

# Linear Functions

## *Slope of a Line*

### Lesson Notes

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

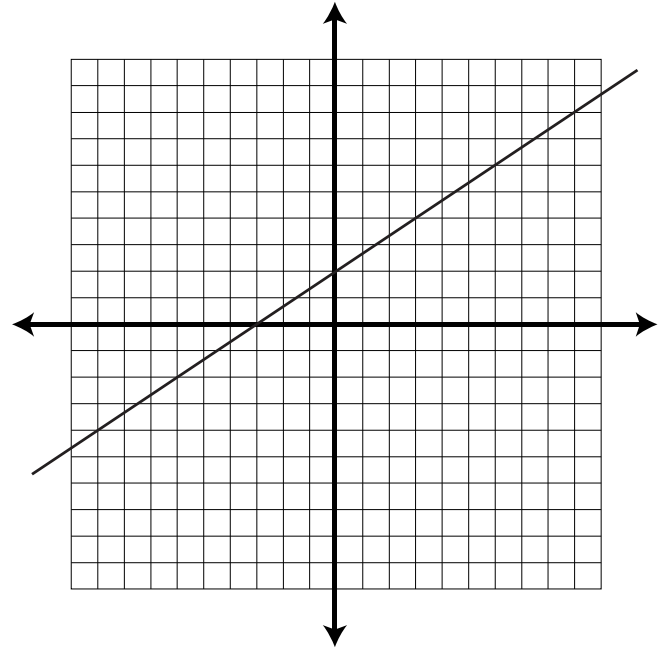


### Introduction

Find the slope of each line.

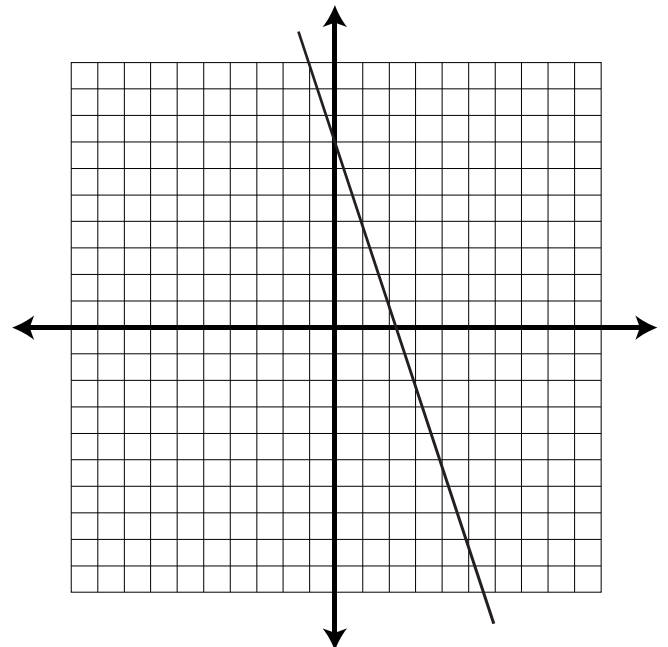
a) using slope =  $\frac{\text{rise}}{\text{run}}$

