PHY107: Equation Sheet 3 (Ch. 11-13 and 15)

Not everything here will be needed for the exam and you may need to derive equations from what is given here.

Static Equilibrium

$$\sum F_x = 0 \qquad \sum F_y = 0 \qquad \sum F_z = 0$$

$$\sum \vec{\tau} = 0 \quad \text{about any point}$$

Determination of center of mass:

$$\vec{r}_{cm} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2 + \ldots}{m_1 + m_2 + \ldots} = \frac{\sum m_i \vec{r}_i}{\sum m_i}$$

Young's Modulus

$$E = \frac{\textit{Tensile stress}}{\textit{Tensile strain}}$$

$$\frac{F}{A} = E\frac{\Delta L}{L}$$

Shearing Modulus

$$G = \frac{\text{Shearing stress}}{\text{Shearing strain}}$$

$$\frac{F}{A} = G\frac{\Delta x}{L}$$

Bulk Modulus

$$B = \frac{\text{Volume stress}}{\text{Volume strain}}$$

$$\frac{F}{A} = B\frac{\Delta V}{V}$$

Gravitation

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

$$U = -\frac{Gm_1m}{r}$$

Kepler's Law of periods

$$\frac{T^2}{r^3} = \frac{4\pi^2}{GM}$$

Simple Harmonic Motion

$$F = -kx$$

$$f = \frac{1}{T} \qquad T = \frac{1}{f}$$

$$\omega = \frac{2\pi}{T} = 2\pi f$$

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

$$\omega = \sqrt{\frac{k}{m}}$$

$$E_{tot} = \frac{1}{2}mv^2 + \frac{1}{2}kx^2 = \frac{1}{2}kx_o^2 = \text{constant}$$

Simple Pendulum

$$\omega = \sqrt{\frac{g}{l}}$$

Physical Pendulum

$$\omega = \sqrt{\frac{mgd}{I}}$$

Torsional Pendulum

$$\omega = \sqrt{\frac{\kappa}{I}}$$

Damped Oscillations

$$\sum F_x = -kx - bv = ma_x$$

$$-kx - b\frac{dx}{dt} = m\frac{d^2x}{dt^2}$$

$$x(t) = Ae^{-\frac{b}{2m}t}\cos(\omega t + \phi)$$

where $\omega = \sqrt{\frac{k}{m} - \left(\frac{b}{2m}\right)^2} = \sqrt{\omega_0^2 - \left(\frac{b}{2m}\right)^2}$