Projectile Motion

SECTION 3

SECTION OBJECTIVES

- Recognize examples of projectile motion.
- Describe the path of a projectile as a parabola.
- Resolve vectors into their components and apply the kinematic equations to solve problems involving projectile motion.

TWO-DIMENSIONAL MOTION

In the last section, quantities such as displacement and velocity were shown to be vectors that can be resolved into components. In this section, these components will be used to understand and predict the motion of objects thrown into the air.

Use of components avoids vector multiplication

How can you know the displacement, velocity, and acceleration of a ball at any point in time during its flight? All of the kinematic equations could be rewritten in terms of vector quantities. However, when an object is propelled into the air in a direction other than straight up or down, the velocity, acceleration, and displacement of the object do not all point in the same direction. This makes the vector forms of the equations difficult to solve.

One way to deal with these situations is to avoid using the complicated vector forms of the equations altogether. Instead, apply the technique of resolving vectors into components. Then you can apply the simpler one-dimensional forms of the equations for each component. Finally, you can recombine the components to determine the resultant.

Components simplify projectile motion

When a long jumper approaches his jump, he runs along a straight line, which can be called the *x*-axis. When he jumps, as shown in **Figure 13,** his velocity has both horizontal and vertical components. Movement in this plane can be depicted by using both the *x*- and *y*-axes.

Note that in **Figure 14(b),** a jumper's velocity vector is resolved into its two vector components. This way, the jumper's motion can be analyzed using the kinematic equations applied to one direction at a time.

Figure 13
When the long jumper is in the air, his velocity has both a horizontal and a vertical component.

Figure 14
(a) A long jumper's velocity while sprinting along the runway can be represented by a horizontal vector. **(b)** Once the jumper is airborne, the jumper's velocity at any instant can be described by the components of the velocity.