

# ANSWERS

## TO CHECK YOUR UNDERSTANDING

### CHAPTER 1

- CYU 1:** (a) Yes.  
(b) No.
- CYU 2:** No.
- CYU 3:** a, b, c, f
- CYU 4:** No.
- CYU 5:** b, d
- CYU 6:** (a) 11 m  
(b) 5 m
- CYU 7:** No.
- CYU 8:** Yes.
- CYU 9:** (a) The magnitude of  $\vec{B}$  is equal to the magnitude of  $\vec{A}$ .  
(b) The direction of  $\vec{B}$  is opposite to the direction of  $\vec{A}$ .
- CYU 10:** Vector  $\vec{A}$  is perpendicular to vector  $\vec{B}$ .
- CYU 11:** Vector  $\vec{A}$  points in the same direction as vector  $\vec{B}$ .
- CYU 12:**  $\vec{A}$  and  $\vec{D}$
- CYU 13:** (a)  $A_x$  is  $-$  and  $A_y$  is  $+$   
(b)  $B_x$  is  $+$  and  $B_y$  is  $-$   
(c)  $R_x$  is  $+$  and  $R_y$  is  $+$
- CYU 14:** No.
- CYU 15:** Yes.
- CYU 16:** (a)  $A_x = 0$  units and  $A_y = +12$  units  
(b)  $A_x = -12$  units and  $A_y = 0$  units  
(c)  $A_x = 0$  units and  $A_y = -12$  units  
(d)  $A_x = +12$  units and  $A_y = 0$  units
- CYU 17:** No.
- CYU 18:** a

### CHAPTER 2

- CYU 1:** 0 m
- CYU 2:** scalar quantity
- CYU 3:** No.
- CYU 4:** a
- CYU 5:** average velocity = 2.7 m/s due east, average speed = 8.0 m/s
- CYU 6:** Yes.
- CYU 7:** No.
- CYU 8:** c
- CYU 9:** No.
- CYU 10:** No.
- CYU 11:** the rifle with the short barrel
- CYU 12:** 1.73  $v$
- CYU 13:** a
- CYU 14:** b
- CYU 15:** b
- CYU 16:** b

### CHAPTER 3

- CYU 1:** b
- CYU 2:** c
- CYU 3:** a and c
- CYU 4:** (a) Yes; when the object is at its highest point.  
(b) No.
- CYU 5:** No.
- CYU 6:** b
- CYU 7:** (a) when the ball is at its highest point in the trajectory  
(b) at the initial and final positions of the motion
- CYU 8:** Yes.
- CYU 9:** Both bullets reach the ground at the same time.
- CYU 10:** (a) The displacement is greater for the stone thrown horizontally.  
(b) The impact speed is greater for the stone thrown horizontally.  
(c) The time of flight is the same for both stones.
- CYU 11:** No.
- CYU 12:** Ball A has the greater launch speed.
- CYU 13:** (a) +70 m/s  
(b) +30 m/s  
(c) +40 m/s  
(d) -60 m/s
- CYU 14:** No.
- CYU 15:** The two times are the same.
- CYU 16:** (a) The range toward the front is the same as the range toward the rear.  
(b) The range toward the front is greater than the range toward the rear.
- CYU 17:** swimmer A

### CHAPTER 4

- CYU 1:** b
- CYU 2:** c
- CYU 3:** d
- CYU 4:** No, because two or more forces can cancel each other, leading to a net force of zero.
- CYU 5:** c
- CYU 6:** a and d
- CYU 7:** b
- CYU 8:** Yes, because the ratio of the two weights depends only on the masses of the objects, which are the same on the earth and on Mars.
- CYU 9:** a
- CYU 10:** d

**CYU 11:** No.

**CYU 12:** a

**CYU 13:** b

**CYU 14:** c

**CYU 15:** To pull, because the upward component of the pulling force reduces the normal force and, therefore, also reduces the force of kinetic friction acting on the sled.

**CYU 16:** 43°

**CYU 17:** c, a, b

**CYU 18:** a

**CYU 19:** a

**CYU 20:** b

**CYU 21:** d

**CYU 22:** No, because there must always be a vertical (upward) component of the tension force in the rope to balance the weight of the crate.

