Holt Physics
Section Reviews

To jump to a location in this book

1. Click a bookmark on the left.

To print a part of the book

1. Click the Print button.
2. When the Print window opens, type in a range of pages to print.

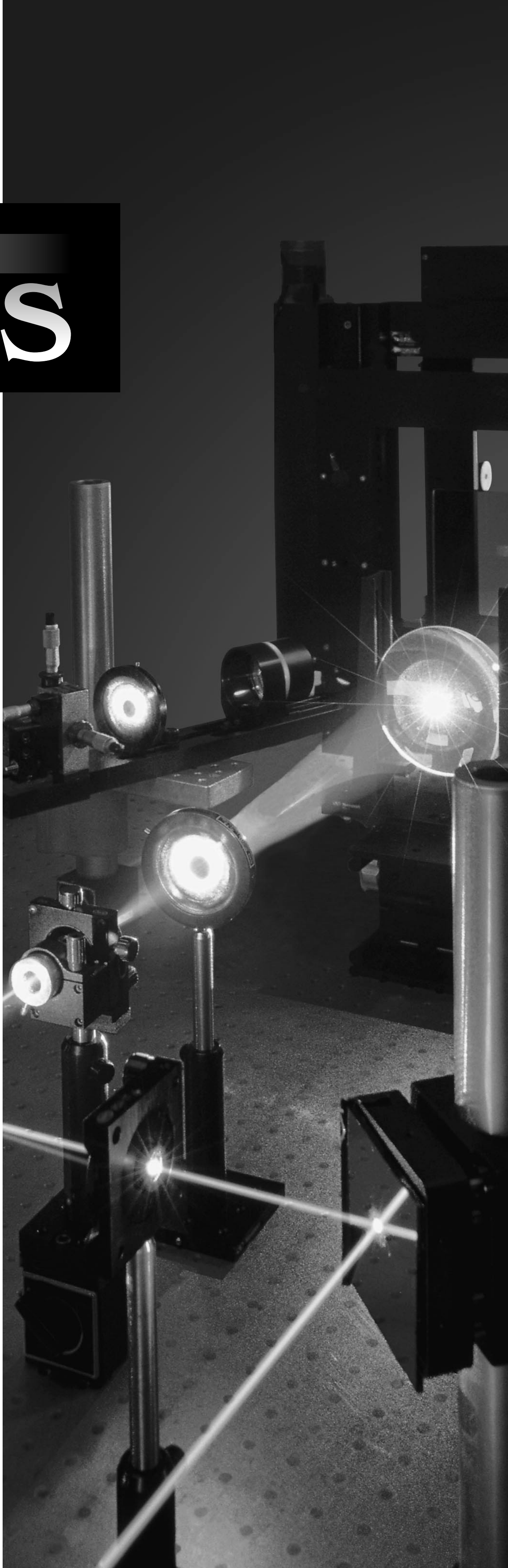
The page numbers are displayed in the bar at the bottom of the document. In the example below, “1 of 151” means that the current page is page 1 in a file of 151 pages.

Menu Print

HOLT

PHYSICS

SECTION REVIEWS



HOLT, RINEHART AND WINSTON

A Harcourt Classroom Education Company

Austin • New York • Orlando • Atlanta • San Francisco • Boston • Dallas • Toronto • London

Menu Print

Holt Physics

Section Reviews

This workbook consists of review and reinforcement activities that focus on key skills or concepts from a section of the *Holt Physics* text.

Graph Skills challenge students to make the connection between physics principles, equations, and their visual representation in a graph.

Diagram Skills bridge the gap between a real, physical situation and the diagram that simplifies it so that key physics principles and equations can be applied.

Math Skills provide additional practice linking mathematical operations with chapter content.

Concept Reviews reinforce fundamental knowledge from a section of the text.

Mixed Reviews include items that check students' comprehension of a variety of concepts from throughout the chapter.

Worksheet Authors

Phillip G. Bunce
James Bowie High School
Austin, TX

Judith R. Edgington, Ph. D.
Physics/Science Education Consultant and Curriculum Designer
Austin, TX

Cover Photo: © Lawrence Manning/CORBIS
Cover Design: Jason Wilson

Printed in the United States of America

ISBN 0-03-057361-0

1 2 3 4 5 6 095 04 03 02 01 00

Menu Print

Contents

Menu Print

Chapter 9 Fluid Mechanics

Chapter 10 Heat

Chapter 11 Thermodynamics

Chapter 12 Vibrations and Waves

Chapter 13 Sound

Chapter 14 Light and Reflection

Chapter 15 Refraction

Chapter 16 Interference and Diffraction

Menu Print

NAME ______________ DATE ______________ CLASS ______________

Section **1-1**

HOLT PHYSICS

Concept Review

What is Physics?

1. Which areas of physics deal with the following?

a. how fast things move ______________

b. how the shape of a cave affects an echo ______________

c. which sunglasses are best for cutting the glare on a ski slope ______________

d. how the cooling system in a refrigerator works ______________

e. what lightning is ______________

f. how energy is produced by the sun ______________

2. Laws governing speed limits on highways are determined by a majority vote by citizens of a state or their representatives. Compare this democratic procedure to the way scientific laws are established with regard to the following questions. Explain your reasoning.

a. Can scientific laws be changed by a vote?

____

b. Can the speed of light be legislated?

____

c. Can scientists from other countries change what physicists in the United States think?

____

Menu Print

NAME ______________ DATE ______________ CLASS ______________

Section **1-2**

HOLT PHYSICS

Math Skills

Measurements in Experiments

Power	Prefix	Abbreviation
10^{-18}	atto-	a
10^{-15}	femto-	f
10^{-12}	pico-	p
10^{-9}	nano-	n
10^{-6}	micro-	μ
10^{-3}	milli-	m
10^{-2}	centi-	c

Power	Prefix	Abbreviation
10^{-1}	deci-	d
10^{1}	deka-	da
10^{3}	kilo-	k
10^{6}	mega-	M
10^{9}	giga-	G
10^{12}	tera-	T
10^{15}	peta-	P
10^{18}	exa-	E

1. How many picoseconds are there in 1 Ms? ______________

2. How many micrograms make 1 kg? ______________

3. How many nanometers are there in 1 cm? ______________

4. Rewrite the following quantities in scientific notation without prefixes.

a. 3582 gigabytes ______________

b. 0.0009231 milliwatts ______________

c. 53657 nanoseconds ______________

d. 5.32 milligrams ______________

e. 88900 megahertz ______________

f. 0.00000083 centimeters ______________

5. Rewrite the following quantities in units with SI prefixes.

a. 36582472 g ______________

b. 0.000000452 m ______________

c. 53236 V ______________

d. 4.62×10^{-3} s ______________

6. Express the measurement 4.29478416 kg with 8, 6, 4, and 2 significant figures.

______________ ______________

______________ ______________

NAME ________ DATE ________ CLASS ________

Section 1-3

HOLT PHYSICS

Math Skills

The Language of Physics

1. Calculate the following products and quotients without using a calculator.

a. $(3.0 \times 10^5) \times (2.0 \times 10^3)$ ________

b. $(3.0 \times 10^5) \div (2.0 \times 10^3)$ ________

c. $(3.0 \times 10^2) \div (2.0 \times 10^5)$ ________

d. $(3.0 \times 10^{-2}) \times (2.0 \times 10^5)$ ________

e. $(3.0 \times 10^{-2}) \div (2.0 \times 10^{-5})$ ________

f. $(3.0 \times 10^{-2}) \times (2.0 \times 10^{-5})$ ________

2. Round off the following numbers to one figure.

a. 3.7×10^5 ________

b. 6.1×10^5 ________

c. 8.2×10^{-9} ________

d. 0.000067 ________

e. 7439262 ________

f. 0.0006739 ________

3. Find the order of magnitude of the following results without using a calculator.

a. 97×192 ________

b. $96.8639 \div 883.3525$ ________

4. a. Estimate the width and height in centimeters of a half-gallon milk container. Show your assumptions and your work.

b. Use your numbers to obtain a rough estimate of the volume of milk in a half-gallon container. ________

c. The volume of a half-gallon is about 1890 cm^3. How close was your estimate? ________

NAME ______________ DATE ______________ CLASS ______________

Chapter 1

HOLT PHYSICS

Mixed Review

The Science of Physics

Power	Prefix	Abbreviation
10^{-18}	atto-	a
10^{-15}	femto-	f
10^{-12}	pico-	p
10^{-9}	nano-	n
10^{-6}	micro-	μ
10^{-3}	milli-	m
10^{-2}	centi-	c

Power	Prefix	Abbreviation
10^{-1}	deci-	d
10^{1}	deka-	da
10^{3}	kilo-	k
10^{6}	mega-	M
10^{9}	giga-	G
10^{12}	tera-	T
10^{15}	peta-	P
10^{18}	exa-	E

1. Convert the following measurements to the units specified.

a. 2.5 days to seconds ______________

b. 35 km to millimeters ______________

c. 43 cm to kilometers ______________

d. 22 mg to kilograms ______________

e. 671 kg to micrograms ______________

f. 8.76×10^{7} mW to gigawatts ______________

g. 1.753×10^{-13} s to picoseconds ______________

2. According to the rules given in Chapter 1 of your textbook, how many significant figures are there in the following measurements?

a. 0.0845 kg ______________

b. 37.00 h ______________

c. 8 630 000.000 mi ______________

d. 0.000 000 0217 g ______________

e. 750 in. ______________

f. 0.5003 s ______________

Chapter 1

HOLT PHYSICS

Mixed Review *continued*

3. **Without calculating the result,** find the number of significant figures in the following products and quotients.

a. 0.005032×4.0009 ______________

b. $0.0080750 \div 10.037$ ______________

c. $(3.52 \times 10^{-11}) \times (7.823 \times 10^{11})$ ______________

4. Calculate $a + b$, $a - b$, $a \times b$, and $a \div b$ with the correct number of significant figures using the following numbers.

a. $a = 0.005\ 078$; $b = 1.0003$

$a + b =$ ______________ $a - b =$ ______________

$a \times b =$ ______________ $a \div b =$ ______________

b. $a = 4.231\ 19 \times 10^7$; $b = 3.654 \times 10^6$

$a + b =$ ______________ $a - b =$ ______________

$a \times b =$ ______________ $a \div b =$ ______________

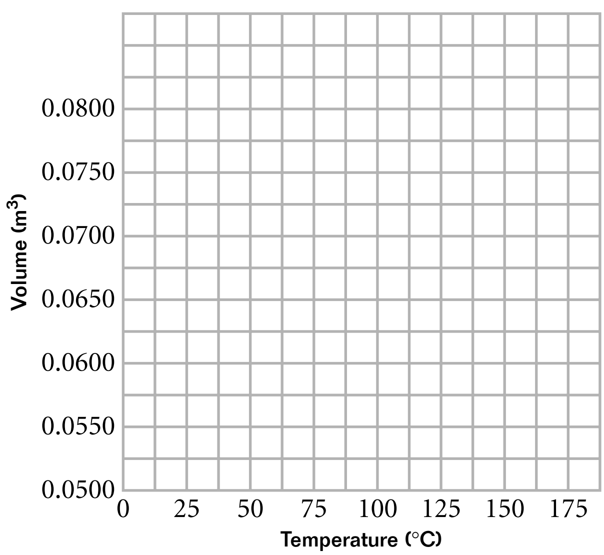
5. Calculate the area of a carpet 6.35 m long and 2.50 m wide. Express your answer with the correct number of significant figures.

____

6. The table below contains measurements of the temperature and volume of an air balloon as it heats up.

In the grid at right, sketch a graph that best describes these data.

Temperature (°C)	Volume (m^3)
2	0.0502
27	0.0553
52	0.0598
77	0.0646
102	0.0704
127	0.0748
152	0.0796



NAME ______________ DATE ______________ CLASS ______________

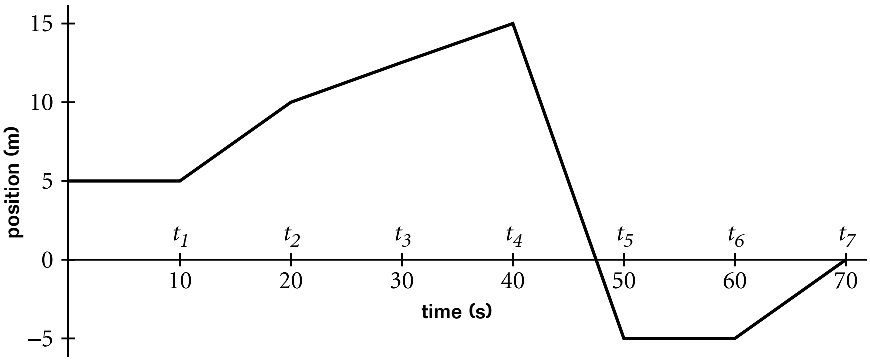
Section **2-1**

HOLT PHYSICS

Graph Skills

Displacement and Velocity

A minivan travels along a straight road. It initially starts moving toward the east. Below is the position-time graph of the minivan. Use the information in the graph to answer the questions.



1. Does the minivan move to the east? If so, during which time interval(s)?

____

2. Does the minivan move to the west? If so, during which time interval(s)?

____

3. Is the minivan's speed between t_1 and t_2 greater than, less than, or equal to its speed between t_2 and t_3?

____

4. Is the minivan's speed between t_4 and t_5 greater than, less than, or equal to its speed between t_6 and t_7?

____

5. Does the minivan ever stop completely? If so, at which time(s)?

____

6. Does the minivan ever move with a constant velocity? If so, at which time(s)?

____

7. What is the total displacement of the minivan during the trip?

____

Section **2-2**

HOLT PHYSICS

Math Skills

Acceleration

A car is traveling down a straight road. The driver then applies the brake, and the car decelerates with a constant acceleration until it stops. Refer to the equations below to answer the questions.

$$\Delta x = \frac{1}{2}(v_i + v_f)\Delta t \qquad v_f = v_i + a(\Delta t)$$

$$\Delta x = v_i(\Delta t) + \frac{1}{2}a(\Delta t)^2 \qquad v_f^2 = v_i^2 + 2a\Delta x$$

1. What is the car's final speed v_f? Explain your answer.

____

____

____

2. You are given the distance the car travels and the length of time it takes for the car to come to a complete stop after the driver applies the brakes. What is the expression for the car's initial speed?

____

3. You are given the car's initial speed and the length of time it takes for the car to come to a full stop after the driver applies the brakes. What is the expression for the magnitude of the car's acceleration?

____

4. You are given the car's initial speed and the distance the car travels before it comes to a complete stop after the driver applies the brakes. What is the expression for the magnitude of the car's acceleration?

____

5. You are given the magnitude of the car's acceleration and the length of time it takes for the car to come to a full stop after the driver applies the brakes. What is the expression for the initial speed of the car, and what is the expression for the distance it traveled before it came to a complete stop?

____

Section **2-3**

HOLT PHYSICS

Math Skills

Falling Objects

A juggler throws a ball straight up into the air. The ball remains in the air for a time Δt before it lands back in the juggler's hand.

$$\Delta y = v_i(\Delta t) + \frac{1}{2}a(\Delta t)^2$$
$$v_f = v_i + a(\Delta t)$$
$$v_f^2 = v_i^2 + 2a\Delta y$$

1. Answer the following questions in terms of Δt and g.

a. What is the acceleration of the ball during the entire time the ball is in the air?

____

b. With what speed did the juggler throw the ball into the air? (Hint: What is the total displacement of the ball during the time it is in the air?)

____

c. How much time elapsed before the ball reached its maximum height?

____

d. How high above the point of release did the ball rise?

____

2. Assume that the ball was in the air for 2.4 s. Answer the following questions:

a. What is the acceleration of the ball during the entire time the ball is in the air?

____

b. With what speed did the juggler throw the ball into the air?

____

c. How much time elapsed before the ball reached its maximum height?

____

NAME ______ DATE ______ CLASS ______

Chapter 2

HOLT PHYSICS

Mixed Review

Motion in One Dimension

1. During a relay race along a straight road, the first runner on a three-person team runs d_1 with a constant velocity v_1. The runner then hands off the baton to the second runner, who runs d_2 with a constant velocity v_2. The baton is then passed to the third runner, who completes the race by traveling d_3 with a constant velocity v_3.

a. In terms of d and v, find the time it takes for each runner to complete a segment of the race.

Runner 1 ______ Runner 2 ______ Runner 3 ______

b. What is the total distance of the race course?

______

c. What is the total time it takes the team to complete the race?

______

2. The equations below include the equations for straight-line motion. For each of the following problems, indicate which equation or equations you would use to solve the problem, but do not actually perform the calculations.

$\Delta x = \frac{1}{2}(v_i + v_f)\Delta t$	$\Delta x = \frac{1}{2}(v_f)\Delta t$
$\Delta x = v_i(\Delta t) + \frac{1}{2}a(\Delta t)^2$	$\Delta x = \frac{1}{2}a(\Delta t)^2$
$v_f = v_i + a(\Delta t)$	$v_f = a(\Delta t)$
$v_f^2 = v_i^2 + 2a\Delta x$	$v_f^2 = 2a\Delta x$

a. During takeoff, a plane accelerates at 4 m/s^2 and takes 40 s to reach takeoff speed. What is the velocity of the plane at takeoff?

______

b. A car with an initial speed of 31.4 km/h accelerates at a uniform rate of 1.2 m/s^2 for 1.3 s. What is the final speed and displacement of the car during this time?

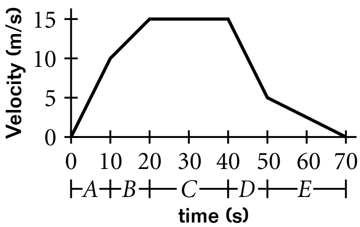
______

Chapter 2

HOLT PHYSICS

Mixed Review *continued*

3. Below is the velocity-time graph of an object moving along a straight path. Use the information in the graph to fill in the table below.



For each of the lettered intervals below, indicate the motion of the object (whether it is speeding up, slowing down, or at rest), the direction of the velocity (+, –, or 0), and the direction of the acceleration (+, –, or 0).

Time interval	Motion	v	a
A			
B			
C			
D			
E			

4. A ball is thrown upward with an initial velocity of 9.8 m/s from the top of a building.

a. Fill in the table below showing the ball's position, velocity, and acceleration at the end of each of the first 4 s of motion.

Time (s)	Position (m)	Velocity (m/s)	Acceleration (m/s^2)
1			
2			
3			
4			

b. In which second does the ball reach the top of its flight?

____

c. In which second does the ball reach the level of the roof, on the way down?

____

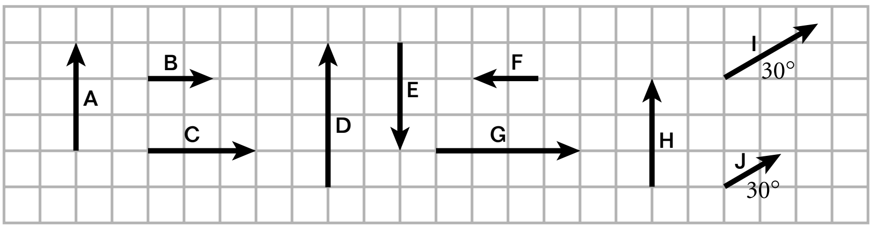
Section 3-1

HOLT PHYSICS

Diagram Skills

Introduction to Vectors

Use the following vectors to answer the questions.



A = 3 m
B = 2 m
C = 3 m
D = 4 m
E = 3 m
F = 2 m
G = 4 m
H = 3 m
I = 3 m
J = 2 m

1. Which vectors have the same magnitude?

____

2. Which vectors have the same direction?

____

3. Which arrows, if any, represent the same vector?

____

4. In the space provided, construct and label a diagram that shows the vector sum 2**A** + **B.** Construct and label a second diagram that shows **B** + 2**A.**

5. In the space provided, construct and label a diagram that shows the vector difference **A** – (**B**/2). Construct and label a second diagram that shows (**B**/2) – **A.**

NAME ______________ DATE ______________ CLASS ______________

Section 3-2

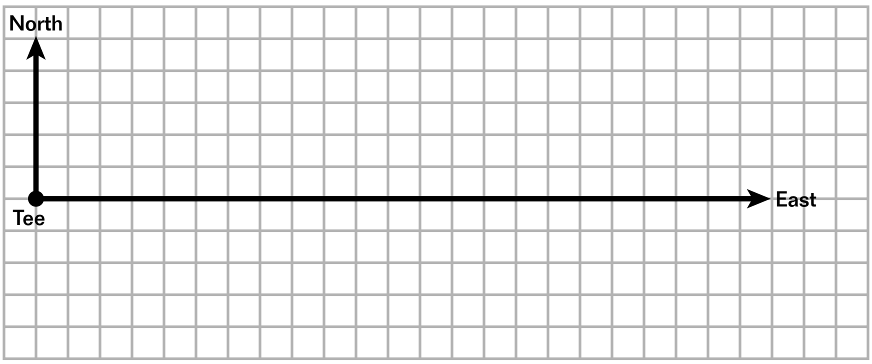
HOLT PHYSICS

Diagram Skills

Vector Operations

One of the holes on a golf course lies due east of the tee. A novice golfer flubs his tee shot so that the ball lands only 64 m directly northeast of the tee. He then slices the ball 30° south of east so that the ball lands in a sand trap 127 m away. Frustrated, the golfer then blasts the ball out of the sand trap, and the ball lands at a point 73 m away at an angle 27° north of east. At this point, the ball is on the putting green and 14.89 m due north of the hole. To his amazement, the golfer then sinks the ball with a single shot.

1. In the space provided, choose a scale, then draw a sketch of the displacement for each shot the golfer made. Label the magnitude of each vector and the angle of each vector relative to the horizontal axis.



2. Use algebraic formulas to find the x and y components of each displacement vector.

Shot 1 x component ____________ y component ____________

Shot 2 x component ____________ y component ____________

Shot 3 x component ____________ y component ____________

Shot 4 x component ____________ y component ____________

3. Find the total displacement (to the nearest meter) the golf ball traveled from the tee to the hole. Assume the golf course is flat. (Hint: Which component of each displacement vector contributes to the total displacement of the ball between the tee and the hole?)

____

NAME ______ DATE ______ CLASS ______

Section 3-3

HOLT PHYSICS

Math Skills

Projectile Motion

After a snowstorm, a boy and a girl decide to have a snowball fight. The girl uses a large slingshot to shoot snowballs at the boy. Assume that the girl fires each snowball at an angle θ from the ground and that the snowballs travel with an initial velocity of v_0.

1. In terms of the initial velocity, v_0, and the launch angle, θ, for what amount of time, Δt, will a snowball travel before it reaches its maximum height above the ground? (Hint: Recall that $v_f = 0$ when an object reaches its maximum height.)

______

2. What is the maximum height, *h*, above the ground that a snowball reaches after it has been launched?

______

3. What is the horizontal distance, *x*, the snowball has traveled when it reaches its maximum height?

______

4. The range, *R*, is the horizontal distance traveled in *twice* the time it takes for an object to reach its maximum height. Using your answers from items 1 and 3, write an expression for the range in terms of v_0, θ, and *g*.

______

5. If the initial velocity, v_0, equals 50.00 m/s, find the maximum height and range for each of the launch angles listed in the table below.

Launch angle	Maximum height (m)	Range (m)
15°		
30°		
45°		
60°		
75°		

Section 3-4

HOLT PHYSICS

Diagram Skills

Relative Motion

The water current in a river moves relative to the land with a velocity v_{WL}, and a boat is traveling on the river relative to the current with a velocity v_{BW}.

1. How is the velocity of the boat relative to the land ($\mathbf{v_{BL}}$) related to $\mathbf{v_{WL}}$ and $\mathbf{v_{BW}}$?

______

2. Suppose that both the boat and the water current move in the same direction and that the boat is moving twice as fast as the current. Draw a vector diagram to determine the velocity of the boat relative to the land, $\mathbf{v_{BL}}$.

2.

3. Suppose that the boat travels in the opposite direction of the current and that the boat is moving twice as fast as the current. Draw a vector diagram to determine the velocity of the boat relative to the land, $\mathbf{v_{BL}}$.

3.

4. Suppose that the boat travels in a direction perpendicular to the current and that the boat is moving twice as fast as the current. Draw a vector diagram to determine the velocity of the boat relative to the land, $\mathbf{v_{BL}}$.

4.

5. Assume that the boat travels with a speed of 4.0 km/h relative to the current and that the current moves due east at a speed of 2.0 km/h relative to the land. Determine the velocity of the boat relative to the land for each of the situations described in items 2–4.

a. v_{BL} for item 2 ______

b. v_{BL} for item 3 ______

c. v_{BL} for item 4 ______

Menu Print

DATE _______________ CLASS ____________________

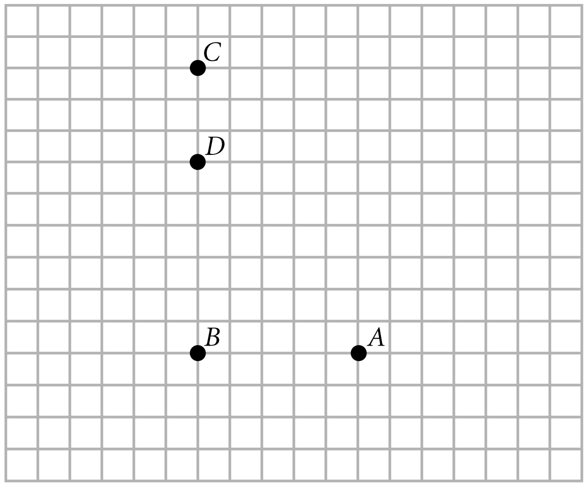
Chapter 3

HOLT PHYSICS

Mixed Review

Two-Dimensional Motion and Vectors

1. The diagram below indicates three positions to which a woman travels. She starts at position *A*, travels 3.0 km to the west to point *B*, then 6.0 km to the north to point *C*. She then backtracks, and travels 2.0 km to the south to point *D*.



a. In the space provided, diagram the displacement vectors for each segment of the woman's trip.

b. What is the total displacement of the woman from her initial position, *A*, to her final position, *D*?

____

c. What is the total distance traveled by the woman from her initial position, *A*, to her final position, *D*?

____

2. Two projectiles are launched from the ground, and both reach the same vertical height. However, projectile B travels twice the horizontal distance as projectile A before hitting the ground.

a. How large is the vertical component of the initial velocity of projectile B compared with the vertical component of the initial velocity of projectile A?

____

b. How large is the horizontal component of the initial velocity of projectile B compared with the horizontal component of the initial velocity of projectile A?

____

c. Suppose projectile A is launched at an angle of 45° to the horizontal. What is the ratio, v_B/v_A, of the speed of projectile B, v_B, compared with the speed of projectile A, v_A?

____

Chapter 3

HOLT PHYSICS

Mixed Review *continued*

3. A passenger at an airport steps onto a moving sidewalk that is 100.0 m long and is moving at a speed of 1.5 m/s. The passenger then starts walking at a speed of 1.0 m/s in the same direction as the sidewalk is moving. What is the passenger's velocity relative to the following observers?

a. A person standing stationary alongside to the moving sidewalk.

____

b. A person standing stationary *on* the moving sidewalk.

____

c. A person walking alongside the sidewalk with a speed of 2.0 m/s and in a direction opposite the motion of the sidewalk.

____

d. A person riding in a cart alongside the sidewalk with a speed of 5.0 m/s and in the same direction in which the sidewalk is moving.

____

e. A person riding in a cart with a speed of 4.0 m/s and in a direction perpendicular to the direction in which the sidewalk is moving.

____

4. Use the information given in item 3 to answer the following questions:

a. How long does it take for the passenger walking on the sidewalk to get from one end of the sidewalk to the other end?

____

b. How much time does the passenger save by taking the moving sidewalk instead of walking alongside it?

____

NAME ______________________ DATE ______________ CLASS ____________________

Section **4-1**

HOLT PHYSICS

Diagram Skills

Changes in Motion

A large, square box of exercise equipment sits on a storeroom floor. A rope is tied around the box. Assume that if the box moves along the floor, there is a backward force that resists its motion.

1. Suppose that the box remains at rest. In the space provided, draw a free-body diagram for the box. Label each force involved in the diagram.

1.

2. Suppose a warehouse worker moves the box by pulling the rope to the right horizontal to the ground. In the space provided, draw a free-body diagram for the box. Label each force involved in the diagram.

2.

3. Suppose the warehouse worker moves the box by pulling the rope to the right at a 50° angle to the ground. In the space provided, draw a free-body diagram for the box. Label each force involved in the diagram.

3.

