BLM 2-6: Chapter 2 Test/Assessment

1. **(a)** D

(b) $$\Delta d = \frac{1}{2}(10\text{ s})\left(20\,\tfrac{\text{m}}{\text{s}}[\text{E}]\right) + 10\text{ s}\left(20\,\tfrac{\text{m}}{\text{s}}[\text{E}]\right) + 10\text{ s}\,\frac{(30+20)}{2}\,\tfrac{\text{m}}{\text{s}}[\text{E}]$$

Δd = 100 m[E] + 200 m[E] + 250 m[E]

Δd = 550 m[E]

(c) Refer to the calculations below.

A) $$\vec{a} = \frac{(20-0)\,\frac{\text{m}}{\text{s}}[\text{E}]}{(10-0)\text{ s}} = 2\,\frac{\text{m}}{\text{s}^2}[\text{E}]$$

B) $$\vec{a} = \frac{(20-20)\,\frac{\text{m}}{\text{s}}[\text{E}]}{(20-0)\text{ s}} = 0\,\frac{\text{m}}{\text{s}^2}[\text{E}]$$

C) $$\vec{a} = \frac{(30-20)\,\frac{\text{m}}{\text{s}}[\text{E}]}{(30-20)\text{ s}} = 1\,\frac{\text{m}}{\text{s}^2}[\text{E}]$$

(d) $$\vec{a}_{\text{ave}} = \frac{(30-20)\,\frac{\text{m}}{\text{s}}[\text{E}]}{(30-10)\text{ s}} = 0.5\,\frac{\text{m}}{\text{s}^2}[\text{E}]$$

(e) The slope of the tangent is found at 33 s.

$$\vec{a} = \frac{\Delta\vec{v}}{\Delta t} = \frac{-12\,\frac{\text{m}}{\text{s}}[\text{E}]}{4\text{ s}} = -3.0\,\frac{\text{m}}{\text{s}^2}[\text{E}] = 3.0\,\frac{\text{m}}{\text{s}^2}[\text{W}]$$

2. **(a)** dynamics **(b)** motion

(c) area **(d)** tangent

3. **(a)** $$\Delta\vec{d} = v_{\text{f}}\Delta t - \frac{1}{2}a\Delta t^2$$

60 m = 12 $\frac{\text{m}}{\text{s}}$(3 s) – $\frac{1}{2}$ a (9 s^2)

60 m = 36 m – 4.5 a(s^2)

24 m = –4.5 a(s^2)

$$\vec{a} = -\frac{24\text{ m}}{4.5\text{ s}^2}$$

$$\vec{a} = -5.33\,\frac{\text{m}}{\text{s}^2}$$

$$\Delta d = \left(\frac{v_1 + v_{\text{f}}}{2}\right)\Delta t$$

$$60\text{ m} = \left(\frac{v_1 + 12\,\frac{\text{m}}{\text{s}}}{2}\right)3\text{s}$$

120m = 3v_1(s) + 36 m

3v_1(s) = 120 m – 36 m

$$v_1 = \frac{84\text{ m}}{3\text{ s}} = 28\,\frac{\text{m}}{\text{s}}$$

4. When the Ferrari catches up to the Jaguar, they will have travelled the same distance during the same time interval. The Jaguar is 80 km ahead, which the Ferrari must make up.

$$\Delta d_{Ferrari} = \Delta d_{Jaguar}$$

$$100\ \tfrac{\text{km}}{\text{h}}(\Delta t) = 80\ \text{km} + 60\ \tfrac{\text{km}}{\text{h}}(\Delta t)$$

$$100\ \tfrac{\text{km}}{\text{h}}(\Delta t) - 60\ \tfrac{\text{km}}{\text{h}}(\Delta t) = 80\ \text{km}$$

$$40\ \tfrac{\text{km}}{\text{h}}(\Delta t) = 80\ \text{km}$$

$$\Delta t = 2\ \text{h}$$

$$\therefore \Delta d_{\text{Ferrari}} = 100\ \tfrac{\text{km}}{\text{h}} \times 2\ \text{h} = 200\ \text{km}$$

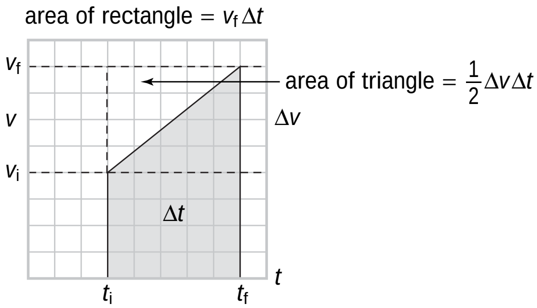
The Ferrari catches up to the Jaguar after travelling 200 km.