**CYU 23:** c

**CYU 24:** No, because the transfer described does not change the total mass being pulled by the engine.

**CYU 25:** a

### CHAPTER 5

- CYU 1:** (a) The velocity is due south and the acceleration is due west.  
(b) The velocity is due west and the acceleration is due north.
- CYU 2:** Yes, if you are going around a curve.
- CYU 3:** the person at the equator
- CYU 4:** a and b
- CYU 5:**  $AB$  or  $DE$ ,  $CD$ ,  $BC$
- CYU 6:** (a)  $4r$   
(b)  $4r$
- CYU 7:** No.
- CYU 8:** the same
- CYU 9:** edge of the turntable
- CYU 10:** car B
- CYU 11:** less than
- CYU 12:** (a) less than  
(b) equal to
- CYU 13:** (a) Yes.  
(b) Yes.  
(c) Yes.  
(d) Yes.
- CYU 14:** vertical

### CHAPTER 6

**CYU 1:** b

**CYU 2:** d

**CYU 3:** d

## A-10 ANSWERS TO CHECK YOUR UNDERSTANDING

- CYU 4: a  
 CYU 5: No.  
 CYU 6: c  
 CYU 7: false  
 CYU 8: c  
 CYU 9: a  
 CYU 10: a, b, and c  
 CYU 11: b  
 CYU 12: d  
 CYU 13: b and d  
 CYU 14: e  
 CYU 15: c  
 CYU 16: a  
 CYU 17: No.

## CHAPTER 7

- CYU 1: No.  
 CYU 2: The total linear momentum is approximately zero because of the random directions and random speeds of the moving people.  
 CYU 3: (a) Yes.  
 (b) No.  
 CYU 4: (a) No.  
 (b) Yes.  
 CYU 5: b  
 CYU 6: (a) No.  
 (b) The impulse of the thrust is equal in magnitude and opposite in direction to the impulse of the force due to air resistance.  
 CYU 7: (a) No.  
 (b) No.  
 CYU 8: equal to  
 CYU 9: Yes.  
 CYU 10: a  
 CYU 11: decrease  
 CYU 12: (a) No.  
 (b) decrease  
 CYU 13: b, c, d  
 CYU 14: the cannonball  
 CYU 15: d  
 CYU 16: No. It is the total kinetic energy of the *system* that is the same before and after the collision.  
 CYU 17: c  
 CYU 18: nearer the heavier end  
 CYU 19: (a) zero  
 (b) Yes, opposite to the motion of the sunbather.  
 CYU 20: a

## CHAPTER 8

- CYU 1: Both axes lie in the plane of the paper. One passes through point A and is parallel to the line BC. The other passes through point A and the midpoint of the line BC.  
 CYU 2: B, C, A  
 CYU 3: No. The instantaneous angular speed of each blade is the same, but the blades are rotating in opposite directions.  
 CYU 4: c

- CYU 5: 1.0 rev/s  
 CYU 6: b  
 CYU 7: Case A  
 CYU 8: a  
 CYU 9: at the north pole or at the south pole  
 CYU 10: c  
 CYU 11: 0.30 m  
 CYU 12: d  
 CYU 13: c  
 CYU 14: b  
 CYU 15:  $8.0 \text{ m/s}^2$   
 CYU 16: a  
 CYU 17: Among the many possible answers are the motions of a Frisbee through the air, the earth in its orbit, a twirling baton that has been thrown into the air, the blades on a moving lawn mower cutting the grass, and an ice skater performing a quadruple jump.

## CHAPTER 9

- CYU 1:  $0^\circ, 45^\circ, 90^\circ$   
 CYU 2: greater torque  
 CYU 3: (a) Yes, if the lever arm is very small.  
 (b) Yes, if the lever arm is very large.  
 CYU 4: the box at the far right  
 CYU 5: (a) C  
 (b) A  
 (c) B  
 CYU 6: Additional forces are necessary.  
 CYU 7: a  
 CYU 8: b  
 CYU 9: Bob  
 CYU 10: A, B, C  
 CYU 11: axis B  
 CYU 12: (a) remains the same  
 (b) remains the same  
 CYU 13: (a) remains the same  
 (b) increases  
 CYU 14: (a) Both have the same translational speed.  
 (b) Both have the same translational speed.  
 CYU 15: axis B  
 CYU 16: solid sphere, solid cylinder, spherical shell, hoop  
 CYU 17: (a) decreases  
 (b) remains the same  
 CYU 18: decrease  
 CYU 19: greater than  
 CYU 20: No.

## CHAPTER 10

- CYU 1: No, because the force of gravity acting on the ball is constant, unlike the restoring force of simple harmonic motion.  
 CYU 2: Both boxes experience the same net force due to the springs.

