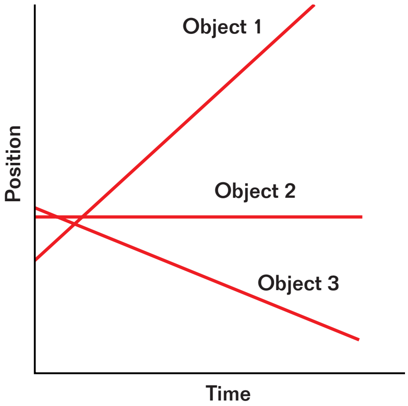

Figure 6
These position-versus-time graphs show that object 1 moves with a constant positive velocity. Object 2 is at rest. Object 3 moves with a constant negative velocity.

Figure 6 represents straight-line graphs of position-versus-time for three different objects. Object 1 has a constant positive velocity because its position increases uniformly with time. Thus, the slope of this line is positive. Object 2 has zero velocity because its position does not change (the object is at rest). Hence, the slope of this line is zero. Object 3 has a constant negative velocity because its position decreases with time. As a result, the slope of this line is negative.

Instantaneous velocity may not be the same as average velocity

Now consider an object whose position versus time graph is not a straight line, but a curve, as in **Figure 7.** The object moves through larger and larger displacements as each second passes. Thus, its velocity increases with time.

For example, between $t = 0$ s and $t = 2.0$ s, the object moves 8.0 m, and its average velocity in this time interval is 4.0 m/s (because $v_{avg} = 8.0$ m/2.0 s). However, between $t = 0$ s and $t = 4.0$ s, it moves 32 m, so its average velocity in this time interval is 8.0 m/s (because $v_{avg} = 32$ m/4.0 s). We obtain different average velocities, depending on the time interval we choose. But how can we find the velocity at an instant of time?

To determine the velocity at some instant, such as $t = 3.0$ s, we study a small time interval near that instant. As the intervals become smaller and smaller, the average velocity over that interval approaches the exact velocity at $t = 3.0$ s. This is called the **instantaneous velocity.**

instantaneous velocity

the velocity of an object at some instant or at a specific point in the object's path

One way to determine the instantaneous velocity is to construct a straight line that is *tangent* to the position-versus-time graph at that instant. The slope of this tangent line is equal to the value of the instantaneous velocity at that point. For example, the instantaneous velocity of the object in **Figure 7** at $t = 3.0$ s is 12 m/s. **Table 2** lists the instantaneous velocities of the object described by the graph in **Figure 7.** You can verify some of these values by carefully measuring the slope of the curve.

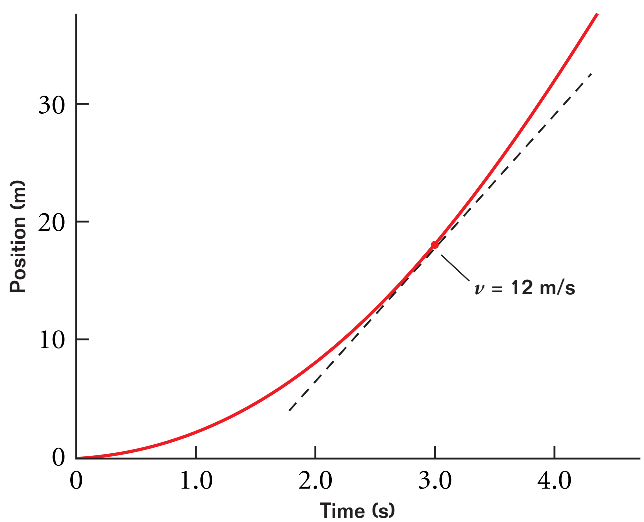

Figure 7
The instantaneous velocity at a given time can be determined by measuring the slope of the line that is tangent to that point on the position-versus-time graph.

Table 2
Velocity-Time Data

t (s)	v (m/s)
0.0	0.0
1.0	4.0
2.0	8.0
3.0	12.0
4.0	16.0