Name Period Date

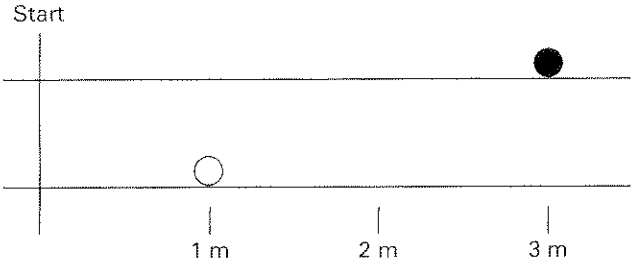
SECTION 1.2 | SPEED MEASURES HOW FAST POSITION CHANGES.

Reinforcing Key Concepts

BIG IDEA The motion of an object can be described and predicted.

KEY CONCEPT Speed measures how fast position changes.

1. **Position can change at different rates.** Two rolling balls pass the starting line at the same time. One second later, the balls' positions are as shown in the diagram below.



a. Without calculating the speed of each ball, explain how the speeds of the two balls compare.

b. Using $S = \frac{d}{t}$, calculate the speed of each ball.

2. **Velocity includes speed and direction.** Objects can have the same speed but different velocities. Read the following animal facts, and then answer the question.

a. A cheetah sprints 100 m in 4 seconds.

b. A peregrine falcon's vertical dive is clocked at 97.2 m/s.

c. A tortoise travels 1000 m at 0.2 m/s.

In each case, does the fact represent a velocity or a speed? Explain.

Name Period Date

SECTION 1.3 | ACCELERATION MEASURES HOW FAST VELOCITY CHANGES.

Reinforcing Key Concepts

BIG IDEA The motion of an object can be described and predicted.

KEY CONCEPT Acceleration measures how fast velocity changes.

1. **Speed and direction can change with time.** Fill in the chart below to show how acceleration is related to changes in speed and direction.

Does Speed Change?	Does Direction Change?	Is There Acceleration?
yes	yes	
yes	no	
no	yes	
no	no	

2. **Acceleration can be calculated from velocity and time.** A change in velocity can be found by comparing the initial velocity and the final velocity of an object. If you know the starting velocity of an object, the final velocity, and the time interval during which the object changed velocity, you can calculate the acceleration of the object.

   A car moving at 30 meters per second slows to 15 meters per second in 5 seconds. What is the acceleration of the car? Show the work you do to solve the problem.

Name _____ Period _____ Date _____

SECTION 2.1 | FORCES CHANGE MOTION.

Reinforcing Key Concepts

BIG IDEA Forces change the motion of objects in predictable ways.

KEY CONCEPT Forces change motion.

1. **A force is a push or a pull.** You use force in many ways to change the motion of objects in your world. Think of an example that demonstrates how you use each of the three kinds of forces—contact, gravity, and friction. Describe your example in the space provided.

   a. Contact force

   _____

   _____

   b. Gravity

   _____

   _____

   c. Friction

   _____

   _____

2. **Newton's first law relates force and motion.** Use what you know about Newton's first law to describe what is happening in the picture below. Label objects at rest with a blue box. Label unbalanced forces with a red arrow.

_____

_____

_____

_____

Name Period Date

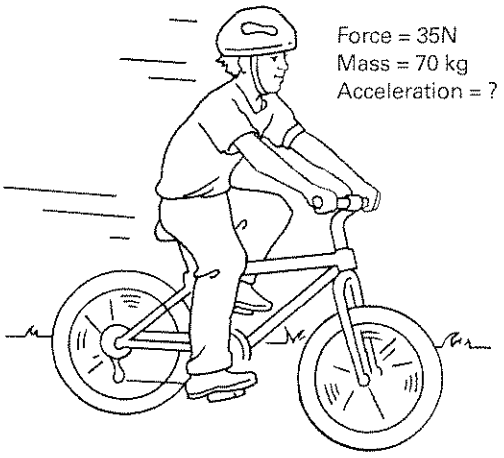
SECTION 2.2 | FORCE AND MASS DETERMINE ACCELERATION.

