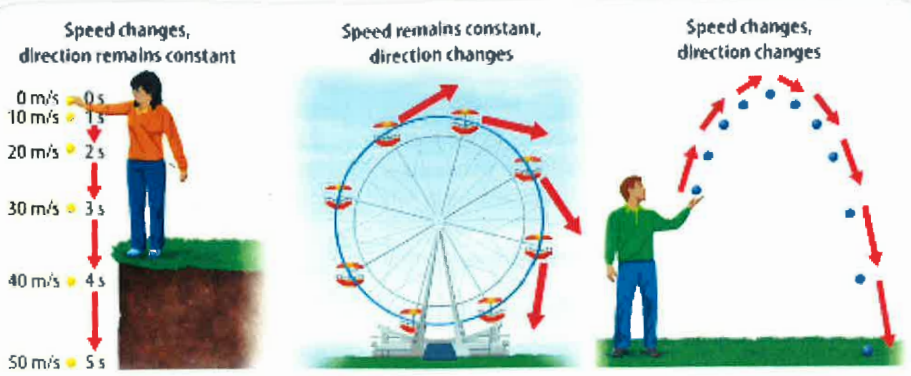

Figure 5 The velocity of an object changes if the speed changes, the direction changes, or both the speed and the direction change.

Changing Velocity

Velocity can change even if the speed of an object remains constant. Recall that velocity includes both an object's speed and its direction of travel. **Figure 5** shows several examples of changing velocity.

In the first panel, the ball drops toward the ground in a straight line, or constant direction. The increased length of each arrow shows that the speed of the ball increases as it falls. As speed changes, velocity changes.

In the second panel, each arrow is the same length. This tells you that the Ferris-wheel cars travel around a circle at a constant speed. However, each arrow points in a different direction. This tells you that the cars are changing direction. As direction changes, velocity changes.

The third panel of **Figure 5** shows the path of a ball thrown into the air. The arrows show that both the ball's speed and direction change, so its velocity changes.

When either an object's speed or velocity changes, the object is accelerating. **Acceleration** *is the measure of the change in velocity during a period of time.*

Calculating Acceleration

When a ball is dropped, as in the first p
of **Figure 5**, its speed increases as it falls to
the ground. The velocity of the ba
changing. Therefore, the ball is accelera
You can calculate acceleration using th
lowing equation:

$$a = \frac{v_f - v_i}{t}$$

Math Skills — Solve a One-Step Equation

Solve for Accerleration A skateboarder moving at 2 m/s starts skating down a ramp. As the skateboarder heads down the ramp, she accelerates to a speed of 6 m/s in 4 seconds. What is the skateboarder's acceleration?

1 This is what you know:

final speed: $v_f = 6$ m/s
initial speed: $v_i = 2$ m/s
time: $t = 4$ s

2 This is what you need to find out: acceleration: a

3 Use this formula:

$$a = \frac{v_f - v_i}{t}$$

4 Substitute:

the values for v_f, v_i, and t: $\frac{6 \text{ m/s} - 2 \text{ m/s}}{4 \text{ s}}$

subtract: $\frac{4 \text{ m/s}}{4 \text{ s}}$

and divide: $= 1 \text{ m/s}^2$

Answer: The acceleration is 1 m/s^2.

Practice As the skateboarder starts moving up the other side of the ramp, her velocity changes from 6 m/s to 0 m/s in 3 seconds. What was her acceleration?