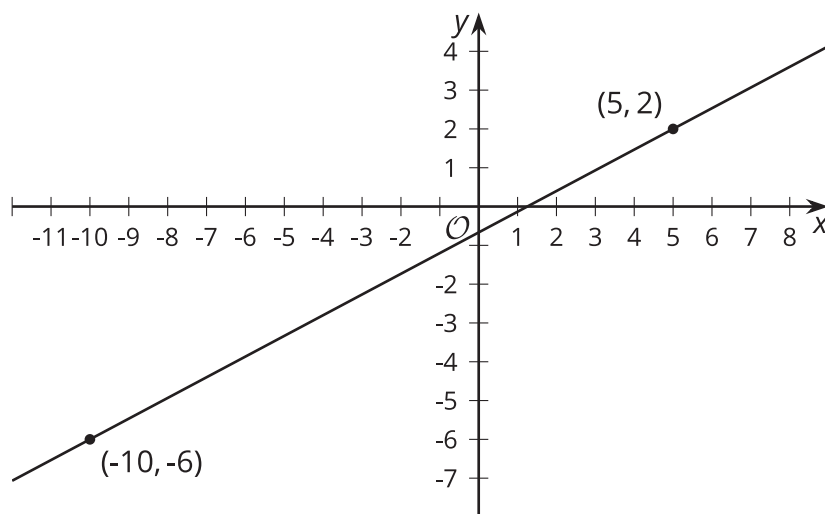




# Equations of Lines

Let's investigate equations of lines.

## 4.1 Remembering Slope

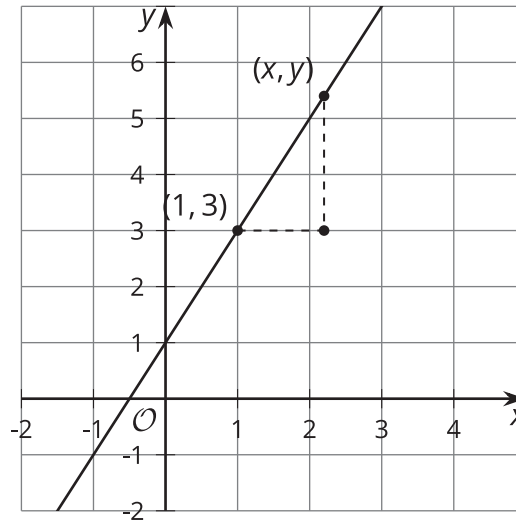


The slope of the line in the image is  $\frac{8}{15}$ . Explain how you know this is true.

## 4.2

## Building an Equation for a Line

1. The image shows a line.



- Write an equation that says the slope between the points  $(1, 3)$  and  $(x, y)$  is 2.
  - Look at this equation:  $y - 3 = 2(x - 1)$   
How does it relate to the equation you wrote?
2. Here is an equation for another line:  $y - 7 = \frac{1}{2}(x - 5)$
- What point do you know this line passes through?
  - What is the slope of this line?
3. Next, let's write a general equation that we can use for any line. Suppose we know that a line passes through a particular point,  $(h, k)$ .
- Write an equation that says the slope between points  $(x, y)$  and  $(h, k)$  is  $m$ .
  - Look at this equation:  $y - k = m(x - h)$ . How does it relate to the equation you wrote?

## 4.3 Using Point-Slope Form

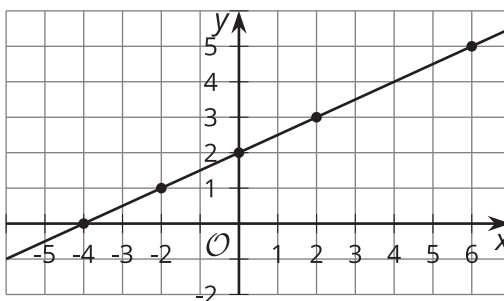
1. Write an equation that describes each line.