using slope =  $\frac{y_2 - y_1}{x_2 - x_1}$



b) using slope =  $\frac{\text{rise}}{\text{run}}$

using slope =  $\frac{y_2 - y_1}{x_2 - x_1}$

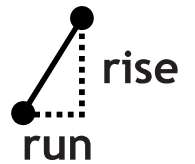


# Linear Functions

## *Slope of a Line*

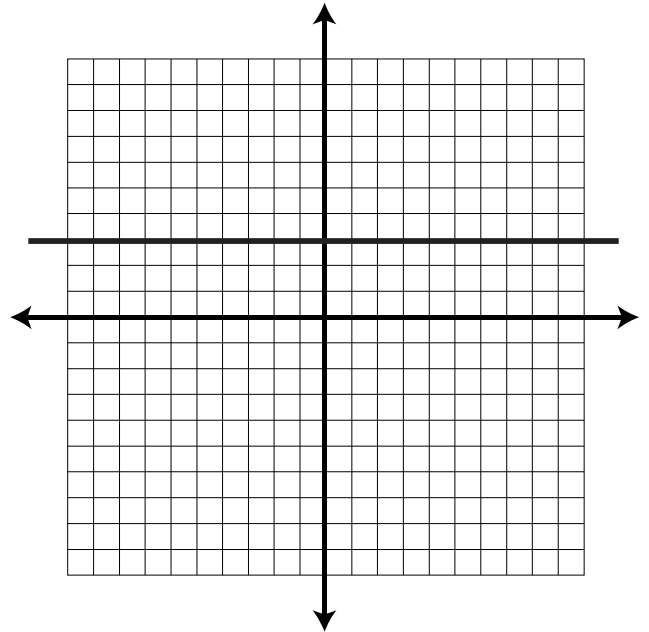
### Lesson Notes

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



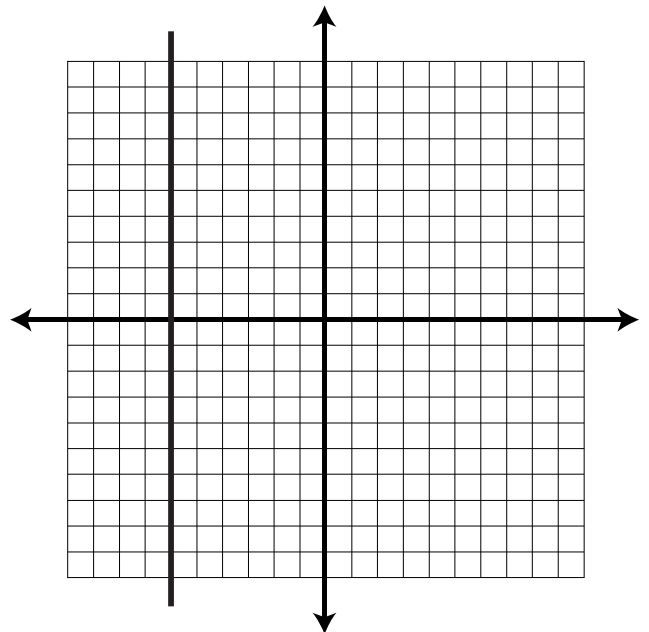
c) using slope =  $\frac{\text{rise}}{\text{run}}$

using slope =  $\frac{y_2 - y_1}{x_2 - x_1}$



d) using slope =  $\frac{\text{rise}}{\text{run}}$

using slope =  $\frac{y_2 - y_1}{x_2 - x_1}$



# Linear Functions

## *Slope of a Line*

### Lesson Notes

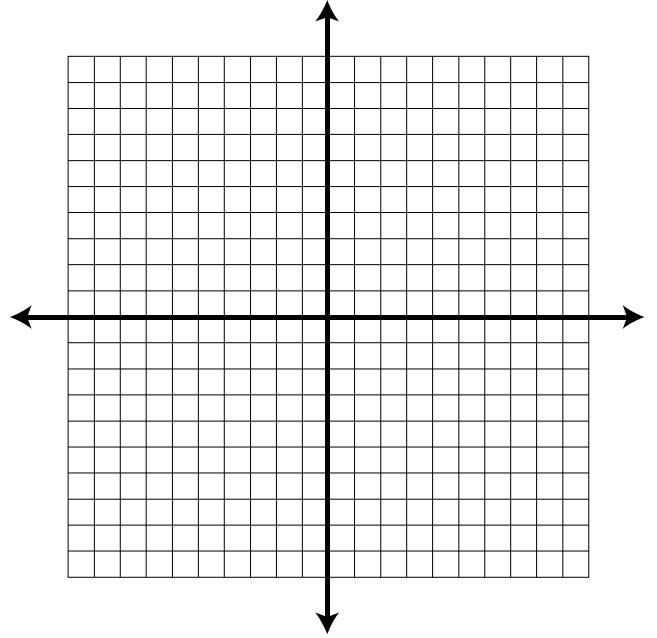
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