- CYU 3: 180 N/m  
 CYU 4: The spring stretches more when attached to the wall.  
 CYU 5: object II  
 CYU 6: at the position  $x = 0 \text{ m}$   
 CYU 7: The particle can cover the greater distance in the same time because at larger amplitudes the maximum speed is greater  
 CYU 8: The same amount of energy is stored in both cases, since the elastic potential energy is proportional to the square of the displacement  $x$ .  
 CYU 9: b, c, a  
 CYU 10: The amplitude is unchanged. The frequency and maximum speed each decrease by a factor of  $\sqrt{2}$ .  
 CYU 11: a  
 CYU 12: the simple-pendulum clock, because its period depends on the acceleration due to gravity  
 CYU 13: Use a shoe and the shoe laces to make a simple pendulum whose period is related to the magnitude  $g$  of the acceleration due to gravity (see Equations 10.5 and 10.16). Measure the period of your pendulum and calculate  $g$ .  
 CYU 14: Yes, because for small angles the period of each person's motion is the same.  
 CYU 15: Yes, because the frequency depends on the mass of the car and its occupants (see Equations 10.6 and 10.11).  
 CYU 16:  $v = \frac{d}{2\pi} \sqrt{\frac{k}{m}}$   
 CYU 17: b  
 CYU 18: The rod with the square cross section is longer.  
 CYU 19: No, because the value of  $B$  given in Table 10.3 applies to solid aluminum, not to a can that is mostly empty space.  
 CYU 20: No, because pressure involves a force that acts *perpendicular* to an area. In Equation 10.18 for shear deformation, the force acts parallel, not perpendicular, to the area  $A$  (see Figure 10.31).  
 CYU 21: Face B experiences the largest stress, and face C experiences the smallest stress.

## CHAPTER 11

- CYU 1: (a) outward  
 (b) inward  
 CYU 2: b  
 CYU 3: a  
 CYU 4: (a) increase  
 (b) decrease  
 (c) remain constant

**CYU 5:** A noticeable amount of water will remain in the tank.

**CYU 6:** b

**CYU 7:** Yes; see Equation 11.4, in which  $P_2$  is the pressure at his wrist and  $P_1$  is the pressure above the water.

**CYU 8:** c

**CYU 9:** Both beams experience the same buoyant force.

**CYU 10:** (a) The readings are the same.  
(b) The final reading is greater than the initial reading.

**CYU 11:** No. You float because the weight of the water you displace equals your weight. Each weight is proportional to  $g$ , so its value makes no difference.

**CYU 12:** No.  $F_B$  depends only on the weight of the water she displaces, which doesn't change.

**CYU 13:** b

**CYU 14:** No.

**CYU 15:** d

**CYU 16:** c

**CYU 17:** e

**CYU 18:** c

**CYU 19:** c

**CYU 20:** b

**CYU 21:** a

**CYU 22:** c

#### CHAPTER 12

**CYU 1:** 178 °X

**CYU 2:** (a) No. (b) Yes. (c) No.

**CYU 3:** It decreases (see Equations 10.5 and 10.16).

**CYU 4:** With equal values for  $\alpha$ , concrete and steel expand (contract) by the same amount as the temperature increases (decreases), thus minimizing problems with thermal stress.

**CYU 5:** The bottom is bowed outward, because it acts like a bimetallic strip.

**CYU 6:** b and d

**CYU 7:** cooled

**CYU 8:** No. When the temperature changes, the change in volume of the cavity within the glass would exactly compensate for the change in volume of the mercury, which would never rise or fall in the capillary tube of the thermometer.

**CYU 9:** Less than. The buoyant force is equal to the weight of the displaced water (see Section 11.6, Archimedes' principle), which is proportional to the water's density. Here, warmer water has a smaller density than cooler water does (see Figure 12.20).

**CYU 10:** a and b

**CYU 11:** the object with the smaller mass

**CYU 12:** c, b, d, a

**CYU 13:** Because heat is released when the water freezes at 0 °C (consistent with the latent heat of fusion of water), and this heat warms the blossoms.

**CYU 14:** c, a, b

**CYU 15:** No, because at sea level water boils at a higher temperature and the stove may not generate enough heat.

**CYU 16:** Because water in an open pot boils at 100 °C, thus preventing the temperature from rising further, whereas under the elevated pressure in the autoclave water has a boiling point above 100 °C.

**CYU 17:** Boiling water has a vapor pressure of one atmosphere, and the cool water in the sealed jar has a lower vapor pressure. The excess external pressure crates a net force pushing on the lid, making it hard to unscrew.

**CYU 18:** Under pressure in the sealed bottle, the soda has a freezing point lower than normal (see Figure 12.35b). The outside temperature is not cold enough to freeze it. When the bottle is opened, the pressure on the liquid decreases to one atmosphere, and the freezing point rises to its normal value. The liquid is now cold enough to freeze.

**CYU 19:** As the water vapor is removed, more forms in an attempt to reestablish equilibrium between liquid and vapor. When the pumping is rapid, the required latent heat is supplied mostly by the remaining liquid, which cools and eventually freezes.

**CYU 20:** 100%

**CYU 21:** Yes. The dew points on the two nights could be different, Tuesday's being higher than Monday's due to a greater partial pressure of water vapor in the air on Tuesday than on Monday.

