Chapter 6 :

Total 15

3. (a) $p = 1.67 \cdot 10^{-27}\,kg \cdot 5.00 \cdot 10^{6}\,\frac{m}{s} = \underline{8.35 \cdot 10^{-21}\,\frac{kg\,m}{s}}$ (1)

(b) $p = 15.0 \cdot 10^{-3}\,kg \cdot 300\,\frac{m}{s} = \underline{4.5\,\frac{kg\,m}{s}}$

(c) $p = 75.0\,kg \cdot 10.0\,\frac{m}{s} = \underline{750\,\frac{kg\,m}{s}}$

(d) $p = 5.98 \cdot 10^{24}\,kg \cdot 2.98 \cdot 10^{4}\,\frac{m}{s} = \underline{1.78 \cdot 10^{29}}\,\frac{kg\,m}{s}$

5. (a) $p = 3.00 \cdot 10^{-3}\,kg \cdot 1.50 \cdot 10^{3}\,\frac{m}{s} = 4.50\,\frac{kg\,m}{s}$ (0.5)

$V_{Baseball} = \frac{4.50\,kg\,\frac{m}{s}}{0.145\,kg} = \underline{31.0}\,\frac{m}{s}$

(b) $KE = \frac{1}{2} m v^2 = \frac{1}{2} p \cdot v$

$V_{bullet} > V_{baseball}$ $\quad p_{Bullet} = p_{baseball}$ (0.5)

$\rightarrow KE_{bullet} > KE_{baseball}$

9. $\Delta p = 70.0\,kg \cdot 5.20\,\frac{m}{s} = \underline{364\,\frac{kg\,m}{s}}$ (linear impulse)

$\Delta p = \bar{F} \cdot \Delta t$

$\rightarrow \bar{F} = \frac{\Delta p}{\Delta t} = \frac{364\,\frac{kg\,m}{s}}{0.832\,s} = \underline{438\,N}.$ (1)

14. (a) $\frac{\Delta p}{\Delta t} = \frac{1000\,kg\,(-20.0\,\frac{m}{s})}{1\,s} = \underline{-2.00 \cdot 10^{4}\,\frac{kg\,m}{s^2}}$ (0.5)

(b) $F_{BW} = \frac{\Delta p}{\Delta t} = \underline{-2.00 \cdot 10^{4}\,\frac{kg\,m}{s^2}}$ (0.5)

(c) $F_{WB} = -F_{BW} = \underline{+2.00 \cdot 10^{4}\,\frac{kg\,m}{s^2}}$ (0.5)

18. $p_i = 0$ $\quad p_f = m_b v_b + m_m v_m$

$\rightarrow V_m = -\frac{m_b v_b}{m_m} = -\frac{1.2\,kg \cdot 5.0\,\frac{m}{s} \cdot 4.8\,\frac{m}{s^2}}{730\,N} = -0.081\,\frac{m}{s}$ (1)

$x = v_m t$

$-5.0\,m = -0.081\,\frac{m}{s} \cdot t \longrightarrow t = \underline{62\,s}.$

30. Collision:

(1.5)

$$v_{Bullet} \cdot m_{Bullet} = v_0 \cdot (m_{Bullet} + m_{Block})$$

$$\rightarrow v_{Bullet} = \frac{m_{Bullet} + m_{Block}}{m_{Bullet}} v_0$$

Block is falling:

y-comp:

$$y = -\frac{1}{2} g t^2 \rightarrow t = \sqrt{-\frac{2y}{g}} = \sqrt{\frac{2 \cdot 1.00\,m}{9.80\,\frac{m}{s^2}}} = 0.452\,s$$

x-comp:

$$x = v_0 t$$

$$\rightarrow v_0 = \frac{x}{t} = \frac{2.00\,m}{0.452\,s} = 4.43\,\frac{m}{s}$$

$$\rightarrow v_{Bullet} = \frac{258\,g}{8.00\,g} \cdot 4.43\,\frac{m}{s} = \underline{143\,\frac{m}{s}}$$

35. (a) $p_i = 5.00\,g \cdot 20.0\,\frac{cm}{s} = 100\,\frac{g\,cm}{s}$

(1)

$p_f = 5.00\,g \cdot v_1 + 10.0\,g \cdot v_2$

$20.0\,\frac{cm}{s} + v_1 = v_2$

$$\rightarrow 5.00\,g \cdot v_1 + 200\,\frac{g\,cm}{s} + 10.0\,g \cdot v_1 = 100\,\frac{g\,cm}{s}$$

$$15.0\,g \cdot v_1 = -100\,\frac{g\,cm}{s}$$

$$v_1 = \underline{-6.67\,\frac{cm}{s}}$$

$$v_2 = \underline{13.3\,\frac{cm}{s}}$$

(b) $KE_i = \frac{1}{2} \cdot 5.00\,g \cdot \left(20.0\,\frac{cm}{s}\right)^2 = 1.00 \cdot 10^3\,\frac{g\,cm^2}{s^2}$

