

PHYS-101 Formula Sheet for Major Exam II

$$g = 9.80 \text{ m/s}^2$$

$$r = r_0 + v_0 t + \frac{1}{2} a t^2$$

$$v = v_0 + a t$$

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

$$x - x_0 = \frac{(v_0 + v)t}{2}$$

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

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

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

$$f_k = \mu_k N$$

$$f_s \leq \mu_s N$$

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

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

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

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

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

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

$$U_g = mgy$$

$$E = K + U$$

$$W_c = -\Delta U$$

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

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

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

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

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

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

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

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

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

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

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

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

If $\alpha = \text{constant}$,

$$\omega = \omega_0 + \alpha t$$

$$\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$$

$$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$$

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

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

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

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

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

For a solid rotating about a fixed axis,

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

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

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

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

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

For static equilibrium,

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

$$E = \frac{F/A}{\Delta L/L_0}; \quad G = \frac{F/A}{\Delta x/h}; \quad B = -\frac{F/A}{\Delta V/V} = -\frac{\Delta P}{\Delta V/V}$$

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

$$I_{cm}(\text{hoop}) = MR^2$$