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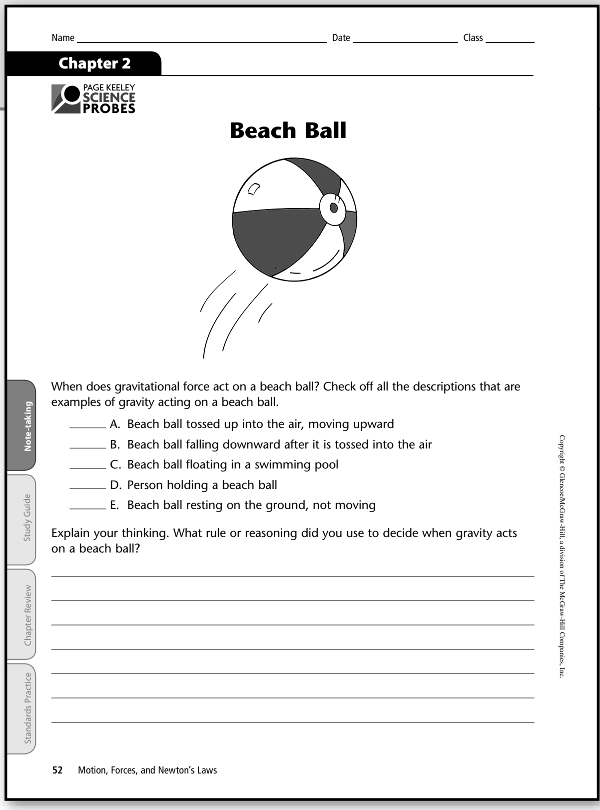
Motion, Forces, and Newton's Laws 51

PAGE KEELEY SCIENCE PROBES

Teacher Notes

The best answer is: all of them. Regardless of whether the beach ball is resting on the ground, floating in water, tossed upward, falling down, or held in someone's hand, there is a gravitational force acting on the ball. The big idea is that gravity is a universal force that acts on all objects on Earth (and in the universe) at all times. Gravitational force increases as mass increases and decreases with increasing distance. The magnitude of the force might change, but the force is always present.

Research has shown that students of all ages have misconceptions related to gravity. For example, some students think gravity acts only when an object is falling. Students who hold this idea think gravity does not act on stationary objects resting on the ground. Some students think an object traveling upward overcomes gravity and there is no gravitational force acting on the object as it travels upward. Some students think gravity does not act on objects in water, especially when they are floating. Some confusion arises when students hear incorrect terms like *zero gravity* or *weightlessness*, when these are actually conditions of microgravity. This probe will help you design instruction that will build a bridge between students' conceptions of gravity as a force that acts only under certain conditions, to a force that is universal.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Chapter 2

PAGE KEELEY SCIENCE PROBES

Beach Ball

When does gravitational force act on a beach ball? Check off all the descriptions that are examples of gravity acting on a beach ball.

_____ A. Beach ball tossed up into the air, moving upward
_____ B. Beach ball falling downward after it is tossed into the air
_____ C. Beach ball floating in a swimming pool
_____ D. Person holding a beach ball
_____ E. Beach ball resting on the ground, not moving

Explain your thinking. What rule or reasoning did you use to decide when gravity acts on a beach ball?

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Name ______________________ Date ______________ Class ________

Note-taking Chapter 2

In what ways do forces affect an object's motion?

Before You Read

Before you read the chapter, think about what you know about motion and forces. Record three things that you already know about motion and forces in the first column. Then write three things that you would like to learn about in the second column. Complete the final column of the chart when you have finished the chapter.

K What I Know	W What I Want to Learn	L What I Learned

Chapter Vocabulary

Lesson 1	Lesson 2	Lesson 3
NEW motion reference point distance displacement speed velocity acceleration **ACADEMIC** satellite	**NEW** force contact force noncontact force friction gravity balanced forces unbalanced forces	**NEW** inertia Newton's first law of motion Newton's second law of motion Newton's third law of motion force pair

A Lesson Content Vocabulary page for each lesson is provided in the Chapter Resources Files.

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Motion, Forces, and Newton's Laws 53

Lesson 1 Describing Motion

7.NS.1, 7.NS.2, 7.NS.7, 7.NS.9, 7.1.5, 7.1.7
Skim or scan *the heading, boldfaced words, and pictures in the lesson. Identify or predict three facts you will learn from the lesson. Discuss your thoughts with a classmate.*

Main Idea	Details

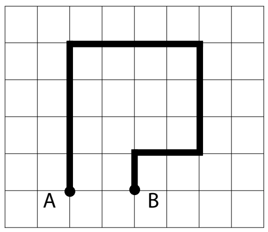
Motion
I found this on page 47.

Describe *an example of* motion. *Include an object, a* reference point, distance, *and* direction.

Example: Sample answer: My pencil fell one meter from my desktop to the floor.	
Object: pencil	Direction: toward the floor
Reference point: desktop	Distance: one meter

I found this on page 48.

Differentiate *between* distance *and* displacement *for an object that traveled from point A to point B as shown.*



Distance:
14 units

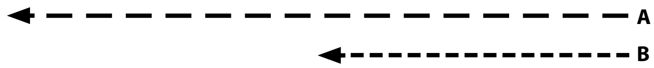
Displacement:
2 units

Speed
I found this on page 48.

Define speed.
the distance an object moves divided by the time it took to move that distance

Velocity
I found this on page 49.

Characterize velocity *as represented by these two arrows.*



Feature	What It Means
Direction	Both arrows designate motion in the same direction.
Length of arrows	A indicates an object that moved farther than B.
Segments of arrows	The velocity of A is greater than the velocity of B, but both are constant.

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Lesson 1 | Describing Motion (continued)

Main Idea | **Details**

I found this on page 50 .

Explain *why each example does or does not represent* acceleration. *Circle the examples that do describe* acceleration.

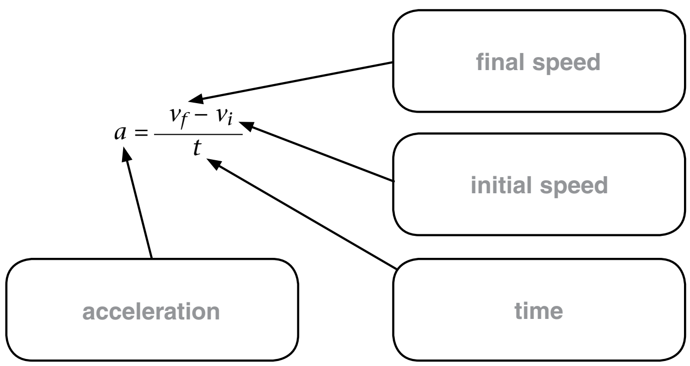
Example	Explanation
A rock falling from a cliff moves faster and faster as it approaches the ground.	The rock's direction stays the same, but its speed is changing.
A book sits on a shelf in a classroom.	The book is not in motion; it has no speed or direction.
A butterfly clings to the paddle of a garden windmill in a steady breeze.	The butterfly's speed is constant, but its direction is constantly changing.
A motorboat moves north across the lake at 20km/h.	Neither the boat's speed nor direction is changing.
An arrow shot from a bow arcs high into the air and then plunges into a bail of hay on the ground.	Both the speed and direction of the arrow change.

