Solutions

PHYS-205A-002 (Final Exam) Fall 2022

Problem 1

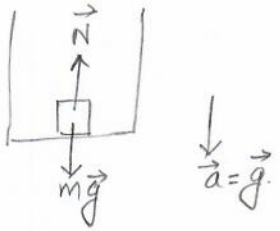
$$\vec{a} = -\hat{z}\, 9.8 \frac{m}{s^2} \qquad (\hat{z} \text{ is vertically up})$$

Problem 2

$$m\vec{a} = m\vec{g} + \vec{N}$$

$$-mg = -mg + N$$

$$\Rightarrow N = 0 \qquad \text{(reads 0.)}$$



Problem 3

magnitude : $\frac{v^2}{R}$

direction : radially inward

Problem 4

$I = MR^2$ → effective radius decreases

→ moment of inertia decreases

Problem 5

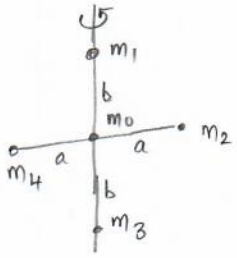
$$I = m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 + m_4 r_4^2 + m_0 r_0^2$$

$$= m_1(0)^2 + m_2 a^2 + m_3(0)^2 + m_4(a^2) + m_0(0)^2$$

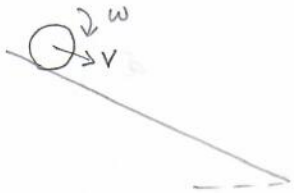
$$= m_2 a^2 + m_4 a^2$$

$$= (2.0)(0.1)^2 + (4.0)(0.1)^2$$

$$= 0.060 \text{ kg m}^2.$$



Problem 6



$$K = \frac{1}{2} M v^2 + \frac{1}{2} I \omega^2$$

$$= \frac{1}{2} M v^2 + \frac{1}{2} M R^2 \omega^2$$

$$= \frac{1}{2} M v^2 + \frac{1}{2} M v^2 \qquad (v = \omega R)$$

$$= M v^2$$

$$K_i + U_i = K_f + U_f$$

$$M v_i^2 + M g h_i = M v_f^2 + M g h_f$$

($v_i = 0$, $h_f = 0$)

$$v_f = \sqrt{g h_i} = \sqrt{(9.8)(1.2)} = 3.4 \ \frac{m}{s}$$

Problem 7

$$K_i + U_i = K_f + U_f$$

$$\frac{1}{2} m v_i^2 - \frac{GMm}{R} = \frac{1}{2} m v_f^2 - \frac{GMm}{\infty}$$

($v_f = 0$)

$$v_i = \sqrt{\frac{2GM}{R}}$$

$$= \sqrt{\frac{2(6.7 \times 10^{-11})(6.0 \times 10^{24})}{6.4 \times 10^{6}}}$$

$$= 11 \ \frac{km}{s}$$