**CYU 22:** The air above the swimming pool probably has a greater partial pressure of water vapor (due to inefficient humidity control) and, therefore, a higher dew point than that in the other room. Evidently, the temperature at the inner window-surfaces is below the dew point of the room with the swimming pool but above the dew point in the other room.

#### CHAPTER 13

**CYU 1:** a

**CYU 2:** b

**CYU 3:** the house with the snow on the roof

**CYU 4:** b

**CYU 5:** c

**CYU 6:** c

**CYU 7:** hollow, air-filled strands

**CYU 8:** c

**CYU 9:** b

**CYU 10:** forced convection

**CYU 11:** strip B

**CYU 12:** a

**CYU 13:** d

**CYU 14:** b

**CYU 15:** e

#### CHAPTER 14

**CYU 1:** Both have the same number of molecules, but oxygen has the greater mass.

**CYU 2:** In general, the number of molecules would be different. But they could be the same, if the molecular masses of the two types of molecules happen to be the same.

**CYU 3:** 66.4%

**CYU 4:** The ideal gas law gives the pressure as  $P = nRT/V$ , where  $T$  and  $V$  are constant. The fan reduces  $n$  in the house and increases it in the attic, so pressure decreases in the house and increases in the attic. The fan has a harder job pushing air out against the higher attic pressure.

**CYU 5:** The ideal gas law gives the gas pressure as  $P = nRT/V$ , where  $V$  and  $n$  are constant. As  $T$  increases, the pressure increases and could cause the can to burst.

**CYU 6:** The ideal gas law gives the gas pressure as  $P = nRT/V$ , where  $V$  and  $n$  are constant. As  $T$  increases, the pressure increases.

**CYU 7:** The ideal gas law gives the gas pressure as  $P = nRT/V$ , where  $T$  and  $n$  are constant. As  $V$  decreases due to the incoming tide, the pressure increases, and your ears pop inward, as if you were climbing down a mountain.

**CYU 8:** The ideal gas law gives the gas volume as  $V = nRT/P$ , where  $T$  and  $n$  are constant. As the pressure  $P$  decreases during the balloon's ascent, the volume increases. The balloon would overinflate if not underinflated to start with.

**CYU 9:** Boyle's law gives the final pressure in the bottle after the cork is pressed in:  $P_f = P_i(V_i/V_f)$ , where  $V_i/V_f$  is the volume of air above the wine before the cork is pressed in divided by the volume after the cork is pressed in. This ratio is much larger for the full bottle than for the half-full bottle, creating a pressure large enough to push the cork out.

## A-12 ANSWERS TO CHECK YOUR UNDERSTANDING

**CYU 10:** Xenon has the greatest and argon the smallest temperature.

**CYU 11:** less than, which follows directly from the impulse–momentum theorem

**CYU 12:** No. The average kinetic energy is proportional to the Kelvin, not the Celsius, temperature.

**CYU 13:** It remains unchanged.

**CYU 14:** argon

**CYU 15:**  $v_{\text{rms, new}}/v_{\text{rms, initial}} = 0.707$

**CYU 16:**  $L$  must be small and there must be many alveoli so that the total effective area  $A$  is large.

**CYU 17:** c, a, b

**CHAPTER 15**

**CYU 1:** d

**CYU 2:** b

**CYU 3:** c

**CYU 4:**  $A \rightarrow B: Q = +$  and  $W = +$   
 $B \rightarrow C: \Delta U = +$  and  $W = 0$

**CYU 5:** a

**CYU 6:** b

**CYU 7:** a

**CYU 8:** c

**CYU 9:** c

**CYU 10:** c

**CYU 11:** b

**CYU 12:** No, because Carnot's principle only states that a reversible engine operating between two temperatures is more efficient than an irreversible engine operating between the same temperatures.

**CYU 13:** d

**CYU 14:** d

**CYU 15:** b

**CYU 16:** c

**CYU 17:** a

**CYU 18:** c

**CYU 19:** b

**CYU 20:** a

**CYU 21:** d

**CYU 22:** c and d

**CYU 23:** the popcorn that results from the kernels; a salad after it has been tossed; a messy apartment

**CYU 24:** b

**CYU 25:** c

**CHAPTER 16**

**CYU 1:** c

**CYU 2:** No. The coil moves back and forth in simple harmonic motion.

**CYU 3:** The wavelength increases.

**CYU 4:** The person pulling on string B should pull harder to increase the tension in the string.

**CYU 5:** In Equation 16.2, the speed would be infinitely large if  $m$  were zero, so it would take no time at all.

**CYU 6:** decrease

**CYU 7:** No, because the particles exhibit simple harmonic motion, in which the acceleration is not always zero.

**CYU 8:** increase

**CYU 9:** a

**CYU 10:** No, because each particle executes simple harmonic motion as the wave passes by.

**CYU 11:** hot day

**CYU 12:** CO and  $N_2$

**CYU 13:** increase

**CYU 14:** Large outer ears intercept and direct more sound power into the auditory system than smaller ones do.

**CYU 15:** No, because not all points on the surface are at the same distance from the source.

**CYU 16:** No, because it is the intensities  $I_1$  and  $I_2$  that add to give to a total intensity  $I_{\text{total}}$ . The intensity levels  $\beta_1$  and  $\beta_2$  do not add to give a total intensity level  $\beta_{\text{total}}$ .

