

Solution

PHYS-205A-001 (Final Exam) Spring 2025

(1)

Problem 1

$$\Delta y = -10.0 \text{ m}$$

$$v_i = 0$$

$$a = -9.8 \frac{\text{m}}{\text{s}^2}$$

$$\Delta t =$$

$$v_f = ?$$

$$v_f^2 = v_i^2 + 2a \Delta y$$

$$v_f^2 = 0^2 + 2(-9.8)(-10.0)$$

$$v_f = 14 \frac{\text{m}}{\text{s}}$$

Problem 2

$$N = mg = (75)(9.8) = 740 \text{ N}$$

Problem 3

$$[K] = \frac{[P]}{[J]} = \frac{[mv]}{[Ft]} = \frac{[mv]}{[m \frac{v}{t} t]} = 1$$

$$P = mv$$

$$J = F \Delta t$$

$\Rightarrow K$ is dimensionless.

Problem 4

Linear:

$$W_L = -F_f d$$

Rotation:

$$W_R = +F_f R \theta$$

$$W_{\text{tot}} = F_f (R\theta - d)$$
$$= 0$$

perfect rolling

$$d = R\theta$$

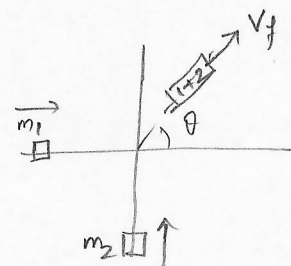
(2)

Problem 5

$$m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i} = (m_1 + m_2) \vec{v}_f$$

$$m_1 \vec{v}_{1i} + 3m_1 \vec{v}_{2i} = (m_1 + 3m_1) \vec{v}_f$$

$$\begin{aligned} \vec{v}_f &= \frac{1}{4} \vec{v}_{1i} + \frac{3}{4} \vec{v}_{2i} \\ &= \frac{1}{4} 35 \hat{i} + \frac{3}{4} 25 \hat{j} \\ &= 8.8 \hat{i} + 19 \hat{j} \end{aligned}$$



$$|\vec{v}_f| = \sqrt{8.8^2 + 19^2} = 21 \frac{\text{m}}{\text{s}}$$

$$\text{direction: } \theta = \tan^{-1} \frac{19}{8.8} = 65^\circ \text{ N of E}$$

Problem 6

$$I = m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 + m_4 r_4^2 + m_5 r_5^2$$

$$= m_2 r_2^2 + m_4 r_4^2$$

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

$$= (m_2 + m_4) a^2 = (2.0 + 4.0) (0.10)^2 = 6.0 \times 10^{-2} \text{ kg m}^2$$

$$r_1 = r_3 = r_5 = 0$$

Problem 7

$$V = - \frac{G m_1}{L} - \frac{G m_2}{\sqrt{2} L} - \frac{G m_3}{L}$$

$$= - \frac{G m}{L} \left(1 + \frac{1}{\sqrt{2}} + 1 \right)$$

$$= - \frac{G m}{L} \left(2 + \frac{1}{\sqrt{2}} \right)$$

$$= - 2.7 \frac{G m}{L}$$