BLM 3-1: Kinematics Equations/Skill Builder

Answers

1. $a = \dfrac{v_f - v_1}{\Delta t}$	**(a)** $v_1 = v_f - a\Delta t$ **(b)** $v_f = v_1 + a\Delta t$ **(c)** $\Delta t = \dfrac{v_f - v_1}{a}$
2. $\Delta d = \left(\dfrac{v_1 + v_f}{2}\right)\Delta t$	**(a)** $v_1 = \dfrac{2\Delta d - v_f\Delta t}{\Delta t}$ **(b)** $v_f = \dfrac{2\Delta d - v_1\Delta t}{\Delta t}$ **(c)** $\Delta t = \left(\dfrac{2}{v_1 + v_f}\right)\Delta d$
3. $\Delta d = v_1\Delta t + \frac{1}{2}a\Delta t^2$	**(a)** $v_1 = \dfrac{\Delta d}{\Delta t} - \dfrac{1}{2}a\Delta t$ **(b)** $a = \dfrac{2}{\Delta t}\left(\dfrac{\Delta d}{\Delta t} - v_1\right)$
4. $\Delta d = v_f\Delta t - \frac{1}{2}a\Delta t^2$	**(a)** $v_f = \dfrac{\Delta d}{\Delta t} + \dfrac{1}{2}a\Delta t$ **(b)** $\alpha = \dfrac{2}{\Delta t}\left(v_f - \dfrac{\Delta d}{\Delta t}\right)$

2.



Since $\Delta v = a\Delta t$, the area of the triangle can be written as $\frac{1}{2}a\Delta t\Delta t$ or $\frac{1}{2}a\Delta t^2$.

Thus, the shaded are under the graph Δd is equal to the area of the rectangle minus the area of the triangle.

$$\Delta d = v_f \Delta t - \frac{1}{2}a\Delta t^2$$

BLM 4-2: Chapter 4 Test/Assessment

Answers

1. **(a)** F: The branch of physics that explains why objects move the way they do is called dynamics.

(b) T

(c) T

(d) F: The force of friction is independent on the area of contact.

(e) T

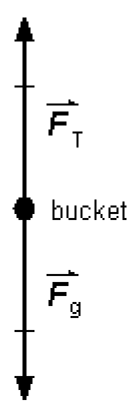
2.

$$\vec{F} = m\vec{g}$$

$$m = \frac{\vec{F}}{\vec{g}} = \frac{30.0\ \text{N[down]}}{9.81\,\frac{\text{m}}{\text{s}^2}\text{[down]}} = 3.06\ \text{kg}$$

3. When an object exerts a force on a flat surface, that surface will exert a force back on the object in a direction perpendicular to the surface. Such a force is called a normal force.

4. **(a)**



(b)

$$F_T = F_g = mg$$

$$F_T = (4.2\ \text{kg})\left(9.81\ \frac{\text{m}}{\text{s}^2}\right) = 41\ \text{N}$$

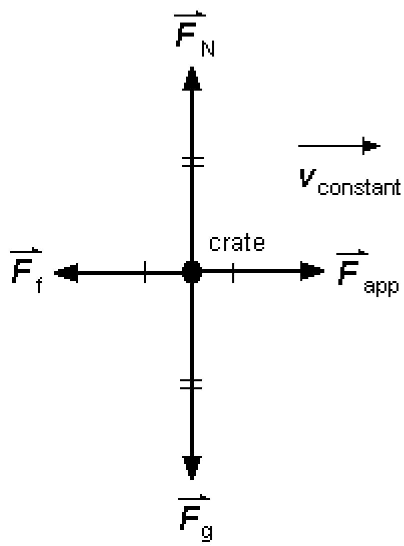
5.

