

## Section 1. 3

### Linear Functions

#### Objectives

1. Define a linear function
2. Graph a linear function
3. Find the slope of a line
4. Find the equation of a line in both slope-intercept and point-slope forms

Definition of a Linear Function--A linear function  $f(x)$  is defined as  $f(x) = mx + b$ , where  $m$  and  $b$  are constants.

Examples:  $f(x) = 2x + 1$   $h(s) = 3s + 2$

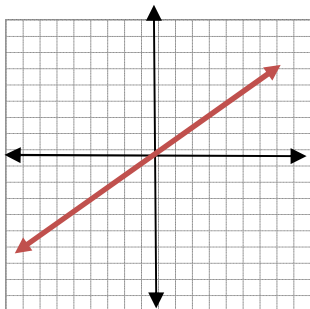
$f(x) = 3x - 2$

↑ slope      ↑ y-intercept

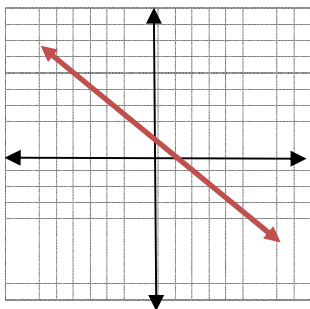
1 variable raised to the power of 1.

#### What is Slope?

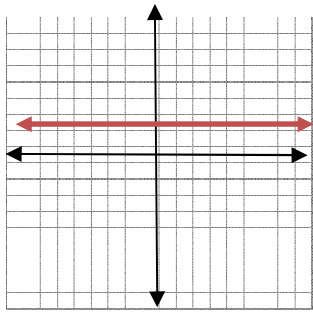
Slope is a number that tells how steeply a line goes up or down.  
= "slant"



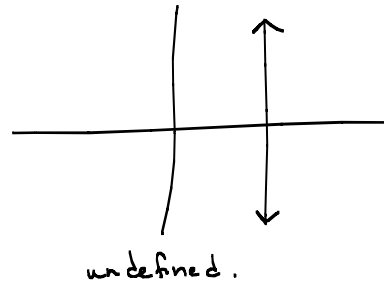
positive slope



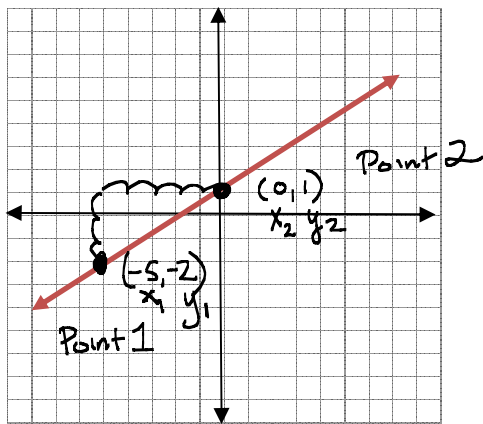
negative slope



zero slope



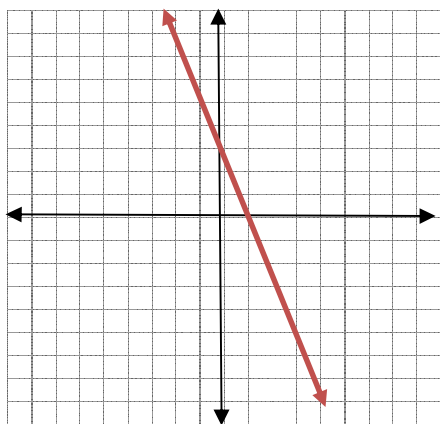
### Finding Slope from a Graph



$$\text{slope} = \frac{3}{5}$$

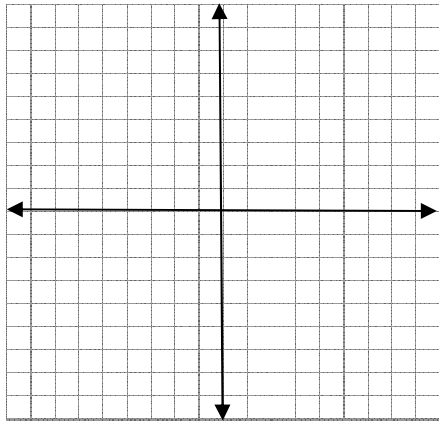
To find the slope from a graph, choose two points on the graph and compare the rise to the run.

