PHYS-101 Formula Sheet for Major Exam II

$g = 9.80\ m/s^2$

$r = r_0 + v_o t + \frac{1}{2} at^2$

$v = v_o + at$

$v^2 = v_0^2 + 2a(x-x_0)$

$- x_o = \frac{(v_o + v)t}{2}$

$a_r = \frac{v^2}{r}$, $a_t = \frac{dv}{dt}$

$\vec{a} = \vec{a}_t + \vec{a}_r$

$\sum \vec{F} = m\vec{a} = \frac{d\vec{p}}{dt}$

$f_k = \mu_k N$

$f_s \le \mu_s N$

$W = \vec{F} \cdot \vec{s}$ if $\vec{F}$ = Constant

$W = \int \vec{F} \bullet d\vec{s}$

$\vec{A} \cdot \vec{B} = A\,B \cos\theta$

$W_{net} = \Delta K = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

$P = \frac{dW}{dt} = \vec{F} \cdot \vec{v}$

$U_s = \frac{1}{2} kx^2$, $F_s = -kx$

$U_g = mgy$

$E = K + U$

$W_c = - \Delta U$

$\Delta E = \Delta K + \Delta U = -f_k d$

$\vec{p} = m\vec{v}$

$\vec{I} = \Delta\vec{p} = \vec{F}\Delta t = \int \vec{F}\ d$

$\vec{p}_{1i} + \vec{p}_{2i} = \vec{p}_{1f} + \vec{p}_2$

$\sum \vec{F}_{ext} = M\vec{a}_{cm}$

$I_{cm}(\text{disk}) = (1/2)MR^2$
$I_{cm}(\text{sphere}) = (2/5)MR^2$

$\vec{R}_{cm} = \frac{\Sigma m_i \vec{r}_i}{\Sigma m_i} = \frac{1}{M} \int \vec{r}\, dm$

$\vec{v}_{cm} = \frac{\Sigma m_i \vec{v}_i}{\Sigma m_i}$; $\vec{p}_{cm} = \Sigma m_i \vec{v}_i$

$\omega = \frac{d\theta}{dt}$; $\alpha = \frac{d\omega}{dt}$

$s = r\,\theta$, $v = r$

$a_t = r\alpha$; $a_r = r\omega^2$

If α = constant,
$\omega = \omega_o + \alpha t$
$\theta = \theta_o + \omega_o t + \frac{1}{2} \alpha t^2$
$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$

$I = \Sigma m_i r_i^2 = \int r^2\, dm$

$I_P = I_{cm} + M h^2$

$\vec{\tau} = \vec{r} \times \vec{F}$

$|\vec{A} \times \vec{B}| = AB \sin\theta$

$P = \frac{dW}{dt} = \tau\,\omega$

For a solid rotating about a fixed axis,

$K_{rot} = \frac{1}{2} I\,\omega^2$, $L_z = I$

$W = \int \tau\, d\theta$

$\vec{L} = \vec{r} \times \vec{p} = m\,\vec{r} \times \vec{v}$

$\vec{\tau} = \frac{d\vec{L}}{dt}$

$\sum \tau_{ext} = \frac{dL}{dt} = I\alpha$

For static equilibrium,
$\Sigma\vec{F} = 0$; $\Sigma\vec{\tau} = 0$

$E = \frac{F/A}{\Delta L / L_o}$; $G = \frac{F/A}{\Delta x / h}$; $B = -\frac{F/A}{\Delta V / V} = -\frac{\Delta P}{\Delta V / V}$

$I_{cm}(\text{thin rod}) = (1/12)ML^2$
$I_{cm}(\text{hoop}) = MR^2$