

PHY140Y Aid Sheet for Term Test 3

Basic Definitions

$$F = ma = m \frac{dv}{dt} = m \frac{d^2x}{dt^2} \quad (1)$$

$$\tau = I\alpha = I \frac{d\omega}{dt} = I \frac{d^2\theta}{dt^2} \quad (2)$$

Force Laws

$$\vec{F} = \frac{GmM}{r^2} \hat{r} \quad \text{Law of Universal Gravitation} \quad (3)$$

$$\vec{F} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} \hat{r} \quad \text{Coulomb's Law,} \quad (4)$$

Moments of Inertia

The moment of inertia of a volume V with mass density $\rho(\vec{r})$ is

$$I \equiv \int_V r^2 \rho(\vec{r}) dV. \quad (5)$$

$$I = \frac{MR^2}{2} \quad \text{solid disk with axis through centre} \quad (6)$$

$$I = \frac{Ml^2}{12} \quad \text{thin rod of length } l \text{ with axis through centre } \perp \text{ to rod} \quad (7)$$

$$I = \frac{2MR^2}{5} \quad \text{uniform solid sphere with axis through centre} \quad (8)$$

Constants

$$k = 1.38 \times 10^{-23} \text{ J/K}^\circ \quad h = 2\pi\hbar = 6.63 \times 10^{-34} \text{ Js} \quad (9)$$

$$G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2 \quad c = 3.00 \times 10^{10} \text{ cm/s} \quad (10)$$

$$a_o = 5.29 \times 10^{-11} \text{ m} \quad \epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N m}^2 \quad (11)$$

Units

$$1 \text{ cal} = 4.184 \text{ J} = 4.184 \times 10^7 \text{ J}$$

$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$

$$1 \text{ atm} = 1.013 \times 10^6 \text{ dynes/cm}^2 = 0.987 \text{ bar}$$

$$1 \text{ hp} = 746 \text{ Watts} = 746 \text{ J/s} = 7.46 \times 10^9 \text{ erg/s}$$

$$0^\circ\text{C} = 273^\circ \text{ K}$$