

Chapter 12 Forces and Motion

Section 12.1 Forces

(pages 356–362)

This section describes what forces are and explains how forces affect the motion of various objects.

Reading Strategy (page 356)

Relating Text and Visuals As you read about forces, look carefully at Figures 2, 3, and 5 in your textbook. Then complete the table by describing the forces and motion shown in each figure. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

Forces and Motion		
Figure	Is Net Force 0?	Effect on Motion
2A		
2B		
3		
5A		
5B		

What is a Force? (pages 356–357)

- A force is defined as a(n) _____ or a(n) _____ that acts on an object.
- Is the following sentence true or false? A force can act to cause an object at rest to move or it can accelerate an object that is already moving. _____
- How can a force change the motion of an object that is already moving?

- Circle the letter of the best answer. What force causes a 1-kg mass to accelerate at a rate of 1 meter per second each second?
 - $1 \text{ kg/m} \cdot \text{s}^2$
 - 1 kg/s
 - $1 \text{ kg} \cdot \text{m}$
 - 1 newton

Combining Forces (pages 357–358)

- The overall force acting on an object after all the forces are combined is the _____.
- How do balanced and unbalanced forces affect the motion of an object?

© Pearson Education, Inc., publishing as Pearson Prentice Hall. All rights reserved.

Chapter 12 Forces and Motion

Friction (pages 359–360)

7. Is the following sentence true or false? Friction is a force that helps objects that are touching move past each other more easily.

8. Circle the letters that identify types of friction.

a. rolling	b. gravity
c. static	d. sliding
9. The friction force that acts on objects that are at rest is _____.
10. Why is less force needed to keep an object moving than to start the object in motion? _____

11. Complete the table below about friction forces.

Types of Friction Forces	
Friction Force	Example
Static	
	Pushing a book along your desk
Rolling	

12. Is the following sentence true or false? Fluid friction is a force that opposes the motion of an object through a fluid such as water.

- Gravity (page 361)**
13. Gravity is a(n) _____ force that pulls objects together.
 14. Is the following sentence true or false? Earth’s gravity acts downward toward the center of Earth. _____
 15. Describe how gravity and air resistance affect the motion of a falling object. _____

 16. Is the following sentence true or false? Terminal velocity is the constant velocity of a falling object when the force of air resistance equals the force of gravity. _____

Projectile Motion (page 362)

17. The curved path caused by the combination of an initial forward velocity and the downward force of gravity is known as _____ motion.

Chapter 12 Forces and Motion

Section 12.2 Newton’s First and Second Laws of Motion

(pages 363–369)

This section discusses how force and mass affect acceleration. The acceleration due to gravity is defined, and mass and weight are compared.

Reading Strategy (page 363)

Building Vocabulary As you read this section, write a definition in the table for each vocabulary word you encounter. Use your own words in the definitions. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

Matter and Motion	
Vocabulary	Definition
Inertia	

Aristotle, Galileo, and Newton (pages 363–364)

Match each scientist with his accomplishment.

Accomplishment	Scientist
_____ 1. Italian scientist who did experiments that helped correct misconceptions about force and motion	a. Aristotle b. Galileo c. Newton
_____ 2. Scientist who studied in England and introduced several laws describing force and motion	
_____ 3. An ancient Greek philosopher who made many scientific discoveries through observation and logical reasoning	

Newton’s First Law of Motion (pages 364–365)

- Is the following sentence true or false? According to Newton’s first law of motion, an object’s state of motion does not change as long as the net force acting on it is zero. _____
- What is inertia? _____

© Pearson Education, Inc., publishing as Pearson Prentice Hall. All rights reserved.

Chapter 12 Forces and Motion

6. Is the following sentence true or false? The law of inertia states that an object in motion will eventually slow down and come to a complete stop if it travels far enough in the same direction.

Newton's Second Law of Motion (pages 365–368)

7. According to Newton's second law of motion, acceleration of an object depends upon the _____ of the object and the _____ acting on it.

Match each term with its description.

- | Description | Term |
|---|-----------------|
| _____ 8. A measure of the inertia of an object | a. mass |
| _____ 9. Net force/Mass | b. net force |
| _____ 10. Causes an object's velocity to change | c. acceleration |
11. Is the following sentence true or false? The acceleration of an object is always in the same direction as the net force acting on the object. _____
12. Is the following sentence true or false? If the same force acts upon two objects with different masses, the acceleration will be greater for the object with greater mass. _____

Weight and Mass (pages 368–369)

13. What is weight? _____

14. Write the formula used to calculate the weight of an object.

15. Is the following sentence true or false? Because the weight formula shows that mass and weight are proportional, doubling the mass of an object will not affect its weight. _____
16. Complete the table below by describing the difference between mass and weight.

Mass and Weight	
Mass	Weight

17. On the moon, the acceleration due to gravity is only about one sixth that on Earth. Thus, an object will weigh _____ on the moon than it weighs on Earth.

Chapter 12 Forces and Motion

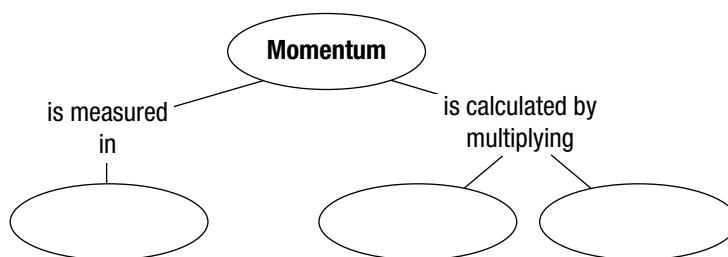
Section 12.3 Newton's Third Law of Motion and Momentum

(pages 372–377)

This section describes action-reaction forces and how the momentum of objects is determined.

