Chapter 3 – Laws of Motion

Section Review 3.1

1. State Newton’s first law in your own words.

2. How is mass related to inertia?

3. What do pounds and newtons measure? Why do scientists use newtons instead of pounds?

4. What is net force and how is it determined?

5. Why are vehicle seat belts and air bags designed with Newton’s first law of motion in mind?

Section Review 3.2

1. List three units in which acceleration can be measured.

 a.

 b.

 c.

2. According to Newton’s second law, what causes acceleration? What resists acceleration?

3. An 8,000-kg helicopter’s velocity increases from 0 m/s to 25 m/s in 5 s. Calculate its acceleration and the net force acting on it.

4. Define the term *net force*.

5. Describe the conceptual relationship between energy and force.

Section Review 3.3

1. Describe the motion of a freely-falling object. Use the words *velocity*, *acceleration*, and *distance* in your answer.

2. What is the difference between mass and weight?

3. If you drop a feather and a baseball in a place where there is no air resistance, how will their motions compare? Explain.

Chapter 3 Review

Understanding Vocabulary

Select the correct term in the Word Bank on page 72, to complete the sentences.

1. "Objects continue moving in the same way," is a way of stating __________________________.

2. An object with more mass has more __________________________.

3. The total of all forces acting on an object is called the _________________________.

4. ________________________ relates force, mass, and acceleration in the equation $F=ma$.

5. The force of gravity on an object is its __________________________.

6. When the force due to gravity equals the force due to air resistance, the speed of a falling object is called its ________________________.

Reviewing Concepts

Section 3.1

1. Define the term force and give three examples of forces.

   a.

   b.

   c.

2. Give an example of Newton's first law in everyday life.

3. Explain why Newton's first law is also known as the law of inertia.

4. List two units for measuring mass and two units for measuring force.

   a. b.

   a. b.

5. One newton is the _________________ it takes to change the _____________________ of a _______________________ mass by ___________________ in 1 s.

Section 3.2

6. What is the net force of an object with zero acceleration?

7. Which of the following have zero acceleration?

   a. a car moving forward at a constant velocity

   b. a kicked ball

   c. a skater turning left

   d. a parked car

8. Write the equation for Newton's second law that you would use in each of the following scenarios. Let F = force, m = mass, and a = acceleration.

a. You know mass and acceleration and want to find the force.

b. You know mass and force and want to find the acceleration.

c. You know force and acceleration and want to find the mass.

9. Provide an example of Newton's second law in everyday life.

Section 3.3

10. By how much does the speed of an object in free fall change each second?

11. A ball is thrown straight up into the air. As it moves upward, its speed ____________ by ____________ each second. As it falls back down its speed ____________ by ____________ each second.

12. An astronaut carries a rock from the Moon to Earth. Is the rock's mass the same on earth as it is on the Moon? Is its weight the same? Explain.

13. What is the direction of air resistance on a falling object?

14. Which two forces are equal when an object is at its terminal speed?

Solving Problems

Section 3.1

1. Order the following mass measurements from smallest to largest: 0.5 kg, 1,000 g, 5 kg, 50 g.

2. Dani and Gina are pushing on a box. Dani pushes with 250 N of force and Gina pushes with 100 N of force.

a. What is the net force if they both push in the same direction?

b. What is the net force if they push in opposite directions?

Section 3.2

3. Use your knowledge of Newton's second law to answer the following:

a. What is the net force required to accelerate a 1,000-kg car at 3 m/s^2?

b. You pull your little cousin in a wagon. You must pull with a net force of 50 N to accelerate her at 2 m/s^2. What is her mass?

c. A 1,500-N force is applied to a 1,000-kg car. What is the car's acceleration?

Section 3.3

4. You drop a ball from the edge of a cliff. It lands 4 s later.

a. Make a table showing the ball's speed each second for 4 s.

Speed				
Time (s)				

b. What is the ball's average speed during the first second it is in free fall?

c. What is the ball's average speed for the whole 4 s?

d. What distance does the ball fall during the 4 s?

5. During a science experiment, your teacher drops a tennis ball out of a window. The ball hits the ground 3 s later.

a. What was the ball's speed when it hit the ground? Ignore air resistance.

b. What was the ball's average speed during the 3 s?

c. How high is the window?

6. Answer the following questions about mass and weight:

a. How many newtons does a 5-kg backpack weigh on Earth?

b. How many newtons does a 5-kg backpack weigh on the Moon?

c. Aya's mass is 45 kg. What is her weight in newtons on Earth?

d. What is Aya's mass on the moon?

e. What is Aya's weight in newtons on the Moon?

Test Practice

Section 3.1

1. According to Newton's first law, only ________ has the ability to change motion

a. inertia b. mass c. force d. gravity

2. A force of 1-N is applied to a 1-kg mass. What acceleration does the force produce?

a. 4.454 m/s^2 b. 4.448 m/s^2 c. 9.8 m/s^2 d. 1 m/s^2

3. Look at the figure on page 73. The net force on the block is 200 N. How large is force A?

a. 100 N b. 200 N c. 300 N d. 400 N

4. Because of their ________, a pair of sunglasses on the dashboard will continue moving forward when the car turns sharply.

a. acceleration b. inertia c. velocity d. weight

Section 3.2

5. Which of the following does not represent Newton's second law?

a. $a = F/m$ b. $F = ma$ c. $m = F/a$ d. $F = m/a$

6. A 3,000-N force is applied to a car which causes an acceleration of 3 m/s^2. What is the mass of the car?

a. 1,000 kg b. 3,000 kg c. 6,000 kg d. 9,000 kg

7. A skater is coasting at a constant velocity. A net force is necessary for all of the following *except*

a. the skater accelerates.
b. the skater continues in the same direction at the same speed.
c. the skater stops.
d. the skater turns to the right.

8. Note the figure on page 74. A 20-N force is applied to each block. How much greater is the acceleration of block A than the acceleration of block B?

a. two times greater
b. four times greater
c. five times greater
d. They have the same acceleration.

Section 3.3

9. Anjali throws a soccer ball straight up in the air with an initial velocity of 19.5 m/s. What will the velocity of the ball be after 3 s?

a. -9.8 m/s b. 0 m/s c. 9.8 m/s d. 48.8 m/s

10. A coconut falls from a tree. What is the average velocity after 2 s?

a. 0 m/s b. 4.9 m/s c. 9.8 m/s d. 19.6 m/s

11. A 50-kg space explorer pilots a rocket to a newly discovered planet. The explorer's weight on the new planet is 250 N. What is the strength of gravity (g) on this planet?

a. 0.2 N/kg b. 5 N/kg c. 9.8 N/kg d. 25 N/kg

12. The ________ velocity of an object in free fall is reached when the forces of gravity and air resistance are equal.

a. average b. initial c. final d. terminal