$$F_f = \mu F_N$$
$$F_{app} = F_f = \mu mg$$
$$F_{app} = 0.21(78\ \text{kg})\left(9.81\frac{\text{m}}{\text{s}^2}\right) = 1.6\times10^2\ \text{N}$$

6. **(a)**

$$F_f = \mu F_N$$
$$F_f = \mu mg$$
$$\mu = \frac{F_f}{mg} = \frac{75\ \text{N}}{(65\ \text{kg})\left(9.81\frac{\text{m}}{\text{s}^2}\right)} = 0.12$$

(b)



BLM 5-7: Chapter 5 Test/Assessment

Answers

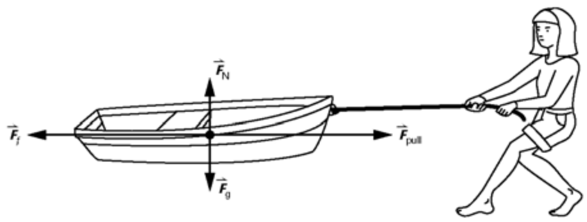
1. first
2. second
3. an equal
4. the net force acting on it is zero
5. terminal velocity
6. N•s
7. impulse
8. The net force is acting upward.
9. $\vec{F} = m\vec{a}$

$$\vec{F} = (6.0\ \text{kg})\left(12.0\ \frac{\text{m}}{\text{s}^2}[\text{forward}]\right)$$
$$\vec{F} = 72\ \text{N}[\text{forward}]$$

10. As the elevator slows to a stop, your acceleration is downward, so the net force on you is downward: $\vec{F}_{\text{net}} = m\vec{a}$ Since $\vec{a}$ is negative, $\vec{F}_{\text{net}}$ is negative or downward. The net force on you is the sum of the gravitational force acting downward and the normal force of the elevator acting upward: $\vec{F}_{\text{net}} = -\vec{F}_{\text{g}} + \vec{F}_{\text{N}} < 0$; therefore, $\vec{F}_{\text{N}} < \vec{F}_{\text{g}}$. Since the normal force is less than the gravitational force and the normal force is your apparent weight, your apparent weight would decrease.

11. The force exerted by your arm muscles and the force exerted by the rope are forces acting on your hand.

12. **(a)**



(b) There is no net force on the boat, because it has neither vertical nor horizontal acceleration.

(c) Action-reaction pairs are forces that act on different objects and have equal magnitudes but opposite directions. The drawing shows an action-reaction pair: The woman pulls the boat with the same force with which the boat pulls her.

13.

$$\vec{F}_{\text{net(on elevator)}} = m\vec{a}$$

$$\vec{F}_{\text{cable}} + \vec{F}_{\text{g}} = m\vec{a}$$

$$\vec{F}_{\text{cable}} + m\vec{g} = m\vec{a}$$

$$\vec{F}_{\text{cable}} = m\vec{a} - m\vec{g}$$

$$\vec{F}_{\text{cable}} = \left(1.10\times10^3\ \text{kg}\right)\left[+0.45\ \frac{\text{m}}{\text{s}^2} - \left(-9.81\ \frac{\text{m}}{\text{s}^2}\right)\right]$$

$$\vec{F}_{\text{cable}} = 1.1\times10^4\ \text{N}[\text{upward}]$$

Since the cable is exerting an upward force on the elevator, the elevator is exerting a downward force of 1.1×10^4 N on the cable.

14. **(a)** $F_{\text{g}} = mg$

$$m = \frac{F_{\text{g}}}{g}$$

$$m = \frac{2.0\times10^7\ \text{N}}{9.81\ \frac{\text{m}}{\text{s}^2}}$$

$$m = 2.04\times10^6\ \text{kg}$$

The mass of the rocket is 2.0×10^6 kg.

