Name _____ Date _____ Class _____

Assess Your Understanding

Describing Motion

When Is an Object In Motion?

1a. REVIEW A(n) _____ is a place or object used for comparison to determine if something is in motion.

b. EXPLAIN Why is it important to know if your reference point is moving? _____

_____

_____

_____

got it?

○ **I get it!** Now I know that an object is in motion if _____

_____

○ **I need extra help with** _____

_____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Name _____ Date _____ Class _____

Describing Motion

When Is an Object In Motion?

An object is in motion if it changes position relative to a reference point. A **reference point** is a place or object used for comparison to determine if something is in motion. To determine motion for an object moving on or near Earth's surface, a reference point that is fixed to Earth, such as a building or tree, is usually used.

To describe motion completely, you need to use units of measurements. Scientists use a system of measurement called the **International System of Units.** In French, this system's name is *Système International,* so it is commonly referred to by the abbreviation SI. **Distance** is the length of the path between two points. The SI unit for length is the meter (m). The distance from the floor to a doorknob is about 1 meter.

Scientists use other units to measure distances much smaller or much larger than a meter. For smaller distances, centimeters and millimeters are used. The prefix *centi-* means "one hundredth." A centimeter is one hundredth of a meter, so there are 100 centimeters in a meter. The prefix *milli-* means "one thousandth," so there are 1,000 millimeters in a meter. To measure distances much larger than a meter, kilometers are used. The prefix *kilo-* means "one thousand," so there are 1,000 meters in a kilometer.

On a separate sheet of paper, explain why for thousands of years people believed that stars moved across Earth's sky. Explain why we now have a different explanation of why stars move across the night sky. Be sure to mention *reference points.*

Name _____ Date _____ Class _____

Lesson Quiz

Describing Motion

Write the letter of the correct answer on the line at the left.

1. ___ Jane is sitting in the family car. Her mother is driving her from their house to the library. Jane waves as she passes her friend Marina. Which of the following is not moving with respect to Jane?

A Marina

B the family car

C the library

D Jane's house

2. ___ Which is the best reason for not using a moving car as a reference point?

A The car will get out of sight too quickly.

B It is difficult to tell other people which car you are using.

C It is difficult to determine which direction motion is occurring.

D The car has moving parts, like rolling tires, that can be distracting.

3. ___ Which of the following is the best reference point for describing the motion of the planets in our solar system?

A a space ship in orbit about Earth

B the center of the Milky Way

C Earth

D the sun

4. ___ Jeff is in a stationary school bus. Which is the best reference point for him to use to determine when the bus starts to move?

A the front entrance of the school

B the school bus sitting next to him

C a car waiting to pick up another student

D a student walking on the sidewalk

Fill in the blank to complete each statement.

5. The SI unit for measuring distance is the _____.

6. There are 1,000 _____ in a meter.

7. There are 1,000 meters in a(n) _____.

8. An object is in _____ if its position changes relative to another object.

9. A(n) _____ is a place or object used for comparison to determine if something is in motion.

10. _____ is the length of the path between two points.

Name _____ Date _____ Class _____

Assess Your Understanding

Speed and Velocity

How Do You Calculate Speed?

1a. IDENTIFY The (instantaneous/average) speed is the speed of the object at a given instant in time. The (instantaneous/average) speed is the speed of the object over a longer period of time.

b. APPLY CONCEPTS The speedometer in a car gives the car's _____ speed.

got it?

○ **I get it!** Now I know to calculate the speed of an object, I need to _____

_____

○ **I need extra help with** _____

_____

How Do You Describe Velocity?

2. ANSWER How do you describe the motion of an object? _____

_____

_____

_____

got it?

○ **I get it!** Now I know that the velocity of an object is _____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Assess Your Understanding

Speed and Velocity

How Do You Graph Motion?

3a. IDENTIFY The _____ of a distance-versus-time graph shows you the speed of a moving object.

b. CALCULATE The rise of a line on a distance-versus-time graph is 900 m and the run is 3 min. What is the slope of the line? _____

_____

c. APPLY CONCEPTS Is it possible for a distance-versus-time graph to be a vertical line? Explain. _____

_____

_____

_____

got it?

○ **I get it!** Now I know to show the motion of an object on a line graph, you _____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Key Concept Summaries

Speed and Velocity

How Do You Calculate Speed?

The **speed** of an object is the distance the object moves per unit of time. Speed is a type of rate. **To calculate the speed of an object divide the distance the object travels by the amount of time it takes to travel that distance.** This can be written as an equation:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Instantaneous speed is the speed at which an object is moving at a given instant in time. But a moving object's speed may change. To calculate the **average speed** of an object, divide the total distance traveled by the total time. The SI unit for speed is m/s, or meters per second.

How Do You Describe Velocity?

To fully describe an object's motion, you need to know both its speed and its direction. **When you know both the speed and direction of an object's motion, you know the velocity of the object.** Speed in a given direction is **velocity.**

How Do You Graph Motion?