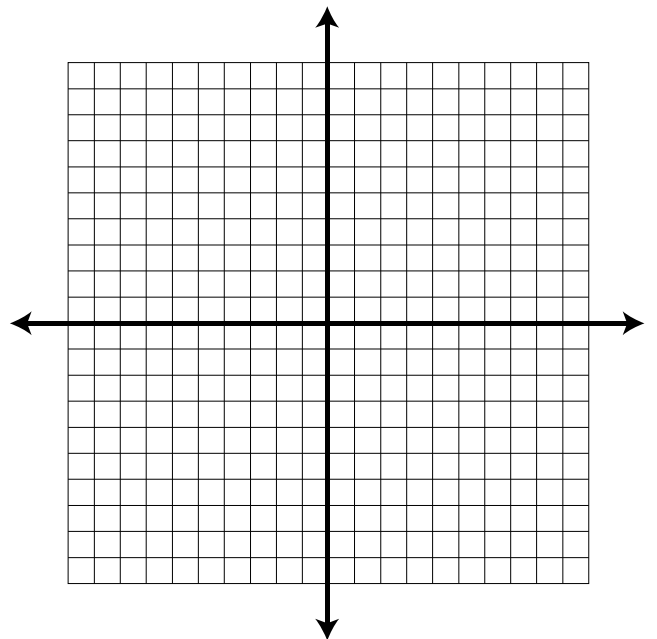
#### Example 1

For each pair of points, graph the line and calculate the slope.

a) A line passes through (-3, 7) and (9, -1).



b) A line passes through (0, -3) and (0, 3)



# Linear Functions

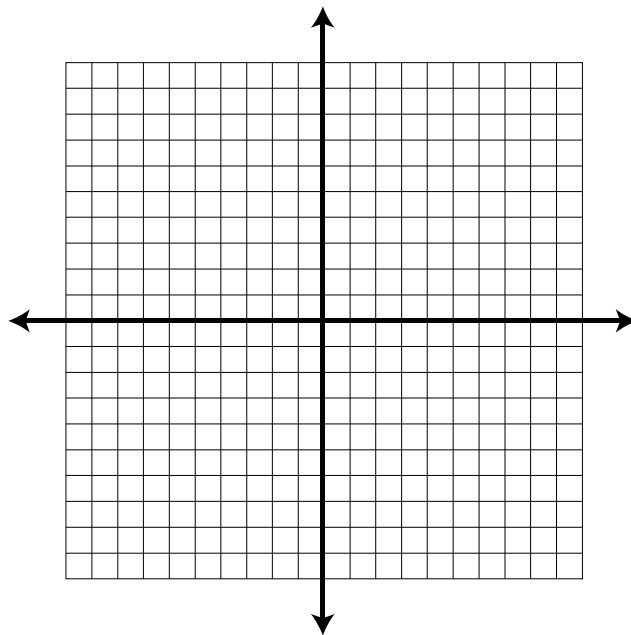
## *Slope of a Line*

### Lesson Notes

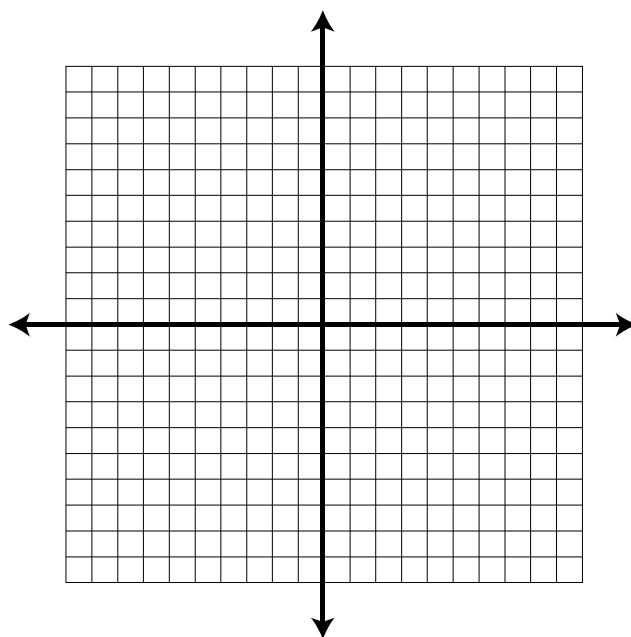
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



c) A line passes through  $(-10, -10)$  and  $(10, -10)$ .



d) A line passes through  $(-3, -5)$  and  $(6, 7)$ .



