Equations

$$\rho = M/V$$

$$v_{xf} = v_{xi} + a_x\left(t_f - t_i\right) \qquad v_{yf} = v_{yi} + a_y\left(t_f - t_i\right)$$

$$x_f = x_i + \tfrac{1}{2}\left(v_{xi} + v_{xf}\right)\left(t_f - t_i\right) \qquad y_f = y_i + \tfrac{1}{2}\left(v_{yi} + v_{yf}\right)\left(t_f - t_i\right)$$

$$x_f = x_i + v_{xi}\left(t_f - t_i\right) + \tfrac{1}{2}a_x\left(t_f - t_i\right)^2 \qquad y_f = y_i + v_{yi}\left(t_f - t_i\right) + \tfrac{1}{2}a_y\left(t_f - t_i\right)^2$$

$$v_{xf}^2 = v_{xi}^2 + 2a_x\left(x_f - x_i\right) \qquad v_{yf}^2 = v_{yi}^2 + 2a_y\left(y_f - y_i\right)$$

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

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

$$v_x = \lim_{\Delta t \to 0}\frac{\Delta x}{\Delta t} = \frac{dx}{dt} \qquad a_x = \lim_{\Delta t \to 0}\frac{\Delta v_x}{\Delta t} = \frac{dv_x}{dt}$$

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

$$\Sigma\vec{F} = m\vec{a} \qquad \left|F_G\right| = \frac{Gm_1m_2}{r^2} = mg$$

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

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

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

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

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

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

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

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

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

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

$$k_b = 1.38\text{x}10^{-23}\ \text{J/K}$$

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

$x_{\mathrm{cm}} = \dfrac{\sum m_i x_i}{\sum m_i}$ $\quad \vec{\mathrm{v}}_{\mathrm{cm}} = \dfrac{\sum m_i \vec{\mathrm{v}}_i}{\sum m_i}$ $\quad \sum \vec{F}_{\mathrm{ext}} = \dfrac{d\vec{p}}{dt}$

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

$W = \int_{s_i}^{s_f} \vec{F}\cdot d\vec{s} = -\Delta U$ $\quad \vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z = AB\cos\phi$

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

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

$U_s = \frac{1}{2}kx^2$ $\quad P = \vec{F}\cdot\vec{\mathrm{v}}$ $\quad \tau = rF\sin\phi$ $\quad \sum\tau = I\alpha$

$I = \sum m_i r_i^2 = \int r^2 dm$ $\quad I = I_{\mathrm{CM}} + MD^2$

$\lambda = M/L$ $\quad x_{cm} = \dfrac{1}{M}\int x dm$

$K_{\mathrm{R}} = \frac{1}{2}I\omega^2$ $\quad L = I\omega$ $\quad W_{\mathrm{R}} = \tau\theta$

$\vec{\tau} = \vec{r}\times\vec{F}$ $\quad \vec{L} = \vec{r}\times\vec{p}$ $\quad \sum\vec{\tau} = \dfrac{d\vec{L}}{dt}$

For $\vec{C} = \vec{A}\times\vec{B}$ $\quad C = AB\sin\phi$

$\vec{A}\times\vec{B} =$

$$\left(A_yB_z - A_zB_y\right)\hat{i} - \left(A_xB_z - A_zB_x\right)\hat{j} + \left(A_xB_y - A_yB_x\right)\hat{k}$$

Moments of inertia about axes through the center of mass:

$I_{rod} = \frac{1}{12}ML^2$ $\quad I_{hollow\ sphere} = \frac{2}{3}MR^2$ $\quad I_{solid\ sphere} = \frac{2}{5}MR^2$

$x = A\cos(\omega t + \phi_0)$ $\quad \omega = 2\pi f$ $\quad f = 1/T$

$\mathrm{v} = -A\omega\sin(\omega t + \phi_0)$ $\quad a = -A\omega^2\cos(\omega t + \phi_0)$

$\dfrac{d^2x}{dt^2} + \omega^2 x = 0$ $\quad \omega = \sqrt{k/m}$ $\quad \omega = \sqrt{g/L}$

$T = \dfrac{2\pi}{\omega} = 2\pi\sqrt{I/MgL}$ $\quad U_g = -\dfrac{Gm_1m_2}{r}$ $\quad \mathrm{v} = \lambda/T$

$\mathrm{v} = \sqrt{\gamma k_B T/m}$ $\quad y(x,t) = A\sin(kx \pm \omega t + \phi_0)$

$k = 2\pi/\lambda$ $\quad n = \mathrm{c}/\mathrm{v}$