquad$ $a_x = \lim_{\Delta t \to 0} \dfrac{\Delta \mathrm{v}_x}{\Delta t} = \dfrac{d\mathrm{v}_x}{dt}$

$az^2 + bz + c = 0$ $\qquad$ $z = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$\Sigma\vec{F} = m\vec{a}$ $\qquad$ $|F_G| = \dfrac{Gm_1m_2}{r^2}$ $\qquad$ $F_g = mg$

$f_S^{\max} = \mu_S n$ $\qquad$ $f_k = \mu_k n$

$a_r = \mathrm{v}^2 / r$ $\qquad$ $T = 2\pi r / \mathrm{v} = 2\pi r^{3/2} / \sqrt{GM}$

$s = r\theta$ $\qquad$ $\omega_{avg} = \dfrac{\theta_f - \theta_i}{t_f - t_i}$ $\qquad$ $\omega = \lim_{\Delta t \to 0} \dfrac{\Delta\theta}{\Delta t} = \dfrac{d\theta}{dt}$

$\alpha_{avg} = \dfrac{\omega_f - \omega_i}{t_f - t_i}$ $\qquad$ $\alpha = \lim_{\Delta t \to 0} \dfrac{\Delta\omega}{\Delta t} = \dfrac{d\omega}{dt}$ $\qquad$ $T = \dfrac{2\pi}{\omega}$

$\mathrm{v}_t = r\omega$ $\qquad$ $a_t = r\alpha$ $\qquad$ $\vec{\mathrm{v}}' = \vec{\mathrm{v}} - \vec{\mathrm{v}}_o$ $\qquad$ $\vec{\mathrm{r}}' = \vec{\mathrm{r}} - \vec{\mathrm{v}}_o t$

$\theta_f = \theta_i + \frac{1}{2}(\omega_i + \omega_f)(t_f - t_i)$

$\theta_f = \theta_i + \omega_i(t_f - t_i) + \frac{1}{2}\alpha(t_f - t_i)^2$

$\omega_f = \omega_i + \alpha(t_f - t_i)$

$\omega_f^2 = \omega_i^2 + 2\alpha(\theta_f - \theta_i)$

$g = 9.80 \text{ m/s}^2 = 32.2 \text{ ft/s}^2$ $\qquad$ $G = 6.67\text{x}10^{-11} \text{ Nm}^2/\text{kg}^2$

$$\vec{p} = m\vec{v} \qquad \vec{J} = \vec{F}_{avg}\Delta t \qquad \vec{J} = \int_{t_i}^{t_f} \vec{F}dt = \vec{p}_f - \vec{p}_i$$

$$x_{\text{cm}} = \frac{\sum m_i x_i}{\sum m_i} \qquad \vec{v}_{\text{cm}} = \frac{\sum m_i \vec{v}_i}{\sum m_i} \qquad \sum \vec{F}_{\text{ext}} = \frac{d\vec{p}}{dt}$$

$$K = \tfrac{1}{2} m v^2 \qquad W = F \cos\phi \, s = K_f - K_i$$

$$W = \int_{s_i}^{s_f} \vec{F} \cdot d\vec{s} = -\Delta U \qquad \vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z = AB\cos\phi$$

$$U_g = mgy \qquad E = K + U \qquad F_s = -kx \qquad F_x = -\frac{dU}{dx}$$

$$v_{1f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1i} \qquad v_{2f} = \frac{2m_1}{m_1 + m_2} v_{1i}$$

$$P_{avg} = W / \Delta t \qquad P = dW / dt \qquad W_{NC} = E_f - E_i$$

$$U_s = \tfrac{1}{2} k x^2 \qquad P = \vec{F} \cdot \vec{v} \qquad \tau = rF\sin\phi \qquad \sum \tau = I\alpha$$

$$I = \sum m_i r_i^2 \qquad I = I_{\text{CM}} + MD^2$$

$$K_{\text{R}} = \tfrac{1}{2} I\omega^2 \qquad W_{\text{R}} = \tau\theta$$

Moments of inertia about axes through the center of mass:

$$I_{hoop} = MR^2 \qquad I_{disk} = \tfrac{1}{2} MR^2 \qquad I_{rod} = \tfrac{1}{12} ML^2$$

$$I_{hollow\ sphere} = \tfrac{2}{3} MR^2 \qquad I_{solid\ sphere} = \tfrac{2}{5} MR^2$$