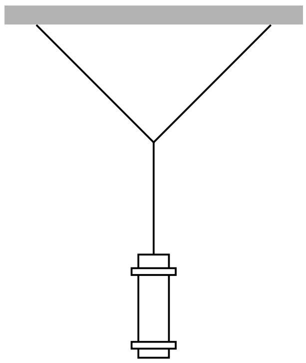
Section 4-2

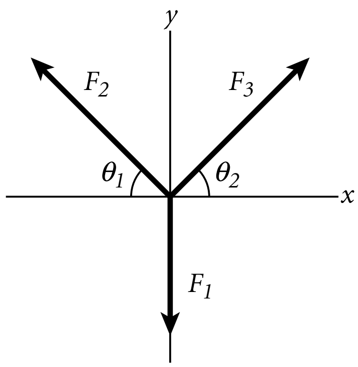
HOLT PHYSICS

Diagram Skills

Newton's First Law

A lantern of mass m is suspended by a string that is tied to two other strings, as shown in the figure below. The free-body diagram shows the forces exerted by the three strings on the knot.





1. In terms of $\mathbf{F_1}$, $\mathbf{F_2}$, and $\mathbf{F_3}$, what is the net force acting on the knot? (Hint: The lantern is in equilibrium.)

____

2. Find the magnitudes of the x and y components for each force acting on the knot. (Assume the positive directions are to the right and up.)

String 1 (F_1) x component ______________ y component ______________

String 2 (F_2) x component ______________ y component ______________

String 3 (F_3) x component ______________ y component ______________

3. In terms of F_1, F_2, and F_3, what is the magnitudes of the net force acting on the knot in the x direction? in the y direction?

$F_{x\ net}$ = ____

$F_{y\ net}$ = ____

4. Assume that $\theta_1 = 30°$, $\theta_2 = 60°$, and the mass of the lantern is 2.1 kg. Find F_1, F_2, and F_3.

F_1 = ____

F_2 = ____

F_3 = ____

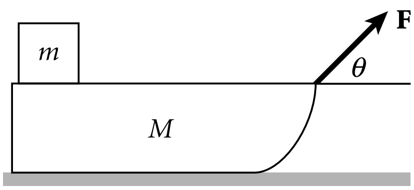
Section **4-3**

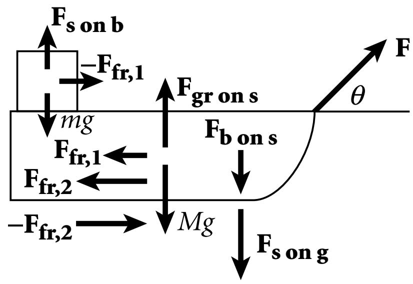
HOLT PHYSICS

Diagram Skills

Newton's Second and Third Laws

The figure on the left below illustrates a sled with a mass of *M* pulled horizontally along the ground by a force with a magnitude of *F*. A box with a mass of *m* lies on the sled and remains at rest relative to the sled. Assume there is friction between the surface of the sled and the box and between the surface of the ground and the sled. The figure on the right below shows the *force* diagram for this situation.





1. Identify any action-reaction pairs in the force diagram.

______

2. Which of the forces shown would be included in the free-body diagram of the box?

______

3. Which of the forces shown would be included in the free-body diagram of the sled?

______

4. What is the net force on the box in the horizontal direction? ______

5. What is the net force on the box in the vertical direction? ______

6. What is the net force on the sled in the horizontal direction? ______

7. What is the net force on the sled in the vertical direction? ______

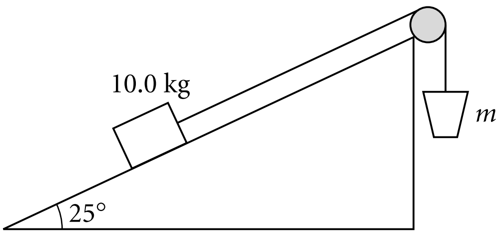
Section 4-4

HOLT PHYSICS

Concept Review

Everyday Forces

A wooden box with a mass of 10.0 kg rests on a ramp that is inclined at an angle of 25° to the horizontal. A rope attached to the box runs parallel to the ramp and then passes over a frictionless pulley. A bucket with a mass of *m* hangs from the end of the rope. The coefficient of static friction between the ramp and the box is 0.50. The coefficient of kinetic friction between the ramp and the box is 0.35.



1. Suppose the box remains at rest relative to the ramp. What is the maximum magnitude of the friction force exerted on the box by the ramp?

____

2. Suppose the box slides along the ramp. What is the maximum magnitude of the friction force exerted on the box by the ramp?

____

3. Suppose the bucket has a mass of 2.0 kg.

a. What is the friction force exerted on the box by the ramp?

____

b. Does the box remain at rest relative to the ramp?

____

4. Suppose water is added to the bucket so that the total mass of the bucket and its contents is 6.0 kg.

a. What is the friction force exerted on the box by the ramp?

____

b. Does the box remain at rest relative to the ramp?

____

Chapter 4

HOLT PHYSICS

Mixed Review

Forces and the Laws of Motion

1. A crate rests on the horizontal bed of a pickup truck. For each situation described below, indicate the motion of the crate relative to the ground, the motion of the crate relative to the truck, and whether the crate will hit the front wall of the truck bed, the back wall, or neither. Disregard friction.

a. Starting at rest, the truck *accelerates* to the right.

____

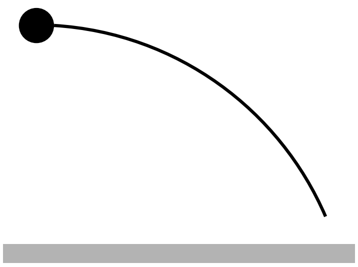
b. The crate is at rest relative to the truck while the truck moves to the right with a constant velocity.

____

c. The truck in item b slows down.

____

2. A ball with a mass of *m* is thrown through the air, as shown in the figure.



a. What is the gravitational force exerted on the ball by Earth?

____

b. What is the force exerted on Earth by the ball?

____

c. If the surrounding air exerts a force on the ball that resists its motion, is the *total* force on the ball the same as the force calculated in part a?

____

d. If the surrounding air exerts a force on the ball that resists its motion, is the *gravitational* force on the ball the same as the force calculated in part a?

____

Chapter 4

HOLT PHYSICS

Mixed Review *continued*

3. Two blocks of masses m_1 and m_2, respectively, are placed in contact with each other on a smooth, horizontal surface. A constant horizontal force F to the right is applied to m_1. Answer the following questions in terms of F, m_1, and m_2.

a. What is the acceleration of the two blocks?

____

b. What are the horizontal forces acting on m_2?

____

c. What are the horizontal forces acting on m_1?

____

d. What is the magnitude of the contact force between the two blocks?

____

4. Assume you have the same situation as described in item 3, only this time there is a frictional force, F_k, between the blocks and the surface. Answer the following questions in terms of F, F_k, m_1, and m_2.

a. What is the acceleration of the two blocks?

____

b. What are the horizontal forces acting on m_2?

____

c. What are the horizontal forces acting on m_1?

____

d. What is the magnitude of the contact force between the two blocks?

____

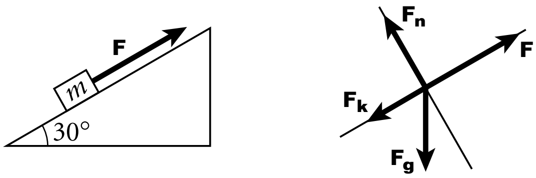
Section **5-1**

HOLT PHYSICS

Math Skills

Work

A crate with a mass of *m* is on a ramp that is inclined at an angle of 30° from the horizontal. A force with a magnitude of *F* directed parallel to the ramp is used to pull the crate with a constant speed up the ramp a distance of *d*.



1. What is the work done on the crate by the applied force *F*?

____

2. What is the work done on the crate by the gravitational force exerted on the crate by Earth?

____

3. What is the work done on the crate by the normal force, with a magnitude of F_n, exerted on the crate by the ramp? (Hint: recall that the normal force is perpendicular to the surface of the ramp.)

____

4. What is the work done on the crate by the frictional force F_k?

____

5. What is the total force acting on the crate?

____

6. What is the work done on the crate by the total force?

____

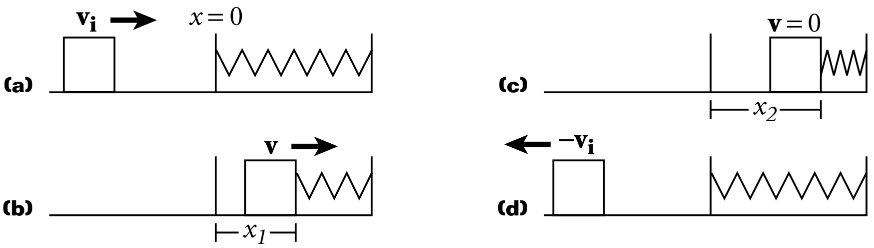
Section 5-2

HOLT PHYSICS

Diagram Skills

Energy

As shown in the diagram, a block with a mass of m slides on a frictionless, horizontal surface with a constant velocity of v_i. It then collides with a spring that has a spring constant of k. The block fully compresses the spring, comes to rest briefly, and then moves in the opposite direction with a velocity of $-v_i$.



1. Examine the situation shown in part (**a**) of the diagram.

a. What is the kinetic energy of the block? ______________

b. What is the potential energy associated with the block's position? ______________

c. What is the mechanical energy for this system? ______________

2. Examine the situation shown in part (**b**) of the diagram.

a. What is the kinetic energy of the block? ______________

b. What is the potential energy associated with the block's position? ______________

c. What is the mechanical energy for this system? ______________

3. Examine the situation shown in part (**c**) of the diagram.

a. What is the kinetic energy of the block? ______________

b. What is the potential energy associated with the block's position? ______________

c. What is the mechanical energy for this system? ______________

4. Examine the situation shown in part (**d**) of the diagram.

a. What is the kinetic energy of the block? ______________

b. What is the potential energy associated with the block's position? ______________

c. What is the mechanical energy for this system? ______________

NAME ______________________ DATE ______________ CLASS ________________

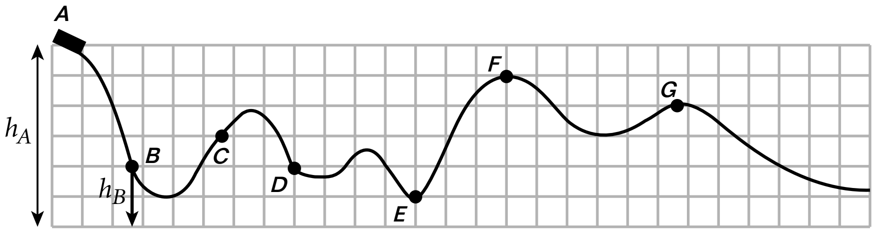
Section **5-3**

HOLT PHYSICS

Diagram Skills

Conservation of Energy

A roller-coaster car with a mass of *m* moves along a smooth track as diagrammed in the graph below. The car leaves point *A* with no initial velocity and travels to other points along the track. The zero energy level is taken as the energy of point *A*.



1. **a.** What is the car's kinetic energy at point *A*? ______________________

b. What is the potential energy associated with the car at point *A*? ______________________

c. What is the car's kinetic energy at point *B*? ______________________

d. What is the potential energy associated with the car at point *B*? ______________________

2. **a.** What is the speed of the car at point *A*? ______________________

b. What is the speed of the car at point *B*? ______________________

3. Assume the mass of the car is 65.0 kg and it starts at 30.0 m above the ground. Use the graph above to find the kinetic energy, potential energy, and velocity for points *C, D, E, F,* and *G* to complete the table.

Location	KE_A	PE_A	$KE_{location}$	$PE_{location}$	$v_{location}$
C					
D					
E					
F					
G					

4. For each location, what do you notice about the sum $KE_A + PE_A$ compared with the sum $KE_{location} + PE_{location}$?

____

____

____

Section 5-4

HOLT PHYSICS

Concept Review

Power

A man accidentally knocks a flowerpot off a high window ledge. The flowerpot drops straight down under the influence of gravity.

1. What is the velocity of the flowerpot as it falls?

____

2. What is the distance the flowerpot falls?

____

3. What is the force acting on the flowerpot as it falls?

____

4. What is the work done on the flowerpot as it falls?

____

5. Assume the flowerpot has a mass of 5.00 kg and drops a total distance of 15.0 m. In the space provided, graph the work done on the flowerpot as a function of time.

6. The flowerpot described in item 5 falls for a total of 1.75 s. What is the power delivered by the flowerpot in this interval? ($g = 9.81$ m/s^2)

____

Chapter 5

HOLT PHYSICS

Mixed Review

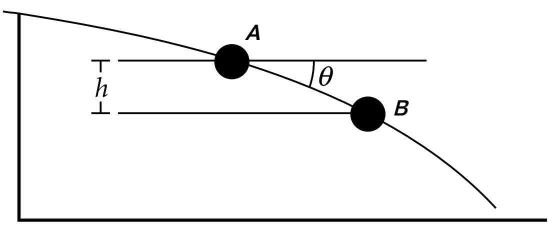
Work and Energy

1. A ball has a mass of 3 kg. What is the work done on this ball by the gravitational force exerted by Earth if the ball moves 2 m along each of the following directions?

a. downward (along the force) ______________

b. upward (opposite the force) ______________

2. A stone with a mass of m is thrown off a building. As the stone passes point A, it has a speed of v_A at an angle of θ to the horizontal. The stone then travels a vertical distance h to point B, where it has a speed v_B.



a. What is the work done on the stone by the gravitational force due to Earth while the stone moves from A to B?

____

b. What is the change in the kinetic energy of the stone as it moves from A to B?

____

c. What is the speed v_B of the stone in terms of v_A, g, and h?

____

d. Does the change in the stone's speed between A and B depend on the mass of the stone?

____

____

e. Does the change in the stone's speed between A and B depend on the angle θ?

____

Chapter 5

HOLT PHYSICS

Mixed Review *continued*

3. An empty coffee mug with a mass of 0.40 kg gets knocked off a tabletop 0.75 m above the floor onto the seat of a chair 0.45 m above the floor. Assume that the gravitational potential energy, PE_g, is measured using the floor as the zero energy level.

a. What is the initial gravitational potential energy associated with the mug's position on the table?

______

b. What is the final gravitational potential energy associated with the mug's position on the chair seat?

______

c. What was the work done by the gravitational force as it fell from the table to the chair?

______

d. Suppose that zero level for the energy was taken to be the ceiling of the room rather than the floor . Would the answers to items a to c be the same or different?

______

______

4. A carton of shoes with a mass of m slides with an initial speed of v_i m/s down a ramp inclined at an angle of 23° to the horizontal. The carton's initial height is h_i, and its final height is h_f, and it travels a distance of d down the ramp. There is a frictional force, F_k, between the ramp and the carton.

a. What is the initial mechanical energy, ME_i, of the carton? (Hint: Apply the law of conservation of energy.)

______

b. If μ is the coefficient of friction between the ramp and the carton, what is F_k?

______

c. Express the final speed, v_f, of the carton in terms of v_i, g, d, and μ.

______

NAME ______________________ DATE ______________ CLASS ____________________

Section **6-1**

HOLT PHYSICS

Graph Skills

Momentum and Impulse

Use this grid for items 1–6.

1. A soccer ball with a mass of 0.950 kg is traveling east at 10.0 m/s. Using a ruler and a scale of 1.0 square per 1.0 kg•m/s, draw a vector representing the momentum of the soccer ball.

2. A force of 2.00×10^2 N directed south is exerted on the ball for 0.025 s. Using the technique you used in item 1, draw a vector representing the impulse on the soccer ball.

3. The final momentum of the soccer ball is the initial momentum plus the change in momentum. Add your vectors from the previous questions to draw the final momentum vector of the ball.

4. Use your scale (1.0 square = 1.0 kg•m/s) to find the magnitude of the final momentum.

____

5. Using your value for final momentum and the mass given in item 1, find the final speed of the ball.

____

6. How can you determine the angle at which the ball is traveling?

____

____

____

Use this grid for item 7.

7. Use the techniques you used in items 1–5 to find the final speed of a 0.150 kg baseball that initially travels east at 40.0 m/s and is then hit with a westward force of 1250 N over a 0.010 s interval.

____

____

____

____

NAME ______________ DATE ______________ CLASS ______________

Section 6-2

HOLT PHYSICS

Concept Review

Conservation of Momentum

A radioactive nucleus is initially at rest. When it decays, it splits into two moving parts, one of which has exactly 50 times the mass of the other. Assume there are no external forces acting on the nucleus, and answer the following questions.

1. What is the total momentum of the nucleus before the fission (split) occurs?

____

2. What is the total momentum of the pieces after the event?

____

3. Assume the less massive particle moves east (0°). In words, compare the size and direction of the two momentum vectors.

____

____

____

4. Because the masses are different, the velocities must be different. Determine the ratio of the velocity of the small particle to the velocity of the large particle.

____

5. What generalization can you make about the relative velocities and the masses in this type of situation?

____

____

____

DATE ______________ CLASS ____________________

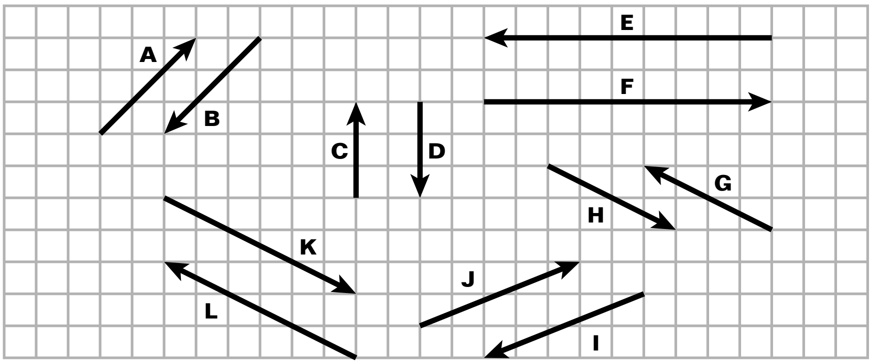
Section **6-3**

HOLT PHYSICS

Diagram Skills

Elastic and Inelastic Collisions

Use the following vectors to answer items 1–5.



Consider a collision between two objects. Assume that the initial momentum of object 1 is represented by vector **A** ($\mathbf{p}_{1,i} = \mathbf{A}$) and the initial momentum of object 2 is represented by vector **K** ($\mathbf{p}_{2,i} = \mathbf{K}$).

1. In the space below, construct a vector diagram showing the total initial momentum just before the collision.

2. Which vector above represents the total initial momentum?

____

3. Which vector above represents the total final momentum?

____

4. If the final momentum of object 1 is represented by vector **H** ($\mathbf{p}_{1,f} = \mathbf{H}$), construct a vector diagram in the space below to find the final momentum vector, $\mathbf{p}_{2,f}$. (Remember that $\mathbf{p}_{1,f} + \mathbf{p}_{2,f} = \mathbf{p}_f$.)

5. Which vector above represents $\mathbf{p}_{2,f}$?

____

Chapter 6

HOLT PHYSICS

Mixed Review

Momentum and Collisions

1. A pitcher throws a softball toward home plate. The ball may be hit, sending it back toward the pitcher, or it may be caught, bringing it to a stop in the catcher's mitt.

a. Compare the change in momentum of the ball in these two cases.

b. Discuss the magnitude of the impulse on the ball in these two cases.

c. In the space below, draw a vector diagram for each case, showing the initial momentum of the ball, the impulse exerted on the ball, and the resulting final momentum of the ball.

2. a. Using Newton's third law, explain why the impulse on one object in a collision is equal in magnitude but opposite in direction to the impulse on the second object.

b. Extend your discussion of impulse and Newton's third law to the case of a bowling ball striking a set of 10 bowling pins.

Chapter 6

HOLT PHYSICS

Mixed Review *continued*

3. Starting with the conservation of total momentum, $\mathbf{p_f} = \mathbf{p_i}$, show that the final velocity for two objects in an inelastic collision is

$$\mathbf{v_f} = \left(\frac{m_1}{m_1 + m_2}\right)\mathbf{v_{1,i}} + \left(\frac{m_2}{m_1 + m_2}\right)\mathbf{v_{2,i}}.$$

4. Two moving billiard balls, each with a mass of *M*, undergo an elastic collision. Immediately before the collision, ball *A* is moving east at 2 m/s and ball B is moving east at 4 m/s.

a. In terms of *M*, what is the total momentum (magnitude and direction) immediately before the collision?

____

b. The final momentum, $M(\mathbf{v_{A,f}} + \mathbf{v_{B,f}})$, must equal the initial momentum. If the final velocity of ball *A* increases to 4 m/s east because of the collision, what is the final momentum of ball *B*?

____

c. For each ball, compare the final momentum of the ball to the initial momentum of the other ball. These results are typical of head-on elastic collisions. What generalization about head-on elastic collisions can you make?

____

____

____

Section 7-1

HOLT PHYSICS

Concept Review

Measuring Rotational Motion

1. Convert the following angles from degrees to radians.

a. 17.0° ______________ **c.** 50.0° ______________ **e.** –20.0° ______________

b. 170.0° ______________ **d.** 230.0° ______________ **f.** 340.0° ______________

2. Convert the following angles from radians to degrees.

a. 1.00 rad ______________ **c.** –2.50 rad ______________ **e.** 3.14 rad ______________

b. 4.14 rad ______________ **d.** 3.78 rad ______________ **f.** 1.57 rad ______________

3. A car moves forward 10.0 m in 1.5 s. Each tire rotates through an arc length of 10.0 m, and each car tire has a radius of 3.5×10^{-1} m.

a. Find the angular displacement of one of the tires.

b. Find the average angular speed of the tire.

c. Assume the tire starts from rest and accelerates uniformly. Find the angular acceleration of the tire.

d. What is the instantaneous angular speed of the tire after 1.5 s?

4. The period, *T*, of rotational motion is the time required for one complete revolution, or the time for the object to rotate through 2π rad. Starting with $\Delta\theta = \omega\Delta t$, show that $T = \frac{2\pi r}{v}$.

Section **7-2**

HOLT PHYSICS

Concept Review

Tangential and Centripetal Acceleration

1. A wheel accelerates from rest at 1.0 rad/s^2. Find the instantaneous angular speed of the wheel at the following times.

a. 0.10 s ______________ **c.** 1.0 s ______________ **e.** 5.0 s ______________

b. 0.50 s ______________ **d.** 2.0 s ______________ **f.** 10.0 s ______________

2. If the wheel in item 1 has a radius of 0.35 m, find the tangential speed of a point on the rim of the wheel at each time in item 1.

a. ______________ **c.** ______________ **e.** ______________

b. ______________ **d.** ______________ **f.** ______________

3. If the wheel in item 1 has a radius of 0.35 m, find the tangential acceleration of a point on the rim of the wheel.

4. Find the ratio of the centripetal accelerations for the sets of rotating objects described below.

a. $r_1 = r_2 = 2.00$ m; $v_{t,1} = 10.0$ m/s, $v_{t,2} = 5.00$ m/s

b. $v_{t,1} = v_{t,2} = 10.0$ m/s; $r_1 = 2.00$ m, $r_2 = 1.00$ m

c. $\omega_1 = \omega_2 = 10.0$ rad/s; $r_1 = 2.00$ m, $r_2 = 1.00$ m

5. Consider a car moving at a constant speed of 35.0 m/s on a flat road. The car turns around a curve that is 65.0 m in radius.

a. Find the centripetal acceleration of the car. ______________

b. What provides the force necessary to make the car turn? ______________

Section **7-3**

HOLT PHYSICS

Concept Review

Causes of Circular Motion

1. Newton's universal law of gravitation states that $F_g = \frac{m_1 m_2}{r^2}$. Consider a system of two masses, $m_1 = m_2 = M$, at a distance $r = R_o$. The gravitational force on each of these masses would be $F_o = G\frac{MM}{R_o^2} = G\frac{M^2}{R_o^2}$. Find the ratio of the new gravitational force to the original force, F_o, for each of the following situations.

a. $m_1 = M$, $m_2 = 2M$, $r = R_o$. ______________________________

b. $m_1 = m_2 = 2M$, $r = R_o$. ______________________________

c. $m_1 = m_2 = M$, $r = 2R_o$. ______________________________

d. $m_1 = m_2 = M$, $r = -R_o$. ______________________________

2. For each situation in item 1, write a sentence that summarizes in words what has changed and how that change has affected the gravitational force.

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

d. ______________________________

____

3. Why is a force necessary to create circular motion?

____

____

____

NAME ______________ DATE ______________ CLASS ______________

Chapter 7

HOLT PHYSICS

Mixed Review

Rotational Motion and the Law of Gravity

1. Complete the following table.

	s (m)	r (m)	$\Delta\theta$ (rad)	Δt (s)	ω (rad/s)	v_t (m/s)	a_c (m/s^2)
a.	4.5		1.5	0.50			
b.		0.50	8.5		8.5		
c.	3.2	0.20			58		
d.	1250		2.0	17			
e.	3750	750				86	

2. Describe the force that maintains circular motion in the following cases.

a. A car exits a freeway and moves around a circular ramp to reach the street below.

____

____

b. The moon orbits Earth.

____

____

c. During gym class, a student hits a tether ball on a string.

____

____

3. Determine the change in gravitational force under the following changes.

a. one of the masses is doubled ______________

b. both masses are doubled ______________

c. the distance between masses is doubled ______________

d. the distance between masses is halved ______________

e. the distance between masses is tripled ______________

4. Some plans for a future space station make use of rotational force to simulate gravity. In order to be effective, the centripetal acceleration at the outer rim of the station should equal about 1 g, or 9.81 m/s^2. However, humans can withstand a difference of only 1/100 g between their head and feet before they become disoriented. Assume the average human height is 2.0 m, and calculate the minimum radius for a safe, effective station. (Hint: The ratio of the centripetal acceleration of astronaut's feet to the centripetal acceleration of the astronaut's head must be at least 99/100.)

5. As an elevator begins to descend, you feel momentarily lighter. As the elevator stops, you feel momentarily heavier. Sketch the situation, and explain the sensations using the forces in your sketch.

6. Two cars start on opposite sides of a circular track. One car has a speed of 0.015 rad/s; the other car has a speed of 0.012 rad/s. If the cars start π radians apart, calculate the time it takes for the faster car to catch up with the slower car.

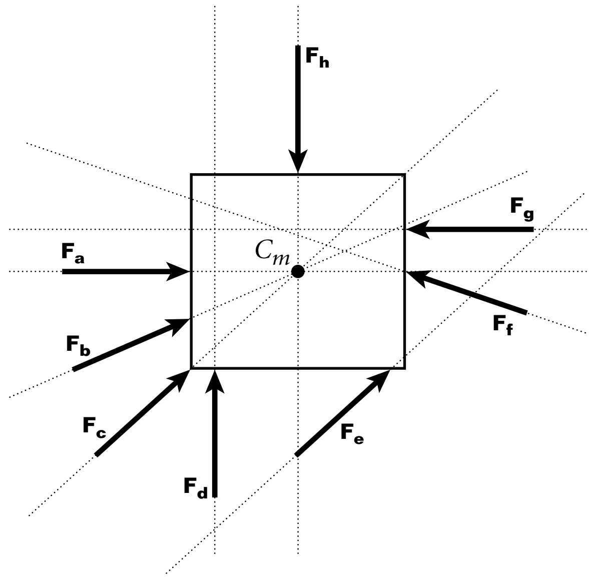
Section **8-1**

HOLT PHYSICS

Concept Review

Torque

1. Use the diagram at right to complete the following items. The arrows represent force vectors, and the dashed lines represent the lines of action of the forces.



a. Identify the forces that exert a torque on the object.

______

b. Redraw the diagram, and include only the forces that exert a torque on the object.

c. If each force has the same magnitude, which force exerts the largest torque? Explain your answer.

______

______

2. Two people pull on the knobs on opposite sides of a door. Sherry pulls from the inside of the door with a force of 145 N at a 90.0° angle to the door. José pulls from the outside with a 165 N force at an angle of 45.0° to the door. The doorknob is 83.0 cm from the hinge.

a. Calculate the torque Sherry exerts on the door. ______

b. Calculate the torque José exerts on the door. ______

c. Will the door rotate toward Sherry or toward José? Explain your answer.

______

______

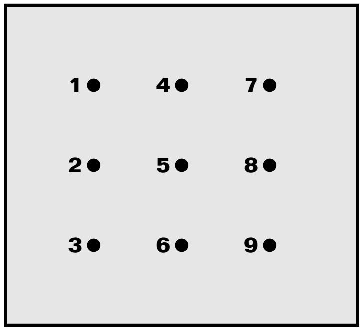
Section **8-2**

HOLT PHYSICS

Diagram Skills

Rotation and Inertia

Use the diagram at right to answer items 1–4.



