Solutions PHYS-205A-001 (Final Exam) Spring 2022

Problem 1

$$\vec{a} = -g\hat{z} \qquad g = 9.8 \frac{m}{s^2}$$

Problem 2

magnitude is uniform ($a_c = \omega^2 R$)

direction is radially inward.

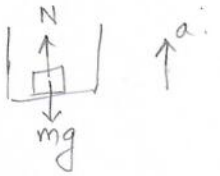
Problem 3

Gravitational field due to a mass M at a point in space is the gravitational force it would exert on a unit mass.

$$\vec{g}_1 = \frac{F_{21}}{m_2}$$

$\vec{g}_1$: field; F_{21}: force.

Problem 4



$$ma = -mg + N$$

$$N = mg + ma = 75(9.8 + 2.0) = 890 \text{ Newton}$$

Problem 5

$\alpha = ?$

$\Delta\theta =$

$\Delta t = 8.00 s$

$\omega_i = 0$

$\omega_f = 75.0 \frac{rad}{s}$

$$\alpha = \frac{\omega_f - \omega_i}{\Delta t} = \frac{75.0 - 0}{8.00} = 9.38 \frac{rad}{s^2}$$

$\Delta x = \Delta\theta R$

$v = \omega R$

$a = \alpha R$

$$a = \alpha R = (9.38)(0.300) = 2.81 \frac{m}{s^2}.$$

Problem 6

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

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

$$= (2.0 + 4.0)(0.100)^2 = 0.060 \text{ kg m}^2$$

Problem 7

$$\frac{1}{2} M \cancel{v_A^2}^{=0} + \frac{1}{2} I \cancel{\omega_A^2}^{=0} + Mgh_A = \frac{1}{2} M v_E^2 + \frac{1}{2} I \omega_E^2 + Mgh_E$$

$$Mg(h_A - h_E) = \frac{1}{2} M v_E^2 + \frac{1}{2} \frac{2}{5} M R^2 \omega_E^2 \qquad v_E = \omega_E R_E$$

$$\cancel{M} g(h_A - h_E) = \left(\frac{1}{2} + \frac{1}{5}\right) \cancel{M} v_E^2$$

$$g(h_A - h_E) = \frac{7}{10} v_E^2$$

$$v_E = \sqrt{\frac{10}{7} g(h_A - h_E)}$$

$$= \sqrt{\frac{10}{7} (9.8)(40.0 - 20.0)}$$

$$= 17 \frac{m}{s}$$