**CYU 17:** (a)  $1/4$

(b) 2

**CYU 18:** (a)  $f_o$  is smaller than  $f_s$ , and  $f_o$  decreases during the fall.

(b)  $f_o$  is greater than  $f_s$ , and  $f_o$  increases during the fall.

**CYU 19:** No, because the observed frequency is less than the source frequency, so the car is moving away from him.

**CYU 20:** (a) greater in air

(b) greater under water

**CYU 21:** No, because there is no relative motion of the cars.

**CYU 22:** (a) minus sign in both places

(b) the truck driver

**CHAPTER 17**

**CYU 1:** (a)  $-3$  cm

(b)  $-2$  cm

**CYU 2:** No, because if the two sound waves have the same amplitude and frequency, they might cancel in a way analogous to that illustrated in Figure 17.2b and no sound will be heard.

**CYU 3:** b

**CYU 4:** c

**CYU 5:** a

**CYU 6:** d

**CYU 7:** a

**CYU 8:** c

**CYU 9:** b

**CYU 10:** d

**CYU 11:** (a) 4

(b) 3

(c) node

(d) 110 Hz

**CYU 12:** b

**CYU 13:** d

**CYU 14:** b

**CYU 15:** (a) antinode

(b) node

(c)  $\frac{1}{4}\lambda$

(d) lowered

**CYU 16:** b

**CYU 17:** c ( $\frac{1}{4}\lambda$  is the distance between an antinode and an adjacent node.)

**CYU 18:** a

**CHAPTER 18**

**CYU 1:** c

**CYU 2:**  $+3.2 \times 10^{-13}$  C on object A and  $-3.2 \times 10^{-13}$  C on object B

**CYU 3:**  $+1.6 \times 10^{-13}$  C on object A and  $-3.2 \times 10^{-13}$  C on object B

**CYU 4:** b and e

**CYU 5:** Yes, because the charge on the balloon will induce a slight charge of opposite polarity in the surface of the ceiling, analogous to that in Figure 18.8.

**CYU 6:** a

**CYU 7:** b

**CYU 8:** C, A, B

**CYU 9:** the electron, because, being less massive, it has the greater acceleration

**CYU 10:** No, because the force of the spring changes direction when the spring is stretched compared to when it is compressed, while the electrostatic force does not have this characteristic.

**CYU 11:** d

**CYU 12:** 0 N/C

**CYU 13:** (a) corner C

(b) negative

(c) greater

**CYU 14:** a

**CYU 15:** (a) No.

(b) No.

**CYU 16:** For rod A, the field points perpendicularly away from the rod. For rod B, it points parallel to the rod and is directed from the positive toward the negative half.

**CYU 17:** (a) false

(b) false

(c) true

(d) false

(e) false

**CYU 18:** d

**CYU 19:** The flux does not change, as long as the charge remains within the Gaussian surface.

**CYU 20:** The same flux passes through each, since each encloses the same net charge.

**CYU 21:** (a)  $q_1$  and  $q_2$

(b)  $q_1$ ,  $q_2$ , and  $q_3$

**CHAPTER 19**

**CYU 1:** (a) Yes.

(b) No.

- (c) Yes.  
(d) Yes.
- CYU 2:** The work is the same in all three cases (see Equation 19.4).
- CYU 3:** The electron arrives at a plate first.
- CYU 4:** a
- CYU 5:** b
- CYU 6:** c
- CYU 7:** a
- CYU 8:** d
- CYU 9:** (a) remains the same  
(b) decreases
- CYU 10:** the electron
- CYU 11:** (a) +2.0 V  
(b) 0 V  
(c) +2.0 V
- CYU 12:** The electric field is zero.
- CYU 13:** b
- CYU 14:** a
- CYU 15:** c
- CYU 16:** (a) bottom of a valley  
(b) top of a mountain
- CYU 17:** (a) decreases  
(b) increases  
(c) increases  
(d) increases
- CYU 18:** (a) decreases  
(b) increases  
(c) remains the same  
(d) increases

