

Solutions

Prob. 1

$$W = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

$$125000 = \frac{1}{2} m (30)^2 - \frac{1}{2} m (20)^2$$

$$= 250 m$$

$$m = 500 \text{ kg}$$

Problem 2

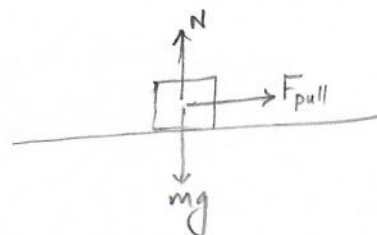
(a) gravity, normal force, $\vec{F}_{\text{pull}}$

$$(b) W_N = \vec{N} \cdot \vec{d} = N d \cos 90 = 0$$

$$(c) W_g = m\vec{g} \cdot \vec{d} = mg d \cos 90 = 0$$

$$(d) W_{\text{pull}} = \vec{F}_{\text{pull}} \cdot \vec{d} = F_{\text{pull}} d \cos(0)$$

$$= (80.0)(10.0)(1) = 800. \text{ J}$$



$$(e) \Delta K = W_N + W_g + W_{\text{pull}}$$

$$= 0 + 0 + 800.$$

$$= 800. \text{ J}$$

Prob. 3

(a) gravity.

(b) $W_g = \Delta K$

$$\Delta U_g + \Delta K = 0$$

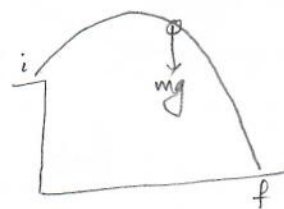
$$K_i + U_i = K_f + U_f$$

$$\frac{1}{2} m v_i^2 + m g h_i = \frac{1}{2} m v_f^2 + m g h_f$$

$$\frac{1}{2} (10.0)^2 + (9.8)(30.0) = \frac{1}{2} v_f^2 + 0$$

$$v_f^2 = (10.0)^2 + 2(9.8)(30.0)$$
$$= 688$$

$$\Rightarrow v_f = 26 \frac{m}{s}$$

Prob. 4

$$(m_1 + m_2) v_i = m_1 v_{1f} + m_2 v_{2f}$$

$\downarrow$
 $= 0$

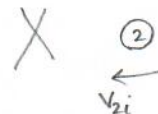
$$v_{1f} = - \frac{m_2}{m_1} v_{2f}$$

$$= - \frac{0.020}{90.0} 60.0 = - 0.0133 \frac{m}{s} = - 1.33 \frac{cm}{s}$$

1 - person
2 - arrowProb. 5

$$v_{1f} = \left(\frac{m_1 - m_2}{m_1 + m_2} \right) v_{1i} + \left(\frac{2m_2}{m_1 + m_2} \right) v_{2i}$$
$$= \frac{9}{11} (+5.0) + \frac{2}{11} (-5.0) = +3.2 \frac{m}{s}$$

$$v_{2f} = \left(\frac{2m_1}{m_1 + m_2} \right) v_{1i} + \left(\frac{m_2 - m_1}{m_1 + m_2} \right) v_{2i}$$
$$= \frac{20}{11} (+5.0) - \frac{9}{11} (-5.0) = +13 \frac{m}{s}$$



$$m_1 = 10 m_2$$

 $\longrightarrow +$

Prob. 6

$$x_{cm} = \frac{m_T x_T + m_B x_B}{m_T + m_B}$$

$$x_{cm}^{old} = \frac{(80.0)(+10.0) + (60.0)(+2.00)}{80.0 + 60.0} = 6.57 \text{ m}$$

$$x_{cm}^{new} = \frac{(60.0)(+10.0) + (80.0)(+2.00)}{80.0 + 60.0} = 5.43 \text{ m}$$

$$x_{cm}^{new} - x_{cm}^{old} = 5.43 - 6.57 = -1.14 \text{ m.}$$

Prob. 7

$$v_i = 0$$

$$v_f = 24.0 \frac{\text{m}}{\text{s}}$$

$$\Delta x =$$

$$\Delta t = 8.00 \text{ s}$$

$$a = ?$$

$$a = \alpha R$$

$$v_f = v_i + a \Delta t$$

$$24.0 = 0 + a(8.00)$$

$$\Rightarrow a = 3.00 \frac{\text{m}}{\text{s}^2}$$

$$a = \alpha R$$

$$3.00 = \alpha(0.300)$$

$$\alpha = 10.0 \frac{\text{rad}}{\text{s}^2}$$

Problem 8

$$N_1 + N_2 = mg$$

$$\Rightarrow mg = 880.0 \text{ N}$$

$$N_1(1.80 - x) = N_2 x$$

$$x = \frac{N_1}{N_1 + N_2} (1.80 \text{ m}) = \frac{550}{550 + 330} (1.80 \text{ m}) = 1.13 \text{ m.}$$