# Linear Functions

## *Slope of a Line*

### Lesson Notes

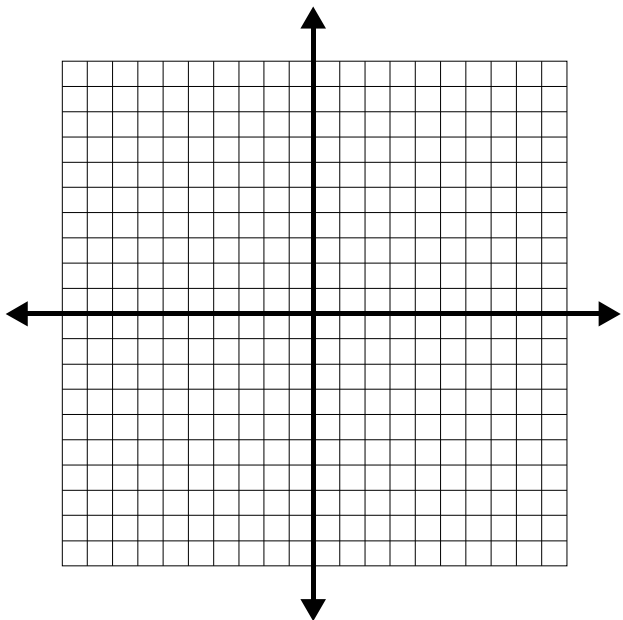
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



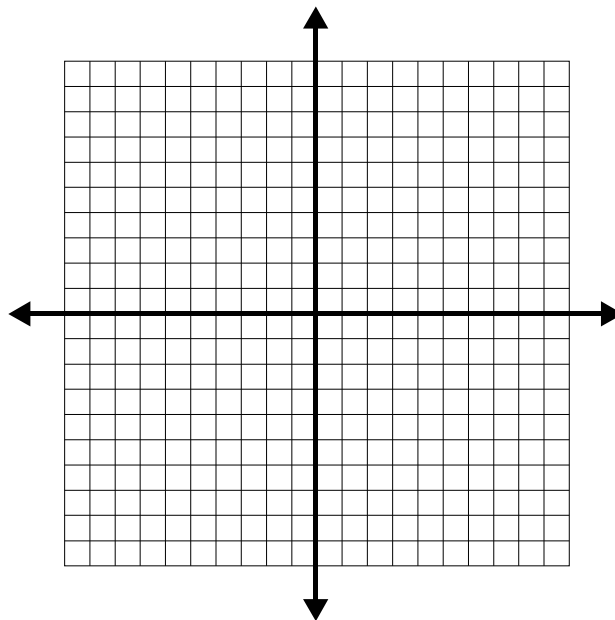
### Example 2

Draw each of the following lines, given the slope and a point on the line.

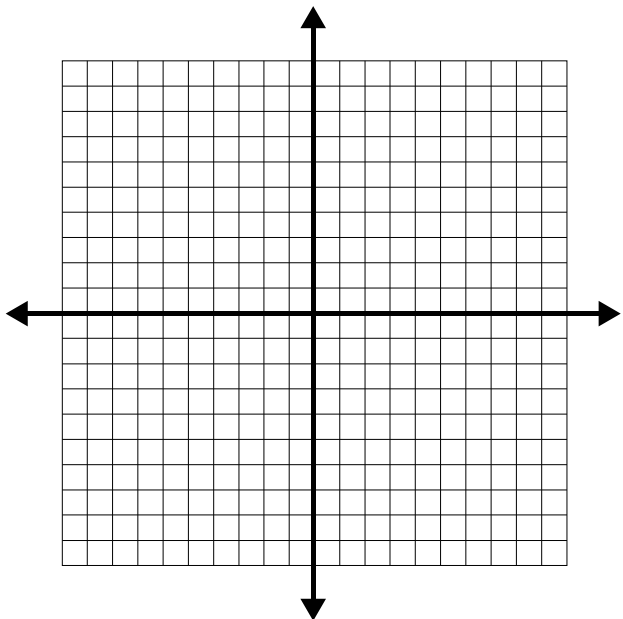
a) Slope =  $\frac{1}{3}$ , Point = (-4, -5)



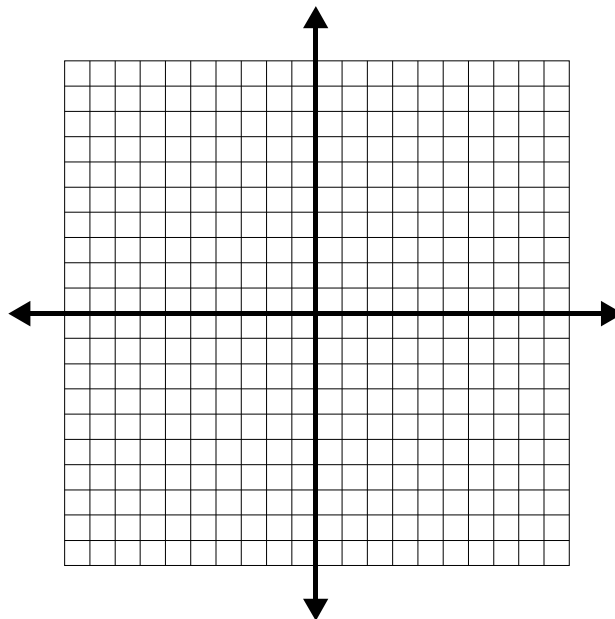
b) Slope = -2, Point = (-3, 7)



c) Slope = undefined, Point = (6, -2)



d) Slope = 0, Point = (-8, 9)



