p192 67, 70, 73, 76, 77

(67) $m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$

$\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = \frac{1}{2} m_1 v_1'^2 + \frac{1}{2} m_2 v_2'^2$

$m_1 = m \qquad v_1' = -\frac{v_1}{4}$

$m v_1 = m\left(-\frac{v_1}{4}\right) + m_2 v_2'$

$m v_1^2 = m\left(-\frac{v_1}{4}\right)^2 + m_2 v_2'^2$

$v_2' = \dfrac{m v_1 + \frac{m v_1}{4}}{m_2} = \frac{5 m v_1}{4 m_2}$

$m v_1^2 = \frac{m v_1^2}{16} + m_2\left(\frac{5 m v_1}{4 m_2}\right)^2$

$\frac{15 m v_1^2}{16} = \frac{m_2 25 m^2 v_1^2}{16 m_2^2}$

$m_2 = \frac{25}{15} m$

$m_2 = \frac{5}{3} m$

(70)

collision: $m_b v_b + \cancel{m_w v_w} = (m_b + m_w) V$

(a)

$$V = \frac{m_b v_b}{m_b + m_w}$$

$$= \frac{(0.029\ kg)(510\ ms^{-1})}{(0.029\ kg + 1.40\ kg)} = 10.35\ ms^{-1}$$

rising block

$$\Sigma E_b = \Sigma E_a$$

$$\frac{1}{2}(\cancel{m_b + m_w}) V^2 = (\cancel{m_b + m_w}) gh$$

$$h = \frac{V^2}{2g} = \frac{(10.35\ ms^{-1})^2}{2(9.81\ ms^{-2})}$$

$$h = 5.5\ m$$

(73) (a) $m_m V_m + \cancel{m_E V_E} = (m_m + m_E) V$ we can assume the earth is stationary

$$V = \frac{m_m V_m}{(m_m + m_E)} = \frac{(1 \times 10^8\ kg)(15 \times 10^3\ ms^{-1})}{(1 \times 10^8\ kg + 6.0 \times 10^{24}\ kg)}$$

$$V = 2.5 \times 10^{-13}\ ms^{-1}$$

(b) $$\frac{\Delta E_k}{E_k} = \frac{\frac{1}{2}(m_m + m_E)V^2}{\frac{1}{2} m_m V_m^2} = \frac{(1 \times 10^8\ kg + 6 \times 10^{24}\ kg)(2.5 \times 10^{-13}\ ms^{-1})^2}{(1 \times 10^8\ kg)(15 \times 10^3\ ms^{-1})^2}$$

$$\frac{\Delta E_k}{E_k} = 1.7 \times 10^{-17}$$

(c) $\Delta E_k = \frac{1}{2} m_E V^2 = \frac{1}{2}(6 \times 10^{24})(2.5 \times 10^{-13})^2 = 0.19\ J$

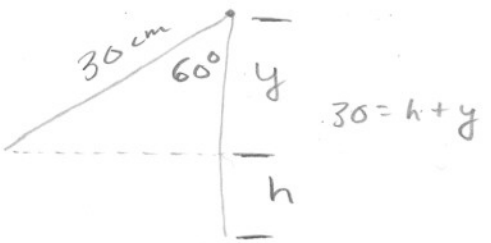
(76) (a) $\Sigma E_b = \Sigma E_a$

$\cancel{mg}h = \frac{1}{2}\cancel{m}v_A^2$

$v_A = \sqrt{2gh}$

$v_A = \sqrt{2(9.81\ ms^{-2})(0.15m)}$

$v_A = 1.7\ ms^{-1}$



$\cos 60 = \frac{y}{30}$

$y = 30 \cos 60 = 15$

$h = 30 - y = 15\ cm$

(b) $m_A v_A + \cancel{m_B v_B} = m_A v_A' + m_B v_B'$

$\cancel{\frac{1}{2}} m_A v_A^2 + \cancel{\frac{1}{2} m_B v_B^2} = \cancel{\frac{1}{2}} m_A v_A'^2 + \cancel{\frac{1}{2}} m_B v_B'^2$

$(0.04\ kg)(1.7\ ms^{-1}) = (0.04\ kg) v_A' + (0.06\ kg) v_B'$

$(0.04\ kg)(1.7\ ms^{-1})^2 = (0.04\ kg) v_A'^2 + (0.06\ kg) v_B'^2$

$0.068 = .04 v_A' + .06 v_B'$

$0.1156 = .04 v_A'^2 + .06 v_B'^2$

$v_A' = \frac{0.068 - .06 v_B'}{.04} = 1.7 - .015 v_B'$

$0.1156 = .04(1.7 - .015 v_B')^2 + .06 v_B'^2$

$0.1156 = .04(2.89 - .051 v_B' + 2.25 \times 10^{-4} v_B'^2) + .06 v_B'^2$

$\cancel{0.1156} = \cancel{.1156} - .002 v_B' + 9 \times 10^{-6} v_B'^2 + .06 v_B'^2$

$.002 v_B' = .06 v_B'^2$

$v_B' = 0.03\ ms^{-1}$

$v_A' = 1.7 - .015 v_B' = 1.7 - 0.015(.03\ ms^{-1})$

$v_A' = 1.7\ ms^{-1}$

76 (c) $\Sigma E_b = \Sigma E_a$

$$\frac{1}{2}mv^2 = mgh$$

$$h = \frac{v^2}{2g}$$

A: $h = \frac{(1.7\ ms^{-1})^2}{2(9.81\ ms^{-2})} = \underline{0.15\ m}$

B: $h = \frac{(0.03\ ms^{-1})^2}{2(9.81\ ms^{-2})} = \underline{4.6 \times 10^{-5}\ m}$

(77) $0 = m_n v_n + m_\alpha v_\alpha$ $\qquad m_n = 57\, m_\alpha$

$$v_n = \frac{-m_\alpha v_\alpha}{m_n}$$

$$= -\frac{m_\alpha (3.8 \times 10^5\ ms^{-1})}{57\, m_\alpha}$$

$$v_n = \underline{6700\ ms^{-1}}$$