(b)

$$\vec{F}_{\text{net}} = m\vec{a}$$

$$\vec{a} = \frac{\vec{F}_{\text{engines}} + \vec{F}_{\text{g}}}{m}$$

$$\vec{a} = \frac{\left(2.5\times10^7\ \text{N}\right) - \left(2.0\times10^7\ \text{N}\right)}{2.04\times10^6\ \text{kg}}$$

$$\vec{a} = 2.45\ \frac{\text{m}}{\text{s}^2}[\text{upward}]$$

The acceleration of the rocket is 2.5 m/s^2[upward].

(c)

$$v = v_{\text{i}} + at$$

$$v = 0 + \left(10.0\ \frac{\text{m}}{\text{s}^2}\right)(7.0\ \text{min})\left(60\ \frac{\text{s}}{\text{min}}\right)$$

$$v = 4.2\times10^3\ \frac{\text{m}}{\text{s}}[\text{upward}]$$

The rocket reaches a velocity of 4.2×10^3 m/s[upward].

15. **(a)**

$$v = v_{\text{i}} + a\Delta t$$

$$\Delta t = \frac{v - v_{\text{i}}}{a}$$

$$\Delta t = \frac{0 - 45.0\ \frac{\text{m}}{\text{s}}}{-9.81\ \frac{\text{m}}{\text{s}^2}}$$

$$\Delta t = 4.59\ \text{s}$$

It takes the flare 4.59 s to reach its highest point.

14. (a) $F_g = mg$

$$m = \frac{F_g}{g}$$

$$m = \frac{2.0 \times 10^7 \text{ N}}{9.81 \ \frac{\text{m}}{\text{s}^2}}$$

$$m = 2.04 \times 10^6 \text{ kg}$$

The mass of the rocket is 2.0×10^6 kg.

(b)

$$\vec{F}_{\text{net}} = m\vec{a}$$

$$\vec{a} = \frac{\vec{F}_{\text{engines}} + \vec{F}_g}{m}$$

$$\vec{a} = \frac{\left(2.5 \times 10^7 \text{ N}\right) - \left(2.0 \times 10^7 \text{ N}\right)}{2.04 \times 10^6 \text{ kg}}$$

$$\vec{a} = 2.45 \ \frac{\text{m}}{\text{s}^2}[\text{upward}]$$

The acceleration of the rocket is 2.5 m/s^2[upward].

(c)

$$v = v_i + at$$

$$v = 0 + \left(10.0 \ \frac{\text{m}}{\text{s}^2}\right)(7.0 \text{ min})\left(60 \ \frac{\text{s}}{\text{min}}\right)$$

$$v = 4.2 \times 10^3 \ \frac{\text{m}}{\text{s}}[\text{upward}]$$

The rocket reaches a velocity of
4.2×10^3 m/s[upward].

15. (a)

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

$$\Delta t = \frac{v - v_i}{a}$$

$$\Delta t = \frac{0 - 45.0 \ \frac{\text{m}}{\text{s}}}{-9.81 \ \frac{\text{m}}{\text{s}^2}}$$

$$\Delta t = 4.59 \text{ s}$$

It takes the flare 4.59 s to reach its highest point.

(b)

$$\Delta d = v_{\mathrm{i}} + \frac{1}{2}a\Delta t^2$$

$$\Delta d = 0.0\ \frac{\mathrm{m}}{\mathrm{s}} + \frac{1}{2}\left(9.81\frac{\mathrm{m}}{\mathrm{s}^2}\right)(4.587\ \mathrm{s})^2$$

$$\Delta d = 1.03\times10^2\ \mathrm{m}$$

The flare rises to 1.03×10^2 m above ground.

16. (a)

$$\Delta d = v_{\mathrm{i}}\Delta t + \frac{1}{2}a\Delta t^2$$

$$\Delta d = 0 + \frac{1}{2}g\Delta t^2$$

$$\Delta t = \sqrt{\frac{2\Delta d}{g}}$$

$$\Delta t = \sqrt{\frac{2(-8.00\ \mathrm{m})}{-9.81\frac{\mathrm{m}}{\mathrm{s}^2}}}$$

$$\Delta t = 1.28\,\mathrm{s}$$

The acorn is in the air for 1.28 s.