Reading Strategy (page 372)

Summarizing As you read about momentum in this section, complete the concept map to organize what you learn. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.



Newton's Third Law (page 373)

1. According to Newton's third law of motion, what happens whenever one object exerts a force on a second object? _____

2. The equal and opposite forces described by Newton's third law are called _____ and _____ forces.
3. Circle the letters that identify each sentence that is true about action-reaction forces.
 - a. Newton's second law describes action-reaction forces.
 - b. Forces always exist in pairs.
 - c. Action-reaction forces never cancel.
 - d. All action-reaction forces produce motion.
4. Is the following statement true or false? Action-reaction forces do not cancel each other because the action force is always greater than the reaction force. _____

Momentum (pages 374–375)

5. Circle the letter of each factor that affects the momentum of a moving object.

a. mass b. volume c. shape d. velocity
6. If two identical objects are moving at different velocities, the object that is moving faster will have _____ momentum.

Chapter 12 Forces and Motion

7. Your in-line skates are sitting in a box on a shelf in the closet. What is their momentum? _____
8. Is the following sentence true or false? An object with a small mass can have a large momentum if the object is traveling at a high speed. _____
9. Write the momentum formula, including the correct units.

10. Circle the letter of the object that has the greatest momentum.
 - a. a 700-gram bird flying at a velocity of 2.5 m/s
 - b. a 1000-kilogram car traveling at 5 m/s
 - c. a 40-kilogram shopping cart rolling along at 0.5 m/s
 - d. a 300-kilogram roller coaster car traveling at 25 m/s

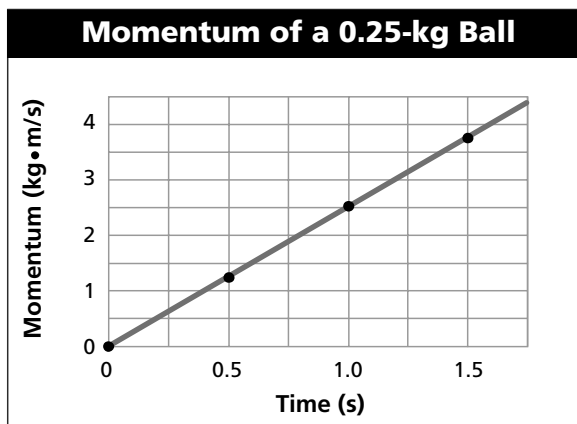
Conservation of Momentum (pages 376–377)

11. What does conservation of momentum mean? _____

12. Is the following sentence true or false? Objects within a closed system can exert forces on one another, but other objects and forces cannot leave or enter the system. _____
13. According to the law of conservation of momentum, what happens to the total momentum of a system if no net force acts on the system?

14. Is the following sentence true or false? In a closed system with two objects, the loss of momentum of one object equals the gain in momentum of the other object. _____

For questions 15 and 16, refer to the graph below.



15. The momentum of the ball at one second is _____.
16. What is the speed of the ball at 0.5 seconds? Show your calculation. *Hint:* Solve the momentum formula for velocity.

Chapter 12 Forces and Motion

Section 12.4 Universal Forces

(pages 378–382)

This section defines four forces that exist throughout the universe. Each force is described and its significance is discussed.

Reading Strategy (page 378)

Comparing and Contrasting As you read this section, compare two universal forces by completing the table. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

Universal Nuclear Forces			
Force	Acts on Which Particles?	Acts Over What Distance?	Relative Strength
Strong nuclear			
Weak nuclear			

- What are the four universal forces?
 - _____
 - _____
 - _____
 - _____

Electromagnetic Forces (pages 378–379)

- Is the following sentence true or false? Electromagnetic force is associated with charged particles. _____
- Name the only two forces that can both attract and repel. _____
- Objects with like charges _____ one another, and objects with opposite charges _____ one another.
- Circle the letters of the sentences that correctly describe magnets or magnetic forces.
 - Magnetic forces act on certain metals.
 - Magnets have two poles, north and south.
 - Two poles that are alike attract each other.
 - Magnetic forces can both attract and repel.

Nuclear Forces (pages 379–380)

- The force that holds particles in the nucleus together is the _____.
- What evidence suggests that nuclear forces have a powerful force of attraction? _____

© Pearson Education, Inc., publishing as Pearson Prentice Hall. All rights reserved.

Chapter 12 Forces and Motion

8. Circle the letter of the best answer. Over extremely short distances, approximately how many times stronger is the strong nuclear force than the electric force of repulsion?
a. 10 b. 100 c. 1000 d. 10,000
9. Compare and contrast the strong and weak nuclear forces. _____

Gravitational Force (pages 380–382)

10. State Newton’s law of universal gravitation. _____

11. Circle the letter of each sentence that is true about gravitational force.
a. The closer two objects are to one another, the weaker the gravitational force.
b. The farther apart two objects are, the weaker the gravitational force.
c. The greater the mass of an object, the stronger its gravitational force.
d. Earth’s gravitational force is stronger than the gravitational force of the sun.
12. The gravitational force of attraction between two objects depends on _____ and _____.
13. Is the following sentence true or false? Gravity is the weakest universal force, but it is the most effective force over long distances. _____
14. The sun’s mass is much greater than the mass of Earth, so the sun’s gravitational force is much _____ than that of Earth.
15. Why does the moon orbit Earth in a nearly circular path? _____

16. Is the following sentence true or false? The gravitational pull of the moon is the primary cause of Earth’s ocean tides.

17. Is the following sentence true or false? An artificial satellite in a high orbit will slow down and lose altitude due to the pull of Earth’s gravity. _____
18. List four uses of artificial satellites. _____

