

## Acceleration

Read from **Lesson 1** of the **1-D Kinematics** chapter at **The Physics Classroom**:

<http://www.physicsclassroom.com/Class/1DKin/U1L1e.html>

**MOP Connection:** Kinematic Concepts: sublevels 4 and 7

### Review:

The instantaneous velocity of an object is the \_\_\_\_\_ of the object with a \_\_\_\_\_.

### The Concept of Acceleration

1. Accelerating objects are objects that are changing their velocity. Name the three controls on an automobile that cause it to accelerate.
2. An object is accelerating if it is moving \_\_\_\_\_. Circle all that apply.  
a. with changing speed    b. extremely fast    c. with constant velocity  
d. in a circle    e. downward    f. none of these
3. If an object is NOT accelerating, then one knows for sure that it is \_\_\_\_\_.  
a. at rest    b. moving with a constant speed  
c. slowing down    d. maintaining a constant velocity

### Acceleration as a Rate Quantity

Acceleration is the rate at which an object's velocity changes. The velocity of an object refers to how fast it moves and in what direction. The acceleration of an object refers to how fast an object changes its speed or its direction. Objects with a high acceleration are rapidly changing their speed or their direction. As a rate quantity, acceleration is expressed by the equation:

$$\text{acceleration} = \frac{\Delta \text{Velocity}}{\text{time}} = \frac{v_{\text{final}} - v_{\text{original}}}{\text{time}}$$

4. An object with an acceleration of  $10 \text{ m/s}^2$  will \_\_\_\_\_. Circle all that apply.  
a. move 10 meters in 1 second    b. change its velocity by  $10 \text{ m/s}$  in 1 s  
c. move 100 meters in 10 seconds    d. have a velocity of  $100 \text{ m/s}$  after 10 s
5. Ima Speedin puts the pedal to the metal and increases her speed as follows:  $0 \text{ mi/hr}$  at 0 seconds;  $10 \text{ mi/hr}$  at 1 second;  $20 \text{ mi/hr}$  at 2 seconds;  $30 \text{ mi/hr}$  at 3 seconds; and  $40 \text{ mi/hr}$  at 4 seconds. What is the acceleration of Ima's car?
6. Mr. Henderson's (imaginary) Porsche accelerates from 0 to  $60 \text{ mi/hr}$  in 4 seconds. Its acceleration is \_\_\_\_\_.  
a.  $60 \text{ mi/hr}$     b.  $15 \text{ m/s/s}$     c.  $15 \text{ mi/hr/s}$     d.  $-15 \text{ mi/hr/s}$     e. none of these
7. A car speeds up from rest to  $+16 \text{ m/s}$  in 4 s. Calculate the acceleration.
8. A car slows down from  $+32 \text{ m/s}$  to  $+8 \text{ m/s}$  in 4 s. Calculate the acceleration.

## 1-D Kinematics

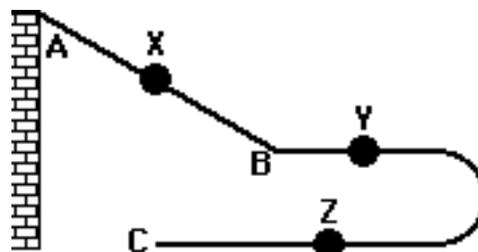
### Acceleration as a Vector Quantity

Acceleration, like velocity, is a vector quantity. To fully describe the acceleration of an object, one must describe the direction of the acceleration vector. A **general rule of thumb** is that if an object is moving in a straight line and slowing down, then the direction of the acceleration is opposite the direction the object is moving. If the object is speeding up, the acceleration direction is the same as the direction of motion.

9. Read the following statements and indicate the direction (up, down, east, west, north or south) of the acceleration vector.

	Description of Motion	Dir'n of Acceleration
a.	A car is moving eastward along Lake Avenue and increasing its speed from 25 mph to 45 mph.	
b.	A northbound car skids to a stop to avoid a reckless driver.	
c.	An Olympic diver slows down after splashing into the water.	
d.	A southward-bound free kick delivered by the opposing team is slowed down and stopped by the goalie.	
e.	A downward falling parachutist pulls the chord and rapidly slows down.	
f.	A rightward-moving Hot Wheels car slows to a stop.	
g.	A falling bungee-jumper slows down as she nears the concrete sidewalk below.	

10. The diagram at the right portrays a Hot Wheels track designed for a pun physics lab. The car starts at point A, descends the hill (continually speeding up from A to B); after a short straight section of track, the car rounds the curve and finishes its *run* at point C. The car continuously slows down from point B to point C. Use this information to complete the following table.



Point	Direction of Velocity of Vector	Direction of Acceleration Vector
X	Reason: _____ _____	Reason: _____ _____
Y	Reason: _____ _____	Reason: _____ _____
Z	Reason: _____ _____	Reason: _____ _____