1. If the figure above has a uniform density, which point best represents the center of mass?

____

2. Imagine that a small hole is cut in the block at the following locations, possibly causing the center of mass to shift. In each case, identify the point toward which the center of mass will move.

a. a single hole is cut at point 1: ______________________________

b. a single hole is cut at point 4: ______________________________

c. a single hole is cut at point 8: ______________________________

d. a single hole is cut at point 5: ______________________________

3. Now imagine that a small amount of mass is added at the following locations. Again, identify the point toward which the center of mass will move.

a. a single addition of mass is made at point 3: ______________________________

b. a single addition of mass is made at point 2: ______________________________

c. a single addition of mass is made at point 6: ______________________________

d. a single addition of mass is made at point 5: ______________________________

4. If a force is applied at point 1 to the right the force will exert a clockwise torque on the object.

a. Which two points define the lever arm for this situation? ______________________________

b. Where and in what direction should an equal force be applied to keep the object in equilibrium?

____

____

NAME ______________________ DATE ______________ CLASS ______________

Section **8-3**

HOLT PHYSICS

Concept Review

Rotational Dynamics

1. A hollow ball and a solid ball have the same mass (15.0 kg) and radius (1.5 m). Both are rotating at 750 rpm.

a. What is the angular speed of each ball?

hollow ______________________ solid ______________________

b. What is the moment of inertia for each ball? (Hint: Refer to **Table 8-1** on page 285 of your textbook.)

hollow ______________________ solid ______________________

c. What is the angular momentum of each ball?

hollow ______________________ solid ______________________

d. A small frictional torque of 0.10 N•m is exerted on both balls. Find the angular acceleration of each ball.

hollow ______________________ solid ______________________

e. Based on your answer for part d, which ball will continue to spin for a longer time?

____

2. A 7.3 kg bowling ball is rolled down a lane with an initial translational speed of 3.6 m/s and zero rotational speed.

a. What is the initial energy of the ball? ______________________

b. The radius of the ball is 12.0 cm. What is the moment of inertia of the ball? ______________________

c. When the ball reaches the pins, it has rotational and translational kinetic energy. If the ball is rolling without slipping ($v = \omega r$), what is the translational speed of the ball? (Hint: Assume the energy from part a is conserved.) ______________________

d. Frictional force makes the ball roll instead of slide. Explain how this affects the energy of the ball and how friction affects the final speed of the ball.

____

____

NAME ______________ DATE ______________ CLASS ______________

Section 8-4

HOLT PHYSICS

Concept Review

Simple Machines

1. If friction is included in the analysis of any machine, the energy put into the machine is more than the work. How is it that simple machines make a task easier?

____

____

____

2. A pulley system with a mechanical advantage of 15 is used to lift a 1750 N piano to a third-floor balcony that is 7.0 m above the ground.

a. If friction is negligible, how much work must be done? ______________

b. What applied force must the movers use? ______________

c. How much rope will the movers pull in? ______________

d. If friction is not negligible, is the input energy greater than or less than your answer to part a?

____

3. Calculate the efficiency of the following.

a. $W_{in} = 1850$ J, $W_{out} = 1700$ J ______________

b. an object weighing 150 N is lifted 9.0 m using 1500 J of energy ______________

c. a force of 150 N is exerted along a 3.0 m inclined plane to raise an object weighing 425 N to a height of 1.0 m ______________

4. Explain why a real machine can never have an efficiency of 100 percent.

____

____

____

5. What may be done to increase the efficiency of a real machine?

____

____

____

____

Chapter 8

HOLT PHYSICS

Mixed Review

Rotational Equilibrium and Dynamics

1. **a.** On some doors, the doorknob is in the center of the door. What would a physicist say about the practicality of this arrangement? Why would physicists design doors with knobs farther from the hinge?

____

____

b. How much more force would be required to open the door from the center rather than from the edge?

____

2. Figure skaters commonly change the shape of their body in order to achieve spins on the ice. Explain the effects on each of the following quantities when a figure skater pulls in his or her arms.

a. moment of inertia

____

b. angular momentum

____

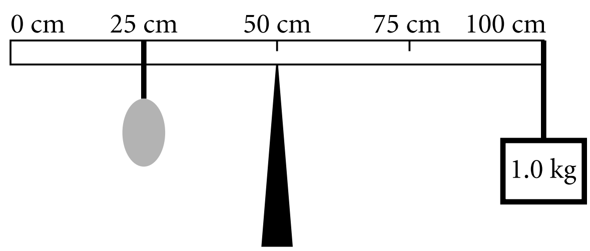
c. angular speed

____

3. For the following items, assume the objects shown are in rotational equilibrium.

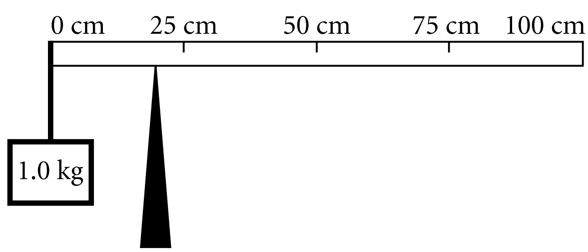
a. What is the mass of the sphere to the right?

____



b. What is the mass of the portion of the meter-stick to the left of the pivot? (Hint: 20% of the mass of the meterstick is on the left. How much must be on the right?)

____



Chapter 8

HOLT PHYSICS

Mixed Review *continued*

4. A force of 25 N is applied to the end of a uniform rod that is 0.50 m long and has a mass of 0.75 kg.

a. Find the torque, moment of inertia, and angular acceleration if the rod is allowed to pivot around its center of mass. ______

b. Find the torque, moment of inertia, and angular acceleration if the rod is allowed to pivot around the end, away from the applied force. ______

5. A satellite in orbit around Earth is initially at a constant angular speed of 7.27×10^{-5} rad/s. The mass of the satellite is 45 kg, and it has an orbital radius of 4.23×10^{7} m.

a. Find the moment of inertia of the satellite in orbit around Earth. ______

b. Find the angular momentum of the satellite. ______

c. Find the rotational kinetic energy of the satellite around Earth. ______

d. Find the tangential speed of the satellite. ______

e. Find the translational kinetic energy of the satellite. ______

6. A series of two simple machines is used to lift a 13300 N car to a height of 3.0 m. Both machines have an efficiency of 0.90 (90 percent). Machine A moves the car, and the output of machine B is the input to machine A.

a. How much work is done on the car? ______

b. How much work must be done on machine A in order to achieve the amount of work done on the car? ______

c. How much work must be done on machine B in order to achieve the amount of work from machine A? ______

d. What is the overall efficiency of this process? ______

NAME ________________________ DATE ______________ CLASS ________________

Section **9-1**

HOLT PHYSICS

Concept Review

Fluids and Buoyant Force

A raft is made of a plastic block with a density of 650 kg/m^3, and its dimensions are 2.00 m × 3.00 m × 5.00 m.

1. What is the volume of the raft?

____

2. What is its mass?

____

3. What is its weight?

____

4. What is the raft's apparent weight in water?
(Hint: density of water = 1.00×10^3 kg/m^3)

____

5. What is the buoyant force on the raft in water?

____

6. What is the mass of the displaced water?

____

7. What is the volume of the displaced water?

____

8. How much of the raft's volume is below water? How much is above?

____

9. Answer items 5–8 using ethanol (density = 0.806×10^3 kg/m^3) instead of water.

____

____

____

____

NAME ______________________ DATE ______________ CLASS ____________________

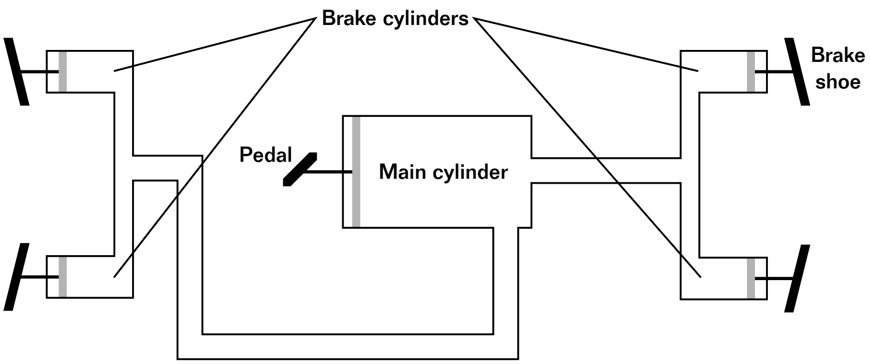
Section 9-2

HOLT PHYSICS

Concept Review

Fluid Pressure and Temperature

A car's brake system transfers pressure from the main cylinder to the brake shoes on all four wheels, as shown in the diagram. The surface area of the main cylinder piston is 7.20×10^{-4} m^2 (7.20 cm^2), and that of the piston in each individual brake cylinder is 1.80×10^{-4} m^2 (1.80 cm^2). The driver exerts a 5.00 N force on the pedal.



1. What is the pressure exerted on the main cylinder?

____

2. What is the pressure added to the liquid in this brake system?

____

3. What is the pressure added to each brake cylinder?

____

4. What is the force exerted on each brake shoe?

____

5. As the driver pushes the pedal, the piston moves 2.00×10^{-2} m (2.00 cm) in the main cylinder.

a. How much volume of brake fluid is pushed out of the main cylinder?

____

b. How much does the piston move in each of the brake cylinders?

____

Menu Print

NAME ______________________ DATE ______________ CLASS ______________

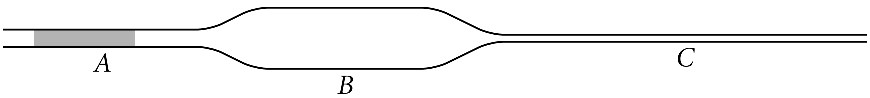
Section **9-3**

HOLT PHYSICS

Math Skills

Fluids in Motion

Every second, 1.20 m^3 of water enters a heating system through a pipe of medium width, *A*, with a cross-sectional area of 0.200 m^2. The water then flows into a wide pipe, *B*, with an area of 0.600 m^2, and flows out through a narrow pipe, *C*, with an area of 0.100 m^2.



1. What is the flow rate in each pipe?

____

2. What is the length of the segment of pipe *A* that contains 1.20 m^3 of water? Sketch the marks on the diagram above showing the segments of pipes *B* and *C* that would contain the same amount of water. What is the length of each segment?

____

3. How much time is required for water to travel the lengths you found in pipe *A*? in pipe *B*? in pipe *C*?

____

4. What is the flow speed of water in each pipe?

____

5. Does the speed of water increase when it enters a narrow pipe? Does the flow rate increase? Explain.

____

____

Section 9-4

HOLT PHYSICS

Concept Review

Properties of Gases

A volume of 2.40×10^{-3} m^3 of hydrogen gas is enclosed in a cylinder with a movable piston at 300 K under a pressure of 203 kPa (2.00 atm). The density of hydrogen under these conditions is 0.180 kg/m^3.

1. Calculate the mass of hydrogen in the cylinder.

______

2. The gas is cooled down to 150 K, and the pressure is increased to 609 kPa (6.00 atm). Calculate the volume in the gas.

______

3. What is the ratio of the final and initial temperature? pressure? volume?

______

______

4. How did an increase in pressure affect the volume? How did the decrease in temperature affect the volume?

______

______

______

5. Did the mass of hydrogen in the cylinder increase or decrease? Explain.

______

______

______

6. Find the density of hydrogen in the cylinder after the process. Has it increased or decreased? In what ratio?

______

______

______

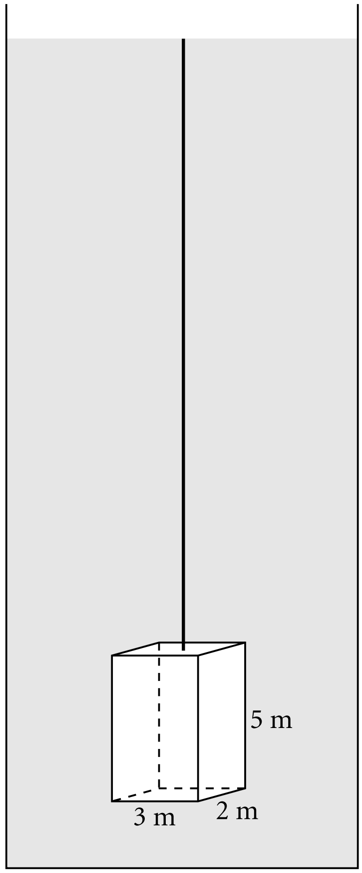
Chapter 9

HOLT PHYSICS

Mixed Review

Fluid Mechanics

1. A crate with dimensions of 2.00 m × 3.00 m × 5.00 m is immersed in sea water ($\rho = 1.025 \times 10^3$ kg/m^3) with the 3.00 × 2.00 sides as the top and bottom. The crate is held with a cable so that the top is 20.0 m below the surface of the water.



a. Calculate the hydrostatic pressure on the top of the crate and on the bottom of the crate.

______

b. Find the absolute pressure at the top and at the bottom of the crate. ($P_0 = 1.01 \times 10^5$ N/m^2)

______

c. Find the forces exerted on the top and on the bottom of the crate by these pressures.

______

d. On the diagram at right, sketch in vectors representing the direction and magnitude of these forces.

e. What is the net force exerted by the water on the crate?

______

f. The crate's weight is 2.50×10^6 N. Will it sink when the cable is cut? Explain.

______

______

g. Calculate the volume of the crate.

______

h. Use Archimedes' principle to find the buoyant force on the crate. How is it related to your answer to item e?

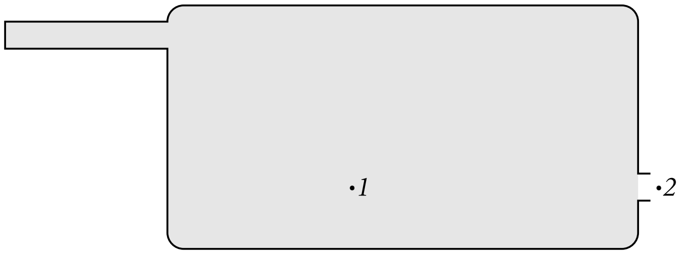
______

______

Chapter 9

HOLT PHYSICS
Mixed Review *continued*

2. A very large boiler has a very small opening near the bottom, as shown in the diagram below. Water ($\rho = 1.00 \times 10^3$ kg/m^3) is constantly added through the top of the boiler to keep the boiler full. Pressure at the point labeled *1* is 1.00×10^6 N/m^2 above atmospheric pressure ($P_0 = 1.01 \times 10^5$ N/m^2).



a. Write the general form of Bernoulli's equation for the points labeled *1* and *2*.

______

b. Explain why $h_1 = h_2$ in this case. Write the simplified form of Bernoulli's equation that results from this conclusion.

______

______

c. Can you assume that v_1 is approximately zero? Explain.

______

______

d. Write the reduced form of Bernoulli's equation that results from this assumption.

______

e. How does P_2 compare with the atmospheric pressure P_0? How does it compare with P_1?

______

f. Use this information to find the rate of flow of water out of the small opening. (Hint: solve Bernoulli's equation for v_2).

______

NAME ______________________ DATE ______________ CLASS ______________

Section 10-1

HOLT PHYSICS

Math Skills

Temperature and Thermal Equilibrium

1. The temperature at one of the Viking sites on Mars was found to vary daily from –90.0°F to –5.0°C. Convert these temperatures to Kelvin.

____

2. Mercury boils at 357°C and freezes at –38.9°C.

a. Convert these temperatures to Kelvin.

____

b. Can a mercury thermometer be used to measure temperatures between 500°C and 600°C? between 100°C and 200°C?

____

____

3. You walk out of a sauna at 45°C into a tub in which the water temperature is 309 K.

a. Is your skin initially in thermal equilibrium with the water?

____

b. Is your bath going to feel cold or warm?

____

4. Nitrogen becomes a liquid at –195.8°C under atmospheric pressure. Oxygen becomes a liquid at –183.0°C.

a. Convert these temperatures to Kelvin.

____

b. A sealed tank containing a mixture of nitrogen and oxygen is cooled to 82.8 K and maintained under atmospheric pressure. Are the contents now a liquid or a gas? Explain.

____

____

Section 10-2

HOLT PHYSICS

Concept Review

Defining Heat

1. A 1.000×10^3 kg car is moving at 90.0 km/hr (25.0 m/s) as it exits a freeway. The driver brakes to meet the speed limit of 36.0 km/hr (10.0 m/s).

a. What was the car's kinetic energy on the freeway?

____

b. What is its kinetic energy after slowing down?

____

c. Did the internal energy of the car, road, and air increase or decrease in this process? By how much?

____

d. Was work done by the car brakes and other friction forces in the process? How much?

____

____

2. A 2.00×10^2 kg sled is sliding downhill at a constant speed of 5.00 m/s until it passes a tree 20.0 m down.

a. What was the potential energy associated with the sled and the sled's kinetic energy and total mechanical energy at the top of the hill?

____

b. What were these energies at the bottom of the hill?

____

c. What was the change in the sled's total energy?

____

d. What was the change in the internal energy of the sled and its environment? How might that change be observed in the snow?

____

____

Section **10-3**

HOLT PHYSICS

Graph Skills

Changes in Temperature and Phase

A 20.0 kg ice block is removed from a freezer whose temperature is –25.0°C and placed in an ice box with freshly caught fish. After a few hours, all the ice was melted. The final temperature of the water and the fish was 5°C.

The melting point of ice is 0.00°C. The heat capacities and latent heats are given as c_p (ice) = 2.09 × 10^3 J/kg•°C; L_f(ice) = 3.33 × 10^5 J/kg; c_p (water) = 4.19 × 10^3 J/kg•°C. Use this information to answer the questions below.

1. How much energy did the solid ice absorb to reach its melting point and remain solid?

____

2. How much energy was absorbed to turn the ice into water?

____

3. How much energy was absorbed to bring the temperature of that water to 5°C?

____

4. Draw a graph showing all of the process. (Let each box on the grid represent 0.4 × 10^6 J or 0.5 × 10^6 J.)

Section 10-4

HOLT PHYSICS

Concept Review

Controlling Heat

1. What is the role of the silver coating inside a thermos bottle?

______

______

______

2. You are cooking spaghetti atop a stove in a copper-coated stainless-steel pan filled with water. How is energy transferred from the flame to the spaghetti?

______

______

______

3. You are making toast for breakfast. Is most of the energy transferred from the heating element to the bread by convection or by radiation?

______

______

______

4. How would you answer item 3 differently if you were cooking chicken on a barbecue grille?

______

______

5. Why does wearing a wet shirt on a hot day make you feel cooler?

______

______

Chapter 10

HOLT PHYSICS

Mixed Review

Heat

1. A small bag containing 0.200 kg of lead shot at a temperature of 15.0°C falls from a 40.0 m high tower. Instead of bouncing back, the bag makes a small hole in the ground. The specific heat of lead is 1.28×10^2 J/kg•°C.

a. Find the initial potential energy of the lead.

____

b. How much energy did the lead lose as heat?

____

c. The temperature of the lead after impact was 17.0°C. What was the increase in internal energy of the lead? How does it compare to the amount of lost potential energy?

____

____

d. How much internal energy was added to the ground?

____

2. A very shallow pond contains 1.50×10^5 kg of water at 23°C. At the end of a windy day, 1.00×10^3 kg of water was lost by evaporation. It takes 2.26×10^6 J for 1 kg of water to evaporate.

a. How much energy was removed from the pond by heat of evaporation?

____

b. How much water was left in the pond?

____

c. By how much did the temperature of the water drop in the pond? (Hint: the specific heat capacity for water is 4.19×10^3 J/(kg•°C).)

____

d. Assuming there were no other changes in energy, what was the temperature of the water at the end of the day?

____

Chapter 10

HOLT PHYSICS

Mixed Review *continued*

3. Exactly two kilograms of boiling water (100.0°C) are poured into a long, insulated aluminum pipe. The mass of the pipe is 5.000 kg, and its temperature is 20.0°C. The specific heat capacity of water is 4.19×10^3 J/kg•°C, and the specific heat capacity of aluminum is 8.99×10^2 J/kg•°C.

a. Given that the final temperature of the water is x°C and the final temperature of the pipe is y°C, explain why $y = x$.

____

____

b. Write expressions for the temperature change in water and in the pipe itself.

____

c. Write an expression for the amount of energy removed from the water.

____

d. Write an expression for the amount of energy added to the aluminum.

____

e. Explain under what conditions these two amounts of energy may be considered equal.

____

____

f. Assuming that these conditions are realized, find the final temperature of the water and pipe.

____

____

Section **11-1**

HOLT PHYSICS

Concept Review

Relationships Between Heat and Work

1. A gas enclosed in a cylinder occupies 0.030 m^3. It is compressed under a constant pressure of 3.5×10^5 Pa until its final volume is exactly one-third of its initial volume.

a. What was the change in the gas volume? ______________

b. How much work was done? ______________

c. The gas lost 5.0×10^3 J as heat during the compression process. Did the internal energy of the gas increase or decrease? By how much?

____

2. A steel marble at room temperature is placed in a plastic-foam cup containing ice and water at 0°C. After thermal equilibrium is reached, the temperature of the ice-water mixture and marble is 0°C.

a. Was energy transferred between the marble and the water as heat? Which object lost energy?

____

b. Was any work done on the marble or by the marble? ______________

c. Did the internal energy of the marble increase or decrease? What was a measurable effect of this change?

____

d. Did the internal energy of the water-ice mixture increase or decrease? How could this be observed?

____

e. Did the internal energy of the system consisting of the water-ice mixture and the marble increase or decrease?

____

Section **11-2**

HOLT PHYSICS

Diagram Skills

Thermodynamic Processes

1. A gas trapped in a cylinder does 540 J of work by expansion. At the end of the process, the internal energy has decreased by 860 J.

a. How much energy was transferred as heat between the gas and its environment?

______

b. Did the gas gain or lose energy in this transfer? Explain.

______

______

c. In the space below, sketch a diagram of the gas container, and draw arrows showing the energy transfers as work and as heat.

2. The same amount of work (540 J) is done to **compress** the gas, this time in an **isothermal** process.

a. What is the change in internal energy of the gas?

______

b. How much energy is transferred as heat?

______

c. Is that energy removed from or added to the gas? Sketch a diagram showing the energy transfers as work and as heat.

NAME ______________________ DATE ______________ CLASS ______________

Section **11-3**

HOLT PHYSICS

Concept Review

Efficiency of Heat Engines

1. A steam engine absorbs 4.00×10^4 J and expels 3.20×10^4 J as heat.

a. How much work is done?

____

b. What is the efficiency of this engine?

____

c. If the engine exerts a constant force through a displacement of 25 m, how great is the force exerted by the engine?

____

2. The efficiency of a diesel engine is 0.35. The engine absorbs 2.00×10^4 J as heat.

a. How much work does the engine do?

____

b. How much heat is expelled?

____

c. If this engine exerts a force of 175 N on an object, how far will the object be displaced?

____

3. An experimental gasoline engine performs at 32 percent efficiency and does 1.60×10^2 J of work in each cycle.

a. How much energy does the engine absorb as heat in a cycle?

____

b. How much energy is lost in each cycle?

____

c. How much work would the same engine do if it absorbed the same amount of heat per cycle as described in **a,** but was operating at a 38 percent efficiency?

____

NAME ______________________ DATE ______________ CLASS ____________________

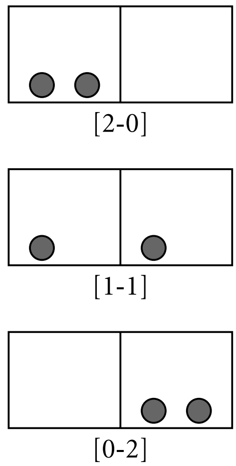
Section **11-4**

HOLT PHYSICS

Math Skills

Entropy

1. A box divided by a removable partition contains two marbles in the left compartment. The partition is removed, the box is shaken, and the partition is put back into the box. Follow the steps at right to list the possible arrangements and distributions of the marbles in the box.



a. In how many ways can the marbles be arranged so that the following occur.

- both of them are in the left compartment, as in distribution [2-0]

____

- each one is in different compartment, as in distribution [1-1]

____

- both of them are in the right compartment, as in distribution [0-2]

____

b. How many possible ways are there for arranging the two marbles in the box? ______________

c. Which of the distributions is the most likely to occur? ______________

2. Repeat the exercise above using a box that contains four marbles.

a. In how many ways can you create each of the possible distributions [4-0], [3-1], [2-2], [1-3], [0-4]?

____

b. How many possible arrangements of the marbles are there altogether? ______________

c. Which distribution is most likely to occur? ______________

d. Which distribution has more disorder? ______________

3. Explain how your answers about the situations of boxes with marbles relate to the increase in molecular disorder that occurs when sugar is stirred into coffee.

____

____

____

NAME ______________________ DATE ______________ CLASS ____________________

Chapter 11

HOLT PHYSICS

Mixed Review

Thermodynamics

1. A system does 300 J of work at the same time that 1000 J of energy is transferred to the system as heat. What is the change in the system's internal energy?

____

2. Air is being compressed in a cylinder of area 0.025 m^3 under a constant pressure of 3.0×10^5 Pa, and the volume of the air in the cylinder is reduced to 0.020 m^3.

a. By how much is the volume of air reduced?

____

b. How much work is done in the process?

____

c. The cylinder is thermally insulated, making the process adiabatic. What is the change in internal energy of the gas?

____

3. A gasoline engine runs with 28 percent efficiency. It expels 3.60×10^4 J of heat in each cycle.

a. Find the heat absorbed in one cycle.

____

b. Find the work output in one cycle.

____

4. When you use a pump to push air into a bicycle tire, the pump and the air eventually warm up.

a. Explain how this is related to the first law of thermodynamics.

____

____

b. Explain how this fact is related to the second law of thermodynamics.

____

____

Chapter 11

HOLT PHYSICS

Mixed Review *continued*

5. A basketball bounces to half of its original height when dropped. In the space below, sketch energy bar diagrams describing the ball's potential energy, the ball's kinetic energy, the internal energy of the ball, and the ball's environment at each of the following four instants.

- just before the ball is dropped
- immediately after the first bounce
- at its highest point after the first bounce
- immediately after the second bounce

Before ball is dropped

Immediately after first bounce

At high point after first bounce

Immediately after second bounce

Section **12-1**

HOLT PHYSICS

Concept Review

Simple Harmonic Motion

1. A clown is rocking on a rocking chair in the dark. His glowing red nose moves back and forth a distance of 0.42 m exactly 30 times a minute, in a simple harmonic motion.

a. What is the amplitude of this motion?

____

b. What is the period of this motion?

____

c. What is the frequency of this motion?

____

d. The top of the clown's hat contains a small light bulb that shines a narrow light beam. The beam makes a spot on the wall that goes back and forth between two dots placed 1.00 m apart as the clown rocks. What are the amplitude, period, and frequency of the spot's motion?

____

____

____

2. A 5.00 kg block hung on a spring causes a 10.0 cm elongation of the spring.

a. What is the restoring force exerted on the block by the spring?

____

b. What is the spring constant?

____

c. What force is required to stretch this spring 8.50 cm horizontally?

____

d. What will the spring's elongation be when pulled by a force of 77.7 N?

____

Menu Print

DATE ______________ CLASS ____________________

Section 12-2

HOLT PHYSICS

Math Skills

Measuring Simple Harmonic Motion

1. A spring-mass system vibrates exactly 10 times per second. Find its period and its frequency.

____

2. A pendulum swings with a period of 0.20 seconds.

a. What is its frequency?

____

b. How many times does it pass the lowest point on its path in 1.0 second? in 7.0 seconds?

____

3. A spring-mass system completes 20.0 vibrations in 5.0 seconds, with a 2.0 cm amplitude.

a. Find its frequency and its period.

____

b. The same mass is pulled 5.0 cm away from the equilibrium position, then released. What will the period, the frequency, and the amplitude be?

____

4. A pendulum completes 30.0 oscillations per minute. Find its frequency, its period, and its length.

____

5. A spring has a 2.000×10^3 N/m spring constant.

a. What mass will make it oscillate 5.0 times per second? 10.0 times per second?

____

b. You want the mass-spring system to operate at a higher frequency. Should you increase or decrease the mass?