**CHAPTER 20**

- CYU 1:** d
- CYU 2:** 0.50 A
- CYU 3:** b
- CYU 4:** a
- CYU 5:** b, d, and e
- CYU 6:** c (A value for the current is also needed.)
- CYU 7:** a
- CYU 8:** c
- CYU 9:** b and d
- CYU 10:** The 75-W bulb. See Equation 20.15c.
- CYU 11:** d
- CYU 12:** e
- CYU 13:** in parallel
- CYU 14:** b
- CYU 15:** c
- CYU 16:** a, b, d, and e
- CYU 17:** There are two ways. One is to form two groups of two parallel resistors and then connect the groups in series. The other is to form two groups of two series resistors and then connect the groups in parallel.
- CYU 18:** Junction rule:  $I_1 + I_3 = I_2$   
Loop rule, loop *ABCD*:  
 $3.0 \text{ V} + 7.0 \text{ V} + I_3 R_3 = I_1 R_1$   
Loop rule, loop *BEFC*:  
 $5.0 \text{ V} = I_3 R_3 + 7.0 \text{ V} + I_2 R_2$
- CYU 19:** c

- CYU 20:** b
- CYU 21:**  $\text{ohm} \times \text{farad}$   
 $= (\text{volt/ampere})(\text{coulomb/volt})$   
 $= \text{coulomb/ampere}$   
 $= \text{coulomb}/(\text{coulomb/second})$   
 $= \text{second}$

- CYU 22:** e

**CHAPTER 21**

- CYU 1:** c
- CYU 2:** d
- CYU 3:** (a) Yes.  
(b) No, because the particle could move either parallel or anti-parallel to the magnetic field.
- CYU 4:** b
- CYU 5:** d
- CYU 6:** particle 3
- CYU 7:** b
- CYU 8:** c
- CYU 9:** b
- CYU 10:** c
- CYU 11:** (a) The direction of the magnetic force reverses.  
(b) The direction of the magnetic force does not change.
- CYU 12:** B and D (a tie), A, C
- CYU 13:** a
- CYU 14:** (a) repelled  
(b) repelled
- CYU 15:** (a) attracted  
(b) repelled
- CYU 16:** c
- CYU 17:** a
- CYU 18:** Part *a*: There is a point to the right of both wires where the total magnetic field is zero.  
Part *b*: There is a point between the wires where the total magnetic field is zero. This point is closer to the wire carrying the current  $I_2$ .
- CYU 19:** A, D, C, B
- CYU 20:** d
- CYU 21:** No, because aluminum is a non-ferromagnetic material.
- CYU 22:** b

**CHAPTER 22**

- CYU 1:** No. With both the magnet and coil moving at the same velocity with respect to the earth, there is no relative motion between the magnet and the coil, which is needed for there to be an induced current in the coil.
- CYU 2:** d
- CYU 3:** a
- CYU 4:** b
- CYU 5:** c
- CYU 6:** b
- CYU 7:** A lightning bolt is a large electric current that changes in time and, thus, produces a magnetic field that also changes in time. When

this changing field passes through a coil or loop of wire in an appliance, it can, via Faraday's law, create an induced emf, which can lead to an induced current.

- CYU 8:** c
- CYU 9:** a and d
- CYU 10:** a
- CYU 11:** b
- CYU 12:** Answer 1: downward and decreasing  
Answer 2: upward and increasing
- CYU 13:** c
- CYU 14:** d
- CYU 15:** b
- CYU 16:** With the headlights off, the engine does not need to do the work of keeping the battery charged.
- CYU 17:** a
- CYU 18:** c
- CYU 19:** b
- CYU 20:** b and d

**CHAPTER 23**

- CYU 1:** The ratio decreases by a factor of 3.
- CYU 2:** (a) the circuit containing the inductor  
(b) the circuit containing the resistor
- CYU 3:** less than
- CYU 4:** decreases
- CYU 5:** decreases
- CYU 6:** d
- CYU 7:** (a) increases  
(b) increases
- CYU 8:** a
- CYU 9:** (a) remains the same  
(b) decreases
- CYU 10:** in phase (see Equation 23.8, in which  $X_L = X_C$ )
- CYU 11:** (a) Yes.  
(b) Yes.
- CYU 12:** a
- CYU 13:** (a) left to right  
(b) left to right

**CHAPTER 24**

- CYU 1:** d
- CYU 2:** a
- CYU 3:** because, according to Faraday's law of electromagnetic induction, the emf depends on how rapidly the magnetic field of the wave is changing and this is determined by the frequency of the wave
- CYU 4:** e
- CYU 5:** d
- CYU 6:** b
- CYU 7:** No. The same Doppler change results when the star moves away from the earth and when the earth moves away from the star. Only the relative motion between the star and the earth can be detected.
- CYU 8:** B, A, C
- CYU 9:** Yes.