$$\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - (-2)}{0 - (-5)} = \frac{3}{5}$$

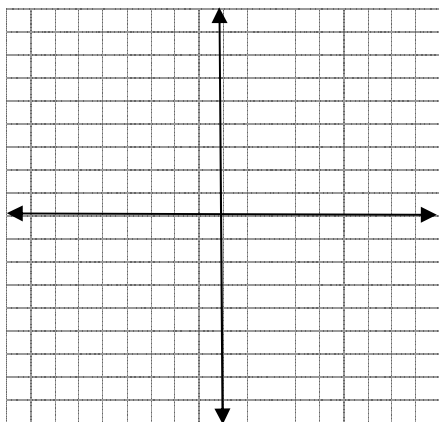


## Graph Lines Given a Point and a Slope

Example: Draw the graph of the line that contains the point (2, -4) and has a slope of  $\frac{1}{2}$ .



Example: Draw the graph of the line that contains the point (3, 5) and has a slope of -2.



## Finding an Equation of a Line Given a Point and a Slope

Sometimes you will be asked to find the equation of a line that passes through a certain point and has a certain slope.

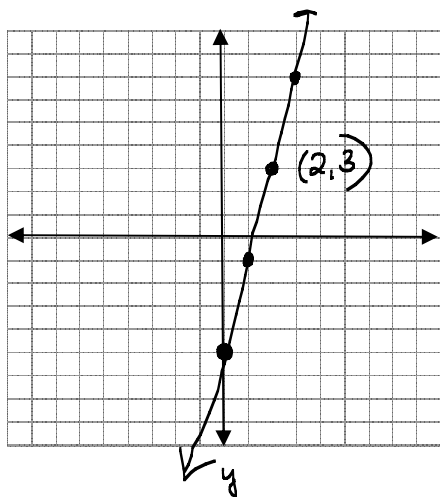
Use the Point-Slope Form:

$$\underline{y - y_1 = m(x - x_1)}$$

where  $(x_1, y_1)$  is the point and  $m$  is the slope.

Example: Find the equation of a line with slope 4 containing the point  $(2, 3)$ .  $m = 4$   
 $x_1, y_1$

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 3 &= 4(x - 2) && \rightarrow \text{solve for } y. \\ y - 3 &= 4x - 8 \\ \begin{array}{c} +3 \\ - \end{array} & \begin{array}{c} +3 \\ +3 \end{array} \\ y &= 4x - 5 \\ f(x) &= 4x - 5 \\ & \begin{array}{cc} \uparrow & \uparrow \\ m & b \end{array} \\ \frac{\text{rise}}{\text{run}} &= \frac{4}{-1} \end{aligned}$$



Example: Find the equation of a line with slope  $\frac{1}{2}$  containing the point  $(-2, 4)$ .

