

PHYS-101 Formula Sheet for Major Exam II-022

$r = r_0 + v_0 t + \frac{1}{2} a t^2$ $v = v_0 + a t$ $v^2 = v_0^2 + 2a(x - x_0)$ $x - x_0 = \frac{(v_0 + v)t}{2}$	$\omega = \frac{d\theta}{dt}; \quad \alpha = \frac{d\omega}{dt}$ $s = r \theta, \quad v = r \omega$ $a_t = r \alpha; \quad a_r = \frac{v^2}{r} = r \omega^2$ $\vec{a} = \vec{a}_t + \vec{a}_r$
$\sum \vec{F} = m \vec{a} = \frac{d\vec{p}}{dt}$ $f_k = \mu_k N$ $f_s \leq \mu_s N$ $W = \int \vec{F} \cdot d\vec{s}$ $W = \vec{F} \cdot \vec{s} \quad \text{if } \vec{F} = \text{Constant}$	<p>If $\alpha = \text{constant}$,</p> $\omega = \omega_0 + \alpha t$ $\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$ $\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$
$\vec{A} \cdot \vec{B} = AB \cos \theta$ $ \vec{A} \times \vec{B} = AB \sin \theta$	$I = \sum_i m_i r_i^2 = \int r^2 dm$ $I_p = I_{com} + M h^2$ $\vec{\tau} = \vec{r} \times \vec{F}$ $\tau = r F \sin \theta = r_{\perp} F = r F_t$
$W_{net} = \Delta K = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$ $P = \frac{dW}{dt} = \vec{F} \cdot \vec{v}$ $U_s = \frac{1}{2} k x^2, \quad F_s = -kx$ $U_g = mgy$ $E_{mech} = K + U$ $\Delta U = -W \quad \text{for a conservative force}$ $\Delta K + \Delta U + \Delta E_{th} = W_{ext}$ <p>where $\Delta E_{th} = f_k d$</p>	$W = \int \tau d\theta$ $= \tau \Delta \theta \quad \text{if } \tau \text{ is constant}$ $\vec{l} = \vec{r} \times \vec{p} = m \vec{r} \times \vec{v}$ $l = m r_{\perp} v = m r v_{\perp}$ <p>For a solid rotating about a fixed axis,</p> $K_{rot} = \frac{1}{2} I \omega^2, \quad L_z = I \omega$ $\Delta K = \frac{1}{2} I (\omega_f^2 - \omega_i^2) = W$
$\left\{ \vec{J} = \int \vec{F} dt = \vec{F}_{avg} \Delta t \right\} = \Delta \vec{p}$ $\vec{p}_{1i} + \vec{p}_{2i} = \vec{p}_{1f} + \vec{p}_{2f}$	$P = \frac{dW}{dt} = \tau \omega$ $\vec{\tau} = \frac{d\vec{l}}{dt}$ $\sum \vec{\tau}_{ext} = \frac{d\vec{L}}{dt} = I \vec{\alpha}$
$\sum \vec{F}_{ext} = M \vec{a}_{cm}$ $\vec{r}_{com} = \frac{1}{M} \sum_{i=1}^n m_i \vec{r}_i = \frac{1}{M} \int \vec{r} dm$ $v_{com} = \frac{1}{M} \sum_{i=1}^n m_i \vec{v}_i = \frac{1}{M} \sum_{i=1}^n \vec{p}_i = \frac{\vec{P}}{M}$	$g = 9.80 \text{ m/s}^2$ $I_{com}(\text{cylinder}) = (1/2)MR^2$ $I_{com}(\text{solid sphere}) = (2/5)MR^2$ $I_{com}(\text{thin rod}) = (1/12)ML^2$ $I_{com}(\text{hoop}) = MR^2$