Calculating Acceleration

I found this on page 51 .

Point out *parts of the formula for* acceleration.

$$a = \frac{v_f - v_i}{t}$$



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Motion, Forces, and Newton's Laws 55

Lesson 1 | Describing Motion (continued)

Main Idea | **Details**

I found this on page 51 .

Differentiate *positive and negative* acceleration.

In positive acceleration, final speed is greater than initial speed. In negative acceleration, initial speed is greater than final speed.

Using Graphs to Represent Motion

I found this on page 52 .

Diagram motion.

A. *Draw a displacement-time graph. Label the axes, and represent an animal that:*
- *starts speeding up right away.*
- *rests, and then*
- *speeds away from the resting point.*

Accept all reasonable responses. Student diagrams should show a line sloping immediately up and to the right from the origin, then leveling off, and then sloping up and to the right again.

I found this on page 53 .

B. *Draw a speed-time graph. Label the axes. Represent an animal that:*
- *remains at rest for three hours,*
- *steadily increases speed for three hours, and then*
- *travels at a constant rate for three hours.*

Accept all reasonable responses. Student diagrams should show a line flat from the origin, then sloping up and to the right, then leveling off again.

Analyze It Summarize why you must know an object's speed to calculate acceleration even though there is no "s" for speed in the acceleration formula.

Accept all reasonable responses. Sample answer: The acceleration formula takes into account the initial speed and final speed of an object. Both of these are measures of the object's speed at given times.

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Lesson 2 Forces

7.NS.3, 7.NS.4, 7.NS.5, 7.NS.7, 7.NS.8, 7.NS.11, 7.DP.2, 7.DP.3, 7.DP.4, 7.DP.5, 7.DP.6, 7.DP.7, 7.DP.8, 7.DP.9, 7.DP.10, 7.DP.11, 7.1.5, 7.1.6, 7.1.7
Skim or scan *the heading, boldfaced words, and pictures in the lesson. Identify or predict three facts you will learn from the lesson. Discuss your thoughts with a classmate.*

Main Idea	Details

What are forces?
I found this on page 57.

Characterize forces.

Force

- can be a push or a pull
- exerted by one object on another
- has both size and direction

can change an object's
- speed
- direction

Types of Forces
I found this on page 58.

Accept all reasonable responses. Sample answers are shown.

Students should circle *applied*, *elastic*, and *normal* in red and *electric*, *magnetic*, and *gravity* in blue.

Classify forces. *Differentiate* contact forces *from* noncontact forces. *Circle the* contact forces *in red. Circle the* noncontact forces *in blue.*

Type of Force	Example
Applied	the push of a baker's hand kneading dough
Elastic	the pull of a stretched rubber band
Normal	the push of a table against a pencil that sits on its surface
Electric	the static electric pull from a balloon on a person's hair
Magnetic	the pull of a magnet against the front of a refrigerator
Gravity	the pull of a diver from a diving board toward the swimming pool

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Motion, Forces, and Newton's Laws 57

Lesson 2 | Forces (continued)

Main Idea | **Details**

Friction
I found this on page 59.

Identify *factors that affect the* force *of* friction.

Factors that Affect Friction	
	roughness of surfaces
	weight of an object

Gravity
I found this on page 60.

Assess *how distance and mass affect the* force *of* gravity *between two objects.*

Distance	Mass
As the distance between two objects increases, the gravitational force between the objects decreases.	As the mass of one or both objects increases, the gravitational force between them increases.

Combining Forces
I found this on page 61.

Students should circle 100 N and 10 N in blue and both 0 N in red.

Calculate *net* forces. *Circle* balanced forces *in red and* unbalanced forces *in blue.*

Combined Forces	Net Force (Draw an arrow to show direction.)
→ 30 N → 70 N	→ 100 N
→ 30 N ← 40 N	← 10 N
→ 60 N ← 60 N	0 N
→ 18 N → 12 N ← 30 N	0 N

Synthesize It Suppose that you want to build a machine to perform some task. Why must you understand all about forces to complete your mission?

Accept all reasonable responses. Sample answer: Machines are made of moving parts. The motion of the parts must be caused by forces, and the moving parts are subject to friction and gravity.

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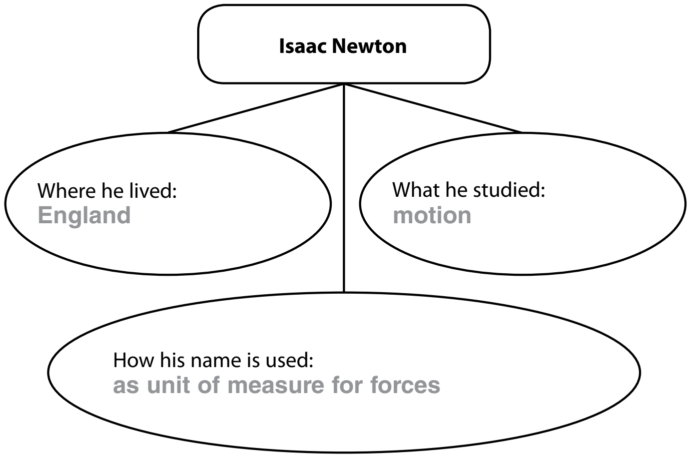
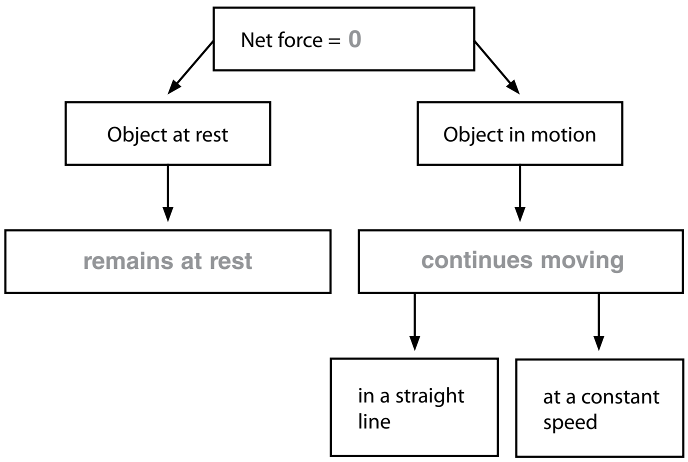
Lesson 3 Newton's Laws of Motion

7.NS.2, 7.NS.7, 7.NS.9, 7.NS.11, 7.DP.1, 7.DP.3, 7.DP.5, 7.DP.6, 7.DP.7, 7.DP.10, 7.DP.11, 7.1.6, 7.1.7
Skim or scan *the heading, boldfaced words, and pictures in the lesson. Identify or predict three facts you will learn from the lesson. Discuss your thoughts with a classmate.*

Main Idea	Details
Newton's Laws *I found this on page* 65.	**Relate** *details about Isaac Newton.*



Main Idea	Details
Newton's First Law *I found this on page* 65.	**Define** inertia. Inertia is the tendency of an object to resist a change in motion.
I found this on page 65.	**Diagram** *the concept of* Newton's first law of motion.



