# 1.3 Slope as a Rate of Change

Equations of lines are the most important equations in science, engineering, and mathematics. Many real-life phenomena are described (or modeled) by lines or equations of lines. The speed of an object under constant acceleration, the work you do in climbing a ladder, and the profit a theater owner makes by showing a movie can all be described by an equation for a line. Even situations that cannot be described exactly by lines can often be accurately approximated by such equations. In fact, approximation by lines is one of the fundamental ideas behind the differential calculus.

In this section we begin our study of change by noting that the slope of a line can be interpreted as the rate of change of one quantity with respect to another. We use this idea to motivate a definition of rate of change for quantities that are related by nonlinear functions.

**Java Applet**
*Lines and Slopes*
Students can graph a line given two points or given a slope and $y$-intercept. Allows students to work with different forms for the equation of a line.

## Lines and Slope

WEB In algebra you learned that a nonvertical line in the Cartesian plane, or $(x, y)$-plane, can be described by an equation of the form

$$y = mx + b.$$

The constant $m$ is the *slope* of the line and tells us that when $x$ increases by 1, $y$ changes by $m$. The value of $y$ increases if $m > 0$, decreases if $m < 0$, and is unchanged if $m = 0$. See Fig. 1.20. The number $b$ is called the $y$-intercept of the line and tells us that the point $(0, b)$ is on the graph of the line.

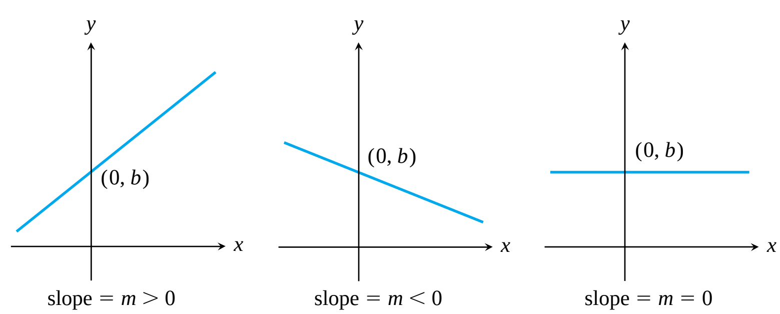


FIGURE 1.20 Slopes of lines.

### EXAMPLE 1 Graphing a line

The equation

$$-3x + 4y - 8 = 0 \qquad (1)$$

is the equation of a line. Find the slope and $y$-intercept of the line and sketch its graph.

**Solution**

Solving (1) for $y$ we have

$$y = \frac{3}{4}x + 2. \qquad (2)$$