(b)

$$v = v_{\mathrm{i}} + a\Delta t$$

$$v = 0.0\ \frac{\mathrm{m}}{\mathrm{s}} + \left(-9.81\ \frac{\mathrm{m}}{\mathrm{s}^2}\right)(1.277\ \mathrm{s})$$

$$v = -12.5\ \frac{\mathrm{m}}{\mathrm{s}}$$

The acorn's velocity is 12.5 m/s[downward] when it reaches the ground.

17.

$$\vec{F}\Delta t = \Delta\vec{p}$$

$$\vec{F} = \frac{m(\vec{v}_{\mathrm{f}} - \vec{v}_{\mathrm{i}})}{\Delta t}$$

$$\vec{F} = \frac{(0.057\ \mathrm{kg})\left[(10\ \tfrac{\mathrm{m}}{\mathrm{s}}) - (-13\ \tfrac{\mathrm{m}}{\mathrm{s}})\right]}{7.00\times10^{-3}\ \mathrm{s}}$$

$$\vec{F} = 1.87\times10^2\ \mathrm{N}$$

The average force of the racquet on the ball was 1.9×10^2 N.

18. Cars are made with bumpers that retract during a collision in order to increase the time of the collision, thus reducing the force of the impact.

BLM 6-4: Chapter 6 Test/Assessment

Answers

1. $W = F_{\parallel}\Delta d$ = (10.0 N) (0.50 m) = 5.0J

2. $W = mg\Delta h$ = (110 kg) (9.80 $\frac{\mathrm{m}}{\mathrm{s}^2}$) (2.8 m)
= 3018.4 J = 3.0×10^3 J

3. $W = F\Delta d \cos\theta$ = (160 N) (15 m) (cos 40°)
= 1838.5 J = 1.8×10^3 J

4. $E_{\mathrm{k}} = mv^2$ = (1000 kg) $(25\frac{\mathrm{m}}{\mathrm{s}})^2$
= 312 500 J = 3×10^5 J

5. $W = E_{\mathrm{k}} = E_{\mathrm{k2}} - E_{\mathrm{k1}}$

$W = \frac{1}{2}mv_2{}^2 - 0$

$50\text{ J} = \frac{1}{2}(30\text{ kg})(v_2{}^2)$

$v_2{}^2 = (50\text{ J}) \div \left(\frac{1}{2}\right)(3.0\text{ kg})$

$v_2 = 3.3\text{ m/s}$

6. $E_g = mg\Delta h$

$= (65\text{ kg})(9.80\ \frac{\text{m}}{\text{s}^2})(10.0\text{ m})$

$= 6370\text{J} = 6.4 \times 10^3\text{ J}$

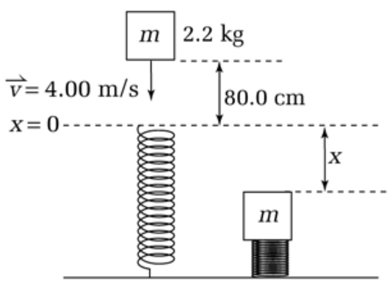
7. $E_{g\,(top)} = E_{k\,(bottom)}$

$6370\text{ J} = \frac{1}{2}\text{m}v_2$

$v^2 = (6370) \div \left(\frac{1}{2}\right)(65\text{ kg})$

$v = 14\text{ m/s}$

8. The spring was compressed approximately 0.76 m.



Let the maximum compression of the spring be x. Consider x to be in the vertical direction.

$$E_g' + E_k' + E_e' = E_g + E_k + E_e$$

$$mgx + 0\text{ J} + \tfrac{1}{2}kx^2 = mg\Delta h + \tfrac{1}{2}mv^2 + 0\text{ J}$$

$$(2.2\text{ kg})\left(9.81\ \frac{\text{m}}{\text{s}^2}\right)(x) + \tfrac{1}{2}\left(65\ \frac{\text{N}}{\text{m}}\right)(x)^2$$

$$= (2.2\text{ kg})\left(9.81\ \frac{\text{m}}{\text{s}^2}\right)(0.80\text{ m}) + \tfrac{1}{2}(2.2\text{ kg})\left(4.00\ \frac{\text{m}}{\text{s}}\right)^2$$

$$32.5\text{ Nm}\,x^2 + 21.582\text{ kg}\frac{\text{m}^2}{\text{s}^2}x - 34.8656\text{ kg}\frac{\text{m}^2}{\text{s}^2} = 0$$