## A-14 ANSWERS TO CHECK YOUR UNDERSTANDING

**CYU 10:** The light intensity that is not transmitted is absorbed by the polarizer and the analyzer. The polarizer absorbs one-half of the incident intensity, and the analyzer absorbs four-tenths of the incident intensity.

**CYU 11:** unpolarized: c  
horizontally polarized: b  
vertically polarized: c

**CYU 12:** because the transmission axis of the Polaroid material is nearly horizontal, in the same direction as the polarized light reflected from the lake

## CHAPTER 25

**CYU 1:**  $55^\circ$

**CYU 2:** Yes.

**CYU 3:** Yes.

**CYU 4:**  $f_{\text{inside}} = +0.30 \text{ m}$ ,  $f_{\text{outside}} = -0.30 \text{ m}$

**CYU 5:** (a) concave

(b) The sodium unit and engine are located at the focal point of the mirror.

**CYU 6:** Open the surface up to produce a more gently curving shape.

**CYU 7:** No.

**CYU 8:** (a) upright

(b) upside down

**CYU 9:** (a) Yes, provided the object distance is greater than the focal length of the mirror.

(b) It is not possible for a convex mirror to project an image directly onto a screen.

**CYU 10:** (a) No.

(b) No.

**CYU 11:** (a) The magnitude of the image distance becomes larger.

(b) The magnitude of the image height becomes larger.

**CYU 12:** (a) No. You can see yourself anywhere on the principal axis.

(b) You cannot see yourself when you are between the center of curvature and the focal point of the mirror because your image is behind you.

**CYU 13:** A, D, and E

**CYU 14:** The image will never be located beyond the focal point (behind the mirror).

## CHAPTER 26

**CYU 1:** slab B

**CYU 2:** liquid B

**CYU 3:** Yes. To see why, apply Snell's law at the air–water interface and at the water–glass interface.

**CYU 4:** the one filled with water

**CYU 5:** liquid A

**CYU 6:** c

**CYU 7:** b

**CYU 8:** a

**CYU 9:** c

**CYU 10:** The critical angle for a water–air interface is  $48.8^\circ$  (see Equation 26.4). Any light emitted at an angle greater than  $48.8^\circ$  with respect to the vertical is incident on the surface at an angle exceeding the critical angle. It is totally internally reflected and doesn't exit the water.

**CYU 11:** No. To see why, apply Snell's law at both surfaces of the glass slab and use Equation 26.4.

**CYU 12:** c (They are most effective when the angle of incidence is the Brewster angle and the reflected light is 100% polarized.)

**CYU 13:** liquid A

**CYU 14:** a (Since  $n = 1.520$  for red light and  $n = 1.538$  for violet-colored light, the critical angle for total internal reflection is greater for red than for violet-colored light.)

**CYU 15:** b

**CYU 16:** Yes.

**CYU 17:** a

**CYU 18:** the lens

**CYU 19:** converging lens,  $d_o = \frac{1}{2}f$

**CYU 20:** d

**CYU 21:** the glasses of the farsighted person, since they use converging lenses

**CYU 22:** 13 cm

**CYU 23:** Light normally passes from air ( $n = 1.00$ ) into the cornea ( $n = 1.38$ ), at which time most of the eye's refraction of the light occurs. If water ( $n = 1.33$ ) replaces air, the similarity of the index of refraction of water to that of the cornea reduces the eye's normal refraction and causes blurred vision. Goggles preserve the air–cornea boundary.

**CYU 24:** b

**CYU 25:** hawk, kestrel, eagle

**CYU 26:** a

**CYU 27:** 0.042 rad

**CYU 28:** b

**CYU 29:** the longer telescope

**CYU 30:** microscope

**CYU 31:** c, d, e, f

**CYU 32:** because chromatic aberration is related to the refraction of light and not to the reflection of light

## CHAPTER 27

**CYU 1:** (a) constructive

(b) destructive

(c) destructive

**CYU 2:** c

**CYU 3:** Yes.

**CYU 4:** a

**CYU 5:** (a)  $d_1$  and  $\lambda_2$

(b)  $d_2$  and  $\lambda_1$

**CYU 6:** (a) The pattern would be the same.  
(b) The positions of the light and dark fringes would be interchanged.

**CYU 7:** No, because  $\theta$  in Equations 27.1 and 27.2 approaches  $90^\circ$  as  $\lambda$  becomes larger and larger.