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Motion, Forces, and Newton's Laws 59

Lesson 3 | Newton's Laws of Motion (continued)

Main Idea | **Details**

I found this on page 66.

Students should circle the first and third examples in red and the second and fourth examples in blue.

Describe *the forces in each scenario. Circle the examples of balanced forces in red and unbalanced forces in blue.*

Scenario	Description of Forces
A cable holds a car at the top of a free-fall ride.	The force of the cable pulling up on the car is equal to the force of gravity.
A cable accelerates a free-fall ride car into upward motion from the ground.	While the car is accelerating, the force of the cable is greater than the force of gravity.
A cable pulls a car to the top of a free-fall ride at a constant velocity.	The force of the cable and the force of the gravity are equal.
A cable releases; a free-fall ride car accelerates to the ground.	The force of gravity is greater than the force of the cable.

I found this on page 67.

Sample examples are shown. Students might give other examples.

Explain *three effects of unbalanced forces.*

Unbalanced Forces		
Effect: speeding up	Effect: slowing down	Effect: changing direction
Example: The upward force of a bungee cord that is greater than the force of gravity accelerates you into the air.	Example: You stop pedaling your bike and coast to a stop.	Example: Cables on a swing ride pull you toward the center of the ride; gravity pulls downward; and your direction continually changes.

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60 Motion, Forces, and Newton's Laws

Lesson 3 | Newton's Laws of Motion (continued)

Main Idea | **Details**

Newton's Second Law of Motion

I found this on page 68.

Identify *the parts of the formula described by* Newton's second law of motion.

acceleration → $a = \frac{F}{m}$ ← force, mass

I found this on page 68.

Generalize *the relationship between mass, acceleration, and net force.*

The greater the mass, the greater the force needed to produce the same acceleration.

Newton's Third Law

I found this on page 69.

Paraphrase Newton's third law of motion.

For every action force, there is an equal but opposite reaction force.

I found this on page 69.

Organize *information about* force pairs.

Force Pair — exerted by two objects on each other

- direction: opposite
- size: equal

Newton's Laws in Action

I found this on page 70.

Explain *two situations in which Newton's laws do not apply to the motion of objects.*

1. with very tiny objects, such as atoms or electrons
2. for objects that approach the speed of light

Connect It Describe how Newton's first, second, and third laws apply to you eating your breakfast.

Accept all reasonable responses. Sample answer: Gravity pulls my toast to my plate, and the toast will stay at rest until it is acted upon by a force (first law). The toast's acceleration is 0 m/s^2, so Newton's second law can be used to calculate the net force on the toast. Gravity pulls the toast against the table with the same force that the table presses up against the toast (third law).

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Motion, Forces, and Newton's Laws 61

Review **Motion, Forces, and Newton's Laws**

Chapter Wrap-Up

Now that you have read the chapter, think about what you have learned. Complete the final column in the chart on the first page of the chapter.

Use this checklist to help you study.

- ❏ *Complete your Foldables® Chapter Project.*
- ❏ *Study this chapter in your Notebook.*
- ❏ *Study the definitions of vocabulary words.*
- ❏ *Reread the chapter, and review the charts, graphs, and illustrations.*
- ❏ *Review the Understanding Key Concepts at the end of each lesson.*
- ❏ *Look over the Chapter Review at the end of the chapter.*

THE BIG IDEA **Summarize It** Reread the chapter Big Idea and the lesson Key Concepts. Summarize why games and fun activities make good examples to explain the principles of motion and forces.

Accept all reasonable responses. Sample answer: Many activities that people find fun involve motion of either objects that people are playing with or of the people themselves. Several games that people play involve placing a ball into motion, which requires the skilled use of forces to control the ball's speed and direction. Amusement park rides put people into motion. The combination of gravity and inertia produce an exciting sensation because people know that, without the restraints built into the rides, the force generated by the ride would hurl the rider according to Newton's laws of motion.

Challenge Choose your favorite sport. Do an analysis of the forces and motion that occur in a typical game. Write and illustrate a descriptive essay that summarizes your analysis, and share your essay with your class.

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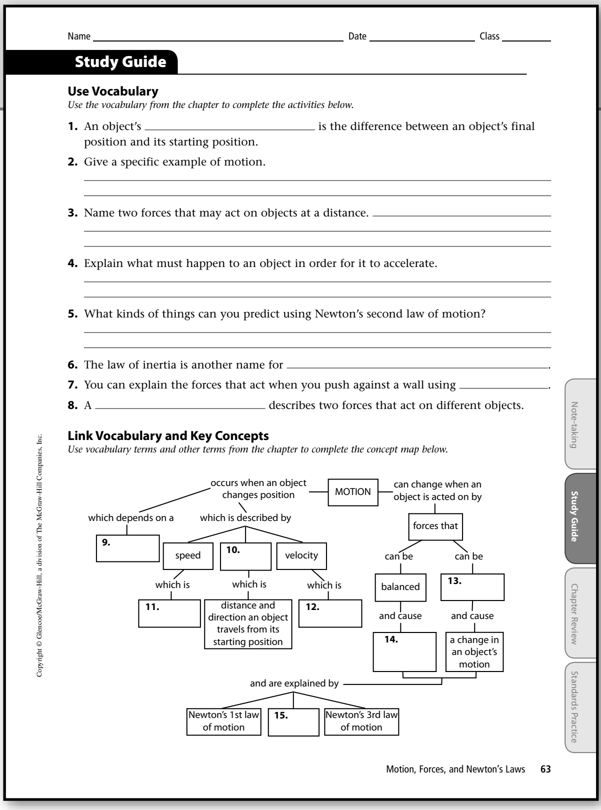
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Study Guide

Use Vocabulary

Use the vocabulary from the chapter to complete the activities below.

1. An object's ____________________ is the difference between an object's final position and its starting position.
2. Give a specific example of motion.
3. Name two forces that may act on objects at a distance. ____________
4. Explain what must happen to an object in order for it to accelerate.
5. What kinds of things can you predict using Newton's second law of motion?
6. The law of inertia is another name for ____________________.
7. You can explain the forces that act when you push against a wall using ____________.
8. A ____________________ describes two forces that act on different objects.