Use the quadratic equation to solve for x.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-21.582 \pm \sqrt{(21.582)^2 - 4(32.5)(-34.8656)}}{2(32.5)}$$

$$x = 0.75564\text{ m} \ \text{ or } \ -1.41970\text{ m}$$

Since the mass has gone below the reference level
of $x = 0$, the value of x must be negative. Therefore, choose the value $x \cong -1.4$ m.

9. (a) The spring constant of the diving board was 1.3×10^3 N/m.

$$F = kx$$
$$k = \frac{F}{x}$$
$$k = \frac{mg}{\lambda}$$
$$k = \frac{735.75\ \text{N}}{0.55\ \text{m}}$$
$$k \cong 1.3 \times 10^3\ \frac{\text{N}}{\text{m}}$$

(b) At this point, all of the elastic potential energy of the diving board is transferred to the diver as kinetic energy. The diver's maximum speed will be 2.3 m/s.

$$E_\text{e}' + E_\text{k}' = E_\text{e} + E_\text{k}$$
$$0\ \text{J} + \tfrac{1}{2}mv^2 = \tfrac{1}{2}kx^2 + 0\ \text{J}$$
$$v = \sqrt{\frac{kx^2}{m}}$$
$$v = \sqrt{\frac{1337.73\ \tfrac{\text{N}}{\text{m}}(0.55\ \text{m})^2}{75.0\ \text{kg}}}$$
$$v \cong 2.3\ \frac{\text{m}}{\text{s}}$$

(c) The diver's kinetic energy is transformed into gravitational potential energy at the maximum height, which is 28 cm above the board.

$$E_\text{g}' + E_\text{k}' = E_\text{g} + E_\text{k}$$
$$mg\Delta h + 0\ \text{J} = 0\ \text{J} + \tfrac{1}{2}mv^2$$
$$\Delta h = \frac{v^2}{2g}$$
$$\Delta h = \frac{(2.32\ \tfrac{\text{m}}{\text{s}})^2}{2(9.81\tfrac{\text{m}}{\text{s}^2})}$$
$$\Delta h \cong 0.28\ \text{m}$$

10. (a) Maximum elastic potential energy of the spring: 29 J

$$E_\text{e} = \tfrac{1}{2}kx^2$$
$$E_\text{e} = \tfrac{1}{2}\left(750\ \frac{\text{N}}{\text{m}}\right)(0.28\ \text{m})^2$$
$$E_\text{e} \cong 29\ \text{J}$$

(b) Maximum velocity of the ball: approximately 5.4 m/s

$$E'_\mathrm{k} + E'_\mathrm{e} = E_\mathrm{k} + E_\mathrm{e}$$

$$\tfrac{1}{2}mv^2 + 0\ \mathrm{J} = 0\ \mathrm{J} + \tfrac{1}{2}kx^2$$

$$v = \sqrt{\frac{kx^2}{m}}$$

$$v = \sqrt{\frac{\left(750\ \tfrac{\mathrm{N}}{\mathrm{m}}\right)(0.28\ \mathrm{m})^2}{2.0\ \mathrm{kg}}}$$

$$v \cong 5.4\ \frac{\mathrm{m}}{\mathrm{s}}$$

(c) Maximum vertical height of the ball up the ramp: 1.5 m

$$E'_\mathrm{k} + E'_\mathrm{g} = E_\mathrm{k} + E_\mathrm{g}$$

$$0\ \mathrm{J} + mg\Delta h = \tfrac{1}{2}mv^2 + 0\ \mathrm{J}$$

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

$$\Delta h = \frac{(5.42\ \tfrac{\mathrm{m}}{\mathrm{s}})^2}{2(9.81\tfrac{\mathrm{m}}{\mathrm{s}^2})}$$

$$\Delta h \cong 1.5\ \mathrm{m}$$

11. (a)