____

Section **12-3**

HOLT PHYSICS

Concept Review

Properties of Waves

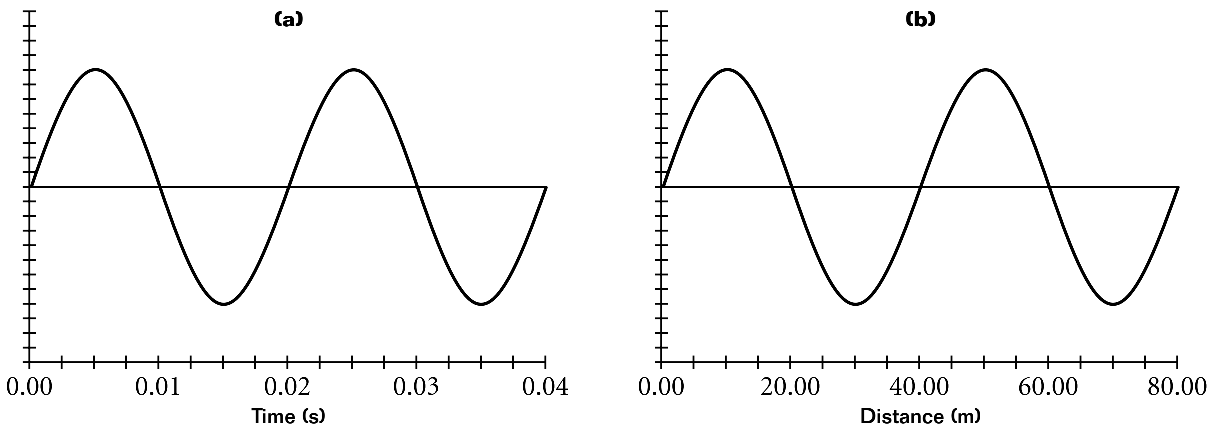
1. Radio waves travel at the speed of light (3.00×10^8 m/s). An amateur radio system can receive radio signals at frequencies between 8.00 MHz and 1.20 MHz. What is the range of the wavelengths this system can receive?

____

____

____

2. Graph (**a**) below describes the density versus time of a pressure wave traveling through an elastic medium. Graph (**b**) describes the density versus distance for the same wave.



a. Use graph (**a**) to find the period of oscillation of this wave and its frequency.

____

b. Use graph (**b**) to find the wavelength and the speed.

____

NAME ______________________ DATE ______________ CLASS ____________________

Section **12-4**

HOLT PHYSICS

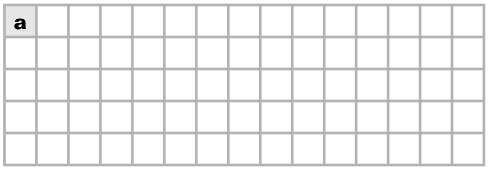
Graph Skills

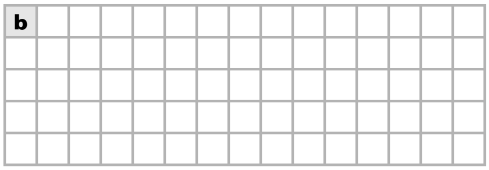
Wave Interactions

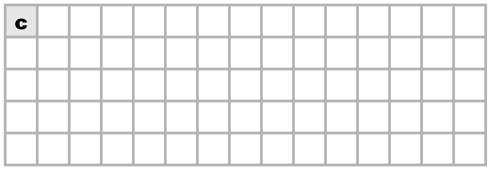
1. A wave of 0.25 cm amplitude traveling on a string interferes with a wave of 0.35 cm amplitude that was generated at the other end with the same frequency. Their maxima occur at the same points on the string.

a. Sketch a graph of each individual wave traveling through the same area of the string for one period on the grids labeled (**a**) and (**b**).

b. Sketch a graph of the wave shape resulting from interference on the grid labeled (**c**).







2. A 15.0 m long string is tied at one end (point *B*) and shaken repeatedly at the other end (point *A*) with a 2.00 Hz frequency. This generates waves that travel at 20.0 m/s in the string.

a. How long does it take for each pulse to travel from *A* to *B* and return to *A*?

____

b. What is the wavelength of these waves?

____

c. Are the pulses inverted when reflected from *B*?

____

Chapter 12

HOLT PHYSICS

Mixed Review

Vibrations and Waves

1. A pendulum with a mass of 0.100 kg was released. The string made a 7.0° angle with the vertical. The bob of the pendulum returns to its lowest point every 0.10 s.

a. What is its period? What is its frequency?

____

____

b. The pendulum is replaced by one with a mass of 0.300 kg and set to swing with a 15° angle. Do the following quantities increase, decrease, or remain the same?

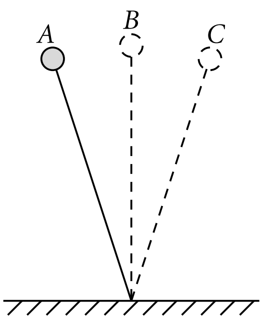
period ______________________________

frequency ______________________________

total energy ______________________________

speed at the lowest point ______________________________

2. A narrow, flat steel rod is anchored at its lower end, with a 0.500 kg ball welded to the top end. A force of 6.00 N is required to hold the ball 10.0 cm away from its central position.



If this arrangement is modeled as an oscillating horizontal mass-spring system, vibrating with a simple harmonic motion, find

a. the force constant, k, of the spring.

____

b. the period and frequency of the oscillations.

____

3. Find the acceleration due to gravity at a place where a simple pendulum 0.150 m long completes 1.00×10^2 oscillations in 3.00×10^2 seconds. Could this place be on Earth?

____

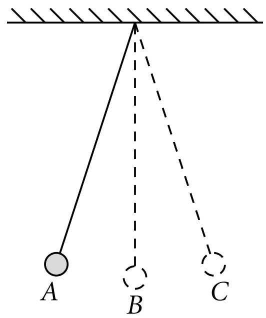
____

Chapter 12

HOLT PHYSICS

Mixed Review *continued*

4. Consider the first two cycles of a pendulum swinging from position *A* with a period of 2.00 s.



a. At which times is the bob found at positions *A*, *B*, and *C* during the first two cycles?

______

______

b. At which times and locations is gravitational potential energy at a maximum? At which times is kinetic energy at a maximum?

______

______

c. At which times and locations is the velocity at a maximum? the restoring force? the acceleration?

______

______

______

5. The frequency of a pressure wave is 1.00×10^2 Hz. Its wavelength is 3.00 m. Find the speed of wave propagation.

______

6. A pressure wave of 0.50 m wavelength propagates through a 3.00 m long coil spring at a speed of 2.00 m/s. How long does it take for the wave to travel from one end of the coil to the other? How many wavelengths fit in the coil?

______

______

Section 13-1

HOLT PHYSICS

Concept Review

Sound Waves

1. In an experiment for measuring the speed of sound, a gun was shot 715 m away from the observer. It was heard 2.13 seconds after the flash was seen. What was the speed of sound in air at that time?

____

2. Sound travels at 1530 m/s in sea water. A signal sent down from a ship is reflected at the bottom of the ocean and returns 1.35 s later. Assuming the speed of sound was not affected by changes in the water, how deep was the ocean at that point?

____

3. A train at rest blows a whistle to alert passengers that it is about to depart from a subway station. The pitch of this whistle is 1.14×10^4 Hz. The speed of sound in the air in that subway tunnel is 342 m/s. The speed of sound in iron is 5130 m/s.

a. What is the wavelength of that sound in the air?

____

b. What is the distance between consecutive areas of compression and of rarefaction in the spherical sound waves spreading from the whistle in the air?

____

c. Assuming that the sound was loud enough to be heard from the end of the 1200 m long tunnel, when was it heard through air? through the rails?

____

d. What was the apparent frequency of the sound waves that reached the end of the tunnel?

____

e. As the train left the station, did the frequency appear to change for a listener on the platform? inside the train? at the other end of the tunnel?

____

____

Section **13-2**

HOLT PHYSICS

Concept Review

Sound Intensity and Resonance

Refer to the following table to answer the following questions.

Intensity (W/m^2)	Decibel level (dB)
1.0×10^{-9}	30
1.0×10^{-8}	40
1.0×10^{-7}	50
1.0×10^{-6}	60

Intensity (W/m^2)	Decibel level (dB)
1.0×10^{-5}	70
1.0×10^{-4}	80
1.0×10^{-3}	90
1.0×10^{-2}	100

1. While practicing his instrument at home, a young drummer produces sounds with 0.5 W of power. Assume the sound waves spread spherically, with no absorption in the medium.

a. What is the intensity of the sound waves that reach the walls of his room 2.00 to 4.00 m from the drum?

____

b. What is the intensity of the sound waves that reach the family room, 8.00 to 12.0 m from the drum?

____

c. What is the intensity and approximate decibel level of the sound waves that reach the neighbors' home 50.0 m away?

____

2. The sound level 5.00 meters away from a jackhammer is exactly 100 dB.

a. What is the intensity of the sound at that point?

____

b. What is the power of the sound from the jackhammer?

____

c. At what distance from the jackhammer will the noise intensity decrease to 1.00×10^{-8} W/m^2?

____

NAME ______________ DATE ______________ CLASS ______________

Section **13-3**

HOLT PHYSICS

Diagram Skills

Harmonics

1. A 52.0 cm long guitar string has a fundamental frequency of 444 Hz.

a. What is the speed of sound in the string according to these data?

____

b. In the space below, draw the standing wave pattern for the first, the second, and the third harmonics, showing the nodes and the antinodes on the string.

c. What should be the string's length in order to produce a fundamental note of 333 Hz?

____

2. The first harmonic frequency of a violin string is 440 Hz.

a. Find the next harmonic frequencies (overtones) of this string.

____

b. The intensities of the second and third harmonics are about half that of the fundamental one. Sketch a graph of each wave and a graph of their combination to show the resultant waveform for this violin string.

Chapter 13

HOLT PHYSICS

Mixed Review

Sound

1. The speed of sound increases with temperature. It is 331 m/s in air at 0°C and 343 m/s in air at 20°C. A glass pipe vibrates with a frequency of 151 Hz.

a. What is the wavelength of the sound produced by the column of air in the pipe on a cold day (0°C) and on a warmer day (20°C)?

____

____

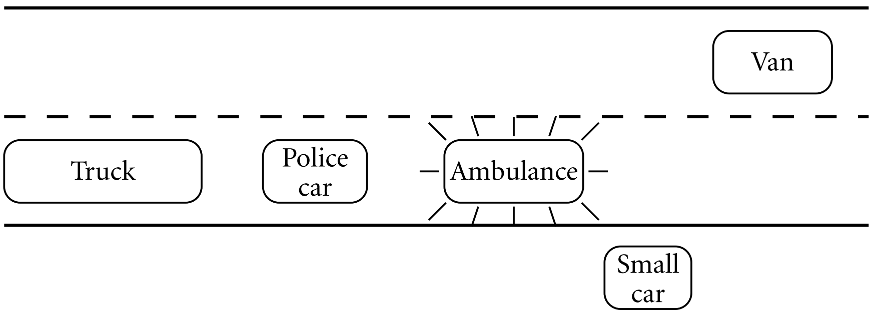
b. How does air temperature affect the wavelength of the sound produced by the pipe?

____

____

2. The driver of an ambulance turns on its siren as the ambulance heads east at 30 mph. A police car is following the ambulance at 30 mph. A truck behind the police car is moving at 20 mph. A van is traveling west in the opposite lane at 20 mph. A small car is stopped at the side of the road. The vehicles are positioned as shown.

a. On the diagram, sketch and label arrows to indicate the velocity of each vehicle.



b. Rank the sounds perceived by the passengers in each of the vehicles in order of decreasing frequency.

____

____

____

____

Chapter 13

HOLT PHYSICS

Mixed Review *continued*

3. A 330 Hz tuning fork is vibrating after being struck. It is placed on a table near but not directly touching other objects, including other tuning forks. Eventually one glass and one other tuning fork start vibrating. Explain why this happens.

4. The first harmonic in a pipe closed at one end is 487 Hz.

a. Find the next two harmonic frequencies that will occur in this pipe.

b. What are the corresponding wavelengths of the first three harmonics? (Hint: assume the speed of sound is 345 m/s.)

c. What is the length of this pipe?

d. Repeat this exercise for a pipe open at both ends.

5. A piano tuner uses a 440 Hz tuning fork to tune a string that is currently vibrating at 445 Hz.

a. How many beats per second does he hear?

b. What other frequency could produce the same sound effect? Explain why.

NAME ______________________ DATE ______________ CLASS ____________________

Section 14-1

HOLT PHYSICS

Concept Review

Characteristics of Light

1. The orbital radius of the Earth (the average Earth-Sun distance) is 1.496×10^{11} m. Mercury's orbital radius is 5.79×10^{10} m and Pluto's is 5.91×10^{12} m. Calculate the time required for light to travel from the Sun to each of the three planets. (Hint: Use 3.00×10^{8} m/s for the speed of light.)

a. Sun-Earth ______________________________

b. Sun-Mercury ______________________________

c. Sun-Pluto ______________________________

2. Typical wavelengths of visible light colors are listed below.

violet	blue	green	orange-yellow	red
420 nm	450 nm	550 nm	600 nm	700 nm

a. Calculate the frequency of the electromagnetic waves that carry these colors.

____

____

b. How does frequency change when wavelength increases?

____

____

____

____

c. Does the speed of light in air depend on frequency? on wavelength?

____

____

____

____

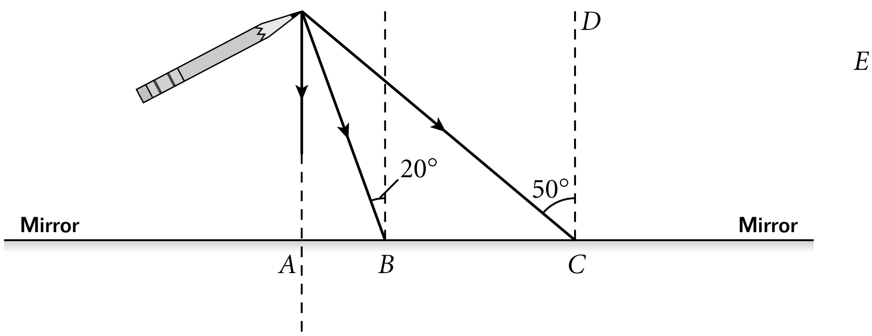
Section 14-2

HOLT PHYSICS

Diagram Skills

Flat Mirrors

1. The point of a 20.0 cm pencil is placed 25.0 cm from a flat mirror. Its eraser is 15.0 cm from the mirror. Three of the light rays from the pencil's point hit the mirror with incident angles of 0°, 20°, and 50° at points *A*, *B*, and *C* as shown.



a. Use a protractor to draw the reflected rays from points *A*, *B*, and *C*.

b. Where do reflected rays or their extensions intersect?

____

c. What is the distance between the pencil's head and its image?

____

d. Would a person's eye located at point *D* perceive one of the reflected rays you drew? Will the person be able to see the image? Explain.

____

____

e. What if the eye is located at point *E*?

____

f. Draw incident rays from the eraser of the pencil to point *A* and to point *B*. Measure their incident angles and write them on the line below.

____

g. Draw the reflected rays and locate the image of the eraser. Draw the pencil's image.

NAME ______________ DATE ______________ CLASS ______________

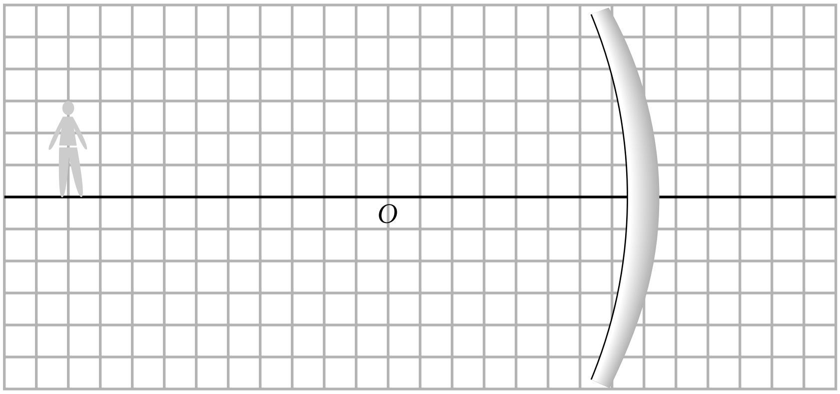
Section **14-3**

HOLT PHYSICS

Diagram Skills

Curved Mirrors

1. A 1.50 m tall child is in a mirror gallery at the amusement park. She is standing in front of a concave mirror with a radius of 4.00 m. She starts walking toward the mirror from a distance of 9.00 m, and she stops every meter to observe her image.



a. Find the focal point of this mirror and label it *F*.

b. Mark the child's locations 9.00 m, 5.00 m, and 1.00 m in front of the mirror, and label them *A*, *B*, *C*.

c. Sketch ray diagrams to locate the image formed when the child is at *A*. Measure the distance from the image to the mirror and record it below.

Distance of *A*'s image = ______________________

d. Repeat question c for the object at positions *B* and *C*.

Distance of *B*'s image = ______________________

Distance of *C*'s image = ______________________

2. Calculate the image location for the object at *A*, *B*, and *C* in item 1, using the mirror equation. Compare your results with your diagrams.

Distance of *A*'s image = ______________________

Distance of *B*'s image = ______________________

Distance of *C*'s image = ______________________

Section **14-4**

HOLT PHYSICS

Concept Review

Color and Polarization

1. It is common knowledge that chlorophyll allows green plants to use light for photosynthesis.

a. Which colors of the visible spectrum do green plants absorb? Explain.

____

____

____

b. A window has just broken in your greenhouse. Until it can be replaced, you can seal the hole with clear plastic that is slightly tinted either red or green. Which would you use? Explain.

____

____

____

2. You have three spotlights: one red, one green, one blue. You also have three buckets: one with red paint, one with green paint, one with blue paint.

a. What color do you see when you shine all three spotlights on a white wall in a dark room?

____

b. What color do you see if you paint the wall blue before shining all three spotlights on it in a dark room?

____

c. What color do you see when you paint the wall with a brush dipped in the red and blue buckets and then shine green light on it?

____

d. What color do you see when you paint the wall with a brush dipped in all three buckets and then shine all three spotlights on it?

____

3. What color do you see when shining green light on a magenta painting?

____

Chapter 14

HOLT PHYSICS

Mixed Review

Light and Reflection

1. Proxima Centauri, the nearest star in our galaxy, is 4.30 light-years away. What is its distance in meters?

____

2. Radio signals emitted from and received by an airplane have a frequency of 3.00×10^{12} Hz and travel at the speed of light.

a. How long is the delay in each message going from the control tower to a jet flying at 1.00×10^{4} m of altitude?

____

b. What is the wavelength of these signals?

____

3. A laser beam is sent to the moon from Earth. The reflected beam is received on Earth after 2.56 seconds. What is the distance from Earth to the moon?

____

4. The background radiation in the universe (believed to come from the Big Bang) includes microwaves with wavelengths of 0.100 cm. What is the frequency of this radiation?

____

5. List five objects that reflect light diffusely. List three objects that reflect light specularly for the most part.

Diffuse reflection ______________________________

____

Specular reflection ______________________________

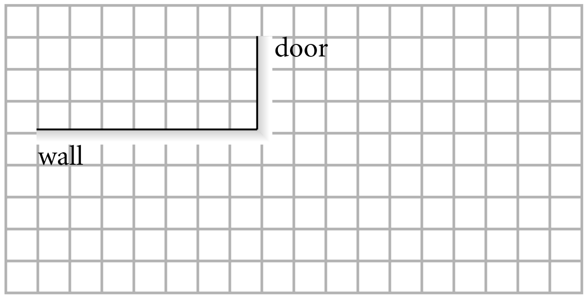
____

Chapter 14

HOLT PHYSICS

Mixed Review *continued*

6. A mirror door is located next to a large wall mirror. The door is closed to create a 90° angle with the wall. You stand 2.00 m from the door and 1.00 m from the wall.



a. On the diagram at right, sketch a top-view diagram of the situation at scale. Label the object (yourself) *A*.

b. Locate your first image in the mirror on the door. Label it *B*. Locate *B*'s image in the mirror on the wall. Label it *C*.

c. Locate your first image in the mirror on the wall and its image in the mirror on the door. Label them *D* and *E*.

d. Where will the next images of the images be located?

____

7. An object located 36.0 cm from a concave mirror produces a real image located 12.0 cm from the mirror.

a. Find the focal length of this mirror

____

b. Find the location, type, and size of the image formed by a 6.00 cm tall object located 30.0 cm, 24.0 cm, 18.0 cm, 12.0 cm, and 6.00 cm in front of the mirror.

____

____

____

8. The concave mirror in the problem above is replaced by a convex one with the same curvature. Find the location of the images produced when the object is located 30.0 cm, 24.0 cm, 18.0 cm, 12.0 cm, and 6.00 cm in front of the mirror.

____

____

____

NAME ______________ DATE ______________ CLASS ______________

Section 15-1

HOLT PHYSICS

Concept Review

Refraction

1. The speed of light in air is 3.00×10^8 m/s.

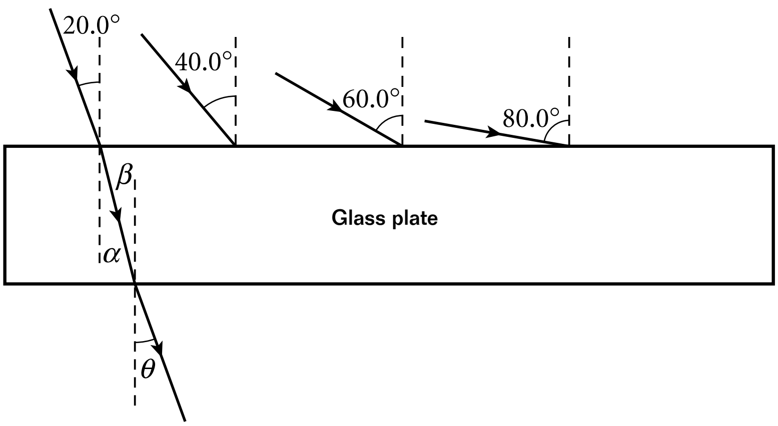
a. How does the index of refraction relate to the speed of light in a medium?

____

b. The index of refraction of water is 1.33. What is the speed of light in water?

____

2. A light ray traveling in air strikes a glass plate with a refractive index of 1.52 at a 20.0° angle from the normal. After refraction, going in and out of the glass, the exiting ray forms an angle θ with the normal to the surface on the other side.



a. Find α, the angle of refraction from air to glass. ______________

b. The plate sides are parallel. Find β, the angle of incidence from glass to air, and θ, the angle of refraction.

____

c. Repeat when the angle of incidence from air is 40°, 60°, and 80°.

____

____

d. Sketch the results on the diagram above.

Section 15-2

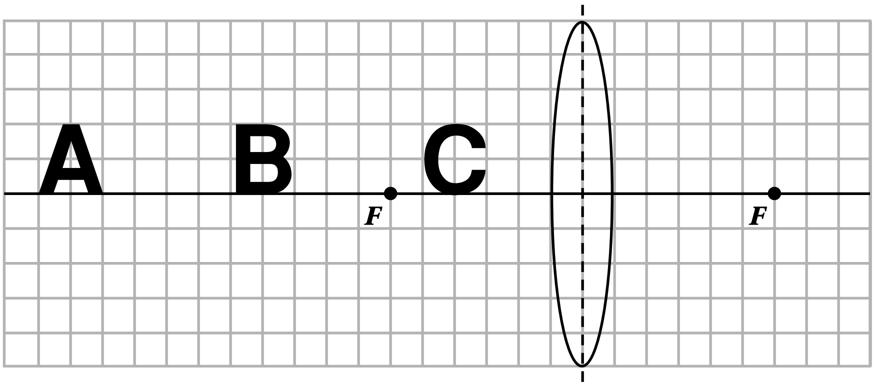
HOLT PHYSICS

Diagram Skills

Thin Lenses

1. A converging lens has a focal length of 3.00 cm. The letters *A*, *B*, and *C* are used as objects placed at distances of 8.00 cm, 5.00 cm, and 2.00 cm, respectively, from the lens.

a. Sketch ray diagrams to locate the image of *A*: Draw one ray from the top of the head parallel to the axis and another ray from the head through the focal point. Verify that the image is also in the ray that passes through the center of the lens.



b. Is the image of *A* real? inverted? magnified?

____

c. Repeat questions a and b for the object at positions *B* and *C*.

____

____

2. Calculate the image location for the object at *A*, *B*, and *C* in problem 1. Compare your results with your diagrams.

____

____

____

Section 15-3

HOLT PHYSICS

Concept Review

Optical Phenomena

Indices of Refraction for Various Substances

Substance	*n*
Diamond	2.419
Sodium chloride	1.544
Glycerine	1.473
Fluorite	1.434

Substance	*n*
Ethyl alcohol	1.361
Water	1.333
Air	1.000

1. A light ray inside a diamond strikes the boundary with air at 20.0° from the normal.

a. Calculate the angle of refraction of that light ray.

____

b. What happens when the incident angle is 32.0°?

____

c. What is the critical angle for this light traveling from diamond to air?

____

d. The diamond is immersed in water. The same light ray strikes the diamond-water boundary at a 20.0° angle. Answer items a, b, and c for this case.

____

____

2. Glass prisms with 90°, 45°, 45° angles are used in periscopes because light entering the right-angle side undergoes internal reflection on the 45° side of the prisms. What happens if the sides of the prisms are made of thin glass and the prisms are filled with water? Use the critical angle of water to answer.

____

____

____

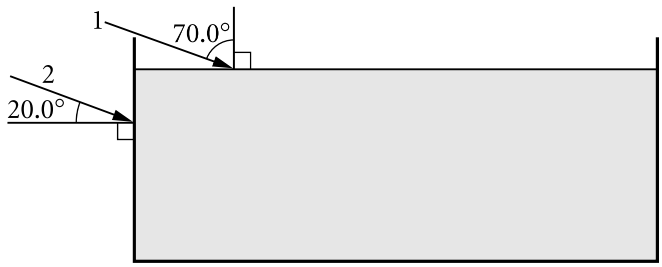
Chapter 15

HOLT PHYSICS

Mixed Review

Refraction

1. Two parallel rays enter an aquarium as shown. Ray 1 forms a 70.0° angle with the normal to the surface. Ray 2 forms a 20.0° angle with the normal to the wall. (Hint: the index of refraction for water is 1.33.)



a. Calculate the angle of refraction of each ray.

____

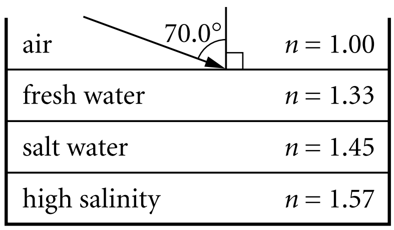
b. Trace the path of each light ray inside the water.

c. Are the refracted rays inside the water still parallel? Will they intersect in the water?

____

____

2. A large beaker contains layers of water of increasing salinity, separated by a thin plastic plate. The lowest layer has the highest salinity and refractive index, as shown in the diagram. A ray of light strikes the surface of fresh water at the top, at a 70.0° angle from the normal.



a. Find the angles of refraction and the angles of incidence at each boundary.

____

____

____

____

b. There is a flat mirror at the bottom of the container. Trace the path of one light ray coming from the air to the bottom of the beaker and back.

Chapter 15

HOLT PHYSICS

Mixed Review *continued*

3. An object located 36.0 cm from a thin converging lens has a real image located 12.0 cm from the lens.

a. Find the focal point of this lens.

____

b. Find the location, type, and size of the image formed by a 6.00 cm tall object located 30.0 cm, 24.0 cm, 18.0 cm, 12.0 cm, and 6.00 cm in front of the lens.

____

____

____

____

____

4. The converging lens in item 3 is replaced by a diverging lens. Now the image of the first object is located 12.0 cm in front of the lens. Find the focal distance of the diverging lens and the location of the images produced when the object is placed at the distances described in item 3b.

____

____

____

____

____

5. A bug placed 1.00 cm under a magnifying glass appears exactly six times larger.

a. Where is the bug's image located?

____

b. What is the focal point of the lens in the magnifying glass?

____

Section 16-1

HOLT PHYSICS

Concept Review

Interference

1. Monochromatic light with a wavelength of 560 nm is used in a double-slit experiment. The distance between the slits was 2.00×10^{-5} m.

a. Find the angle of the first, second, and third bright fringes on the screen.

____

____

b. The experiment is repeated with the distance between slits at 2.00×10^{-6} m. Find the angles of the first three bright fringes.

____

____

c. How does the separation between fringes change when the distance between slits changes? What would you observe if the distance between slits is 2.00 cm?

____

____

____

2. The distance between two slits in a double-slit experiment is 7.00×10^{-6} m. The first order bright fringe produced by monochromatic light appears on the screen at an angle of 3.89° from the central maximum.

a. Determine the wavelength of light used in this experiment.