Link Vocabulary and Key Concepts

Use vocabulary terms and other terms from the chapter to complete the concept map below.

Motion, Forces, and Newton's Laws 63

Use Vocabulary

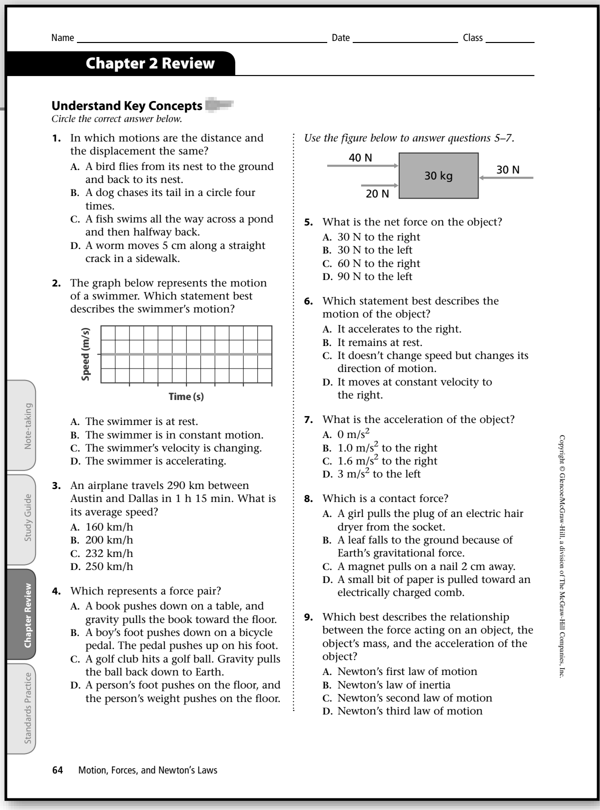
1. displacement
2. Motion takes place when an object changes its position.
3. gravity, magnetism
4. Its speed or velocity must change.
5. Answers will vary. Sample answer: You can predict whether an object, such as a ball, will knock over a group of bottles.
6. Newton's first law of motion
7. Newton's third law of motion
8. force pair

Link Vocabulary and Key Concepts

9. reference point
10. displacement
11. how fast an object changes position
12. speed in a given direction
13. unbalanced
14. no change in an object's motion
15. Newton's second law of motion

Understand Key Concepts

1. D. A worm moves 5 cm along a straight crack in the sidewalk.
2. B. The swimmer is in constant motion.
3. C. 232 km/h
4. B. A boy's foot pushes down on a bicycle pedal. The pedal pushes up on his foot.
5. A. 30 N to the right
6. A. It accelerates to the right.
7. B. 1.0 m/s^2 to the right
8. A. A girl pulls the plug of an electric hair dryer from the socket.
9. C. Newton's second law of motion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Chapter 2 Review

Understand Key Concepts
Circle the correct answer below.

1. In which motions are the distance and the displacement the same?
   A. A bird flies from its nest to the ground and back to its nest.
   B. A dog chases its tail in a circle four times.
   C. A fish swims all the way across a pond and then halfway back.
   D. A worm moves 5 cm along a straight crack in a sidewalk.
2. The graph below represents the motion of a swimmer. Which statement best describes the swimmer's motion?

   A. The swimmer is at rest.
   B. The swimmer is in constant motion.
   C. The swimmer's velocity is changing.
   D. The swimmer is accelerating.
3. An airplane travels 290 km between Austin and Dallas in 1 h 15 min. What is its average speed?
   A. 160 km/h
   B. 200 km/h
   C. 232 km/h
   D. 250 km/h
4. Which represents a force pair?
   A. A book pushes down on a table, and gravity pulls the book toward the floor.
   B. A boy's foot pushes down on a bicycle pedal. The pedal pushes up on his foot.
   C. A golf club hits a golf ball. Gravity pulls the ball back down to Earth.
   D. A person's foot pushes on the floor, and the person's weight pushes on the floor.

Use the figure below to answer questions 5–7.

5. What is the net force on the object?
   A. 30 N to the right
   B. 30 N to the left
   C. 60 N to the right
   D. 90 N to the left
6. Which statement best describes the motion of the object?
   A. It accelerates to the right.
   B. It remains at rest.
   C. It doesn't change speed but changes its direction of motion.
   D. It moves at constant velocity to the right.
7. What is the acceleration of the object?
   A. 0 m/s^2
   B. 1.0 m/s^2 to the right
   C. 1.6 m/s^2 to the right
   D. 3 m/s^2 to the left
8. Which is a contact force?
   A. A girl pulls the plug of an electric hair dryer from the socket.
   B. A leaf falls to the ground because of Earth's gravitational force.
   C. A magnet pulls on a nail 2 cm away.
   D. A small bit of paper is pulled toward an electrically charged comb.
9. Which best describes the relationship between the force acting on an object, the object's mass, and the acceleration of the object?
   A. Newton's first law of motion
   B. Newton's law of inertia
   C. Newton's second law of motion
   D. Newton's third law of motion

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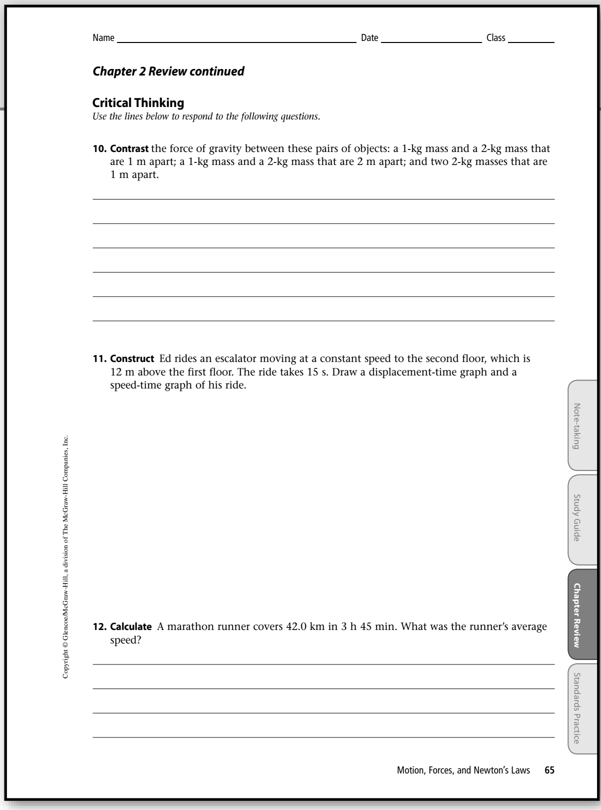


Name ______________ Date ______________ Class ______________

Chapter 2 Review continued

Critical Thinking

Use the lines below to respond to the following questions.