$KE_{2f} = \frac{1}{2} \cdot 10.0\,g \cdot \left(13.3\,\frac{cm}{s}\right)^2 = 889\,\frac{g\,cm^2}{s^2}$

$$\rightarrow \frac{KE_{2f}}{KE_i} = \underline{0.889}\,.$$

(0.5)

38. $p_i = 4 \cdot m \cdot v_i$

$p_f = m \cdot v_{1f} + 3m \cdot v_{2f}$

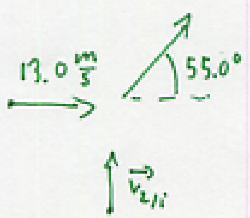
(a) $v_i = \frac{v_{1f} + 3v_{2f}}{4} = \frac{4.00\frac{m}{s} + 3 \times 2.00\frac{m}{s}}{4} = \underline{\underline{2.50\frac{m}{s}}}$ (1)

(b) $KE_i = \frac{1}{2} \cdot 4m \cdot v_i^2 = 3.13 \cdot 10^5 J$

$KE_f = \frac{1}{2} \cdot m \cdot v_{1f}^2 + \frac{1}{2} \cdot 3m \cdot v_{2f}^2 = 3.50 \cdot 10^5 J$

$W = \Delta KE = \underline{\underline{3.75 \cdot 10^4 J}}$ (0.5)

44.



$v_{f1x} = 13.0\frac{m}{s}$

$v_{f1y} = v_{2/i}$

$\tan 55.0° = \frac{v_{f1y}}{v_{f1x}}$ (1)

$\rightarrow v_{f1y} = 13.0\frac{m}{s} \cdot \tan 55.0° = 18.6\frac{m}{s} = \underline{\underline{41.5\frac{mi}{h}}}$

The driver of the northward moving vehicle is not telling the truth.

58.

(1.5)

$E_i = 0$

$E_f = m_T g(-r) + \frac{1}{2} m_T v^2$

$\rightarrow \quad v^2 = 2gr$

$p_i = m_T \sqrt{2gr}$

$p_f = (m_T + m_J) \cdot v_f$

$\rightarrow \quad v_f = \frac{m_T}{m_T + m_J} \sqrt{2gr}$ $\qquad m = m_T + m_J$

$E_i' = mg(-r) + \frac{1}{2} m v_f^2$

$E_f' = mg\,y$

$\rightarrow y = -r + \frac{v_f^2}{2g} = -r + \left(\frac{m_T}{m_T + m_J}\right)^2 \cdot r = r \cdot \left(\left(\frac{m_T}{m_T + m_J}\right)^2 - 1\right)$

$= -2.02\,m$

$\rightarrow$ They can reach a limb which is 2.02 m below Tarzan's original height.

Chapter 7

2. $s = \theta \cdot r$

(i) $\theta = 30° = 30° \cdot \frac{\pi \text{ rad}}{180°} = \frac{\pi}{6} \text{rad} \rightarrow s = 2.1 \text{ m}$ (1)

(ii) $\theta = 30 \text{ rad} \rightarrow s = 1.2 \cdot 10^2 \text{ m}$

(iii) $\theta = 30 \text{ rev} = 30 \cdot 2\pi \text{ rad} = 60\pi \text{ rad} \rightarrow s = 7.7 \cdot 10^2 \text{m}$.

13. $\omega = \frac{30}{2} \frac{\text{rev}}{\text{s}} = 30\pi \frac{\text{rad}}{\text{s}}$

$v = \omega r$ (0.5)

$r = \frac{v}{\omega} = \frac{3.00 \cdot 10^8 \frac{\text{m}}{\text{s}}}{30\pi \frac{\text{rad}}{\text{s}}} = 3.18 \cdot 10^6 \text{ m} \approx 3.2 \cdot 10^6 \text{ m}$.

20. $F_c = m r \omega^2$

$\rightarrow \omega = \sqrt{\frac{F_c}{mr}} = \sqrt{\frac{4.0 \cdot 10^{-11} \text{N}}{3.0 \cdot 10^{-16} \text{kg} \cdot 0.150 \text{m}}} = 943 \frac{\text{rad}}{\text{s}} = 150 \frac{\text{rev}}{\text{s}}$. (1)