point-slope  
form

$$y - y_1 = m(x - x_1)$$

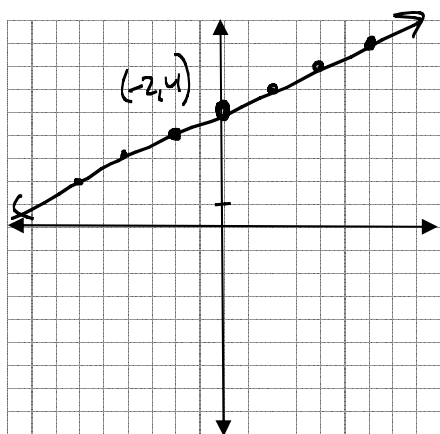
$$y - 4 = \frac{1}{2}(x - (-2))$$

$$y - 4 = \frac{1}{2}(x + 2)$$

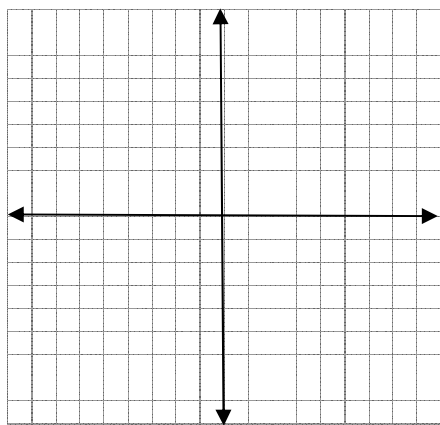
$$y - 4 = \frac{1}{2}x + 1$$

$$y = \frac{1}{2}x + 5$$

$$f(x) = \frac{1}{2}x + 5$$

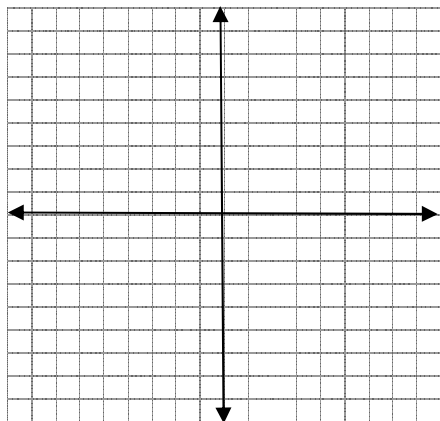


Example: Find the equation of a line with slope -4 containing the point  $(-2, 3)$ .



## Finding an Equation of a Line Given Two Points

Example: Find the equation of a line containing the points  $(3, -6)$  and  $(-2, 4)$ .



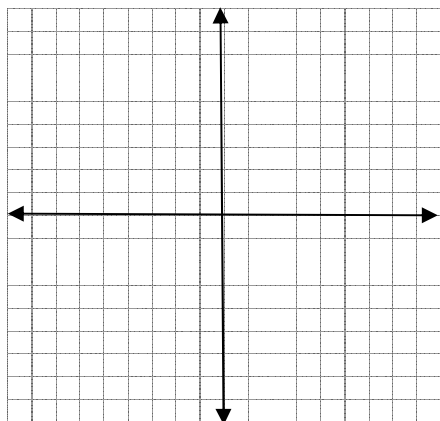
$$y - y_1 = m(x - x_1)$$

$$\text{slope} = m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6 - 4}{3 - (-2)}$$

$$= \frac{-10}{3 + 2}$$

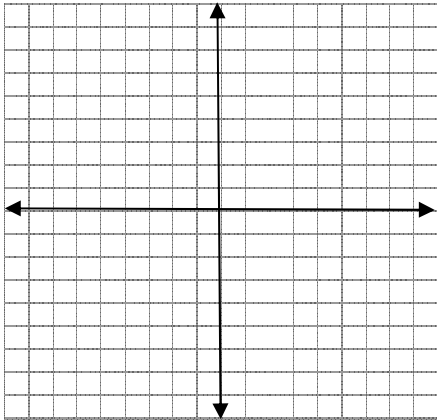
$$m = -2$$

Example: Find the equation of a line containing the points  $(-4, -6)$  and  $(5, 7)$ .

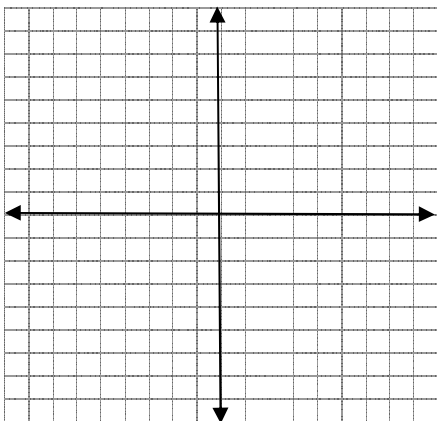


## Graphing an Equation of a Line Given a Slope and a y-intercept.

Example: Draw the graph of the line that has a y-intercept of 5 and has a slope of -2.



