PHYS-101 Formula Sheet for the Final Exam

g = 9.80 m/s^2

$\vec{v} = \vec{v}_o + \vec{a}t$

$\vec{r} - \vec{r}_o = \vec{v}_o t + \frac{1}{2}\vec{a}t^2$

$v^2 = v_o^{\ 2} + 2\vec{a}\cdot(\vec{r} - \vec{r}_o)$

$\vec{r} - \vec{r}_o = \frac{1}{2}(\vec{v} - \vec{v}_o)t$

$a_r = \frac{v^2}{r} \quad a_t = \frac{d|\vec{v}|}{dt}$

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

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

$f_k = \mu_k N$

$f_s \le \mu_s N$

$W = \int \vec{F}\cdot d\vec{s}$; $P = \vec{F}.\vec{V}$

$W = \vec{F}\cdot\vec{s}$, If F is a constant

$W_{net} = \Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$W_c = -\Delta U_c$

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

$\Delta U_g = mg(y_f - y_i)$

$W_{nc} = \Delta K + \Delta U = \Delta E$; $W_{nc} = -F_k d$

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

$\vec{J} = \Delta\vec{p} = \vec{F}\Delta t = \int \vec{F}\,dt$

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

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

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

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

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

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

If α is a constant :

$\omega = \omega_o + \alpha t$

$\theta - \theta_o = \omega_o t + \frac{1}{2}\alpha t^2$

$\theta - \theta_0 = \frac{\omega + \omega_0}{2}t$

$\omega^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$

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

$I_p = I_{cm} + Md^2$

$\vec{\tau} = \vec{r}\times\vec{F}$ $\qquad \vec{A}\cdot\vec{B} = AB\cos\theta$

$|\vec{A}\times\vec{B}| = AB\sin\theta$ $\qquad \vec{A}.\vec{B} = A_xB_x + A_yB_y + A_zB_z$

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

For a solid rotating about a fixed axis :

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

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

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

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

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

For static equilibrium

$\sum \vec{F} = 0$, $\quad \sum \vec{\tau} = 0$

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

$x = x_m\cos(\omega t + \phi)$

$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{k}}$

$E = \frac{1}{2}kx_m^2 = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$

$T = 2\pi\sqrt{\frac{L}{g}}$; $\quad f = 1/T$

$F_g = \frac{Gm_1m_2}{r^2}$

$T^2 = \left(\frac{4\pi^2}{GM_s}\right)r^3$

$U = -\frac{Gm_1m_2}{r}$, $\quad K = \frac{GMm}{2r}$, $\quad E = -\frac{GMm}{2r}$

$v_{esc} = \sqrt{\frac{2GM}{R}}$

$P = \frac{F}{A}$

$P = P_o + \rho gh$

$F_b = \rho_f Vg$

$A_1v_1 = A_2v_2 = \text{constant}$

$P + \frac{1}{2}\rho v^2 + \rho gy = \text{constant}$

$G = 6.67\times10^{-11}\ N\frac{m^2}{kg^2}$

$P_{atm} = 1.013\times10^5\ Pa = 1\ atm$

I_{cm}(disk) = (1/2)MR^2 ; I_{cm}(thin rod) = (1/12)ML^2

I_{cm}(sphere) = (2/5)MR^2 ; I_{cm}(hoop) = MR^2