10. Contrast the force of gravity between these pairs of objects: a 1-kg mass and a 2-kg mass that are 1 m apart; a 1-kg mass and a 2-kg mass that are 2 m apart; and two 2-kg masses that are 1 m apart.

11. Construct Ed rides an escalator moving at a constant speed to the second floor, which is 12 m above the first floor. The ride takes 15 s. Draw a displacement-time graph and a speed-time graph of his ride.

12. Calculate A marathon runner covers 42.0 km in 3 h 45 min. What was the runner's average speed?

Critical Thinking

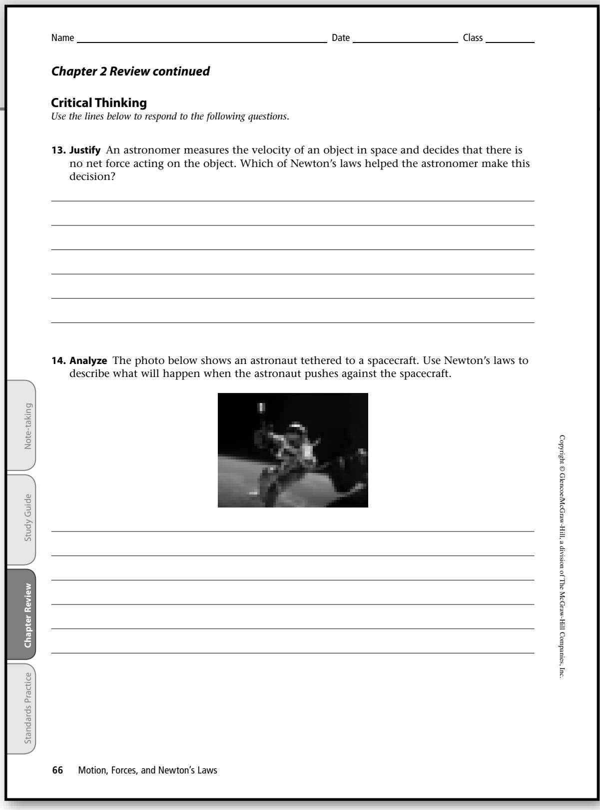
10. The force of gravity is the least between the 1 kg and 2 kg masses that are 2 m apart. It is greatest between the 2 2-kg masses that are 1 meter apart.

11. The displacement-time graph should show a straight line with an upward slope extending from (0,0) to (15,12). The speed-time graph should show a horizontal line from (0,12) to (15,12).

12. 11.2 km/hr

13. She must have observed the object moving at a constant velocity, which would mean that the forces acting on it were balanced. Newton's first law

14. When the astronaut pushes against the spacecraft, the spacecraft will exert an equal but opposite force on the astronaut, causing him to accelerate away from the spacecraft (Newton's third law) until he reaches the end of the tether and an outside force acts on him (Newton's first law). Because his mass is less than that of the spacecraft, the astronaut will accelerate away from the spacecraft at a greater rate than the spacecraft will move away from him (Newton's second law).


Name ______________________ Date ____________ Class ______

Chapter 2 Review continued

Critical Thinking
Use the lines below to respond to the following questions.

13. Justify An astronomer measures the velocity of an object in space and decides that there is no net force acting on the object. Which of Newton's laws helped the astronomer make this decision?

14. Analyze The photo below shows an astronaut tethered to a spacecraft. Use Newton's laws to describe what will happen when the astronaut pushes against the spacecraft.

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66 Motion, Forces, and Newton's Laws

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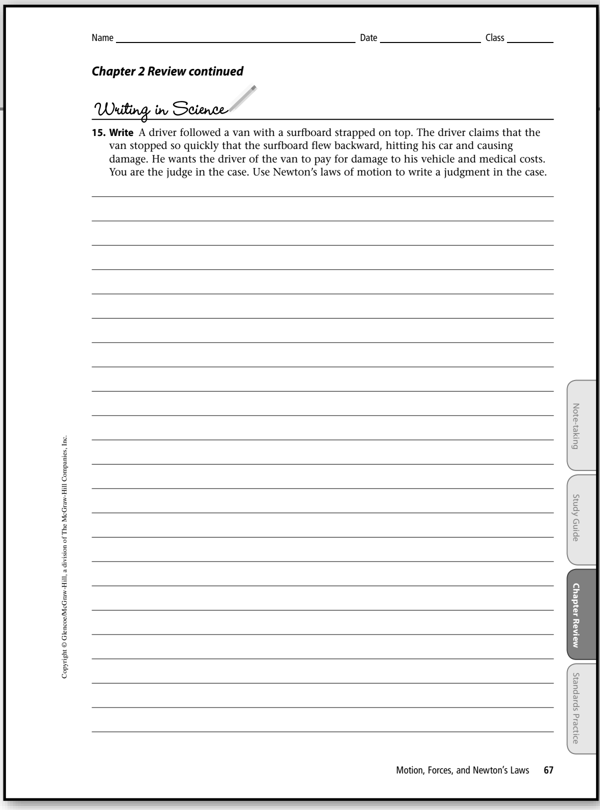
Name ______________ Date ________ Class ______

Chapter 2 Review continued

Writing in Science

15. Write A driver followed a van with a surfboard strapped on top. The driver claims that the van stopped so quickly that the surfboard flew backward, hitting his car and causing damage. He wants the driver of the van to pay for damage to his vehicle and medical costs. You are the judge in the case. Use Newton's laws of motion to write a judgment in the case.

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Writing in Science

15. Students should dismiss the claim of the man because, if the van had been moving forward and suddenly stopped, the surfboard would have continued moving forward, not backward (Newton's first law).

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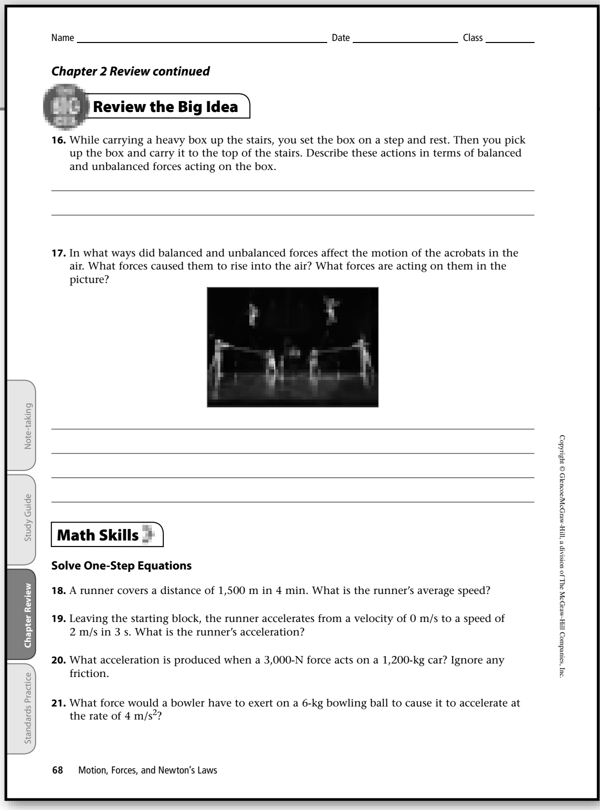
Name ______ Date ______ Class ______

Chapter 2 Review continued

Review the Big Idea

16. While carrying a heavy box up the stairs, you set the box on a step and rest. Then you pick up the box and carry it to the top of the stairs. Describe these actions in terms of balanced and unbalanced forces acting on the box.