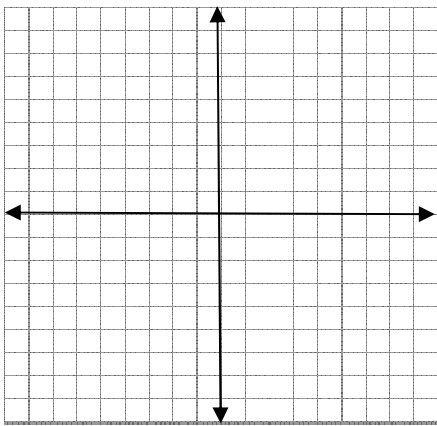
Example: Draw the graph of the line that has a y-intercept of -3 and has a slope of  $\frac{1}{3}$ .



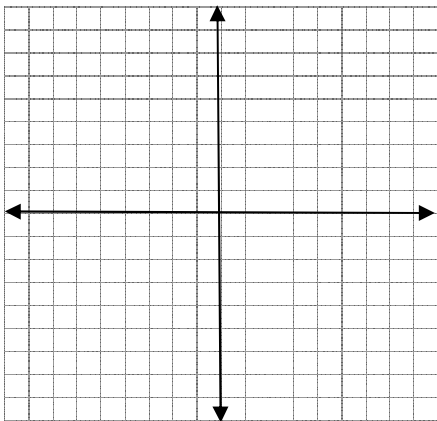
## Finding an Equation of a Line given a Slope and a y-Intercept

Sometimes you will be asked to find the equation of a line that has a certain slope ( $m$ ) and y-intercept ( $b$ ). Use the slope-intercept form  $y = mx + b$ .

Example: Find the equation of the line with a slope of 4 and a y-intercept of -2.

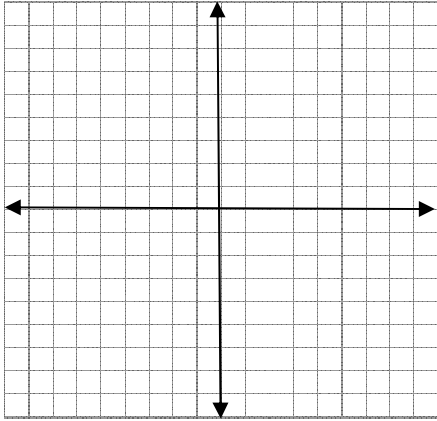


Example: Find the equation of the line with a slope of -3 and a y-intercept of 5.

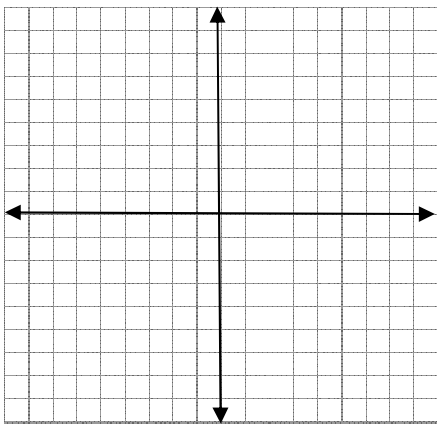


## Graphing Equations in Slope-Intercept Form

Example: Graph  $y = 2x + 5$ .

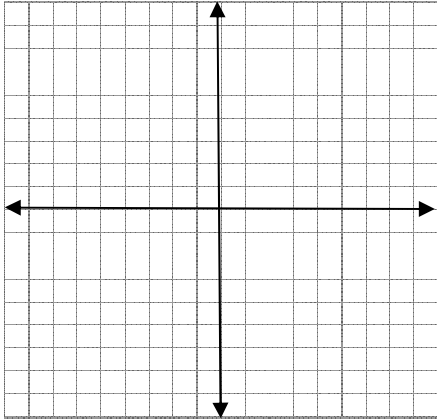


Example: Graph  $y = -3x + 1$



## Equations of Vertical and Horizontal Lines

Example: Graph the equation  $x = 3$ .



Example: Graph the equation  $y = -2$ .