Reinforcing Key Concepts

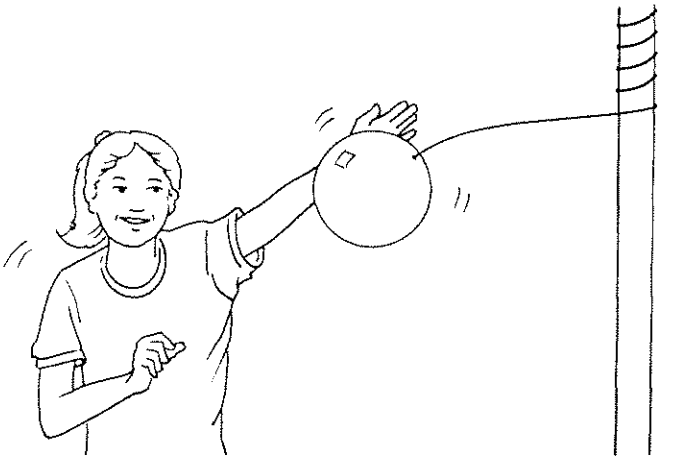
BIG IDEA Forces change the motion of objects in predictable ways.

KEY CONCEPT Force and mass determine acceleration.

1. **Newton's second law relates force, mass, and acceleration.** A force of 35 N acts on a bike and bicyclist with a mass of 70 kg. What is the acceleration of the bike and bicyclist? Show the formula and the work you do to solve the problem.



2. **Forces can change the direction of motion.** Not all objects move in straight lines. Centripetal force keeps an object moving in a circular motion. An example of an object that moves this way is a tether ball. What provides the centripetal force for the tether ball? Draw an arrow to it and label it *centripetal force.* What force causes the tether ball to accelerate around the pole? Draw an arrow to it and label it *accelerating force.*



Name Period Date

SECTION 2.3 | FORCES ACT IN PAIRS.

Reinforcing Key Concepts

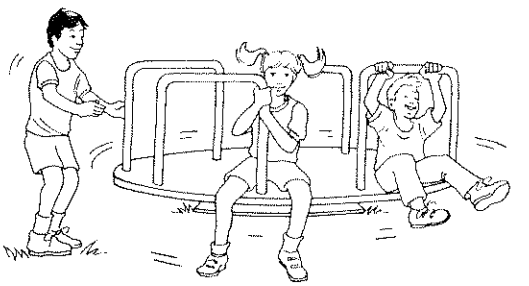
BIG IDEA Forces change the motion of objects in predictable ways.

KEY CONCEPT Forces act in pairs.

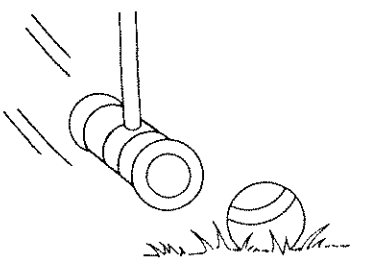
1. **Newton's third law relates action and reaction forces.** Newton's third law states that every time one object exerts a force on another object, the second object exerts a force that is equal in size and opposite in direction back on the first object. Explain how this law is demonstrated when a diver jumps on a diving board.

2. **Newton's three laws describe and predict motion.** Newton's three laws of motion are represented in the three pictures below. In the space provided, explain how the specified law applies to the picture.

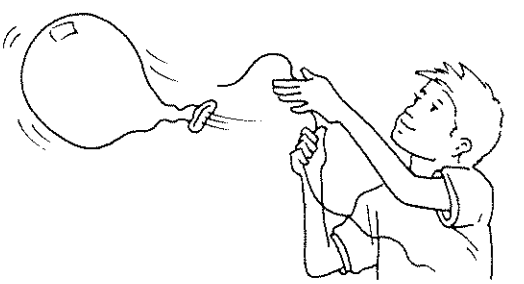
   a. Newton's second law:



   b. Newton's first law:



   c. Newton's third law:



Name Period Date

SECTION 2.4 | FORCES TRANSFER MOMENTUM.

Reinforcing Key Concepts

BIG IDEA Forces change the motion of objects in predictable ways.

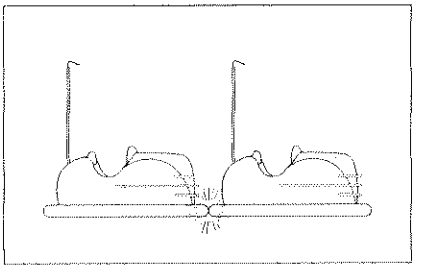
KEY CONCEPT Forces transfer momentum.

1. **Objects in motion have momentum.** The momentum of an object is the product of its mass and velocity. Two balls have the same velocity, but ball A has more momentum than ball B. What can you figure out about ball A?