17. In what ways did balanced and unbalanced forces affect the motion of the acrobats in the air. What forces caused them to rise into the air? What forces are acting on them in the picture?

Math Skills

Solve One-Step Equations

18. A runner covers a distance of 1,500 m in 4 min. What is the runner's average speed?

19. Leaving the starting block, the runner accelerates from a velocity of 0 m/s to a speed of 2 m/s in 3 s. What is the runner's acceleration?

20. What acceleration is produced when a 3,000-N force acts on a 1,200-kg car? Ignore any friction.

21. What force would a bowler have to exert on a 6-kg bowling ball to cause it to accelerate at the rate of 4 m/s^2?

68 Motion, Forces, and Newton's Laws

Review the Big Idea

16. As you carry the box up the stairs, the upward force you exert on yourself and the box is greater than the force of gravity. The forces are unbalanced. When you set the box down, the force of gravity downward equals the force of the step upward, so the forces are balanced. When you lift the box again, you must apply a net upward force to overcome inertia and get the box accelerating upward.

17. When the acrobats were standing on the bars, the forces on them were balanced. The men holding the bars caused the bars to exert an upward, unbalanced force that pushed the acrobats into the air. At present, their upward motion has stopped and the force of gravity is an unbalanced force that will start them falling back toward the bar.

Math Skills

18. 375 m/min, or 6.25 m/s

19. 0.66 m/s^2

20. 2.5 m/s^2

21. 24 N

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Standardized Test Practice

Mark your answer in the answer bubbles below each question.

Multiple Choice

1 Which is the result of an object's motion?
- (A) a change in mass
- (B) a change in position
- (C) a change in reference point
- (D) a change in volume

2 Which would be used to calculate an object's acceleration?
- (A) change in its speed divided by time
- (B) change in its velocity divided by time
- (C) change in its speed divided by velocity
- (D) change in its velocity divided by speed

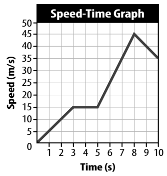
Use the table below to answer questions 3 and 4.

Car	Initial Velocity (m/s)	Final Velocity (m/s)	Time (s)
A	0	25	10
B	25	15	10
C	15	25	20
D	10	10	25

3 Which car had a negative acceleration?
- (A) car A
- (B) car B
- (C) car C
- (D) car D

4 Which car or cars had an acceleration greater than 2 m/s^2?
- (A) car A only
- (B) car B only
- (C) cars A and C
- (D) cars A, C, and D

Use the graph to answer questions 5 and 6.



5 During which time period did the object slow down?
- (A) 0–3 seconds
- (B) 3–5 seconds
- (C) 5–8 seconds
- (D) 8–10 seconds

6 Which term describes the motion in the time period from 3 to 5 seconds?
- (A) at rest
- (B) constant speed
- (C) slowing down
- (D) speeding up

7 Which is a contact force?
- (A) gravity
- (B) friction
- (C) magnetic force
- (D) electrical force

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Multiple Choice

1 B—Correct. A, D: Incorrect. Both describe properties unaffected by motion. C: Incorrect. A change in reference point involves a change in the description of motion.

2 B—Correct. A: Incorrect. This formula does not include direction. C, D: Incorrect. These formulas do not include time.

3 B—Correct. A, C: Incorrect. These cars show a positive acceleration. D: Incorrect. This car shows no acceleration.

4 A—Correct. B: Incorrect. This car has an acceleration of –1 m/s^2. C: Incorrect. This answer includes car C, which has an acceleration of 0.5 m/s^2. D: Incorrect. This answer includes car D, which has an acceleration of 0 m/s^2.

5 D—Correct. A, B, C—At 0–3 seconds the object is speeding up. At 3–5 seconds the object is at constant speed. At 5–8 seconds the object is speeding up.

6 A—Correct. At 3–5 seconds the line on the graph does not change based on the reference point, so the object is at rest. B is incorrect because the line shown would have to be straight and sloped. C is incorrect because the line on the graph would have to move downward in a curve, similar to an umbrella. D is incorrect because the line would have to curve upward, similar to a bowl.

7 B—Correct. A, C, D—All are noncontact forces.

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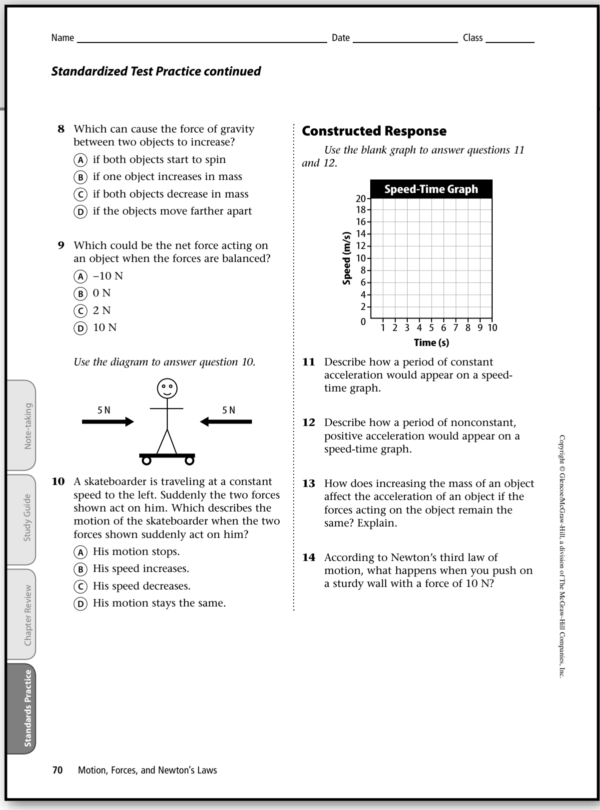
Standardized Test Practice


Name ________________ Date ________ Class ______

Standardized Test Practice continued

8 Which can cause the force of gravity between two objects to increase?
- (A) if both objects start to spin
- (B) if one object increases in mass
- (C) if both objects decrease in mass
- (D) if the objects move farther apart

9 Which could be the net force acting on an object when the forces are balanced?
- (A) –10 N
- (B) 0 N
- (C) 2 N
- (D) 10 N

Use the diagram to answer question 10.

