

# Equations for Exam 4

## Chapter 12

$$\vec{\tau} = \vec{r} \times \vec{F} \quad \text{Equilibrium:} \quad \Sigma \vec{F} = 0, \quad \Sigma \vec{\tau} = 0$$

## Chapter 13

$$F_g = \frac{Gm_1m_2}{R^2} \quad U_g = -\frac{Gm_1m_2}{R} \quad G = 6.67 \times 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2}$$

$$\text{Earth:} \quad M_E = 5.98 \times 10^{24} \text{kg}, \quad R_E = 6.37 \times 10^6 \text{m}, \quad g = \frac{GM_E}{R_E^2} = 9.8 \frac{\text{m}}{\text{s}^2}$$

$$\text{Circular orbit:} \quad a = \frac{v^2}{R} \quad K = \frac{1}{2}m_2v^2 = \frac{Gm_1m_2}{2R} \quad E = K + U_g = -\frac{Gm_1m_2}{2R}$$

$$\text{Any orbit:} \quad E = \text{constant}, \quad \vec{L} = m\vec{r} \times \vec{v} = \text{constant.}$$

## Chapter 14

$$P = \frac{F}{A} \quad P = P_0 + \rho gh \quad 1 \text{ Pa} = 1 \text{ N/m}^2 \quad \text{Buoyancy: } B = \rho_{\text{fluid}}gV$$

$$\text{Atmospheric pressure: } P_0 = 1 \text{ atm} = 1.013 \times 10^5 \text{ Pa}$$

$$\text{Density of water: } \rho_w = 1 \text{ g/cm}^3 = 1000 \text{ kg/m}^3$$

$$\text{Volume flux: } Av = \text{constant} \quad \text{Bernoulli equation: } P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$$

## Chapter 15

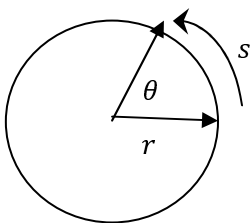
$$F = -kx, \quad a = -\frac{k}{m}x, \quad x = A \cos(\omega t + \phi_0), \quad v_{\text{max}} = \omega A, \quad \omega = \sqrt{\frac{k}{m}}, \quad T = \frac{2\pi}{\omega}$$

$$K = \frac{1}{2}mv^2, \quad U = \frac{1}{2}kx^2, \quad E = K + U = \text{constant}$$

## Earlier Equations

$$v = \frac{dx}{dt} \quad a = \frac{dv}{dt} \quad F = ma \quad W = \int Fdx$$

$$K = \frac{1}{2}mv^2 \quad \Delta K = W \quad \Delta U = -W \quad E = K + U$$



$$s = r\theta \quad \omega = \frac{d\theta}{dt} \quad v = r\omega \quad a = \frac{v^2}{r} = r\omega^2$$

$$x = r \cos \theta, \quad y = r \sin \theta, \quad v_x = -r\omega \sin \theta, \quad v_y = r\omega \cos \theta$$