____

b. Find the angles of the second, third, and fourth bright fringes.

____

____

Section 16-2

HOLT PHYSICS

Concept Review

Diffraction

1. A diffraction grating has 8.00×10^3 lines per centimeter.

a. What is the slit spacing in this grating?

______

b. Is the grating appropriate for observing the diffraction of visible light (400 to 700 nm)? For better results, would you choose a grating with wider spacing? with more lines per centimeter? Explain.

______

______

______

2. The spacing in a diffraction grating is 8.00×10^{-6} m.

a. How many lines per centimeter are there?

______

b. Find the first, second, and third angles at which one would observe maxima when light of 620 nm wavelength is diffracted.

______

______

3. The second-order maxima are observed at 8.12° with the grating above in a diffraction experiment. What is the wavelength?

______

4. Monochromatic light of 570 nm is diffracted by a grating of unknown spacing. The third-order maxima are observed at a 23° angle. What is the spacing in that grating?

______

NAME ______________________ DATE ______________ CLASS ________________

Section **16-3**

HOLT PHYSICS

Concept Review

Lasers

1. Describe the term *coherent light.*

____

____

____

2. Draw a diagram that illustrates coherent light and incoherent light.

3. What type of energy is used to cause the stimulated emission of light waves in a laser?

____

____

4. List three applications of lasers.

____

____

____

Chapter 16

HOLT PHYSICS

Mixed Review

Interference and Diffraction

1. The second-order bright fringes of interference are observed at an 8.53° angle in a double-slit experiment with light of 5.00×10^2 nm wavelength.

a. Determine the slits' separation.

______

b. Find the angle of the tenth-order bright fringe.

______

c. In this experiment, the screen is 2.00 m wide. Its distance from the source is 1.00 m. Could the tenth-order fringe be observed? Why or why not?

______

______

______

______

2. Diffraction of white light with a single slit produces bright lines of different colors.

a. Which wavelengths are more diffracted by the same slit size?

______

______

b. In the space below, sketch a diagram showing the location of red, green and blue lines of the first and second order. Describe the sequence in which the colors appear, beginning with the color closest to the center.

______

______

c. What is the color of the central image?

______

Chapter 16

HOLT PHYSICS

Mixed Review *continued*

3. You have three diffraction gratings. Grating A has 2.0×10^5 lines per meter. Grating B has 9.0×10^6 lines per meter. Grating C has 3.0×10^7 lines per meter.

a. What is the slit distance of each grating?

____

____

b. Which gratings can diffract the following:

- visible light of 500 nm wavelength

____

- X rays of 5.00 nm wavelength

____

- infrared light of 5000 nm wavelength

____

4. You drop pebbles into the water on a rocky beach. When the waves you made reach the rocks, new waves appear to start in the spaces between the rocks.

a. Are these waves coherent?

____

____

b. How is this like a double slit illuminated by a single light source?

____

____

____

Menu Print

NAME ______________ DATE ______________ CLASS ______________

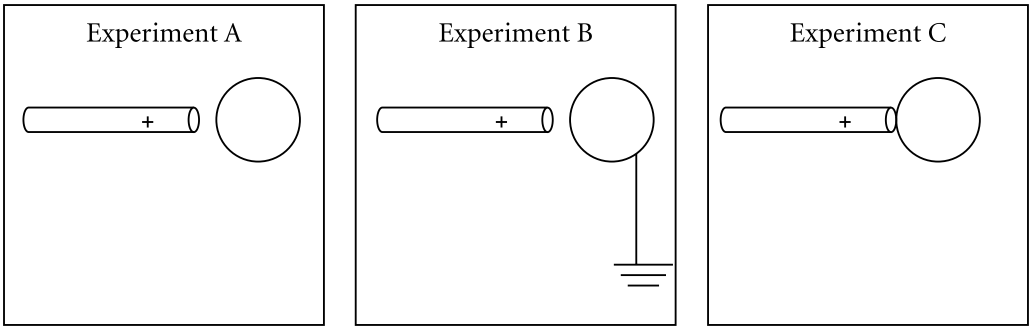
Section **17-1**

HOLT PHYSICS

Concept Review

Electric Charge

1. A plastic rod rubbed with wool was used to charge a small metal sphere in three experiments, as illustrated below. The spheres were held by insulating stands. The sphere in Experiment B was grounded. Assume the rod had a positive charge.



a. Were charges transferred in Experiments A, B, or C? If so, between which objects?

____

____

____

b. Sketch the charge distribution for the spheres in each experiment.

c. The rod was removed after a while. In which experiment(s) did the sphere end up with excess electric charge?

____

d. In which experiment(s) did polarization occur?

____

e. What happened to the excess charge on the rod after it was removed in experiment A? in B? in C?

____

____

____

Section 17-2

HOLT PHYSICS

Math Skills

Electric Force

Use $k_C = 8.99 \times 10^9\ N \bullet m^2/C^2$.

1. Two point charges, q_1 and q_2, of 4.00 μC each, are placed –16.0 cm and 16.0 cm away from the origin on the *x*-axis. A charge q_3 of –1.00 μC is placed 12.0 cm away from the origin on the *y*-axis.

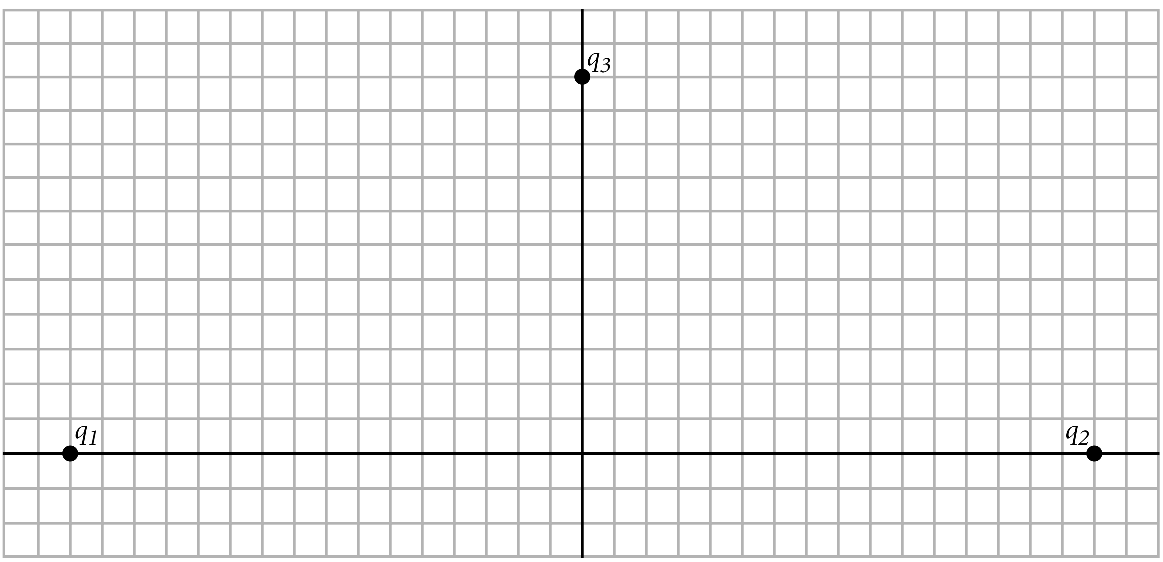
a. Find the distance from q_3 to q_1 and from q_3 to q_2 ______

b. Find the magnitude and the direction of the force F_{13} exerted by q_1 on q_3. ______

c. Find the magnitude and the direction of the force F_{23} exerted by q_2 on q_3. ______

d. Find the magnitude and the direction of the force F_{12} exerted by q_1 on q_2. ______

e. In the space below, sketch the vectors representing forces F_{13} and F_{23}.



f. Find the angle between the q_1–q_3 line and the *x*-axis. ______

g. Find the *x* and *y* components of forces F_{13} and F_{23}. ______

h. Find the resultant force of forces F_{13} and F_{23}. ______

i. If q_3 is released, in which direction will it move? ______

Section **17-3**

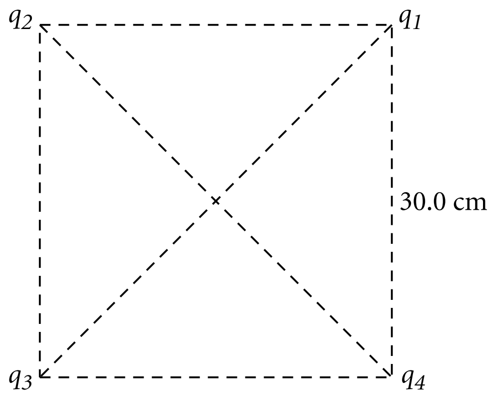
HOLT PHYSICS

Concept Review

The Electric Field

Use $k_C = 8.99 \times 10^9$ N•m^2/C^2.

1. Four positive charges, q_1, q_2, q_3, and q_4, of 8.00 μC, each are arranged to form a 30.0 cm wide square as shown.



a. Find the distance of each charge from the center of the square.

____

b. Find the strength and direction of the electric field vectors of q_1, q_2, q_3, and q_4 at the center of the square.

____

____

c. Find the strength and direction of the electric field at the center of the square.

____

2. In a Millikan experiment, a droplet of mass 4.7×10^{-15} kg floats in an electric field of 3.20×10^4 N/C.

a. What is the force of gravity on this droplet?

____

b. What is the electric force that balances it?

____

c. What is the excess charge?

____

d. How many excess electrons are there on this droplet?

____

Chapter 17

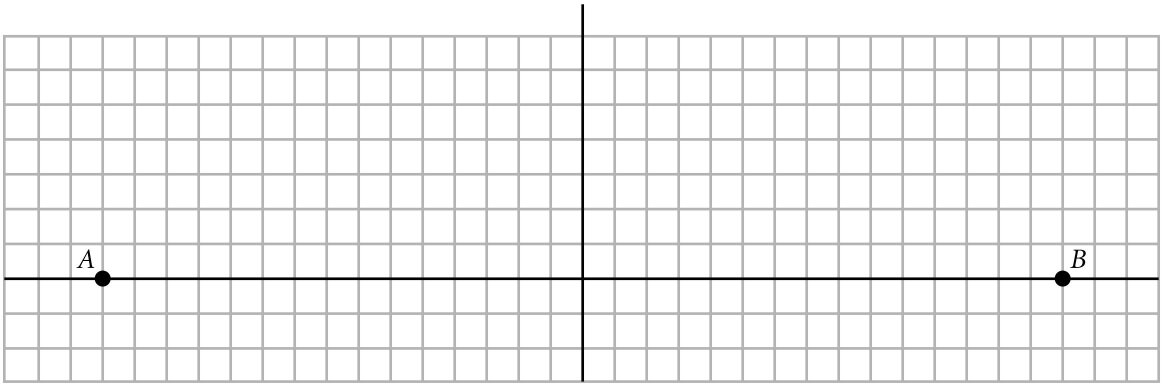
HOLT PHYSICS

Mixed Review

Electric Forces and Fields

Use $k_C = 8.99 \times 10^9\ N \bullet m^2/C^2$.

1. Two spheres, *A* and *B*, are placed 0.60 m apart, as shown. Sphere *A* has $+3.00\ \mu C$ excess charge. Sphere *B* has $+5.00\ \mu C$ excess charge.



a. How many electrons are missing on sphere *A*? on sphere *B*?

____

b. How do the forces of *B* on *A* and *A* on *B* compare? Does the greater charge exert a greater force?

____

____

2. A third spherical charge, *C*, of $+2.00\ \mu C$, is placed on the line connecting spheres *A* and *B*. Find the resultant force exerted by *A* and *B* on *C* when *C* is placed in the following locations.

a. 0.20 m to the left of *A*

____

b. 0.20 m to the right of *A* between *A* and *B*

____

c. exactly in the middle between *A* and *B*

____

Chapter 17

HOLT PHYSICS

Mixed Review *continued*

3. Alpha particles are made of two protons and two neutrons.
$m_p = 1.673 \times 10^{-27}$ kg; $m_n = 1.675 \times 10^{-27}$ kg; $q_e = 1.60 \times 10^{-19}$ C

a. Find the electric force acting on an alpha particle in a horizontal electric field of 6.00×10^2 N/C.

____

b. What is the acceleration of this alpha particle?

____

c. How does this acceleration compare with gravity? Describe the particle's trajectory. Will it be close to horizontal? to vertical free fall?

____

____

____

____

4. A 2.00 μC point charge of mass 5.00 g is suspended on a string and placed in a horizontal electric field. The mass is in equilibrium when the string forms a 17.3° angle with the vertical.

a. In the space below, sketch a free-body diagram of the problem. Show the vertical and horizontal components of the tension force in the string.

b. Find the electric force on the charge in this field.

____

c. Find the strength of the electric field.

____

5. How many electrons are there in 1.00 C? How many electrons are there in 1.00 μC?

____

____

Section 18-1

HOLT PHYSICS

Concept Review

Electrical Potential Energy

Use $k_C = 8.99 \times 10^9$ N•m^2/C^2.

1. A positive charge, q_1, of 5.00×10^{-9} C is placed at (−20.0 cm, 0) of a coordinate system. An equal and opposite charge, q_2, is at (20.0 cm, 0). Sketch a diagram for each of the questions below.

a. What is the potential energy of this pair of charges? Was work done to bring q_2 from infinity to its place near q_1? How much?

____

____

b. A positive charge, q_3, equal to q_1 is placed at (60.0 cm, 0). What is the potential energy of the three charges? Was work done on or by the charges for bringing q_3 from infinity to its place near q_1 and q_2? How much?

____

____

2. An alpha particle travels 5.00 cm in a uniform electric field of 6.00×10^2 N/C. (Alpha particles are made of two protons and two neutrons. $m_p = 1.673 \times 10^{-27}$ kg; $m_n = 1.675 \times 10^{-27}$ kg; $q_e = 1.60 \times 10^{-19}$ C)

a. What is the change in the potential energy of the particle? Does it increase or decrease?

____

b. If the particle is initially at rest, what is its final kinetic energy?

____

c. What is its speed?

____

Section **18-2**

HOLT PHYSICS

Concept Review

Potential Difference

1. A point charge, q_1, of 2.00 μC is placed on the x-axis at (–4.00 cm, 0 cm). An identical charge, q_2, is placed at (4.00 cm, 0 cm). Find the total electric potential due to these charges at the following locations. Use $k_C = 8.99 \times 10^9\ \text{N} \bullet \text{m}^2/\text{C}^2$.

a. the center (0, 0) ______

b. on the y-axis at

- $y = -10.0$ cm ______
- $y = -2.00$ cm ______
- $y = 2.00$ cm ______
- $y = 10.0$ cm ______

c. on the x-axis at

- $x = -10.0$ cm ______
- $x = -2.00$ cm ______
- $x = 2.00$ cm ______
- $x = 10.0$ cm ______

2. Find the electric potential at the center of a square with four point charges q_1, q_2, q_3, q_4, placed at (5.00 cm, 0 cm), (0 cm, 5.00 cm), (–5.00 cm, 0 cm), and (0 cm, –5.00 cm), respectively, for the following cases.

a. $q_1 = q_2 = q_3 = q_4 = 3.00\ \mu\text{C}$

______

b. $q_1 = q_3 = 3.00\ \mu\text{C}$; $q_2 = q_4 = -3.00\ \mu\text{C}$

______

c. $q_1 = q_2 = 3.00\ \mu\text{C}$; $q_3 = q_4 = -3.00\ \mu\text{C}$

______

Section 18-3

HOLT PHYSICS

Concept Review

Capacitance

Use $k_C = 8.99 \times 10^9$ N•m^2/C^2.

1. Consider the following units: picofarad, nanofarad, microcoulomb. Explain what quantities they measure, and write their equivalents using powers of 10.

______

______

______

2. A 1.00 pF and a 1.00 nF capacitor each has a charge of 1.00 μC. Which has a higher potential difference between its plates? Show your calculations, and explain your reasoning.

3. A parallel-plate capacitor holds 2.00×10^2 μC of charge when a potential difference of 5.00×10^2 V is applied between its plates.

a. What is the capacitor's capacity in units of farads and in units of nanofarads?

______

______

b. The potential difference is doubled to 1.000×10^3 V. How does the capacitance change? How does the charge change?

______

______

______

c. How much electrical energy was stored in the capacitor at 5.00×10^2 V? at 1.000×10^3 V?

______

DATE ______________ CLASS ____________________

Chapter 18

HOLT PHYSICS

Mixed Review

Electrical Energy and Capacitance

1. A positive charge, q_1, of 5.00×10^{-9} C is placed at (0, 0) in a coordinate system.

a. Find the potential electrical energy of the two charges when a negative charge, q_2, of 5.00×10^{-9} C is at the following positions in the coordinate system:

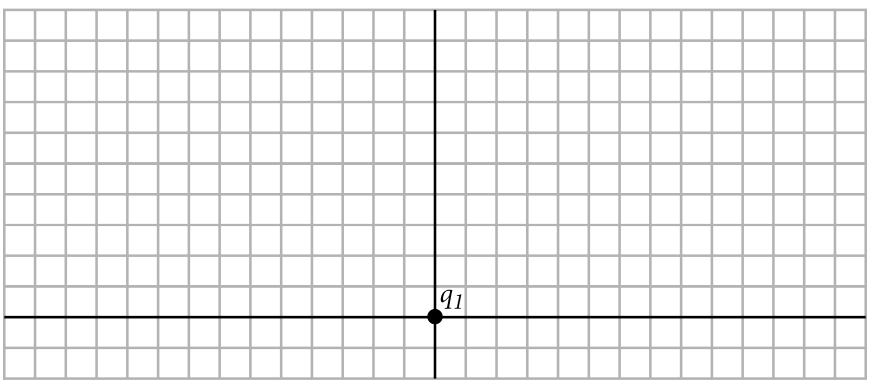
- (50.0 cm, 0 cm) ______________________________
- (40.0 cm, 30.0 cm) ______________________________
- (30.0 cm, 40.0 cm) ______________________________
- (50.0 cm, 0 cm) ______________________________
- (–30.0 cm, 40.0 cm) ______________________________
- (–40.0 cm, 30.0 cm) ______________________________
- (–50.0 cm, 0 cm) ______________________________

b. Does the electrical potential energy of the two charges increase or decrease when q_2 moves around a circle? Explain.

____

____

c. In the space below, sketch the path of the point charge, q_2, in this exercise, and draw the electric force vector acting on it at each of the points indicated in item 1a.



Chapter 18

HOLT PHYSICS

Mixed Review *continued*

2. Electrons are accelerated in the picture tube of a television through a potential difference of 8.00×10^3 V. (Use the values $q_e = 1.60 \times 10^{-19}$ kg and $m_e = 9.109 \times 10^{-31}$ kg.)

a. What is the change in the potential energy of each electron traveling in this tube?

____

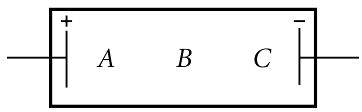
b. What is the change in the kinetic energy of the electrons?

____

c. At what speed do the electrons hit the screen?

____

3. The distance between two vertical plates in a vacuum tube is 6.00 cm. A potential difference of 300 V is applied between the plates. Point *A* is located 1.00 cm from the positive plate, point *B* is at 3.00 cm from it, and point *C* is at 5.00 cm from it.



a. What is the strength of the electric field at points *A*, *B*, and *C*? Is the electric field constant between parallel plates?

____

b. What is the potential difference between the positive plate and points *A*, *B*, and *C*? (Use $\Delta V = Ed$)

____

c. A positive ion with a charge of $+1.60 \times 10^{-19}$ C leaves the positive plate and travels to the negative one. What is its potential energy at the positive plate? at *A*? at *B*? at *C*? at the negative plate?

____

4. A 2.00×10^2 nF capacitor has a 4.0×10^1 μC charge.

a. What is the potential difference between its plates?

____

b. What is the potential energy stored in the capacitor?

____

Section 19-1

HOLT PHYSICS

Concept Review

Electric Current

1. The sphere of a Van de Graaff generator had 6.00 C of charge. When connected to the ground, it was discharged in 24.0 ms. What was the average discharge current?

____

2. The current through a light bulb in a flashlight is 0.750 A.

a. How much charge passed through the filament

- in 20.0 s? ______________________
- in 5.00 min? ______________________
- in 2.00 h? ______________________

b. How many electrons enter the filament every second?

____

____

c. How many exited the filament every second?

____

____

d. Where do the electrons entering the filament come from? Where do they go after exiting?

____

3. A battery supplies a 0.015 A current to a small radio. How long should the radio stay on so that 4.80 C passes through each of the following parts of the circuit:

a. through the battery ______________________

b. through the radio ______________________

c. through the connecting wires ______________________

Section **19-2**

HOLT PHYSICS

Concept Review

Resistance

1. The label on a small heater specifies its electric performance as 115 V, 4.50 A.

a. What is the resistance of the heating filament in this heater?

______

b. How much current will it draw when connected to the following:

- 120 V ______
- 220 V ______
- 60.0 V ______
- 10.0 V ______

2. Three resistors are available for testing a 9.00 V battery. Resistor A has 5.00 kΩ of resistance, resistor B has 5.00 Ω of resistance, and resistor C has 0.0500 Ω of resistance.

a. How much current will each resistor draw?

______

______

b. Which resistor is more useful for testing if the battery is dead? Explain.

______

______

3. An electrical device of 37.2 Ω resistance performs best when the current is 3.62 A. How much voltage should be applied?

______

4. An electronic device performs best with a 1.20 V battery, when the current is between 3.50 mA and 4.20 mA. What is the range of possible resistances for this electronic device?

______

Section 19-3

HOLT PHYSICS

Concept Review

Electric Power

1. A food processor draws 8.47 A of current when connected to a potential difference of 110 V.

a. What is the power consumed by this appliance?

____

b. How much electrical energy is consumed by this food processor monthly (30 days) if it is used on average of 10.0 min every day?

____

c. Assume that the price of electrical energy is 7.00 ¢/kWh. What is the monthly cost of using this food processor?

____

2. The electric meter in a house indicates that the refrigerator consumes 70.0 kWh in a week.

a. What is the power consumption of the refrigerator?

____

b. Assuming it is connected to a potential difference of 120 V , how much current does the refrigerator draw?

____

3. The heating element of an electric broiler dissipates 2.8 kW of power when connected to a potential difference of 120 V.

a. What is the resistance of the element?

____

b. How much current does the broiler draw? Use two ways to find out, and verify your answer.

Chapter 19

HOLT PHYSICS

Mixed Review

Current and Resistance

1. A 60.0 cm metal wire draws 0.185 A from a 36.0 V battery. Will the current increase or decrease when the following changes are performed? Explain whether the change is due to a change in resistance, a change in potential difference, or other reasons.

a. The wire is cut into four pieces, and only one segment is used.

____

b. The wire is bent to form an *M* shape.

____

c. The wire is heated to 500°C.

____

d. The 36.0 V battery is replaced by a 24.0 V battery.

____

2. A 25 Ω resistance heater is connected to a potential difference of 120 V for 5.00 h.

a. How much current does the heater draw?

____

b. How much electric charge travels through the heating element during this time?

____

c. What is the power consumption of the heater?

____

d. Use the power and time to calculate how much energy was consumed.

____

Chapter 19

HOLT PHYSICS

Mixed Review *continued*

3. The label on a three-way light bulb package specifies 100 W, 150 W, 250 W, 120 V.

a. How much current does the light bulb draw in each of the three ways? (Assume three significant figures in each of these measurements.)

b. What is the bulb's resistance in each way?

c. Compare the cost of using the light bulb for 100.0 h in each way. (Assume that the price is 7.00 ¢/kWh.)

4. An electric hot plate draws 6.00 A of current when its resistance is 24.0 Ω.

a. What is the voltage across the hot plate's heating element?

b. How much power does it consume?

c. For what length of time should it be kept on in order to supply 9×10^4 J to a coffeepot? (Assume that all electrical energy is transferred to the coffeepot by heat.)

Section **20-1**

HOLT PHYSICS

Diagram Skills

Schematic Diagrams and Circuits

1. Use the symbols listed in Table 20-1 of the textbook to draw a schematic diagram of an electric circuit that contains one battery, two light bulbs, two resistors, and two switches.

a. Label the switches *S1* and *S2*. Does either cause a short circuit when closed? Explain.

____

____

____

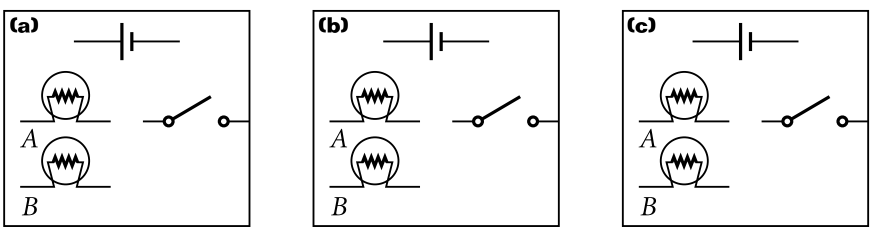
b. Add a switch to your diagram, and connect it so that it causes a short circuit when closed. Label it *S3*.

2. A battery, two bulbs, and one switch are placed as shown below. Draw lines representing the wires for connecting these circuit elements so that the following statements will be true.

a. Both bulbs *A* and *B* are on when the switch is closed.

b. Only bulb *B* is on when the switch is closed.

c. Bulb *A* is always on regardless of the switch, and bulb *B* is on only when the switch is closed.



Section **20-2**

HOLT PHYSICS

Concept Review

Resistors in Series or in Parallel

For each item, sketch a schematic diagram of the circuits and label the components properly.

1. A 12.0 V battery is connected to two resistors in series: $R_1 = 12.00\ \Omega$, $R_2 = 4.00\ \Omega$.

a. Find R_{eq}, the equivalent resistance in this circuit.

______

b. Find the current in the battery and the current in each resistor.

______

c. What is the potential difference, ΔV_{eq}, across the equivalent resistance? What is ΔV across each of the resistors?

______

2. A 12 V battery is connected to two resistors in parallel: $R_1 = 12.00\ \Omega$, $R_2 = 4.00\ \Omega$.

a. Find R_{eq}, the equivalent resistance in this circuit.

______

b. Find the potential difference, ΔV_{eq}, across the equivalent resistance.

______

c. What is the current in the equivalent resistance? What is the current in the battery? What is the current in each resistor?

______

d. What is the potential difference across each of the resistors?

______

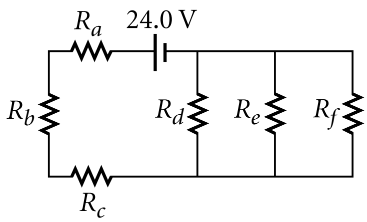
Section **20-3**

HOLT PHYSICS

Concept Review

Complex Resistor Combinations

1. The resistors in the circuit below are identical and equal 12.0 Ω. The battery has a potential difference of 24.0 V. Ignore the internal resistance of the battery. (Sketch schematic diagrams of the intermediate circuits as you reduce the complex circuit to a simpler one.)



a. Determine the equivalent resistance for this circuit.

______

b. Find the current in and the voltage across each resistor.

______ ______

______ ______

______ ______

2. Resistor R_f is removed from its present position and connected in series between R_a and the battery.

a. Sketch a diagram of the new circuit.

b. Find the equivalent resistance of the new circuit and the current in each resistor.

______ ______

______ ______

______ ______

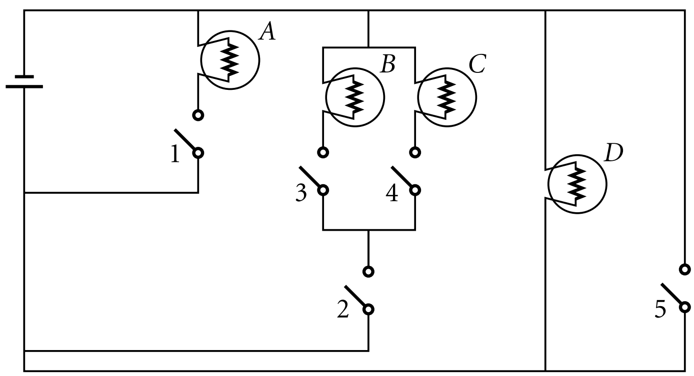
Chapter 20

HOLT PHYSICS

Mixed Review

Circuits and Circuit Elements

1. Consider the circuit shown below.



a. Do any of the bulbs have a complete circuit when all the switches are open? Which one(s)? ______

b. Do any of the switches cause a short circuit when closed? Which one(s)? ______

c. Which switches should be kept open, and which should be closed for the following to occur?