# Linear Functions

## *Slope of a Line*

### Lesson Notes

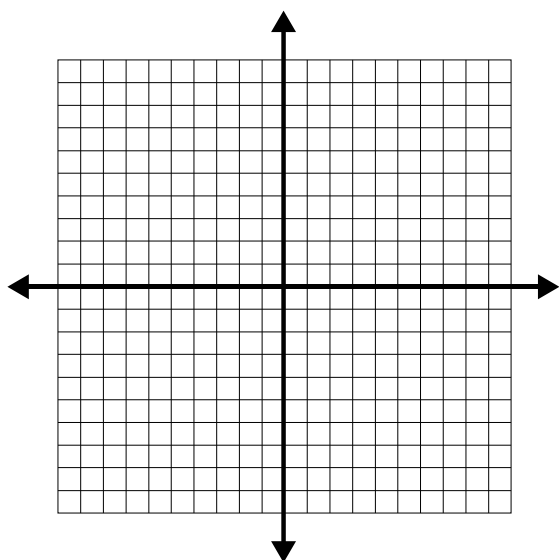
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



#### Example 3

a) A line has points located at  $(-3, 5)$  and  $(4, a)$ . What is the value of  $a$  if the slope is  $-2$ ? Solve this question both graphically and algebraically.

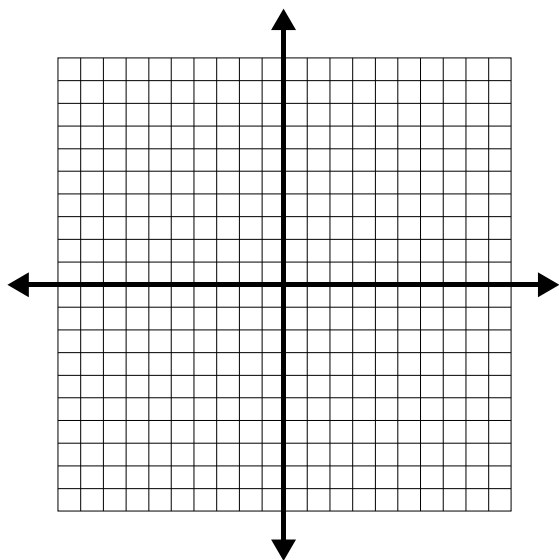
##### Graphical Solution



##### Algebraic Solution

b) A line has points located at  $(a, 3)$  and  $(2, 9)$ . What is the value of  $a$  if the slope is  $\frac{3}{5}$ ? Solve this question both graphically and algebraically.