12. $P = \dfrac{W}{\Delta t}$

$$= \frac{mg\Delta h}{\Delta t}$$

$$= \frac{(1000\ \mathrm{kg})\ (9.81\tfrac{\mathrm{m}}{\mathrm{s}^2})\ (12\ \mathrm{m})}{30\ \mathrm{s}}$$

$$= 3900\ \mathrm{W}$$

13. efficiency = $\dfrac{\mathrm{E_{out}}}{\mathrm{E_{in}}} \times 100\%$

$$\mathrm{E_{in}} = \frac{100\ \mathrm{J}}{0.040}$$

$$= 2500\ \mathrm{J}$$

BLM 7-5: Chapter 7 Test/Assessment

Answers

1. **(a)** opposite

   (b) mechanical

   (c) positive, increases

   (d) conservative

   (e) third

   (f) equal

   (g) impulse

2.(a) Speed of the roller coaster at point B: 12.7 m/s

$$E_{\mathrm{k}}' + E_{\mathrm{g}}' + E_{\mathrm{heat}} = E_{\mathrm{k}} + E_{\mathrm{g}}$$

$$\tfrac{1}{2}mv_{\mathrm{B}}{}^2 + mg\Delta h_{\mathrm{B}} + E_{\mathrm{heat}} = \tfrac{1}{2}mv_{\mathrm{A}}{}^2 + mg\Delta h_{\mathrm{A}}$$

$$\tfrac{1}{2}mv_{\mathrm{B}}{}^2 = -mg\Delta h_{\mathrm{B}} - E_{\mathrm{heat}} + \tfrac{1}{2}mv_{\mathrm{A}}{}^2 + mg\Delta h_{\mathrm{A}}$$

$$v_{\mathrm{B}} = \sqrt{\frac{2(-mg\Delta h_{\mathrm{B}} - E_{\mathrm{heat}} + \tfrac{1}{2}mv_{\mathrm{A}}{}^2 + mg\Delta h_{\mathrm{A}})}{m}}$$

$$v_{\mathrm{B}} = \sqrt{\frac{2\left[-(6.1803\times10^4\ \tfrac{\mathrm{kg\cdot m^2}}{\mathrm{s^2}}) - (1.24\times10^5\ \mathrm{J}) + (1.1250\times10^4\ \mathrm{J}) + (2.4721\times10^5\ \tfrac{\mathrm{kg\cdot m^2}}{\mathrm{s^2}})\right]}{900.0\ \mathrm{kg}}}$$

$$v_{\mathrm{B}} = 12.7\ \frac{\mathrm{m}}{\mathrm{s}}$$

(b) The brakes do work on the roller coaster to reduce its kinetic energy to zero after 10.0 m. The frictional braking force is in the opposite direction of the motion and is -7.26×10^3 N.

$$W = \Delta E_{\mathrm{k}}$$

$$F\Delta d = E_{\mathrm{k\,f}} - E_{\mathrm{k\,i}}$$

$$F = \frac{0 - \tfrac{1}{2}(900.0\ \mathrm{kg})(12.7\ \tfrac{\mathrm{m}}{\mathrm{s}})^2}{10.0\ \mathrm{m}}$$

$$F = -7.26\times10^3\ \mathrm{N}$$

3. The water going over the falls will increase in temperature by approximately 2.3°C.

$$W = \Delta E_{\mathrm{g}}$$

$$W = mg\Delta h$$

$$Q_{\mathrm{gained}} = W$$

$$Q_{\mathrm{gained}} = (1.0\ \mathrm{kg})\left(9.81\ \frac{\mathrm{m}}{\mathrm{s^2}}\right)(979.0\ \mathrm{m})$$

$$Q_{\mathrm{gained}} = 9603.99\ \mathrm{J}$$

$$mc\Delta T = Q_{\mathrm{gained}}$$

$$\Delta T = \frac{Q_{\mathrm{gained}}}{mc_{\mathrm{w}}}$$

$$\Delta T = \frac{9603.99\ \mathrm{J}}{1.0\ \mathrm{kg}(4186\ \tfrac{\mathrm{J}}{\mathrm{kg\cdot^\circ C}})}$$