- only bulbs *A* and *B* are off ______
- only bulbs *A* and *C* are off ______
- only bulbs *B* and *C* are off ______

2. A light bulb of unknown resistance is connected in series with a 9.0 Ω resistor to a 12.0 V battery. The current in the bulb is 0.80 A.

a. In the space below, sketch a schematic diagram of the circuit.

b. Find the equivalent resistance of the circuit.

______

c. Find the resistance of the light bulb.

______

Chapter 20

HOLT PHYSICS

Mixed Review *continued*

3. A light bulb of unknown resistance is connected in parallel to a 48.0 Ω resistor and to a 12.0 V battery. The current through the battery is 2.50 A.

a. In the space below, sketch a schematic diagram of the circuit.

b. Find the potential difference across the resistor and across the bulb.

____

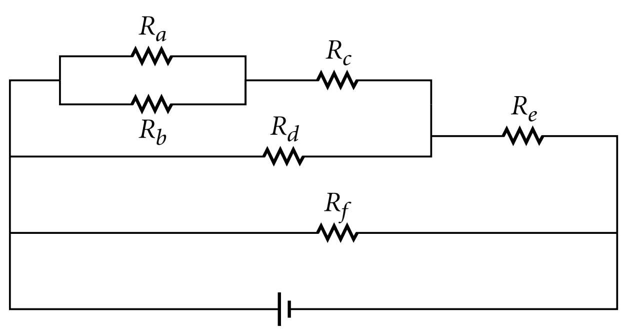
c. Find the current in the resistor and in the bulb.

____

d. Find the resistance of the light bulb.

____

4. In the circuit below, find the equivalent resistance for the following situations.



a. $R_a = R_b = R_c = R_d = R_e = R_f = 10.0\ \Omega$

____

b. $R_a = 10.0\ \Omega$; $R_b = 20.0\ \Omega$; $R_c = 30.0\ \Omega$; $R_d = 40.0\ \Omega$; $R_e = 50.0\ \Omega$; $R_f = 60.0\ \Omega$

____

NAME ____________ DATE ____________ CLASS ____________

Section **21-1**

HOLT PHYSICS

Concept Review

Magnets and Magnetic Fields

1. You have three marbles, A, B, and C, that look identical. Each of them contains either a magnet or a piece of iron. You have observed that A sticks to B, but B does not stick to C.

a. Could all three contain iron?

____

____

b. Could all three contain magnets?

____

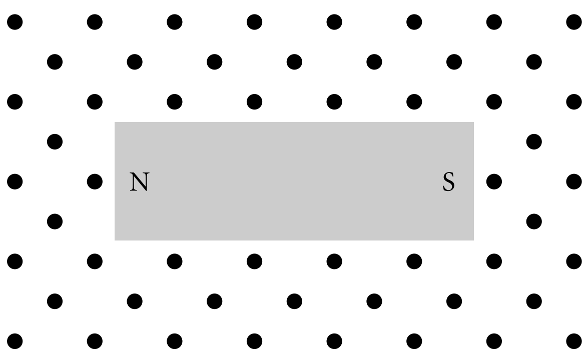
____

c. Which of them contain magnets? Which contain iron?

____

____

2. Many compass needles are placed around a bar magnet at the locations marked on the diagram. Sketch arrows at each point showing to which direction each compass will be pointing.



3. In the space below, sketch a horseshoe magnet, and draw lines indicating the direction of the magnetic field around it.

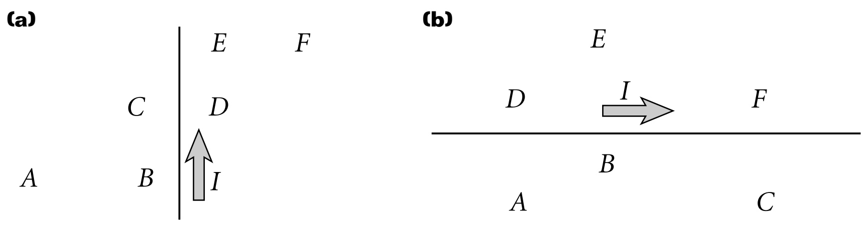
Section **21-2**

HOLT PHYSICS

Diagram Skills

Electromagnetism and Magnetic Domains

1. Use the convention symbols (×, •, and →) to indicate the direction of the magnetic field created by electric currents shown in the following diagrams at points *A, B, C, D, E,* and *F.*



2. How does the strength of the magnetic field at *A* compare with that at *B, C, D, E,* and *F* in the two situations presented in item 1?

____

____

____

3. The direction of the current is reversed. Sketch the corresponding diagrams, and answer items 1 and 2 again.

Section **21-3**

HOLT PHYSICS

Concept Review

Magnetic Force

The charge of an electron is 1.60×10^{-19} C.

1. A proton is moving along the positive *x*-axis with a speed of 1.50×10^{5} m/s in a magnetic field of 2.00 T that is oriented along the positive *y*-axis.

a. In the space below, sketch a diagram representing **B** and **v**.

b. Find the direction and magnitude of the electromagnetic force on the proton.

____

____

c. What is the force when the proton moves along the *y*-axis?

____

2. Repeat item 1 for an electron.

3. Repeat item 1 for an alpha particle made of two protons and two electrons.

4. If the magnetic field is uniform along the *y*-axis, do the particles in items 1, 2, and 3 keep moving in a straight line? Describe their path.

____

____

____

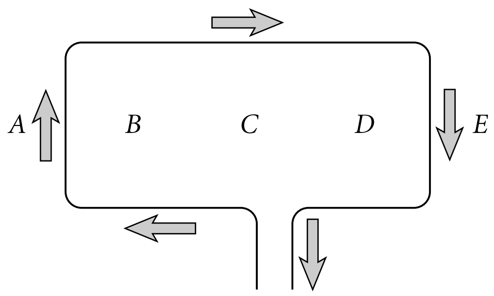
Chapter 21

HOLT PHYSICS

Mixed Review

Magnetism

1. A wire frame carries an electric current in the direction shown. Consider the magnetic field contributed by each segment of the frame at points *A*, *B*, *C*, *D*, and *E*.



a. Use the convention symbols (×, •, and →) to represent the direction of magnetic fields created at point *A* by the vertical segments of the frame. Do they have the same direction? the same strength?

b. Repeat for the horizontal segments.

c. Answer items a and b for points *B*, *C*, *D*, and *E*, and fill in the table below.

	leftmost	rightmost	upper	lower
B				
C				
D				
E				

d. Do the contributions of each segment to the magnetic field cancel out at the center? Explain.

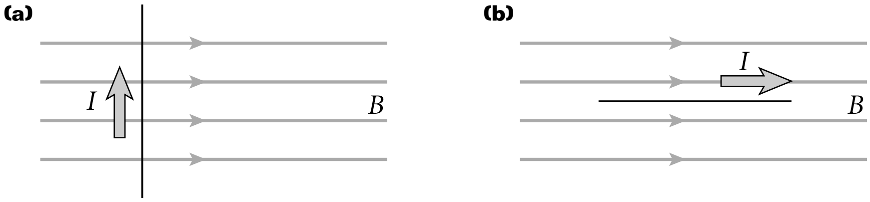
e. Is the magnetic field resulting from the combined effects of the four sides of the frame stronger inside or outside the frame?

Chapter 21

HOLT PHYSICS

Mixed Review *continued*

2. A 2.0 m long conducting wire has a current of 5.0 in a uniform magnetic field of 0.43 T. The field is parallel to the *x*-axis.



a. What is the force on the wire when it is vertical, parallel to the *y*-axis as shown **a**?

____

b. What is the force on the wire when it is horizontal, parallel to the *x*-axis as shown in **b**?

____

3. The wire in item 2 is bent to form a 0.50 m × 0.50 m square carrying the same 5.0 A current, with the positive charges moving clockwise in the frame. The frame is in the same magnetic field ($B = 0.43$ T).

a. Sketch a diagram of the situation. Use arrows to indicate the direction of the current in each segment of the frame.

b. Find the forces acting on each side of the frame. Specify their magnitude and direction.

____

____

____

____

c. Do the forces on the frame cancel each other? Will the frame be able to move? Will it be able to rotate? Explain.

____

____

____

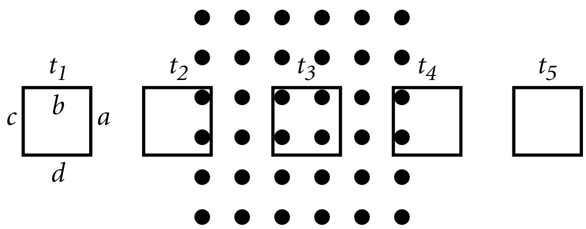
Section **22-1**

HOLT PHYSICS

Concept Review

Induced Current

Consider a loop of wire and a uniform magnetic field as shown below. The loop is shown at five different times as it travels to the right through the magnetic field. The loop is perpendicular to the field.



1. Using the right-hand rule for each side (*a, b, c, d*) of the loop, determine the direction of induced emf for each of the five times above.

side *a*: t_1 ______ t_2 ______ t_3 ______ t_4 ______ t_5 ______

side *b*: t_1 ______ t_2 ______ t_3 ______ t_4 ______ t_5 ______

side *c*: t_1 ______ t_2 ______ t_3 ______ t_4 ______ t_5 ______

side *d*: t_1 ______ t_2 ______ t_3 ______ t_4 ______ t_5 ______

2. Using your answers to item 1, determine the direction (clockwise/counterclockwise) of the current flow for each of the five times.

t_1 ______________ t_2 ______________ t_3 ______________

t_4 ______________ t_5 ______________

3. The loop is a square with sides that are 16.0 cm long, and it is traveling to the right at 8.0 cm/s. The field strength is 1.6 T.

a. What is the area of the loop?

____

b. How long does it take the loop to completely enter the magnetic field?

____

c. What is the magnitude of the induced emf?

____

d. Find the current in the loop of wire that has a resistance of 0.35 Ω.

____

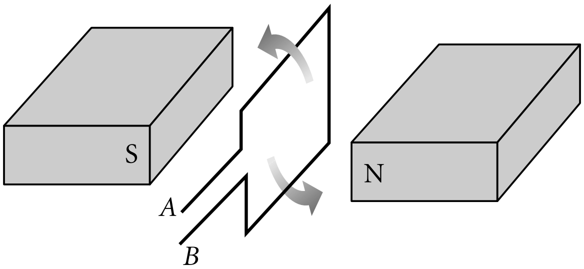
Section **22-2**

HOLT PHYSICS

Concept Review

Alternating Current, Generators, and Motors

Refer to the figure below to answer questions 1–3. Points *A* and *B* represent connections to an external circuit.



1. In which direction will the loop current flow? (Circle one.) *A* to *B* *B* to *A*

2. Suppose you want to *increase* the current. There are several variables to consider. In each case below, choose the appropriate change for each variable. (Circle one.)

a. Number of loops: Increase Decrease

b. Magnetic field strength: Increase Decrease

c. Rotational speed: Increase Decrease

3. The loop shown above is rotating one complete revolution every second. The square loop has sides of 2.5 cm, and the magnetic field strength is 0.75 T. The loop is connected to an 8.0 Ω external circuit.

a. When (in terms of loop orientation) is induced emf at a maximum?

____

b. When (in terms of loop orientation) is induced emf at a minimum?

____

c. How much time passes (in seconds) between maximum emf and zero emf?

____

d. Using your answers from parts a, b, and c, find the average emf induced in the coil.

____

NAME ______________ DATE ______________ CLASS ______________

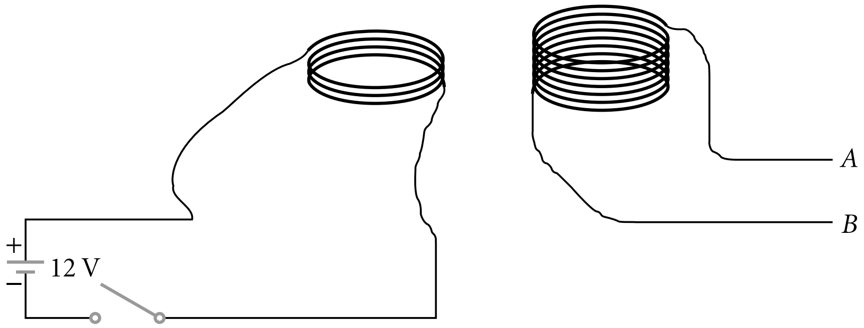
Section 22-3

HOLT PHYSICS

Concept Review

Inductance

Use the figure below to answer the following questions.



1. Draw the magnetic field created by a clockwise current in the primary loop. Include the area outside of the loop and the part of the field that intersects the secondary loop.

2. Label terminals *A* and *B* of the secondary loop with + or – to indicate the induced emf in the loop when the primary switch is shut. (Hint: consider that the positive terminal will repel the moving positive charge.)

3. If the secondary coil has twice as many turns as the primary coil, calculate the maximum potential difference across the secondary coil—right after the primary coil is "turned on."

____

4. Explain why the induced emf in the secondary coil is zero when the primary switch has been shut for a long time.

____

____

____

5. When the switch is opened after having been shut for a long time, the primary coil emf goes to zero, but the secondary coil generates a momentary emf. Explain this in terms of changing magnetic fields.

____

____

____

Chapter 22

HOLT PHYSICS

Mixed Review

Induction and Alternating Current

1. Which of the following actions will induce an emf in a conductor?

a. Move a magnet near the conductor.

b. Move the conductor near a magnet.

c. Rotate the conductor in a magnetic field.

d. Change the magnetic field strength.

e. all of the above

2. A circular loop (10 turns) with a radius of 29 cm is in a magnetic field that oscillates uniformly between 0.95 T and 0.45 T with a period of 1.00 s.

a. How much time is required for the field to change from 0.95 T to 0.45 T?

____

b. What is the cross-sectional area of one turn of the loop?

____

c. Assuming that the loop is perpendicular to the magnetic field, what is the induced emf in the loop?

____

3. Electric generators convert mechanical energy into electrical energy.

a. What are the requirements for generating emf?

____

____

____

b. The mechanical energy input is usually rotational motion. What are two possible sources of rotational motion?

____

____

Chapter 22

HOLT PHYSICS

Mixed Review *continued*

4. A 250-turn generator with circular loops of radius 15 cm rotates at 60.0 rpm in a magnetic field with a strength of 1.00 T.

a. What is the angular speed of the loops?

______

b. What is the area of one loop?

______

c. What is the maximum emf?

______

d. What is the rms emf?

______

5. An electric motor is sometimes called a generator in reverse. Explain your understanding of this statement.

______

______

6. Consider a two-coil transformer joined by a common iron core.

a. If the current in the primary side is increased, what happens to the magnetic field in the core?

______

______

b. What effect does the answer to item 6a have on the secondary coil?

______

______

c. Fully explain the effect of reducing the current to the primary side of a transformer.

______

______

Section **23-1**

HOLT PHYSICS

Concept Review

Quantization of Energy

1. According to the classical theory of physics, the energy radiated by a blackbody approaches infinity as the wavelength of the emitted light approaches zero.

a. Why was this considered a problem for classical physics?

______

______

b. Max Planck solved this problem in 1900. What was the key to the solution?

______

______

c. How does Planck's assumption solve the "ultraviolet catastrophe"?

______

______

2. A ringing bell oscillates at 440 Hz.

a. How much energy (in joules) is carried away in a one-quantum change of this system?

______

b. Convert your answer to units of electron-volts.

______

3. The equation for the maximum kinetic energy of an ejected photo-electron is $KE_{max} = hf - hf_t$.

a. Rearrange this equation to solve for the work function.

______

b. If photoelectrons with 2.55 eV of maximum kinetic energy are observed when a 1.17×10^{15} Hz light is used, find the work function of the metal.

______

NAME ______________________ DATE ______________ CLASS ____________________

Section **23-2**

HOLT PHYSICS

Concept Review

Models of the Atom

1. Write a brief description of Rutherford's model of the atom.

____

____

____

____

2. Why was Rutherford surprised that some of the alpha particles were scattered backwards?

____

____

3. Even though some atoms were scattered backwards, why did Rutherford conclude that the atom was mostly empty space?

____

____

4. A major problem with Rutherford's model is that atoms would quickly collapse rather than continue to exist (as we know from observation of the everyday world). Explain in terms of energy why the Rutherford atom would collapse.

____

____

____

____

DATE ______________ CLASS ________________

Section **23-3**

HOLT PHYSICS

Concept Review

Quantum Mechanics

1. Light acts as both a wave and a particle.

a. Give an example in which light acts like a wave.

____

____

b. Give an example in which light acts like a particle.

____

____

2. Heisenberg's uncertainty principle states that it is impossible to simultaneously measure both the position and the momentum of an object with complete certainty. Explain why this uncertainty is a big concern when conducting measurements on a small object, such as an electron, but is not a consideration when measuring the position and momentum of a large object, such as an athlete. (Hint: Consider the amount of uncertainty relative to the size of the measured value.)

____

____

3. Calculate the de Broglie wavelength for the following objects:

a. a 1550 kg car moving at 29.1 m/s ______________________________

b. a 90 800 kg ship moving at 13.5 m/s ______________________________

c. a 75 kg person moving at 10.5 m/s ______________________________

d. an 8.2 kg baby crawling at 2.2 m/s ______________________________

4. In terms of the uncertainty principle, how was the quantum mechanical model of the atom an improvement over Bohr's model?

____

____

____

____

Chapter 23

HOLT PHYSICS

Mixed Review

Atomic Physics

1. The photoelectric effect does not occur below the threshold frequency, which corresponds to the work function of the metal. Using the concept of quantization of light, explain why this is true.

____

____

2. Why is the maximum kinetic energy of a photoelectron always less than the energy of the photon that ejected the electron?

____

3. a. Some of the alpha particles in Rutherford's experiment were scattered backwards. What conclusion was drawn from this observation?

____

b. Most of the alpha particles continued through the foil almost completely undisturbed. What is implied by this observation?

____

4. De Broglie proposed that all matter has wavelike properties, and electrons have been observed to diffract and exhibit other wavelike properties when passed through a slit.

a. Calculate the de Broglie wavelength of an electron moving at 5.0×10^4 m/s.

____

b. Calculate the de Broglie wavelength of a 25 g ball moving at 5.0×10^1 m/s.

____

c. Explain why you do not observe wavelike properties for objects such as the ball in part b.

____

____

Chapter 23

HOLT PHYSICS

Mixed Review *continued*

5. a. State the uncertainty principle.

____

____

b. Explain why the uncertainty principle supports the theory of an electron cloud rather than a distinct orbit for electrons.

____

____

6. The accuracy of measuring an electron's position and momentum around a nucleus is limited by the change caused by the measuring instrument—the reflection of light photons. The measurement of a planet's position and momentum around the sun is not limited. Explain the difference in terms of the effect of the light used to create an image of the electron and the planet.

____

____

____

7. What is the threshold frequency of a metal whose work function is 4.82 eV?

____

8. Describe the effect of shining a light that has a frequency below the threshold frequency for a given surface.

____

____

9. If the energy deposited by light does not eject electrons, where does it go? (Hint: Consider other parts of an atom.)

____

____

10. How would the energy accumulation in item 9 be observed?

____

____

NAME ______________________ DATE ____________ CLASS ______________

Section **24-1**

HOLT PHYSICS

Concept Review

Conduction in the Solid State

1. Beside each of the properties in the left column, identify the type of material associated with the property. Circle all that apply.

a. low resistance to electron flow	insulator	conductor	semiconductor
b. high resistance to electron flow	insulator	conductor	semiconductor
c. conduction and valence bands overlap	insulator	conductor	semiconductor
d. large energy gap between bands	insulator	conductor	semiconductor
e. small energy gap between bands	insulator	conductor	semiconductor

2. In terms of the size of the energy gap between the valence and conduction bands, explain why it is easier to cause a semiconductor to conduct electricity than to cause an insulator to conduct electricity.

____

____

____

3. For a material to conduct electricity, there must be electrons in the conduction band. Conducting materials have electrons in the conduction band, while semiconductors and insulators normally do not. However, semiconductors and insulators can have electrons in the conduction band if the electrons undergo transitions to higher levels. Discuss different ways of exciting electrons into the conduction band for insulators and semiconductors.

____

____

____

4. An isolated atom does not have energy bands; it has energy levels. Why do we consider energy bands when discussing properties of materials?

____

____

____

Section 24-2

HOLT PHYSICS

Concept Review

Semiconductor Applications

1. When an electron moves into the conduction band in a semiconductor, it leaves behind a hole in the valence band.

a. Is it easier for a neighboring electron to move to the hole in the valence band or to the conduction band?

____

b. Explain the importance of this hole in terms of the conduction of electricity in the semiconductor.

____

____

____

2. Silicon is a commonly used semiconductor. It has four valence electrons.

a. In order to make a p-type semiconductor, how many valence electrons should the doping material have?

____

b. Does this doping material cause the semiconductor to become positively charged? Why or why not?

____

____

c. How many valence electrons should an n-type doping material have?

____

d. Does this cause the semiconductor to become negatively charged?

____

DATE ______________ CLASS ______________

Section **24-3**

HOLT PHYSICS

Concept Review

Superconductors

1. A primary cause of resistance in materials is the thermal vibration of the atoms in the lattice structure. However, even at absolute zero, many materials still have some resistance to electric current. What is the cause of this residual resistance?

____

____

2. In the BCS theory of superconductivity, electrons travel in pairs through a lattice.

a. What happens to the positively charged lattice atoms as one electron passes near those positive charges?

____

____

____

b. What effect does the change in the lattice have on the second electron in the pair?

____

____

____

c. The first electron loses some momentum while interacting with the lattice. Where does this momentum end up?

____

d. Imagine that we could positively identify a Cooper pair. If we were to watch them travel through the lattice, would we see the pair travel together through the entire lattice? Explain your answer.

____

____

____

DATE ______________ CLASS ____________________

Chapter 24

HOLT PHYSICS

Mixed Review

Modern Electronics

1. In the space below, draw diagrams of the valence and conduction bands for an insulator, a semiconductor, and a conductor. Include the relative size of the energy gap.

2. Why do conductors and semiconductors allow current to flow more easily than insulators do?

____

____

3. Individual atoms have energy levels, not bands. What causes energy bands to form in a solid?

____

____

4. What are two methods for exciting electrons into the conduction band in semiconductors?

____

____

5. Two electrons ordinarily repel each other. How is it possible to have electrons bound together in a Cooper pair?

____

____

6. How is the construction of a transistor different from the construction of a diode?

____

____

Chapter 24

HOLT PHYSICS

Mixed Review *continued*

7. a. When doping a semiconductor, what property is important?

____

b. How does doping a semiconductor with an impurity increase the semiconductor's conductivity?

____

____

____

8. Explain the difference between p-type and n-type semiconductors in terms of charge carriers and doping.

____

____

____

9. Why does a diode allow current in one direction and resist current in the other direction?

____

____

____

10. How are superconductors different from conductors and semiconductors?

____

____

____

11. A superconducting ring can be used as a storage device, while a conducting ring cannot. Explain the difference. Where does the energy go in a nonsuperconducting ring?

____

____

____

Section **25-1**

HOLT PHYSICS

Concept Review

The Nucleus

1. A certain atom has eight protons, eight electrons, and eight neutrons.

a. How many nucleons does this atom have?

____

b. What is the atomic number of this atom?

____

c. What is the mass number of this atom?

____

d. If the nucleus of this atom has a mass of 16.124 552 u, calculate the binding energy of the nucleus.

____

e. What is the significance of the binding energy?

____

____

f. Would an atom with eight protons, eight electrons, and nine neutrons be a different element? Explain.

____

____

2. Two protons in a nucleus experience a very large repulsion force.

a. What prevents these two protons from accelerating away from each other?

____

b. As a nucleus gets larger, what happens to the ratio of protons to neutrons?

____

____

NAME ______________________ DATE ______________ CLASS ______________

Section 25-2

HOLT PHYSICS

Concept Review

Nuclear Decay

1. List and describe the three types of radiation emitted by radioactive materials.

____

____

____

2. Find the element produced in the following decays:

a. Nitrogen-17 decays by emitting a beta particle. ______________

b. Uranium-235 decays by emitting an alpha particle. ______________

c. Uranium-238 decays by emitting a beta particle. ______________

d. Plutonium-239 decays by emitting an alpha particle. ______________

3. What does the term *half-life* mean?

____

____

4. What is the decay constant?

____

____

5. What is the mathematical relationship between the decay constant and the half-life of a substance?

____

____

6. Find the decay constant of a material that has a half-life of 14 s.

____

7. Find the half-life of a material that has a decay constant of 2.20×10^{-8} s^{-1}.

____

8. How much of the material in item 7 will remain after two years?

____

NAME ______________ DATE ______________ CLASS ______________

Section 25-3

HOLT PHYSICS

Concept Review

Nuclear Reactions

1. A typical nuclear reaction is ${}^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n$.

a. Is this a fission reaction or a fusion reaction?

____

b. What are the reactants in this reaction?

____

c. What are the products of this reaction?

____

d. Are mass and charge conserved in this reaction?

____

e. This reaction produces three neutrons. What might happen if each neutron is absorbed by another uranium nucleus?

____

____

f. What is the danger of an uncontrolled nuclear reaction?

____

____

2. Another possible reaction is ${}^{1}_{1}H + {}^{3}_{2}He \rightarrow {}^{4}_{2}He + {}^{0}_{1}e + \nu$.

a. Is this a fission reaction or a fusion reaction?

____

b. What are the reactants in this reaction?

____

c. What are the products of this reaction?

____

d. Are mass and charge conserved in this reaction?

____

NAME ______________________ DATE ____________ CLASS ______________

Section 25-4

HOLT PHYSICS

Concept Review

Particle Physics

1. List the four fundamental interactions in order of relative strength. Describe each interaction, including relative strength, effects, and the range of force.

____

____

____

____

2. The four fundamental interactions each have a mediating particle.

a. List the mediating particles for each of the following types of interactions:

gravitational ______________________________

weak ______________________________

electromagnetic ______________________________

strong ______________________________

b. Which mediating particle has not yet been discovered?

____

3. The standard model proposes the existence of a particle called the Higgs boson.

a. What is the reason scientists predict the existence of the Higgs boson?

____

____

____

b. Why has this particle not been observed?

____

____

____

Chapter 25

HOLT PHYSICS

Mixed Review

Subatomic Physics

1. Determine the number of neutrons in the following nuclei:

a. $^{235}_{92}U$ ______

b. $^{238}_{92}U$ ______

c. $^{239}_{93}Pu$ ______

d. $^{2}_{1}H$ ______

e. $^{3}_{1}H$ ______

f. $^{14}_{6}C$ ______

g. $^{17}_{7}N$ ______

h. $^{40}_{18}Ar$ ______

2. Consider the following pairs of nuclei: $^{12}_{6}C$, $^{13}_{6}C$ and $^{238}_{92}U$, $^{239}_{93}Pu$.

a. What does the first pair have in common?

______

b. What is the difference between the nuclei in the first pair?

______

c. What does the second pair have in common?

______

d. What is the difference between the nuclei in the second pair?

______

e. Describe the similarities between the two pairs.

______

______

f. Describe the differences between the two pairs.

______

______

Chapter 25 HOLT PHYSICS

Mixed Review *continued*

3. A nucleus decays by emitting a beta particle.

a. Compare the atomic mass of the new nucleus with that of the original nucleus.

____

____

b. Compare the atomic number of the new nucleus with that of the original nucleus.

____

____

c. Which nucleus would you expect to have a larger binding energy? Explain.

____

____

d. Which nucleus would have a larger mass defect? Explain.

____

____

4. Fusion in the sun creates high temperatures that tend to make the sun expand. What keeps the reaction contained?

____

____

5. A deuteron, ${}^{2}_{1}H$, may decay. Could it decay by emitting an alpha particle? Explain.

____

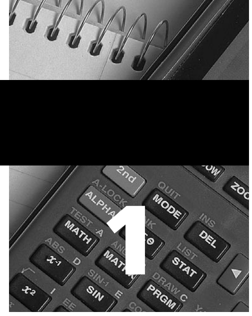
____

6. What two quantities must be conserved in a nuclear reaction equation?

____

____

The Science of Physics



Chapter 1

Section 1-1, p. 1

1. a. mechanics (laws of motion)

b. vibrations and waves (sound or acoustics)

c. optics

d. thermodynamics

e. electricity

f. nuclear physics

2. a. No. Scientist do not vote about their knowledge. They use evidence to support or disprove scientific arguments

b. No. Speed of light is determined in nature. We can only measure it.

c. Yes, by sharing their scientific arguments. Science is a body of knowledge about the universe. Scientists around the world work together to make it grow.