##### Graphical Solution



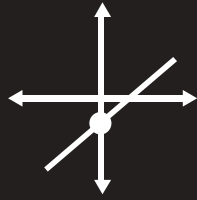
##### Algebraic Solution

# Linear Functions

## *Slope-Intercept Form*

### Lesson Notes

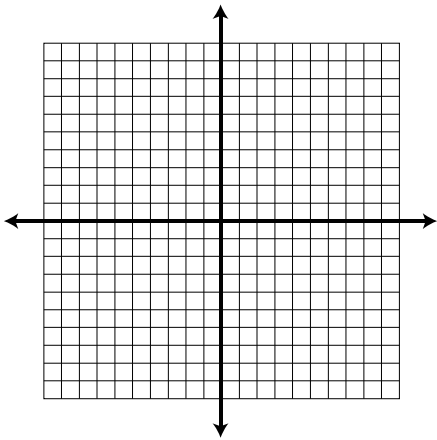
$$y = mx + b$$



## Introduction

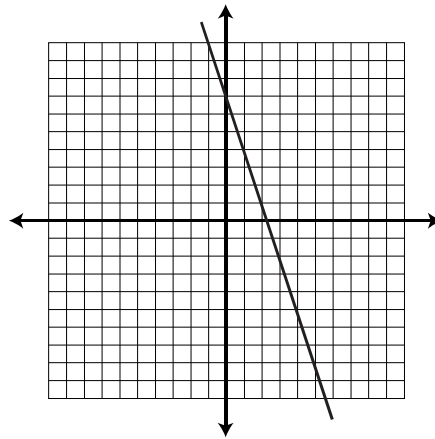
Equation  $\rightarrow$  Graph

a) Draw the graph of  $y = -3x + 7$



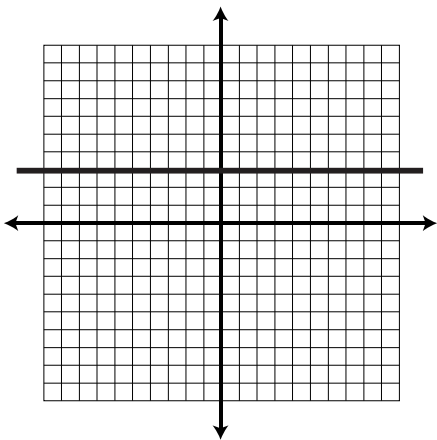
Graph  $\rightarrow$  Equation

b) Determine the slope-intercept equation of the line shown.



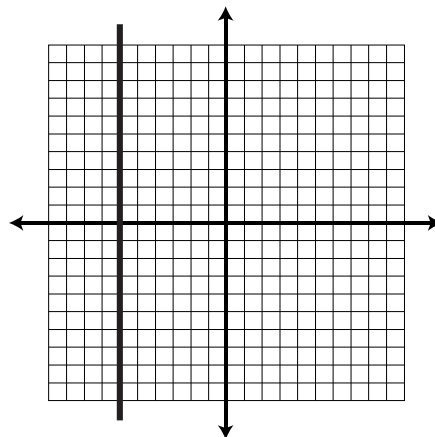
Horizontal Line

c) Find the equation of the horizontal line shown.



Vertical Line

d) Find the equation of the vertical line shown.