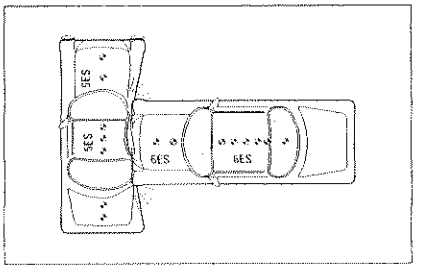
2. **Momentum can be transferred from one object to another.** The action and reaction forces in collisions are one way in which objects transfer momentum. Give an example that demonstrates how momentum is transferred in a collision between two objects.

3. **Momentum is conserved.** The pictures below show two types of collisions. The picture on the left shows a collision between two bumper cars. The picture on the right shows a collision between two test cars. Explain how each example demonstrates conservation of momentum.

a.



b.



4. A bottle rocket made out of a 2-liter soda bottle is launched by pressurizing a small amount of water inside the bottle. The rocket is positioned on a launch pad, and air is pumped into the base of the rocket. When internal air pressure overcomes the friction of the seal at the rocket's base, the rocket will shoot into the air, trailing a small stream of water. Explain how launching this bottle rocket demonstrates Newton's third law.

Name Period Date

SECTION 3.1 | GRAVITY IS A FORCE EXERTED BY MASSES.

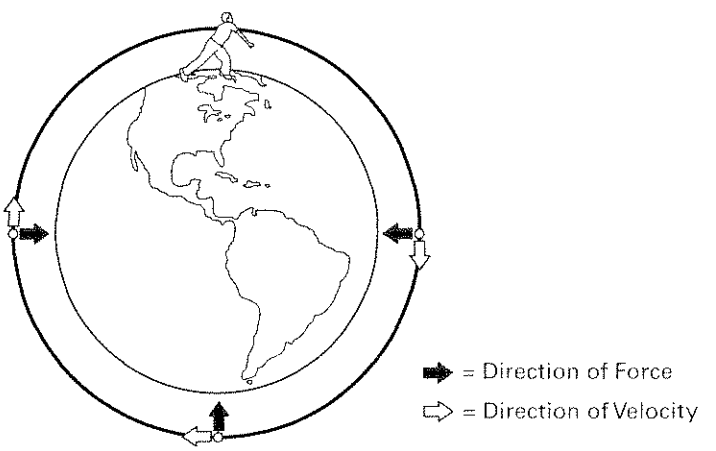
Reinforcing Key Concepts

BIG IDEA Newton's laws apply to all forces.

KEY CONCEPT Gravity is a force exerted by masses.

1. **Masses attract each other.** What factors affect the force of gravity? Why is gravity considered to be a universal force?

2. **Gravity keeps objects in orbit.** Add labels and explanations to the following diagram to explain how objects can orbit Earth.



Name Period Date

SECTION 3.2 | FRICTION IS A FORCE THAT OPPOSES MOTION.

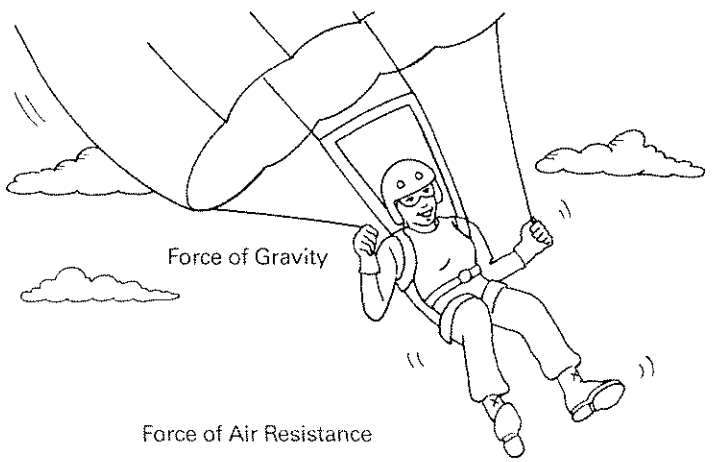
Reinforcing Key Concepts

BIG IDEA Newton's laws apply to all forces.

KEY CONCEPT Friction is a force that opposes motion.

1. **Friction occurs when surfaces slide against each other.** Several factors determine the friction between two surfaces: the types of surfaces, the motion of the surfaces, and the force pressing the surfaces together. Give an example of something that you have done at home or at school that involves friction. Draw a diagram and use arrows to show the applied force and the friction.

2. **Motion through fluids produces friction.** The faster an object moves through the air, the more molecules it can come into contact with in a given amount of time. Look at the picture of the skydiver. Then answer the questions below.



a. How did the force of gravity compare to the force of air resistance just BEFORE the skydiver opened her parachute?

b. How did the force of gravity compare to the force of air resistance just AFTER the parachute opened? Draw arrows on the diagram to show gravity and air resistance.