Section 1-2, p. 2

1. 10^{18}

2. 10^{9}

3. 10^{7}

4. a. 3.582×10^{12} bytes

b. 9.2331×10^{-7} W

c. 5.3657×10^{-5} s

d. 5.32×10^{-3} g

e. 8.8900×10^{10} Hz

f. 8.3×10^{-9} m

5. a. 36.582472 Mgrams

b. 452 nm

c. 53.236 kV

d. 4.62 ms

6. 4.2947842; 4.29478; 4.295; 4.3

Section 1-3, p. 3

1. a. 6.0×10^{8}

b. 1.5×10^{2}

c. 1.5×10^{-3}

d. 6.0×10^{3}

e. 1.5×10^{3}

f. 6.0×10^{-7}

2. a. 4×10^{5}

b. 6×10^{5}

c. 8×10^{-9}

d. 7×10^{-5}

e. 7×10^{6}

f. 7×10^{-4}

3. a. 10^{4}

b. 10^{-1}

4. a. about 10 cm by 25 cm

b. Check student responses, which should indicate that volume = $(\text{width})^2 \times (\text{height})$.

c. Check student responses for consistency with a and b.

III

Chapter 1 Mixed Review

1. a. 2.2×10^{5} s

b. 3.5×10^{7} mm

c. 4.3×10^{-4} km

d. 2.2×10^{-5} kg

e. 6.71×10^{11} μg

f. 8.76×10^{-5} GW

g. 1.753×10^{-1} ps

2. a. 3

b. 4

c. 10

d. 3

e. 2

f. 4

3. a. 4

b. 5

c. 3

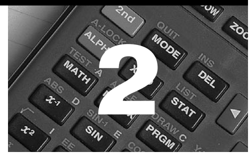
4. a. 1.0054; –0.9952; 5.080×10^{-3}; 5.076×10^{-3}

b. 4.597×10^{7}; 3.866×10^{7}; 1.546×10^{14}; 11.58

5. 15.9 m^2

6. The graph should be a straight line.

Chapter 2



Section 2-1, p. 6

1. Yes, from t_1 to t_4 and from t_6 to t_7.
2. Yes, from t_4 to t_5.
3. greater than
4. greater than
5. Yes, from 0 to t_1 and from t_5 to t_6.
6. Yes, from t_1 to t_2, from t_2 to t_4, from t_4 to t_5, and from t_6 to t_7.
7. −5.0 m (or 5.0 m to the west of where it started)

Section 2-2, p. 7

1. $v_f = 0$. The car is stopped.
2. $v_i = \dfrac{2\Delta x}{\Delta t}$
3. $a = \dfrac{-v_i}{\Delta t}$
4. $a = \dfrac{-v_i^2}{2\Delta x}$
5. $v_i = -a\Delta t \ \Delta x = \frac{1}{2} v_i \Delta t$

Section 2-3, p. 8

1. **a.** $-g$
   b. initial speed $= g(\Delta t/2)$
   c. elapsed time $= \Delta t/2$
   d. height $= g\Delta t^2/8$
2. **a.** −9.81 m/s^2
   b. 12 m/s
   c. 1.2 s

Chapter 2 Mixed Review

1. **a.** $t_1 = d_1/v_1$; $t_2 = d_2/v_2$; $t_3 = d_3/v_3$
   b. total distance $= d_1 + d_2 + d_3$
   c. total time $= t_1 + t_2 + t_3$
2. **a.** $v_f = a(\Delta t)$
   b. $v_f = v_i + a(\Delta t)$; $\Delta x = \frac{1}{2}(v_i + v_f)\Delta t$ or $\Delta x = v_i(\Delta t) + \frac{1}{2}a(\Delta t)^2$
3.

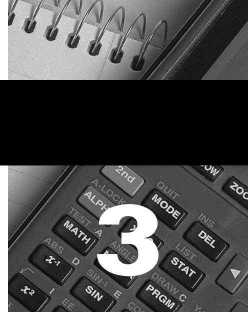
Time interval	Type of motion	v(m/s)	a(m/s^2)
A	speeding up	+	+
B	speeding up	+	+
C	constant velocity	+	0
D	slowing down	+	−
E	slowing down	+	−

4. **a.**

Time (s)	Position (m)	v(m/s)	a(m/s^2)
1	4.9	0	−9.81
2	0	−9.8	−9.81
3	−14.7	−19.6	−9.81
4	−39.2	−29.4	−9.81

   b. 1 s
   c. 2 s

Chapter 3



Section 3-1, p. 11

1. {**A, C, E, H, I**}; {**D, G**}, {**B, F, J**}
2. {**A, D, H**}, {**B, C, G**}, {**I, J**}
3. {**A, H**}
4. Both diagrams should show a vector **A** that is twice as long as the original vector **A,** but still pointing up. The first diagram should have the tip of 2**A** next to the tail of **B.** The second diagram should have the tip of **B** next to the tail of 2**A.** The resultant vectors should have the same magnitude and direction, slanting towards the upper right.
5. Both diagrams should show a vector **B** that is half as long as the original vector **B.** The first diagram should have the tip of **A** next to the tail of –**B**/2, and –**B**/2 should be pointing to the left. The second diagram should have the tip of **B**/2 next to the tail of –**A,** and –**A** should be pointing down. The resultant vectors should have the same magnitude but opposite directions. The first will slant towards the upper left. The second will slant towards the lower right.

Section 3-2, p. 12

1. Check students' graph for accuracy.
2. Shot 1: 45 m; 45 m

   Shot 2: 110 m; 64 m

   Shot 3: 65 m; 33 m

   Shot 4: 0 m; 14.89 m
3. 220 m

Section 3-3, p. 13

1. $\Delta t = v_i \sin \theta / g$
2. $h = v_i^2 (\sin \theta)^2 / g$
3. $x = v_i (\cos \theta)(\Delta t)$
4. $R = \dfrac{2v_i^2 \sin \theta \cos \theta}{g}$
5.

Launch angle	Maximum height (m)	Range (m)
15°	17	130
30°	64	220
45°	130	250
60°	190	220
75°	240	130

III

Section 3-4, p. 14

1. $\mathbf{v_{BL}} = \mathbf{v_{BW}} + \mathbf{v_{WL}}$
2. Student diagrams should show $\mathbf{v_{BW}}$ twice as long as $\mathbf{v_{WL}}$ but both are in the same direction as $\mathbf{v_{BL}}$, which is long as both together.
3. Student diagrams should show $\mathbf{v_{WL}}$ and $\mathbf{v_{BW}}$, longer and opposite in direction. The vector $\mathbf{v_{BL}}$ should be as long as the difference between the two, and in the same direction and in the same direction as $\mathbf{v_{BW}}$.
4. Student diagrams should show $\mathbf{v_{WL}}$ and $\mathbf{v_{BW}}$ at a right angle with $\mathbf{v_{BL}}$ forming the hypotenuse of a right triangle.
5. **a.** 6.0 km/h, due east

   b. 2.0 km/h, due west

   c. 4.5 km/h, $\theta = 26.6°$

Chapter 3 Mixed Review

1. a. The diagram should indicate the relative distances and directions for each segment of the path.
   b. 5.0 km, slightly north of northwest
   c. 11.0 km
2. a. The same
   b. Twice as large
   c. 1.58
3. a. 2.5 m/s, in the direction of the sidewalk's motion
   b. 1.0 m/s, in the direction of the sidewalk's motion
   c. 4.5 m/s, in the direction of the sidewalk's motion
   d. 2.5 m/s, in the direction opposite to the sidewalk's motion
   e. 4.7 m/s, $\theta = 32°$
4. a. 4.0×10^1 seconds
   b. 6.0×10^1 seconds

Forces and the Laws of Motion

Chapter 4

Section 4-1, p. 17

1. The diagram should show two forces: 1) $\mathbf{F_g}$ (or mg) pointing down; 2) an equal and opposite force of the floor on the box pointing up.

2. The diagram should show four forces: 1) $\mathbf{F_g}$ (or mg) pointing down; 2) an equal and opposite force of the floor on the box pointing up; 3) $\mathbf{F}$ pointing to the right, parallel to the ground; 4) $\mathbf{F_{resistance}}$ pointing to the left, parallel to the ground.

3. The diagram should show four forces: 1) $\mathbf{F_g}$ (or mg) pointing down; 2) $\mathbf{F}$ pointing to the right at a 50° angle to the horizontal; 3) a force equal to $\mathbf{F_g}$ minus the vertical component of the force $\mathbf{F}$ being applied at a 50° angle; and 4) $\mathbf{F_{resistance}}$ to the left, parallel to the ground.

Section 4-2, p. 18

1. $\mathbf{F_{net}} = \mathbf{F_1} + \mathbf{F_2} + \mathbf{F_3} = 0$

2. String 1: $0, -mg$

   String 2: $-F_2 \cos \theta_1, F_2 \sin \theta_1$

   String 3: $F_3 \cos \theta_2, F_3 \sin \theta_2$

3. $F_{x\ net} = -F_2 \cos \theta_1 + F_3 \cos \theta_2 = 0$

   $F_{y\ net} =$
   $-F_2 \sin \theta_1 + F_3 \sin \theta_2 + F_1 = 0$

4. $F_1 = 20.6$ N

   $F_2 = 10.3$ N

   $F_3 = 17.8$ N

Section 4-3, p. 19

1. $\mathbf{F_{s\ on\ b}}$ and $\mathbf{F_{b\ on\ s}}$; $\mathbf{F_{g\ on\ s}}$ and $\mathbf{F_{s\ on\ g}}$; $\mathbf{F_{fr,1}}$ and $-\mathbf{F_{fr,1}}$; $\mathbf{F_{fr,2}}$ and $-\mathbf{F_{fr,2}}$.

2. $\mathbf{F_{s\ on\ b}}$, $\mathbf{F_{b\ on\ s}}$, $-\mathbf{F_{fr,1}}$

3. $\mathbf{F_{g\ on\ s}}$, $\mathbf{F_{s\ on\ g}}$; $\mathbf{F_{b\ on\ s}}$, $\mathbf{F_{fr,1}}$, $\mathbf{F}$, $\mathbf{F_{fr,2}}$

4. $\mathbf{F_{x,box}} = m\mathbf{a} = -\mathbf{F_{fr,1}}$

5. $\mathbf{F_{y,box}} = \mathbf{F_{s\ on\ b}} - m\mathbf{g} = 0$

6. $\mathbf{F_{x,sled}} = \mathbf{Ma} = \mathbf{F} \cos \theta - \mathbf{F_{fr,1}} - \mathbf{F_{fr,2}}$

7. $\mathbf{F_{y,sled}} = \mathbf{F_{g\ on\ s}} + \mathbf{F} \sin \theta - \mathbf{F_{b\ on\ s}} - M\mathbf{g} = 0$

Section 4-4, p. 20

1. 44 N

2. 31 N

3. **a.** 21 N, up the ramp

   b. yes

4. **a.** 18 N, down the ramp

   b. yes

Chapter 4 Mixed Review

1. **a.** at rest, moves to the left, hits back wall

   b. moves to the right (with velocity v), at rest, neither

   c. moves to the right, moves to the right, hits front wall

2. **a.** mg, down

   b. mg, up

   c. no

   d. yes

3. **a.** $a = \dfrac{F}{m_1 + m_2}$

   b. $m_2 a$

   c. $F - m_2 a = m_1 a$

   d. $\left(\dfrac{m_1}{m_1 + m_2}\right) F$

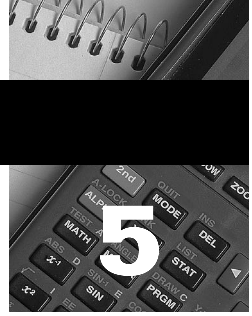
4. **a.** $a = \dfrac{F - F_k}{m_1 + m_2}$

   b. $m_2 a - F_k$

   c. $F - m_2 a - F_k = m_1 a - F_k$

   d. $\left(\dfrac{m_1}{m_1 + m_2}\right)(F - F_k)$

III



Chapter 5

Section 5-1, p. 23

1. Fd

2. $\frac{-mgd}{2}$

3. 0 J

4. $F_k d$

5. 0 N

6. 0 J

Section 5-2, p. 24

1. a. $\frac{1}{2}mv_i^2$

b. 0

c. $\frac{1}{2}mv_i^2$

2. a. $\frac{1}{2}mv^2$

b. $\frac{1}{2}kx_1^2$

c. $\frac{1}{2}mv^2 + \frac{1}{2}kx_1^2$

3. a. 0

b. $\frac{1}{2}kx_2^2$

c. $\frac{1}{2}kx_1^2$

4. a. $\frac{1}{2}mv_i^2$

b. 0

c. $\frac{1}{2}mv_i^2$

Section 5-3, p. 25

1. a. 0

b. mgh_A

c. $\frac{1}{2}mv_B^2$

d. mgh_B

2. a. $v_A = 0$

b. $v_B = \sqrt{2g(h_A - h_B)}$

3.

Location	KE_A	PE_A	$KE_{location}$	$PE_{location}$	$v_{location}$
C	0	1.9×10^4 J	9×10^3 J	9.6×10^3 J	17 m/s
D	0	1.9×10^4 J	1.3×10^4 J	6.4×10^3 J	2.0×10^1 m/s
E	0	1.9×10^4 J	1.6×10^4 J	3.2×10^3 J	22 m/s
F	0	1.9×10^4 J	3×10^3 J	1.6×10^4 J	10 m/s
G	0	1.9×10^4 J	6×10^3 J	1.3×10^4 J	14 m/s

4. The sums are the same.

Section 5-4, p. 26

1. $v = -gt$

2. $d = -\frac{1}{2}gt^2$

3. $F = mg$

4. $W = Fd$

5. The graph should be a curved line.

6. 4.20×10^2 W

Chapter 5 Mixed Review

1. a. 60 J

b. −60 J

2. a. mgh

b. mgh

c. $v_B = \sqrt{v_A^2 + 2gh}$

d. no

e. no

3. a. 2.9 J

b. 1.8 J

c. 1.2 J

d. a, b: different; c: same

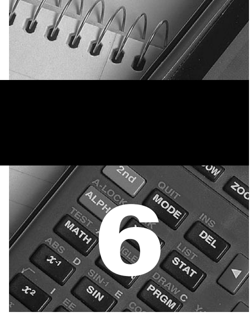
4. a. $\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f + F_k d$

b. $F_k = \mu mg(\cos 23°)$

c. $v_f = \sqrt{mv_i^2 + 2g(d \sin 23° - \mu \cos 23°)}$

III

Chapter 6



Section 6-1, p. 29

1. Student drawings should show a vector with a length of 9.5 squares to the right.
2. Student drawings should show a vector with a length of 5.0 squares pointing down.
3. 10.7 squares, angle –28°
4. 11 kg•m/s
5. 12 m/s
6. use a protractor, or use $\tan^{-1}(5.0/9.5)$
7. Student drawings should show one vector with a length of 6.0 squares to the right and another with a length of 12.5 squares to the right. Final momentum is about 6.5 kg•m/s with a final speed of about 43 m/s.

Section 6-2, p. 30

1. 0 kg•m/s
2. 0 kg•m/s
3. The vectors have equal length and opposite direction.
4. $\frac{v_{small}}{v_{big}} = 50$
5. The ratio of velocities is the inverse ratio of the masses.

Section 6-3, p. 31

1. vector **A** added head-to-tail with vector **K**
2. **F**
3. **F**
4. vector **F** subtracted (tail-to-tail) with vector **H**
5. **J**

Chapter 6 Mixed Review

1. **a.** The change due to the bat is greater than the change due to the mitt.

   b. The impulse due to the bat is greater than the impulse due to the mitt.

   c. Check student diagrams. Bat: vector showing initial momentum and a larger vector in the opposite direction showing impulse of bat, result is the sum of the vectors. Mitt: vector showing initial momentum and an equal length vector showing impulse of mitt, result is the sum, which is equal to zero.

2. **a.** The impulses are equal, but opposite forces, occurring during the same time interval.

   b. The total force on the bowling ball is the sum of forces on pins. The force on the pins is equal but opposite of total force on ball.

3. $m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)v_f$;

   $m_1v_{1i}/(m_1 + m_2) + m_2v_{2i}/(m_1 + m_2) = v_f$

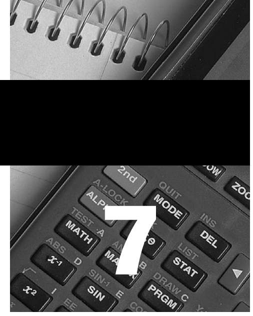
4. **a.** M(6 m/s)

   b. 2 m/s

   c. objects trade momentum; if masses are equal, objects trade velocities

III

Rotational Motion and the Law of Gravity



Chapter 7

Section 7-1, p. 34

1. a. 0.297 rad
b. 2.967 rad
c. 0.873 rad
d. 4.014 rad
e. −0.349 rad
f. 5.934 rad

2. a. 57.3°
b. 237°
c. −143°
d. 217°
e. $(1.8 \times 10^2)°$
f. 90.0°

3. a. 29 rad
b. 19 rad/s
c. 25 rad/s^2
d. 38 rad/s

4. $\omega = v/r$; $\Delta\theta = v\Delta t/r$; $\Delta t = T$ if $\Delta\theta = 2\pi$; $2\pi = vT/r$; $2\pi r/v = T$

Section 7-2, p. 35

1. a. 0.10 rad/s
b. 0.50 rad/s
c. 1.0 rad/s
d. 2.0 rad/s
e. 5.0 rad/s
f. 1.0×10^1 rad/s

2. a. 0.035 m/s
b. 0.18 m/s
c. 0.35 m/s
d. 0.70 m/s
e. 1.8 m/s
f. 3.5 m/s

3. 0.35 m/s^2

4. a. 4
b. 0.5
c. 2

5. a. 18.8 m/s^2
b. friction between tires and road

Section 7-3, p. 36

III

1. a. 2
b. 4
c. $\frac{1}{4}$
d. 1

2. a. double one mass, double the force
b. double both masses, quadruple the force
c. double the radius, decrease the force to $\frac{1}{4}$
d. If measured in the opposite direction, the force will be in the opposite direction.

3. Because of inertia, objects tend to go in a straight line. A force is needed to change the direction of travel.

Chapter 7 Mixed Review

1. a. 3.0, 3.0, 9.0, 27
b. 4.3, 1.0, 4.3, 37
c. 16, 0.28, 11, 6.0×10^2
d. 630, 0.11,74, 8.7
e. 5.0, 44, 0.11, 9.9

2. a. friction
b. gravitational force
c. tension in string

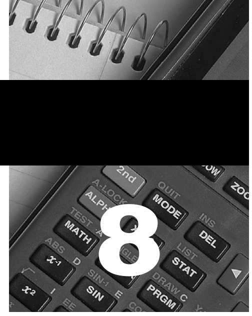
3. a. doubled
b. quadrupled
c. reduced to $\frac{1}{4}$
d. quadrupled
e. reduced to $\frac{1}{9}$

4. 190 m

5. Student diagrams should show vectors for weight and normal force from elevator; descent should show normal force less than weight; stopping should show normal force greater than weight; "weightlessness" feeling is due to acceleration.

6. 1050 s (17.5 min)

Menu Print



Chapter 8

Section 8-1, p. 39

1. **a.** F_d, F_e, F_f, F_g
   b. Student diagrams should show only forces F_d, F_e, F_f, F_g.
   c. F_e exerts the largest torque because it has the largest lever arm.
2. **a.** 1.20×10^2 N•m
   b. 96.8 N•m
   c. The door rotates toward Sherry because she exerts the larger torque.

Section 8-2, p. 40

1. point 5
2. **a.** point 9
   b. point 6
   c. point 2
   d. no change
3. **a.** point 3
   b. point 2
   c. point 6
   d. no change
4. **a.** point 5, point 4
   b. at point 7, to the left

Section 8-3, p. 41

1. **a.** 79 rad/s
   b. 22 kg•m^2, 14 kg•m^2
   c. 1700 kg•m^2/s, 1100 kg•m^2/s
   d. -4.5×10^{-3} rad/s^2, -7.1×10^{-3} rad/s^2
   e. hollow
2. **a.** 47 J
   b. 0.042 kg•m^2
   c. 3.0 m/s
   d. The ball loses energy to external force, the loss of energy reduces the speed of the ball.

Section 8-4, p. 42

1. Simple machines reduce the force required for task at the expense of distance.
2. **a.** 1.2×10^4 J
   b. 120 N
   c. 110 m
   d. greater
3. **a.** 0.92
   b. 0.90
   c. 0.94
4. Friction is always present.
5. lubrication and careful manufacturing

Chapter 8 Mixed Review

1. **a.** If the knob is farther from the hinge, torque is increased torque for a given force.
   b. twice as much
2. **a.** Rotational inertia is reduced.
   b. Angular momentum remains the same.
   c. Angular speed increases.
3. **a.** 2.0 kg
   b. 0.67 kg
4. **a.** 6.2 N•m, 0.016 kg•m^2, 390 rad/s^2
   b. 12 N•m, 0.062 kg•m^2, 190 rad/s^2
5. **a.** 8.1×10^{16} kg•m^2
   b. 5.9×10^{12} kg•m^2/s
   c. 2.1×10^8 J
   d. 3.1×10^3 m/s
   e. 2.2×10^8 J
6. **a.** 4.0×10^4 J
   b. 4.4×10^4 J
   c. 4.9×10^4 J
   d. 0.81

III

Fluid Mechanics

Chapter 9

Section 9-1, p. 45

1. $V = 30.0\ m^3$
2. 1.95×10^4 kg
3. $F_g = 1.91 \times 10^5$ N
4. 0
5. $F_b = 1.91 \times 10^5$ N
6. 1.95×10^4 kg
7. $19.5\ m^3$
8. $19.5\ m^3$; $10.5\ m^3$
9. Ethanol: $F_b = 1.91 \times 10^5$ N; 1.95×10^4 kg; $24.2\ m^3$; $24.2\ m^3$; $5.8\ m^3$

Section 9-2, p. 46

1. $P = 6.94 \times 10^3$ Pa
2. $P = 6.94 \times 10^3$ Pa
3. $P = 6.94 \times 10^3$ Pa
4. 12.5 N
5. **a.** $V = 1.44 \times 10^{-5}\ m^3 (14.4\ cm^3)$
   b. 0.02 m

Section 9-3, p. 47

1. $1.20\ m^3/s$; $1.20\ m^3/s$; $1.20\ m^3/s$
2. 6.00 m; 2.00 m; 12.0 m
3. 1 s, 1 s, 1 s
4. 6.00 m/s; 2.00 m/s; 12.0 m/s
5. Speed increases in order to keep the flow rate constant.

Section 9-4, p. 48

1. $m = 4.32 \times 10^{-4}$ kg
2. $V = 4.00 \times 10^{-4}\ m^3$
3. $T_2/T_1 = 1/2$; $P_2/P_1 = 3/1$; $V_2/V_1 = 1/6$
4. Increasing the pressure reduced the volume. The decrease in temperature reduced the volume.
5. There was no change in mass since the container was sealed.
6. $d = 1.08\ kg/m^3$; The density increased 6 times when volume of the mass was reduced to 1/6 of the original volume.

Chapter 9 Mixed Review

1. **a.** $2.01 \times 10^5\ N/m^2$ (top); $2.51 \times 10^5\ N/m^2$ (bottom)
   b. $3.02 \times 10^5\ N/m^2$; $3.52 \times 10^5\ N/m^2$
   c. $F_{top} = 1.81 \times 10^6$ N; $F_{bottom} = 2.11 \times 10^6$ N
   d. F_{top} is downward; F_{bottom} is upward and greater
   e. net force $= 3.0 \times 10^5$ N; F_{bottom}
   f. The crate will sink because the buoyant force is less than the weight of the crate.
   g. $V = 30.0\ m^3$
   h. $F_b = 3.00 \times 10^5$ N. The buoyant force is equal to the weight of water displace by the crate.
2. **a.** $P_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho v_2^2$
   b. Both have the same depth. $P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$
   c. based on the continuity equation: if $A_1 >> A_2$, then $v_1 << v_2$
   d. $P_1 = P_2 + \frac{1}{2}\rho v_2^2$
   e. $P_2 = P_0$; $P_2 < P_1$ (by $1.00 \times 10^6\ N/m^2$)
   f. 44.7 m/s

Heat

Chapter 10

Section 10-1, p. 51

1. 183 K to 268 K
2. a. 6.30×10^2 K; 2.34×10^2 K
   b. no; yes
3. a. no—tub is 36°C
   b. cold
4. a. 77.4 K; 90.2 K
   b. The nitrogen is a gas because the temperature is above its boiling point. The oxygen is a liquid because the temperature is below its boiling point.

Section 10-2, p. 52

1. a. 3.12×10^5 J
   b. 5.00×10^4 J
   c. increase, 2.62×10^5 J
   d. yes; 2.62×10^5 J
2. a. 3.92×10^4 J; 2.50×10^3 J; 4.17×10^4 J
   b. 0 J; 2.50×10^3 J; 2.50×10^3 J
   c. decreased by 3.92×10^4 J
   d. increase by 3.92×10^4 J; melting the ice

Section 10-3, p. 53

1. 1.04×10^6 J
2. 6.66×10^6 J
3. 4.19×10^5 J
4. 3-part graph with energy in joules on horizontal axis and temperature in degrees celsius on the vertical axis: graph goes up from {0 J, –25°C to 1.04×10^6 J, 0°C}, is horizontal until {7.70×10^6 J, 0°C}, then goes up to 8.12×10^6 J, 0°C}

Section 10-4, p. 54

1. reflect radiation inside the cavity
2. conduction through pan, convection inside water, conduction by contact water to spaghetti
3. radiation
4. convection
5. evaporation extracts energy from the body

Chapter 10 Mixed Review

1. a. 78.5 J
   b. 78.5 J
   c. 51.2 J; less than loss in PE
   d. 27.3 J
2. a. 2.26×10^9 J
   b. 1.49×10^5 kg
   c. 3.62°C
   d. 19.4°C
3. a. They are at thermal equilibrium.
   b. $(100.0 - x)$°C; $(y - 20.0)$°C
   c. (2.000 kg)(4.19×10^3 J/kg•°C) $(100.0 - x)$°C
   d. (5.000 kg) (8.99×10^2 J/kg•°C) $(y - 20.0)$°C
   e. all of the energy was transferred from the water to the pipe, no loss and no other source of energy
   f. 72°C

III

Chapter 11

Section 11-1, p. 57

1. a. 0.020 m^3

b. 7.0×10^3 J

c. 2.0×10^3 J increase

2. a. yes, marble to water

b. no, ΔU by heat only

c. decrease; temperature dropped

d. increase; more water, less ice

e. no change, the cup is insulated

Section 11-2, p. 58

1. a. –320 J

b. The gas lost energy because ΔU was less than 0.

c. Student diagrams should show the *W* arrow and the *Q* arrow pointing OUT of the container.

2. a. 0

b. 540 J out

c. Student diagrams should show the *W* arrow pointing IN and the *Q* arrow pointing OUT.

Section 11-3, p. 59

1. a. 8.0×10^3 J

b. 20%

c. 3.2×10^2 N

2. a. 7.00×10^3 J

b. 1.30×10^4 J

c. 4.0×10^1 m

3. a. 5.0×10^2 J

b. 3.4×10^2 J

c. 1.9×10^2 J

Section 11-4, p. 60

1. a. 1; 2; 1

b. 4

c. [1-1] has probability 2/4

2. a. 1, 4, 6, 4, 1

b. 16

c. [2-2] has probability 6/16

d. [2-2]

3. Equal distribution states are more likely than any other arrangement.

Chapter 11 Mixed Review

1. $\Delta U = 700$ J increase

2. a. 0.005 m^3

b. 1.5×10^3 J

c. 1.5×10^3 J

3. a. 5.00×10^4 J

b. 1.40×10^4 J

4. a. ΔU (compressed air) = *W* (added by person) – *Q* (things warm up)

b. Disorder is increased by increasing internal energy through heat.

5. Graph bars should convey that: $PE_1 = \text{max}$, $KE_1 = 0$, $U_1 = 0$ or U_1 is any amount. Then, $PE_2 = 0$, $KE_2 \le \frac{1}{2}PE_1$, $U_2 \ge U_1 + \frac{1}{2}PE_1$. Then, $PE_3 \le \frac{1}{2}PE_1$, $KE_3 = 0$, $U_3 \approx U_2$. Last: $PE_4 = 0$, $KE_4 \le \frac{1}{4}PE_1$, and $U_4 \ge \frac{3}{4}PE_1$.