$$\Delta T \cong 2.3^\circ\mathrm{C}$$

4. The average force of the racquet on the ball was 1.9×10^2 N.

$$\vec{F}\Delta t = \Delta\vec{p}$$

$$\vec{F} = \frac{m(\vec{v}_\text{f} - \vec{v}_\text{i})}{\Delta t}$$

$$\vec{F} = \frac{(0.057\text{ kg})\left[(10\tfrac{\text{m}}{\text{s}}) - (-13\tfrac{\text{m}}{\text{s}})\right]}{7.00\times10^{-3}\text{s}}$$

$$\vec{F} \cong 1.9\text{ N}$$

5. Cars are made with bumpers that retract during a collision in order to increase the time of the collision, thus reducing the force of the impact

BLM 8-6: Chapter 8 Test/Assessment

Answers

1. frequency, period, wavelength, speed, amplitude

2. $$v = \frac{\lambda}{T} = \frac{2.5\text{ m}}{1.5\text{ s}} = 1.67\text{ m/s}$$

$$\Delta t = \frac{d}{v} = \frac{8\text{ m}}{1.67\text{ m/s}} = 4.8\text{ s}$$

3. **(a)** Three wavelengths are shown.

   (b) Wavelength is 8 cm.

   (c) Amplitude is 3 cm.

   (d) Particle moves 12 cm during the passage of one wave.

4. $$f = \frac{25}{1\text{ min}} = \frac{25}{60\text{ s}} = 0.42\text{ Hz}$$

$$v = f \times 2.0\text{ m} = 0.84\text{ m/s}$$

5. If the original pulse is erect, the transmitted pulse is also erect, but the reflected pulse is inverted.

6. The height of the resultant wave is the sum of the amplitudes of the individual waves.

7. The size of the opening should be nearly the same size as the size of one wavelength.

8. Constructive, destructive

BLM 9-7: Chapter 9 Test/Assessment

Answers

1. longitudinal
2. compressions, rarefactions
3. oscilloscope
4. optically less dense
5. interference fringes
6. diffraction
7. one wavelength
8. $n_{\text{air}} = 1.00$

$$n_{\text{i}} \sin\theta_{\text{i}} = n_{\text{R}} \sin\theta_{\text{R}}$$
$$n_{\text{i}} \sin 52° = (1.00)\sin 90°$$
$$n_{\text{i}} = \frac{1.00 \times 1.000}{\sin 52°}$$
$$n_{\text{i}} = \frac{1.00 \times 1.000}{0.7880}$$
$$n_{\text{i}} = 1.27$$

The index of refraction for the plastic is 1.27.

9. fundamental frequency, f_1 = 128 Hz

frequency of first overtone = $2f_1$ = 256 Hz

frequency of second overtone = $3f_1$ = 384 Hz

10. frequency of first harmonic, f_1 = 256 Hz velocity of sound, v = 344 m/s

$$f_1 = \frac{v}{4L}$$
$$L = \frac{v}{4f_1}$$
$$L = \frac{344 \text{ m/s}}{4(256 \text{ s}^{-1})}$$
$$L = 0.336 \text{ m}$$

The length of the air column is 0.336 m.

11. The beat frequency is equal to the absolute value of the difference between two frequencies.

$$f_{\text{beat}} = |f_2 - f_1|$$
$$f_{\text{beat}} = |443 - 437|$$
$$f_{\text{beat}} = 6 \text{ Hz}$$
$$6 \text{ Hz} \times 5 \text{ s} = 30$$

In five seconds, 30 beats will be heard.

$$\lambda \cong \frac{\Delta y d}{x}$$

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12.

$$\lambda \cong \frac{\Delta y d}{x}$$
$$\Delta y \cong \frac{\lambda x}{d}$$
$$\Delta y \cong \frac{(0.800 \text{ m})(5.70 \times 10^{-7} \text{ m})}{1.90 \times 10^{-5} \text{ m}}$$
$$\Delta y \cong 0.024 \text{ m}$$

The distance from the central line to the first-order line will be 0.024 m.