5 N 5 N

10 A skateboarder is traveling at a constant speed to the left. Suddenly the two forces shown act on him. Which describes the motion of the skateboarder when the two forces shown suddenly act on him?
- (A) His motion stops.
- (B) His speed increases.
- (C) His speed decreases.
- (D) His motion stays the same.

Constructed Response

Use the blank graph to answer questions 11 and 12.

Speed-Time Graph

Speed (m/s): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Time (s): 1 2 3 4 5 6 7 8 9 10

11 Describe how a period of constant acceleration would appear on a speed-time graph.

12 Describe how a period of nonconstant, positive acceleration would appear on a speed-time graph.

13 How does increasing the mass of an object affect the acceleration of an object if the forces acting on the object remain the same? Explain.

14 According to Newton's third law of motion, what happens when you push on a sturdy wall with a force of 10 N?

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8 B—Correct. A: Incorrect. Both objects starting to spin does not describe a change in distance or mass. C, D: Incorrect. Both objects decreasing in mass or moving farther apart would reduce the force of gravity between the objects.

9 B—Correct. A, C, D—These show non-zero net forces, which means the forces are unbalanced.

10 D—Correct. The forces acting on the skateboarder are balanced. A, B, C—Stopped motion, increased speed, or decreased speed describe what could happen if the forces acting on the skateboarder were unbalanced.

Constructed Response

11 A period of constant acceleration would appear as a straight line sloping upward (assuming acceleration is positive).

12 A period of nonconstant, positive acceleration would appear as a curved line sloping upward.

13 Acceleration is force divided by mass. Thus, a constant force divided by an increased mass would give a decreased acceleration.

14 The wall pushes with an equal force of 10 N in the opposite direction, which is back on you.

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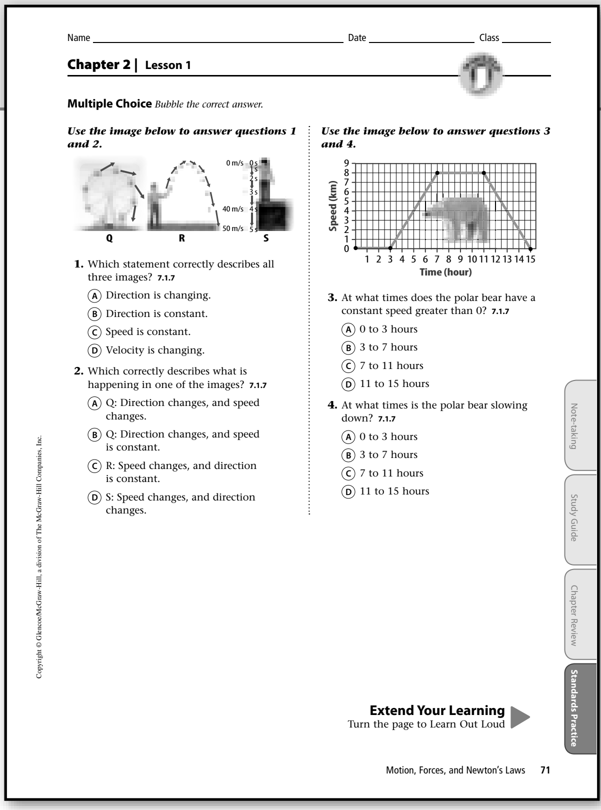
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Chapter 2 | Lesson 1

Multiple Choice *Bubble the correct answer.*

Use the image below to answer questions 1 and 2.

1. Which statement correctly describes all three images? **7.1.7**

Ⓐ Direction is changing.
Ⓑ Direction is constant.
Ⓒ Speed is constant.
Ⓓ Velocity is changing.

2. Which correctly describes what is happening in one of the images? **7.1.7**

Ⓐ Q: Direction changes, and speed changes.
Ⓑ Q: Direction changes, and speed is constant.
Ⓒ R: Speed changes, and direction is constant.
Ⓓ S: Speed changes, and direction changes.

Use the image below to answer questions 3 and 4.

3. At what times does the polar bear have a constant speed greater than 0? **7.1.7**

Ⓐ 0 to 3 hours
Ⓑ 3 to 7 hours
Ⓒ 7 to 11 hours
Ⓓ 11 to 15 hours

4. At what times is the polar bear slowing down? **7.1.7**

Ⓐ 0 to 3 hours
Ⓑ 3 to 7 hours
Ⓒ 7 to 11 hours
Ⓓ 11 to 15 hours

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1. D

2. B

3. C

4. D

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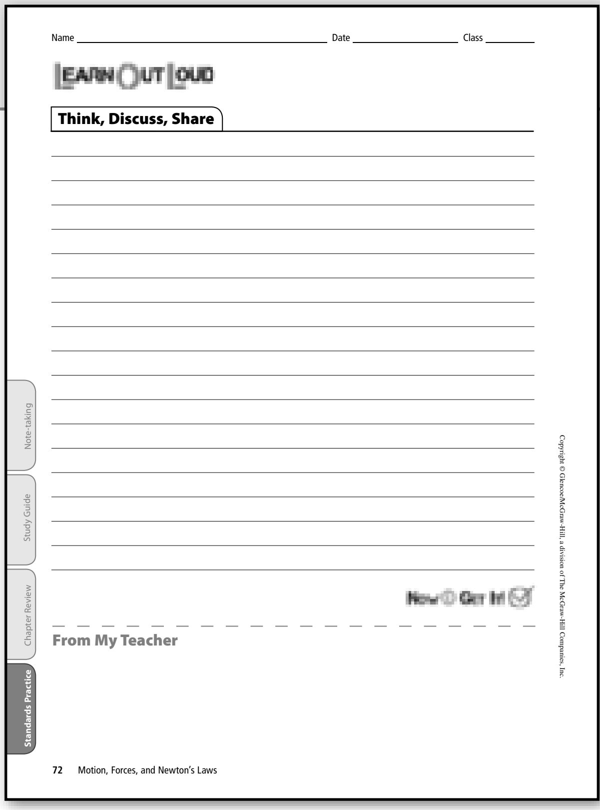
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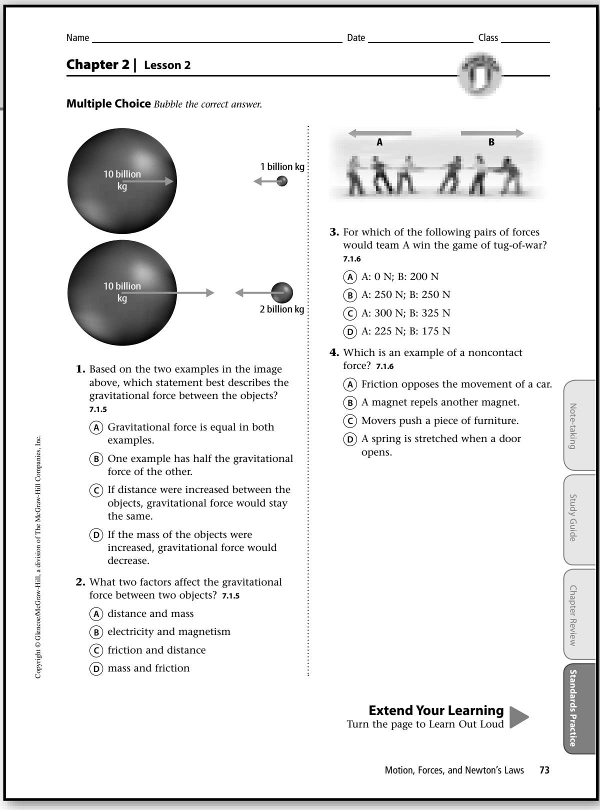