Vibrations and Waves

Chapter 12

Section 12-1, p. 63

1. **a.** 0.21 m
   b. 2.0 s
   c. 0.5 Hz
   d. 0.50 m, 2.0 s, 0.5 Hz
2. **a.** 49.0 N
   b. 4.90×10^2 N
   c. 41.6 N
   d. 15.9 cm

Section 12-2, p. 64

1. 0.1 s, 10 Hz
2. **a.** 5.0 Hz
   b. 10, 70
3. **a.** 4.0 Hz, 0.25 s
   b. 4.0 Hz, 0.25 s, 5.0 cm
4. 0.500 Hz, 2.00 s, 0.0621 m
5. **a.** 1267 kg, 5066 kg
   b. increase

Section 12-3, p. 65

1. 37.5 m, 250 m
2. **a.** 0.02 s, 5×10^1 Hz
   b. 40.00 m, 2.000×10^3 m/s

Section 12-4, p. 66

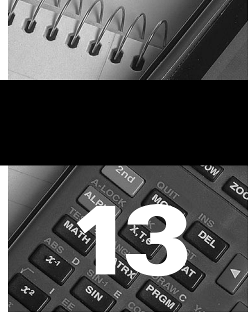
1. **a.** Students' drawings of amplitudes should have magnitudes corresponding to 0.25 and 0.35.
   b. Students' drawings should indicate constructive interference, with a net amplitude of 0.60.
2. **a.** 1.5 s
   b. 10.0 m
   c. yes

III

Chapter 12 Mixed Review

1. **a.** 0.20 s; 5.0 Hz
   b. same, same, increase, increase
2. **a.** 60.0 N/m
   b. 0.574 seconds; 1.74 Hz
3. 6.58 m/s^2; no
4. **a.** A: 0 s, 2 s, 4 s; B: 0.5 s, 1.5 s, 2.5 s, 3.5 s; C: 1, 3 s
   b. PE: 0 s at A, 1 s at C, 2 s at A, 3 s at C, 4 s at A; KE: 0.5 s, 1.5 s, 2.5 s, 3.5 s at B
   c. 0.5 s, 2.5 s at B to the right 1.5 s, 3.5 s at B to the left; 0 s, 2 s, 4 s at A to the right, 1 s, 3 s at C to the left
5. 3.00×10^2 m/s
6. 3.0 s; 6.0

Sound



Chapter 13

Section 13-1, p. 69

1. 336 m/s

2. 1030 m

3. a. 3.00 cm

b. 1.50 cm

c. 3.51 s; 0.234 s

d. 1.14×10^4 Hz (no Doppler effect because the train was stationary)

e. pitch decrease; same; increase

Section 13-2, p. 70

1. a. 9.95×10^{-3} to 2.49×10^{-3} W/m^2

b. 6.22×10^{-4} to 2.76×10^{-4} W/m^2

c. 1.59×10^{-5} W/m^2, about 70

2. a. 1.00×10^{-2} W/m^2

b. 3.14 W

c. 5000 m

Section 13-3, p. 71

1. a. 462 m/s

b. Student diagrams should show antinodes, nodes at both ends; first has one antinode, second has two, third has three.

c. 69.0 cm

2. a. 880 Hz, 1320 Hz, 1760 Hz

b. Check student graphs for accuracy. Wavelength of first harmonic should be two wavelengths of second harmonic, three wavelengths of third harmonic. The second and third harmonics should have half the amplitude. The resultant will be a wave with a large maximum, a smaller peak, a small minimum, and a large minimum.

III

Chapter 13 Mixed Review

1. a. 2.19 m; 2.27 m

b. wavelength increases when temperature increases

2. a. arrows pointing East on ambulance, police, and truck, West on van.

b. police and ambulance (equal), truck, small car, van

3. These objects had the same natural frequency of 330 Hz, so resonance occurred.

4. a. 1460 Hz, 2440 Hz

b. 70.8 cm, 23.6 cm, 14.1 cm

c. 0.177 m

d. 974 Hz, 1460 Hz; 70.8 cm, 35.4 cm, 23.6 cm; 0.354 m

5. a. 5

b. 435 Hz, because it will also provide a difference of 5 Hz.

Light and Reflection

Chapter 14

Section 14–1, p. 74

1. a. 499 s

b. 193 s

c. 1.97×10^4 s

2. a. 7.1×10^{14} Hz; 6.7×10^{14} Hz; 5.5×10^{14} Hz; 5.0×10^{14} Hz; 4.3×10^{14} Hz

b. Frequency decreases when wavelength increases.

c. No, no

Section 14-2, p. 75

1. a. Check student drawings for accuracy. Angles of reflection should be equal.

b. Extensions intersect on the normal through *A*, 25 cm inside the mirror.

c. 50 cm

d. No, but the person will see image by receiving the reflection of some other ray.

e. The person will see the image by receiving reflected Ray from *C*.

f. angle at *A* close to 50°, angle at *B* close to 60°

g. The eraser's image is 15 cm inside.

Section 14-3, p. 76

1. a. midpoint between mirror and *O*

b. markings should be at scale: 1 cm for 1 m

c. *A*'s image is 2.6 m inside.

d. Image locations: *B* at 3.33 m inside the mirror; *C* at 2.00 m outside the mirror

2. 2.60 m; 3.33 m; −2.00 m

Section 14-4, p. 77

1. a. all but green because green is reflected

b. red, because it lets the type of light best absorbed by plants to be transmitted

2. a. white

b. blue

c. black

d. black

3. black

Chapter 14 Mixed Review

1. 4.07×10^{16} m

2. a. 3.33×10^{-5} s

b. 1.00×10^{-4} m

3. 3.84×10^{8} m

4. 3.00×10^{11} Hz

5. Diffuse reflection: (nonshiny surfaces) table top, floor, walls, car paint, posters (answers will vary)

Specular reflection: metallic surfaces, water, mirrors (answers will vary)

6. a. Check student drawings for accuracy.

b. *B* is 4 m from *A* horizontally, *C* is 2 m below *B* vertically

c. *D* is 2 m below *A* vertically, *E* coincides with *C*

d. they will overlap the existing images or objects

Menu Print

7. a. 9.00 cm

b. $p = 30.0$ cm; $q = 12.9$ cm; real; inverted; 2.58 cm tall

$p = 24.0$ cm; $q = 14.4$ cm; real, inverted; 3.60 cm tall

$p = 18.0$ cm; $q = 18.0$ cm; real; inverted; 6.00 cm tall

$p = 12.0$ cm; $q = 36.0$ cm; real; inverted; 2.00 cm tall

$p = 6.0$ cm; $q = -18$ cm; virtual; upright; 18 cm tall

8. $p = 30.0$ cm; $q = -6.92$ cm; virtual; upright; 1.38 cm tall

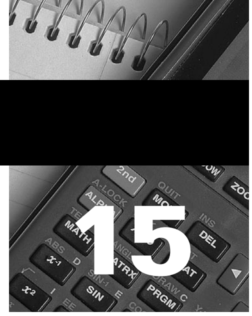
$p = 24.0$ cm; $q = -6.55$ cm; virtual, upright; 1.64 cm tall

$p = 18.0$ cm; $q = -6.00$ cm; virtual; upright; 2.00 cm tall

$p = 12.0$ cm; $q = -5.14$ cm; virtual; upright; 2.57 cm tall

$p = 6.0$ cm; $q = -3.6$ cm; virtual; upright; 3.6 cm tall

III



Chapter 15

Section 15-1, p. 80

1. a. $n = c/v$

b. 2.25×10^8 m/s

2. a. 13.0°

b. 13.0°, 20.0°

c. Angles inside glass: 25°, 35°, 40°; Angles coming out of glass: 40°, 60°, 80°

d. Student sketches should indicate that the rays exiting the glass are parallel to the rays entering it.

Section 15-2, p. 81

1. a. Check student diagrams. Rays should be drawn straight, according to rules for ray tracing.

b. *A* is real, inverted, and smaller.

c. *B* is real, inverted, and smaller; *C* is virtual, upright, and larger

2. *A:* 4.80 cm; *B:* 7.5 cm; *C:* −6.00 cm

Section 15-3, p. 82

1. a. $\theta_r = 55.8°$

b. $\sin \theta_r = 1.28 > 1$: internal reflection

c. $\theta_r = 24.4°$

d. $\theta_r = 38.5°$; $\theta_r = 74.5°$; $\theta_r = 33.4°$

2. $\theta_r = 48.8°$, the angle is too large, light with 45° incident angle will be refracted and exit

Chapter 15 Mixed Review

1. a. Ray 1 at 45°; Ray 2 at 14.9°

b. Rays should intersect inside the aquarium.

c. Because the rays are no longer parallel, they will intersect in the water.

2. a. First boundary: 70.0°, 45.0°

Second boundary: 45.0°, 40.4°

Third boundary: 40.3°, 36.8°

b. Incoming rays get closer and closer to the normal. Reflected rays get farther away from the normal with the same angles.

3. a. 9.00 cm

b. 12.9 cm, 14.4 cm, 18.0 cm, 36.0 cm, −18.0 cm

2.58 cm, 3.6 cm, 6.00 cm, 18.0 cm, −18.0 cm

real, real, real, real, virtual

4. 18.0 cm, with all images virtual and on the left of the lens

−11.2, −10.3, −9.00, −7.20, −4.50

5. a. 6.00 cm in front of the lens

b. 0.857 cm

Chapter 16

Section 16-1, p. 85

1. a. First: 1.6°, Second: 3.2°, Third: 4.8°

b. Bright: 16.2°, 34.0°, 4.01°

c. A smaller slit results in more separation between fringes. With 2 cm, fringes would be so close they would not be distinguishable.

2. a. 475 nm

b. 7.80°, 11.7°, 15.7°

Section 16-2, p. 86

1. a. 1.25×10^{-6} m

b. 18° spacing for 400 nm light and 34° for 700 nm light. More lines per centimeter will give better resolution

2. a. 1250 lines/cm

b. 4.4°, 8.9°, 13°

3. 565 nm

4. 4.38×10^{-6} m

Section 16-3, p. 87

1. Coherent light is individual light waves of the same wavelength that have the properties of a single light wave.

2. Student diagrams should show a coherent light source with light waves moving in the same direction. The incoherent light should have a light source with waves radiating out in different directions.

3. Lasers convert light, electrical energy, or chemical energy into coherent light.

4. Answers will vary. Examples are CD players, laser scalpels, laser range finders.

Chapter 16 Mixed Review

1. a. 6.74×10^{-6} m

b. 47.9°

c. The maximum angle for light to reach the screen in this arrangement is 45°.

2. a. Longer wavelengths are diffracted with a greater angle.

b. First order group of lines: blue, green, red; second order: the same

c. White

3. a. $A = 5.0 \times 10^{-6}$ m, $B = 1.1 \times 10^{-7}$ m, $C = 3.3 \times 10^{-8}$ m

b. visible: A; x-ray: A, B, or C; IR: none

4. a. Neither would work because they would act as different sources, so even with the same frequency, they should not be in phase.

b. Interference is occurring.

Chapter 17

Section 17-1, p. 90

1. a. Experiment A, no charges were transferred. Experiment B, charges were transferred between the sphere and the ground. Experiment C, charges were transferred between the sphere and the rod

b. Student diagrams should show: Sphere A, negative charges (−) on the left, positive (+) on the right; Sphere B, excess (−) all over; Sphere C, excess (+) all over.

c. Sphere B has excess (−); Sphere C has excess (+)

d. Experiment A

e. no change in Experiment A or Experiment B; reduced charge in Experiment C

Section 17-2, p. 91

1. a. 20.0 cm

b. 0.899 N (attraction along the line $q_1 - q_3$)

c. 0.899 N (attraction along the line $q_1 - q_2$)

d. 1.40 N repulsion pulling to the right

e. Student diagrams should show $\mathbf{F_1}$ pointing from q_3 toward q_1 and $\mathbf{F_2}$ pointing from q_3 toward q_2.

f. 36.9°

g. $F_{1x} = -0.719$ N; $F_{2x} = 0.719$ N; $F_{1y} = -0.540$ N; $F_{2y} = -0.540$ N

h. −1.08 N pointing down

i. downward along the y-axis

Section 17-3, p. 92

1. a. 21.2 cm

b. all same strength of 1.60×10^{-6} N/C along the diagonal lines, with $\mathbf{E_1}$ pointing away from q_1, $\mathbf{E_2}$ from q_2, $\mathbf{E_3}$ from q_3, and $\mathbf{E_4}$ from q_4

c. Resultant electric field $\mathbf{E} = 0$

2. a. 4.61×10^{-14} N down

b. 4.61×10^{-14} N up

c. 1.44×10^{-18} C

d. 9 electrons

Chapter 17 Mixed Review

1. a. A; 1.87×10^{13} electrons; B: 3.12×10^{13} electrons

b. the forces are equal and opposite, no

2. a. Resultant = 1.49 N, left; F(A-C) = 1.35 N, left; F(B-C) = 0.140 N, left

b. Resultant = 0.788 N, right; F(A-C) = 1.35 N, right; F(B-C) = 0.562 N, left

c. Resultant = 0.400 N, left; F(A-C) = 0.599 N, right; F(B-C) = 0.999 N, left

3. a. 1.92×10^{16} N

b. 2.87×10^{10} m/s^2

c. 9.81 m/s^2; this is negligible in comparison with the acceleration a; alpha particles will move horizontally

4. a. Check students diagrams for accuracy.

b. 1.53×10^{-2} N

c. 7.65×10^{3} N/C

5. 1 C = 6.25×10^{18}; 1 μC = 6.25×10^{12}

Electrical Energy and Capacitance

Chapter 18

Section 18-1, p. 95

1. a. -5.62×10^{-7} J, yes, 5.62×10^{-7} J of work was done

b. 1.40×10^{-6} J; 8.43×10^{-7} J of work was done on the charges

2. a. 9.60×10^{-18} J; Potential energy decreases

b. 9.60×10^{-18} J

c. 5.36×10^{4} m/s

Section 18-2, p. 96

1. a. 8.99×10^{5} V

b. $y = -10.0$ cm; $V = 3.33 \times 10^{5}$ V

$y = -2.00$ cm; $V = 8.08 \times 10^{5}$ V

$y = 2.00$ cm; $V = 8.08 \times 10^{5}$ V

$y = 10.0$ cm; $V = 3.32 \times 10^{5}$ V

c. $x = -10.0$ cm; $V = 4.28 \times 10^{5}$ V

$x = -2.00$ cm; $V = 1.20 \times 10^{6}$ V

$x = 2.00$ cm; $V = 1.20 \times 10^{6}$ V

$x = 10.0$ cm; $V = 4.28 \times 10^{5}$ V

2. a. 2.16×10^{6} V

b. 0

c. 0

Section 18-3, p. 97

1. pF = 10^{-12} F; nF = 10^{-9} F; μC = 10^{-6} C; Farads measure the ratio of charge to potential difference. Coulombs measure the amount of charge.

2. 1 pF < 1 nF. The 1 pF capacitor has a higher potential difference (1000 times) because $\Delta V = Q/C$

3. a. 4.00×10^{-7} F $= 4.00 \times 10^{2}$ nF

b. Capacitance does not change. Charge doubles (Q is proportional to ΔV, ΔV doubled and C was the same)

c. 5.00×10^{-2} J; 2.00×10^{1} J

III

Chapter 18 Mixed Review

1. a. 4.50×10^{-7} J for all cases

b. *PE* does not change

c. All force vectors should have same magnitude and point toward the center

2. a. -1.28×10^{-15} J; decreases

b. 1.28×10^{-15} J; increases

c. 5.3×10^{-7} m/s

3. a. 5.000×10^{3} V/m; yes, the field is constant

b. ΔV(+plate, A) = 50.0 V; ΔV(+plate, B) = 1.50×10^{2} V; ΔV(+plate, C) = 2.50×10^{2} V

c. *PE* at positive plate = 4.80×10^{-17} J; $PE_A = 4.00 \times 10^{-17}$ J; $PE_B = 2.40 \times 10^{-17}$ J; $PE_C = 8.00 \times 10^{-18}$ J; *PE* at negative plate = 0 J

4. a. 2.00×10^{2} V

b. 4.00×10^{-3} J

Chapter 19

Section 19-1, p. 100

1. 2.50×10^2 A

2. a. 15.0 C; 225 C; 5.40×10^3 C

b. 4.69×10^{18} electrons

c. 4.69×10^{18} electrons

d. Electrons are in the wires and the filament.

3. a. 320 s

b. 320 s

c. 320 s

Section 19-2, p. 101

1. a. 25. 6 Ω

b. 4.70 A; 8.61 A; 2.34 A; 0.391 A

2. a. 1.80×10^{-3} A; 1.80 A; 1.80×10^2 A

b. C (smaller resistor)

3. 134.7 V

4. a. 343 Ω to 286 Ω

b. $R > 255$ Ω

c. $R < 387$ Ω

Section 19-3, p. 102

1. a. 932 W

b. 1.68×10^7 J = 4.66 kWh

c. 32.6 ¢

2. a. 417 W

b. 3.5 A

3. a. 5.1 Ω

b. 24 A

Chapter 19 Mixed Review

1. a. *I* increases because *R* decreases (shorter)

b. no change

c. *I* decreases because *R* increases with temperature

d. *I* decreases

2. a. 4.8 A

b. 8.64×10^4 J

c. 580 W

d. 1.0×10^7 J

3. a. 0.833 A; 1.25 A; 2.08 A

b. 144 Ω; 96.0 Ω; 57.6 Ω

c. 70.0 ¢; $1.05; $1.75

4. a. 144 V

b. 864 W

c. 104 seconds

Chapter 20

Section 20-1, p. 105

1. a. Check student diagrams, which should contain 2 bulbs, 2 resistors, 3 switches, and 1 battery, in a closed ciruict.

b. Check student diagrams to be certain that the switches labeled S1 and S2 cause short circuits when closed.

c. Check student diagrams to be certain that switch S3 causes a short circuit when closed.

2. a. Students should connect one end of bulb A to the battery, the other to the switch, then the other end of the switch to the battery. Also connect one end of B to the battery, and the other end of B to the switch.

b. Students should connect one end of B to the battery, the other to the switch, then the other end of the switch to the battery. Bulb A should simply be left out with no connections.

c. Students should connect each end of B to one end of the battery, the other to the switch, then the other end of the switch to the battery. Also each end of A should be connected to an end of the battery.

Section 20-2, p. 106

1. a. 16.0 Ω

b. 0.750 A for both

c. 12.0 V; 9.0 V; 3.0 V

2. a. 3.00 Ω

b. 12 V

c. 4 A, $I_1 = 1$ A; $I_2 = 3$ A

d. 12.0 V

Section 20-3, p. 107

1. a. 40 Ω

b. $I_a = I_b = I_c = 0.600$ A; $I_d = I_e = I_f = 0.200$ A;

$\Delta V_a = \Delta V_b = \Delta V_c = 7.20$ V; $\Delta V_d = \Delta V_e = \Delta V_f = 2.40$ V

2. a. Check diagram

b. 54 Ω; $I_a = I_b = I_c = I_f = 0.444$ A; $I_d = I_e = 0.222$ A;

$\Delta V_a = \Delta V_b = \Delta V_c = \Delta V_f = 5.33$ V; $\Delta V_d = \Delta V_e = 2.67$ V

III

Chapter 20 Mixed Review

1. a. D

b. switch 5

c. • switches 1 and 3 open, switches 2, 4, and 5 closed

• switches 1 and 4 open, switches 2, 3, and 5 closed

• switch 2 open, switches 1, 3, 4, and 5 closed; or switches 3 and 4 open, switches 1, 2, and 5 closed; or switches 2, 3, and 4 open, switches 1 and 5 closed

2. a. Check students' diagrams, which should show a bulb and a resistor in series with a battery.

b. 15 Ω

c. 6 Ω

3. a. Check students diagrams.

b. 12.0 V, 12.0 V

c. 0.25 A, 2.25 A

d. 5.33 Ω

4. a. $R = 6.15$ Ω

b. $R = 30.4$ Ω

Magnetism

Chapter 21

Section 21-1, p. 110

1. a. No

b. No

c. Magnet: A; Iron: B and C.

2. Arrows should point away from S, toward N, building a composite picture of the magnetic field.

3. Arrows should point away from S, toward N, mostly in the area between the ends of the magnet and around it.

Section 21-2, p. 111

1. a. the field at A, B, C is pointing out (dot symbol); the field at D, E, F is pointing in (× symbol).

b. all reversed: the field at A, B, C is pointing in (× symbol); the field at D, E, F is pointing out (dot symbol)

2. the strength at point A is weaker than B, C, D or E, and about equal to that at F.

3. All directions of field are opposite to the answers in questions 1. The relative strengths remain the same.

Section 21-3, p. 112

1. a. **v**-arrow to the right, **B**-arrow upward

b. •; **F** = 4.8×10^{-14} N, upward, out of the page

c. 0

2. a. **v**-arrow to the left, **B**-arrow upward

b. ×; **F** = 4.8×10^{-14} N, downward, into the page

c. 0

3. a. **v**-arrow to the right, **B**-arrow upward

b. •; **F** = 9.6×10^{-14} N, upward, out of the page

c. 0

4. No. When the force is not zero, it acts perpendicular to velocity. They move in a circle perpendicular to the magnetic field.

Chapter 21 Mixed Review

1. a. The magnetic field from the leftmost segment is • and stronger. The magnetic field from the rightmost segment is × and weaker.

b. At A, both horizontal segments contribute a × magnetic field of equal strength

c. B; ×; × weaker; ×; × same

C; ×; × same; ×; × same

D; ×; × stronger; ×; × same

E; ×; • stronger; ×; × same

d. No. They reinforce each other in the same direction.

e. inside

2. a. **F** = 4.3 N into the page

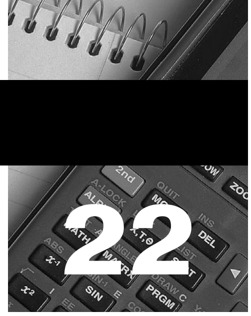
b. **F** = 0

3. a. Diagrams should show clockwise current.

b. Starting from the left side: **F** = 1.1 N into the page; **F** = 0; **F** = 1.1 N out of the page; **F** = 0

c. Forces are equal and opposite, so no translational motion will occur, but it could rotate around a vertical axis.

III



Chapter 22

Section 22-1, p. 115

1. side a: none, down, down, none, none
   side b: none, none, none, none, none
   side c: none, none, down, down, none
   side d: none, none, none, none, none
2. none, clockwise, none, counterclockwise, none
3. **a.** 2.56×10^{-2} m^2
   b. 2.0 s
   c. 2.0×10^{-2} V
   d. 5.7×10^{-2} A

Section 22-2, p. 116

1. *A* to *B*
2. increase, increase, increase
3. **a.** horizontal
   b. vertical
   c. 0.25 s
   d. 1.9×10^{-3} V

Section 22-3, p. 117

1. down through primary coil, and up elsewhere, including through the secondary coil
2. a –, b +
3. 24 V
4. no change in field
5. disappearing field is a change which secondary coil opposes

Chapter 22 Mixed Review

1. e
2. **a.** 0.50 s
   b. 0.26 m^2
   c. 2.6 V
3. **a.** magnetic field, conductor, relative motion
   b. answers may vary, but could include the following: water wheel, windmill, electric motor, combustion engine
4. **a.** 6.28 rad/s
   b. 7.1×10^{-2} m^2
   c. 110 V
   d. 78 V
5. A motor converts electric energy to rotational energy; generators converts rotational energy to electric energy.
6. **a.** increases
   b. induces current while change occurs
   c. It decreases magnetic field which will induce a current while the change occurs.

Atomic Physics

Chapter 23

Section 23-1, p. 120

1. a. This implies that there is an infinite energy output.

b. quantization of energy

c. As wavelength gets shorter, energy in photon gets smaller.

2. a. 2.9×10^{-31} J

b. 1.8×10^{-12} eV

3. a. $hf_t = hf - KE_{max}$

b. 2.30 eV

Section 23-2, p. 121

1. small positively charged nucleus and electrons in planetary orbits

2. He expected diffuse positive charge with no scattering.

3. Most atoms went through.

4. As electrons radiated energy, they would spiral in toward nucleus.

Section 23-3, p. 122

1. a. light radiating from the sun to Earth

b. light scattering off electrons

2. The precision of measurements for very small objects is relatively less than the precision of measurements of very large objects.

3. a. 1.47×10^{-38} m

b. 5.41×10^{-40} m

c. 8.4×10^{-37} m

d. 3.7×10^{-35} m

4. It allowed for electron uncertainty and gave electrons probable but not definite orbits.

Chapter 23 Mixed Review

1. There is not enough energy in any individual photon to liberate the electron.

2. Some energy is used in liberating the electron.

3. a. Atoms contained areas of dense positive charge.

b. The foil is mostly empty space.

4. a. 1.5×10^{-8} m

b. 5.3×10^{-34} m

c. The wavelength is too small to detect.

5. a. Simultaneous measurements of position and momentum cannot be completely certain.

b. A theory of distinct orbits would require precise knowledge of their location at any given time.

6. A photon does not measurably deflect a planet.

7. 1.16×10^{15} m

8. No electrons were ejected.

9. It is absorbed by atoms into vibrational motion, etc.

10. Energy is observed in increased temperature.

Modern Electronics

Chapter 24

Section 24-1, p. 125

1. **a.** conductor
   b. insulator
   c. conductor
   d. insulator
   e. semiconductor
2. Semiconductors have a small energy gap in which electrons can pass.
3. Thermal excitation and electromagnetic fields can provide the energy to excite electrons into the conduction band.
4. Properties of materials are based on many atoms together.

Section 24-2, p. 126

1. **a.** It is easier for the neighboring electron to move into the hole in valence band.
   b. The hole increases conductivity.
2. **a.** 3
   b. No, neutral atoms are added.
   c. 5
   d. No, neutral atoms are added.

Section 24-3, p. 127

1. lattice imperfections
2. **a.** They distort toward the electron.
   b. It increases the force on the electron.
   c. It is transferred via lattice to the second electron.
   d. No, pairs are constantly formed, broken, and reformed.

III

Chapter 24 Mixed Review

1. Check student diagrams; conductor should have overlap, semiconductor have a small gap, insulator have a large gap.
2. They have small or no gap to conduction band.
3. Many atoms are located near each other.
4. They are thermal excitation and application of an electromagnetic field.
5. They are weakly bound through lattice interaction.
6. Transistors have two p-n junctions instead of one, which makes three leads instead of two.
7. **a.** valence electrons
   b. It increases the number of charge carriers available.
8. The n-type are doped with extra valence electron (majority carrier); p-type are doped with one less valence electron (holes are majority carrier).
9. The p-n junction creates an electric potential barrier, which allows current to pass one way but resists flow in other direction.
10. Superconductors have zero resistance.
11. The conducting ring dissipates energy as heat.

Subatomic Physics

Chapter 25

Section 25-1, p. 130

1. a. 16
   b. 8
   c. 16
   d. 2.81 MeV
   e. Energy is required to separate the nucleus.
   f. No, it is the same element but a different isotope.
2. a. strong interaction
   b. decreases

Section 25-2, p. 131

1. alpha—helium nucleus; beta—electron or positron; gamma—photons
2. a. O-17
   b. Th-231
   c. Np-238
   d. U-235
3. It is the time required for half of the sample to decay.
4. It gives decay rate for sample.
5. half-life = 0.693/decay constant
6. $0.050\ s^{-1}$
7. 3.15×10^7 s
8. 25.0% or 1/4

Section 25-3, p. 132

1. a. fission
   b. neutron and uranium nucleus
   c. barium, krypton, and 3 neutrons
   d. yes
   e. more fission
   f. It has high energy output. In a nuclear reactor, the high heat leads to a meltdown.
2. a. fusion
   b. proton and helium-3 nucleus
   c. alpha (He-4), positron and neutrino
   d. yes

Section 25-4, p. 133

1. Strong: 1, hold nucleons, 10^{-15} m; electromagnetic: 10^{-2}, charged particles, $1/r^2$; weak: 10^{-13}, fission, 10^{-18} m; gravitational: 10^{-38}, all mass, $1/r^2$
2. a. graviton; W and Z bosons; photons; gluons
   b. graviton
3. a. It can unify weak and electromagnetic interactions at high energy.
   b. It requires very high energy interaction (1 TeV).

Chapter 25 Mixed Review

1. a. 143
   b. 146
   c. 146
   d. 1
   e. 2
   f. 8
   g. 10
   h. 22
2. a. atomic number
   b. number of neutrons
   c. same number of neutrons
   d. different atomic numbers
   e. Both pairs increase mass by one amu.
   f. First pair are isotopes; second pair are different elements.
3. a. almost the same
   b. one higher
   c. New one is higher; otherwise, it wouldn't decay.
   d. new one
4. gravitational interaction
5. No, there are not enough nucleons to form an alpha particle.
6. mass and charge