**CYU 8:** b

**CYU 9:** c

**CYU 10:** enhances

**CYU 11:** (a) A and C

(b) B

**CYU 12:** c

**CYU 13:** b

**CYU 14:** (a) broadens

(b) contracts

**CYU 15:** a

**CYU 16:** c

**CYU 17:** a, c, b

**CYU 18:** Yes.

**CYU 19:** small  $f$ -number setting

**CYU 20:** (a) the maximum that is closer to the central maximum

(b) away from the central maximum

**CYU 21:** The distance between the bright fringes would decrease.

## CHAPTER 28

**CYU 1:** d

**CYU 2:** a, b

**CYU 3:** C, B, A

**CYU 4:** No, because the term  $v^2/c^2$  in Equations 28.1 and 28.2 would then be zero.

**CYU 5:** c

**CYU 6:** c, d

**CYU 7:** No, because the two diagonals are perpendicular, so that diagonal AC is contracted, whereas diagonal BD is not contracted.

**CYU 8:** greatest mass: c, smallest mass: b

**CYU 9:** a, because then they have more electric potential energy (see Example 8 in Chapter 19)

**CYU 10:** b, because the fully charged capacitor stores electric potential energy (see Section 19.5)

**CYU 11:** a. The work is the change in kinetic energy, which is proportional to the mass (see the work–energy theorem in Section 6.2). The electron has the smaller mass.

**CYU 12:** c

## CHAPTER 29

**CYU 1:** No.

**CYU 2:** (a) red

(b) violet

**CYU 3:** No.

**CYU 4:** b

**CYU 5:** a

- CYU 6:** (a) increases  
(b) increases  
(c) remains the same  
(d) remains the same

**CYU 7:** less than

**CYU 8:** c

**CYU 9:** a

**CYU 10:** No. Photon collisions would cause spinning in a direction from the shiny side of a panel toward the black side.

**CYU 11:** decreases

**CYU 12:** b

**CYU 13:** decreases

**CYU 14:** b

### CHAPTER 30

**CYU 1:** b

**CYU 2:** d

**CYU 3:** The absorption lines belong only to the Lyman series, since very few electrons are present with  $n = 2$  or  $n = 3$ .

**CYU 4:** No, because the location of the electron in a given quantum mechanical energy state is uncertain.

**CYU 5:** when the electron is in the  $n = 1$  state, because then the only possible value for the orbital quantum number is  $\ell = 0$

**CYU 6:** (a) No, because the Bohr model uses the same quantum number  $n$  for the total energy and the orbital angular momentum (see Equations 30.13 and 30.8).

(b) Yes, because quantum mechanics uses the quantum number  $n$  for the total energy but the quantum number  $\ell$  for the orbital angular momentum.

**CYU 7:** (a) Yes, because the Bohr model uses the same quantum number  $n$  for the orbital angular momentum and the total energy (see Equations 30.8 and 30.13).

(b) No, because quantum mechanics uses the quantum number  $\ell$  for the orbital angular momentum but the quantum number  $n$  for the total energy.

**CYU 8:**  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

**CYU 9:** (a) No.

(b) Yes.

**CYU 10:** b

**CYU 11:** c

**CYU 12:** a

**CYU 13:** c

**CYU 14:** d

**CYU 15:** a

### CHAPTER 31

**CYU 1:** c, d

**CYU 2:** a

**CYU 3:** No, because they could have different numbers of protons (different atomic numbers).

**CYU 4:** Yes, because the total number  $A$  of nucleons could be the same, and it is the value of  $A$  that determines the radius.

**CYU 5:** c

**CYU 6:** d, c, a, b

**CYU 7:** d

**CYU 8:** It is not possible, because the total mass of the decay products is greater than the mass of the parent nucleus,  ${}_{92}^{238}\text{U}$ , indicating that energy would not be released.

**CYU 9:** b

**CYU 10:** Yes, because the decay of any single nucleus occurs randomly and can happen at any moment.

**CYU 11:** Yes.

**CYU 12:** b, because the gold statue does not contain carbon atoms

**CYU 13:** too small

**CYU 14:** No, because in 700 years the activity of a sample would have decreased to an immeasurably small fraction of its initial value.

**CYU 15:** e

### CHAPTER 32

**CYU 1:** Yes, if the absorbed dose of the radiation is different for each type of radiation (see Equation 32.4).

**CYU 2:** c

**CYU 3:** neutrons,  $\alpha$  particles,  $\gamma$  rays

**CYU 4:** c

**CYU 5:** (a) because it violates the conservation of nucleon number  
(b) because it violates the conservation of nucleon number  
(c) because it violates the conservation of electric charge

**CYU 6:** d

**CYU 7:** electrons, protons, neutrons

**CYU 8:** No, because the binding energy per nucleon is greater for the original nucleus than for the two fragments, as indicated in Figure 31.5.

**CYU 9:** b and d

**CYU 10:** a, b, and c

**CYU 11:** No, because the binding energy per nucleon is greater for the original nuclei than for the nucleus resulting from the fusion, as indicated in Figure 32.9.

**CYU 12:** b and d

**CYU 13:** a