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Chapter 2 | Lesson 2

Multiple Choice *Bubble the correct answer.*

1. Based on the two examples in the image above, which statement best describes the gravitational force between the objects? **7.1.5**

Ⓐ Gravitational force is equal in both examples.

Ⓑ One example has half the gravitational force of the other.

Ⓒ If distance were increased between the objects, gravitational force would stay the same.

Ⓓ If the mass of the objects were increased, gravitational force would decrease.

2. What two factors affect the gravitational force between two objects? **7.1.5**

Ⓐ distance and mass

Ⓑ electricity and magnetism

Ⓒ friction and distance

Ⓓ mass and friction

3. For which of the following pairs of forces would team A win the game of tug-of-war? **7.1.6**

Ⓐ A: 0 N; B: 200 N

Ⓑ A: 250 N; B: 250 N

Ⓒ A: 300 N; B: 325 N

Ⓓ A: 225 N; B: 175 N

4. Which is an example of a noncontact force? **7.1.6**

Ⓐ Friction opposes the movement of a car.

Ⓑ A magnet repels another magnet.

Ⓒ Movers push a piece of furniture.

Ⓓ A spring is stretched when a door opens.

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1. B

2. A

3. D

4. B

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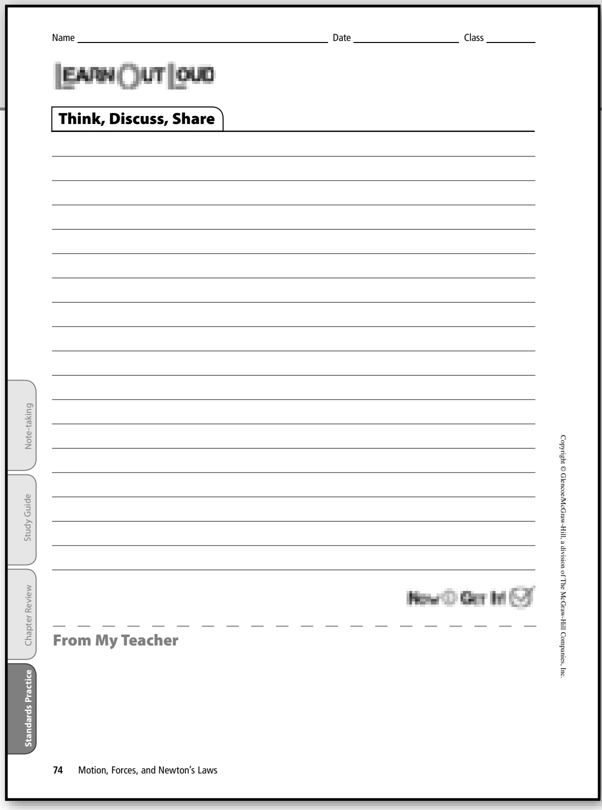
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Chapter 2 Lesson 3

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Chapter 2 | Lesson 3

Multiple Choice *Bubble the correct answer.*

Use the table below to answer questions 1 and 2.

Object	Mass (kilograms)
W	17 kg
X	68 kg
Y	51 kg
Z	34 kg

1. If all of the objects accelerated at the same rate, which would require the greatest force? **7.1.7**

Ⓐ W
Ⓑ X
Ⓒ Y
Ⓓ Z

2. If acceleration is equal to net force divided by an object's mass, which object needs 34 N to accelerate 2 m/s^2? **7.1.7**

Ⓐ W
Ⓑ X
Ⓒ Y
Ⓓ Z

Use the table below to answer questions 3 and 4.

Object	Force
J	20 N to the left
K	35 N to the right
L	46 N to the right
M	66 N to the left

3. Which force would keep object M from changing its motion? **7.1.7**

Ⓐ 33 N to the left
Ⓑ 33 N to the right
Ⓒ 66 N to the left
Ⓓ 66 N to the right

4. Which force would change the direction of the object? **7.1.7**

Ⓐ J: 15 N to the left
Ⓑ K: 35 N to the left
Ⓒ L: 50 N to the left
Ⓓ M: 66 N to the left

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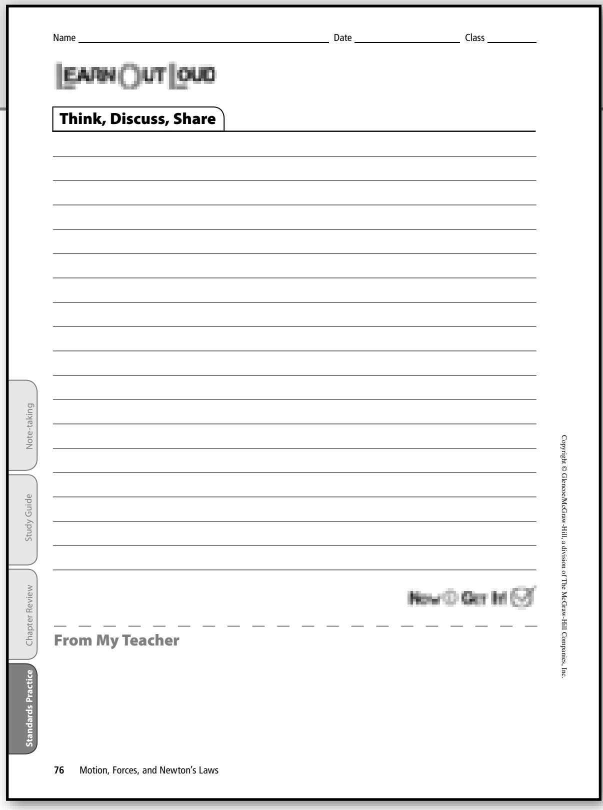
1. B

2. A

3. C

4. C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