You can show the motion of an object on a line graph in which you plot distance versus time. Time is shown on the *x*-axis (the horizontal axis) and distance is shown on the *y*-axis (the vertical axis). Each point on the line represents the distance an object has traveled during a particular time. The steepness of a line on a graph is its **slope.** The slope tells you how fast one variable changes in relation to the other variable in the graph. In other words, slope tells you the rate of change. Since speed is the rate that distance changes in relation to time, the slope of a distance-versus-time graph represents speed. To calculate the slope of a line, divide the rise (vertical change between two points) by the run (horizontal change between the same two points).

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$

Amber walked to the swimming pool, stopping to talk to Maria on her way there. Amber walked at a constant speed of 100 m/min for the first four minutes; then she visited with Maria for three minutes; then walked for two more minutes at a constant speed of 75 m/min. In words, describe how a distance-versus-time graph of Amber's progress would look.

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Name ______________________ Date __________ Class __________

Lesson Quiz

Speed and Velocity

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

1. ____________ On a distance-versus-time graph, a speed of zero would appear as a horizontal line.

2. ____________ The SI unit for speed is m/min.

3. ____________ A distance-versus-time graph will never show a horizontal line.

4. ____________ The slope of a line is found by multiplying the rise by the run.

5. ____________ On a distance-versus-time graph, a straight line indicates that an object's speed is zero.

6. ____________ Speed in a given direction is called velocity.

Fill in the blank to complete each statement.

7. A speedometer shows the ____________ speed of a vehicle.

8. To describe an object's motion, you need to know both its speed and its ____________.

9. The ____________ speed of an object is found by dividing the total distance by the total time.

10. Alfonso ran the 1,000-meter race in 2.5 minutes. Alfonso's average speed was ____________ m/min.

Name _____ Date _____ Class _____

Assess Your Understanding

Acceleration

What Is Acceleration?

1a. DEFINE The rate at which velocity changes is called _____

b. INFER A softball has a (positive/negative) acceleration when it is thrown. A softball has a (positive/negative) acceleration when it is caught.

c. EXPLAIN A girl skates around the perimeter of a circular ice rink at a constant speed of 2 m/s. Is the girl accelerating? Explain. _____

_____

_____

got it?

○ **I get it!** Now I know that in science acceleration refers to _____

_____

○ **I need extra help with** _____

_____

How Do You Graph Acceleration?

got it?

○ **I get it!** Now I know that the two types of graphs that you can use to analyze the motion of an accelerating object are _____

_____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Key Concept Summaries

Acceleration

What Is Acceleration?

In everyday language, acceleration means "the process of speeding up." Scientists define **acceleration** as the rate at which velocity changes. **In science, acceleration refers to increasing speed, decreasing speed, or changing direction.** Whenever an object's speed changes, the object accelerates. The change in speed can be either to speed up or to slow down. Slowing down is sometimes called deceleration, or negative acceleration. Even an object moving at constant speed can be accelerating—as long as it is changing direction.

Acceleration describes the rate at which velocity changes. If an object is not changing direction, you can describe its acceleration as the rate at which its speed changes. To determine the acceleration of an object moving in a straight line, use the following equation.

$$\text{Acceleration} = \frac{(\text{Final Speed} - \text{Initial Speed})}{\text{Time}}$$

If speed is measured in meters per second (m/s) and time is measured in seconds, the SI unit of acceleration is meters per second per second, or m/s^2.

How Do You Graph Acceleration?

You can use both a speed-versus-time graph and a distance-versus-time graph to analyze the motion of an accelerating object. The slope of the speed-versus-time graph is the acceleration. A slanted straight line on a speed-versus-time graph means that the acceleration of the object is constant, but not zero. If the line slants upward, speed was increasing. If the line slopes downward, speed was decreasing.

Compare and contrast the graphs of distance versus time and speed versus time.

Name _____ Date _____ Class _____

Lesson Quiz

Acceleration

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

1. _____ If a train is slowing down, it <u>is</u> accelerating.

2. _____ To find the acceleration of an object moving in a straight line, you must calculate the change in <u>distance</u> for each unit of time.

3. _____ A Ferris wheel turning at a constant speed of 5 m/s <u>is not</u> accelerating.

4. _____ An airplane is flying west at 200 km/h. Two hours later, it is flying west at 300 km/h. Its average acceleration is <u>100</u> km/h^2.

5. _____ A speed-versus-time graph for a car's motion is a horizontal line at a speed of 12 m/s. The car's acceleration during this time is <u>12</u> m/s^2.

6. _____ The SI units for acceleration are <u>km/h^2</u>.

Fill in the blank to complete each statement.

7. The rate at which the velocity of an object changes is the object's rate of _____.

8. An airplane is accelerating at 8 m/s^2. Each second its speed increases by _____ m/s.

9. An airplane is accelerating at –8 m/s^2. The distance the airplane travels each second is _____ than the distance it traveled during the previous second.

10. An amusement park ride falls straight down for 4 seconds. During this time, the ride accelerates from a speed of 0 m/s to 40 m/s. The ride's rate of acceleration during the 4 seconds is _____ m/s^2.