a. the line passing through point  $(-2, 8)$  with slope  $\frac{4}{5}$

b. the line passing through point  $(0, 7)$  with slope  $-\frac{7}{3}$

c. the line passing through point  $(\frac{1}{2}, 0)$  with slope  $-1$

d. the line in the image



2. Using the structure of the equation, what point do you know each line passes through? What's the line's slope?

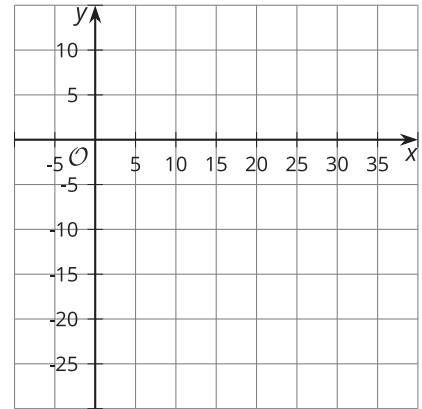
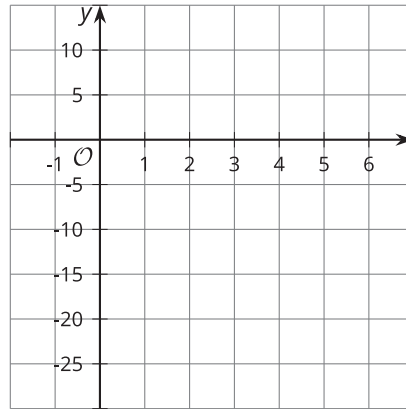
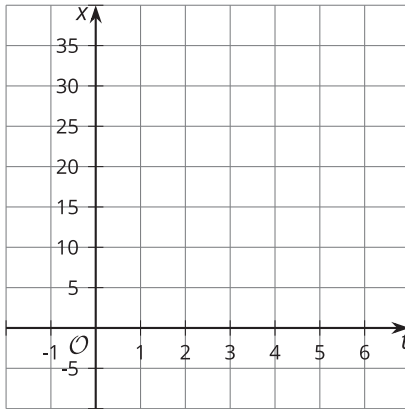
a.  $y - 5 = \frac{3}{2}(x + 4)$

b.  $y + 2 = 5x$

c.  $y = -2(x - \frac{5}{8})$

## Are you ready for more?

Another way to describe a line, or other graphs, is to think about the coordinates as changing over time. This is especially helpful if we're thinking of tracing an object's movement. This example describes the  $x$ - and  $y$ -coordinates separately, each in terms of time,  $t$ .

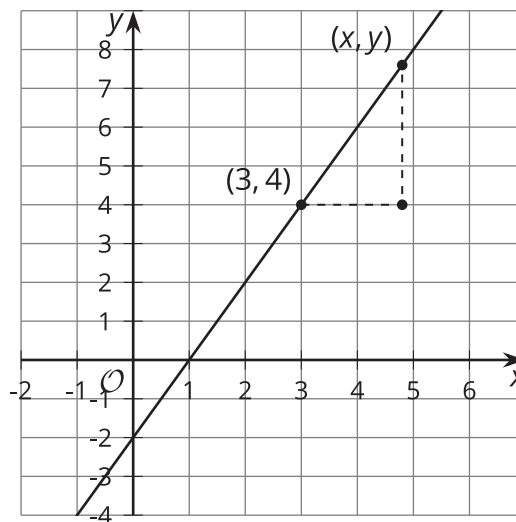


1. On the first grid, create a graph of  $x = 2 + 5t$  for  $-2 \leq t \leq 7$  with  $x$  on the vertical axis and  $t$  on the horizontal axis.
2. On the second grid, create a graph of  $y = 3 - 4t$  for  $-2 \leq t \leq 7$  with  $y$  on the vertical axis and  $t$  on the horizontal axis.
3. On the third grid, create a graph of the set of points  $(2 + 5t, 3 - 4t)$  for  $-2 \leq t \leq 7$  on the  $xy$ -plane.

## Lesson 4 Summary

The line in the image can be defined as the set of points that have a slope of 2 with the point  $(3, 4)$ .

An equation that says point  $(x, y)$  has slope 2 with  $(3, 4)$  is  $\frac{y-4}{x-3} = 2$ . This equation can be rearranged to look like  $y - 4 = 2(x - 3)$ .



The equation is now in **point-slope form**, or  $y - k = m(x - h)$ , where:

- $(x, y)$  is any point on the line.
- $(h, k)$  is a particular point on the line that we choose to substitute into the equation.
- $m$  is the slope of the line.

Other ways to write the equation of a line include slope-intercept form,  $y = mx + b$ , and standard form,  $Ax + By = C$ .

To write the equation of a line passing through  $(3, 1)$  and  $(0, 5)$ , start by finding the slope of the line. The slope is  $-\frac{4}{3}$  because  $\frac{5-1}{0-3} = -\frac{4}{3}$ . Substitute this value for  $m$  to get  $y - k = -\frac{4}{3}(x - h)$ . Now we can choose any point on the line to substitute for  $(h, k)$ . If we choose  $(3, 1)$ , we can write the equation of the line as  $y - 1 = -\frac{4}{3}(x - 3)$ .

We could also use  $(0, 5)$  as the point, giving  $y - 5 = -\frac{4}{3}(x - 0)$ . We can rearrange the equation to see how point-slope and slope-intercept forms relate, getting  $y = -\frac{4}{3}x + 5$ . Notice that  $(0, 5)$  is the  $y$ -intercept of the line. The graphs of all three of these equations look the same.