PHYSICS 111

Final Exam Equation Sheet

Motion with constant Acceleration

$$v = \frac{\Delta x}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t}$$

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

$$\Delta x = \frac{1}{2}(v + v_0)t$$

$$v = v_0 + at$$

$$v^2 = v_0{}^2 + 2a(\Delta x)$$

Newton's 2nd Law

$$\vec{F}_{net} = \sum \vec{F} = m\vec{a}$$

means

$$\sum F_x = ma_x \quad and \quad \sum F_y = ma_y$$

Forces

$$F_G = G\frac{m_1 m_2}{r^2}$$

$$W = mg$$

$$F_c = ma_c = m\frac{v^2}{r}$$

$$f_s \le \mu_s F_N$$

$$f_k = \mu_k F_N$$

$$G = 6.673 \times 10^{-11}\,\frac{N \cdot m^2}{kg^2}$$

$$g = 9.80\frac{m}{s^2}, \quad near \quad Earth's \quad surface$$

$$R_{Earth} = 6.38 \times 10^6\, m$$

$$m_{Earth} = 5.98 \times 10^{24}\, kg$$

Work, Energy & Power

$$W = Fd\cos\theta$$

$$PE_G = mgh$$

$$KE = \frac{1}{2}mv^2$$

$$W_{net} = KE_f - KE_i = \Delta KE$$

$$W_{gravity} = -\Delta PE$$

$$W_{NC} = \Delta KE + \Delta PE$$

$$P = \frac{Energy}{time} = \frac{Work}{time} = Fv$$

Rotational Motion

$$\omega = \frac{\Delta\theta}{\Delta t} \qquad \alpha = \frac{\Delta\omega}{\Delta t}$$

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

$$\Delta\theta = \frac{1}{2}(\omega + \omega_0)t$$

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

$$\omega^2 = \omega_0{}^2 + 2\alpha(\Delta\theta)$$

$$s_{arc} = r\theta \qquad v_T = r\omega \qquad a_T = r\alpha \qquad a_c = r\omega^2$$

Torque & Moment of Inertia, Energy

$$\tau = Fl \qquad \tau = I\alpha \qquad I = \sum mr^2$$

KE = ½ $I\omega^2$ (rotational KE)

Impulse & Momentum

$$\vec{J} = \vec{F}\Delta t = \Delta\vec{p}$$

$$\Delta p = m\Delta v = m(v_f - v_i)$$

L = Iω (angular momentum)

Collisions (Elastic, 2-Body, v_2=0)

$$v_1' = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)v_1 \qquad v_2' = \left(\frac{2m_1}{m_1 + m_2}\right)v_1$$

Collisions – (Inelastic)

$$v = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

Center of Mass

$$x_{cm} = \frac{m_1 x_1 + m_2 x_2 + \ldots}{m_1 + m_2 + \ldots}$$

$$v_{cm} = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

Pressure

P = F/A