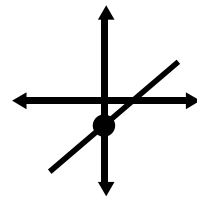


# Linear Functions

## *Slope-Intercept Form*

### Lesson Notes

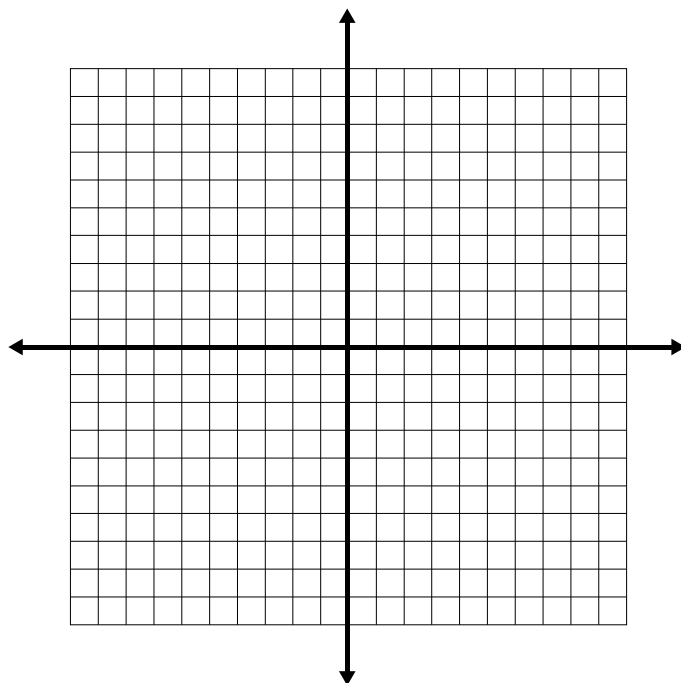
$$y = mx + b$$



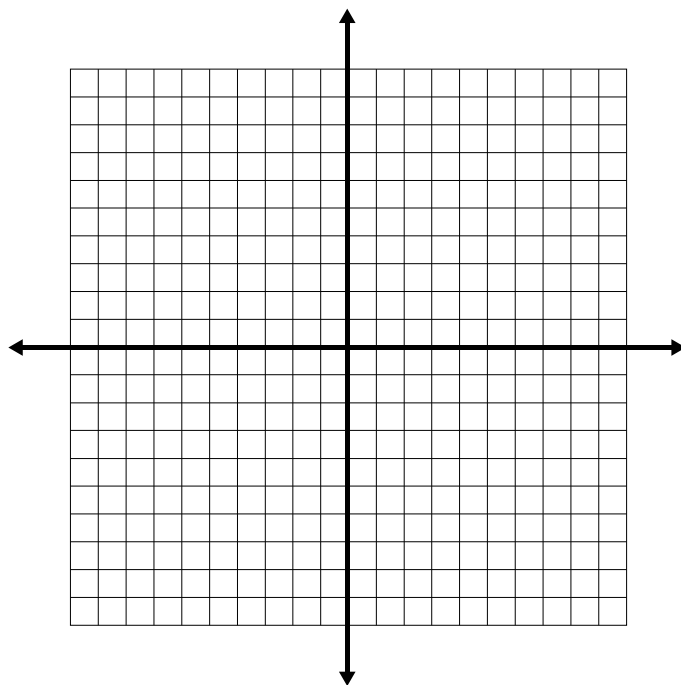
#### Example 1

Given the following slope-intercept equations, graph the line.

a)  $y = 3x - 2$



b)  $y = -\frac{4}{3}x + 1$



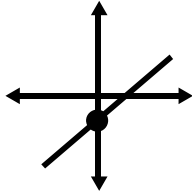


# Linear Functions

## *Slope-Intercept Form*

### Lesson Notes

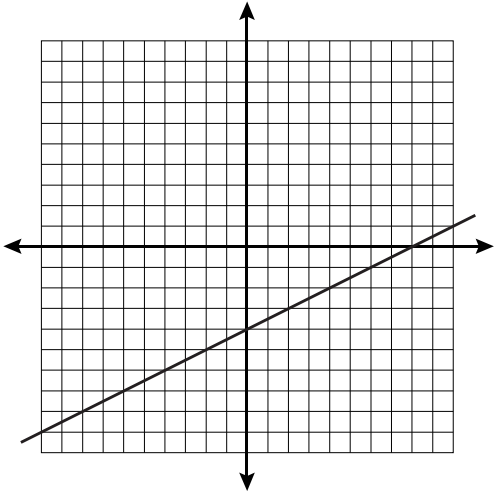
$$y = mx + b$$



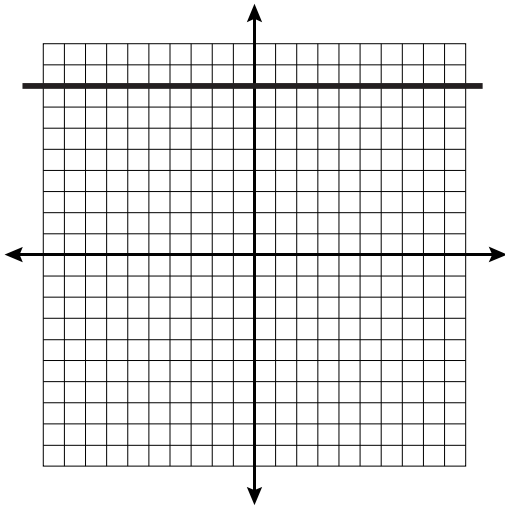
### Example 2

Write the equation of each graph.

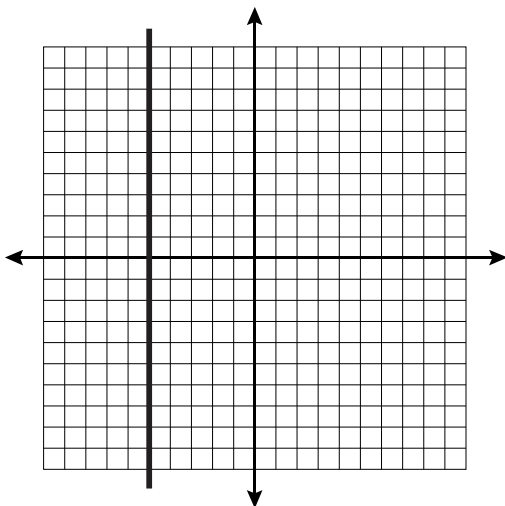
a)



b)



c)

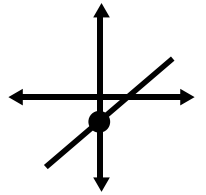


# Linear Functions

## Slope-Intercept Form

### Lesson Notes

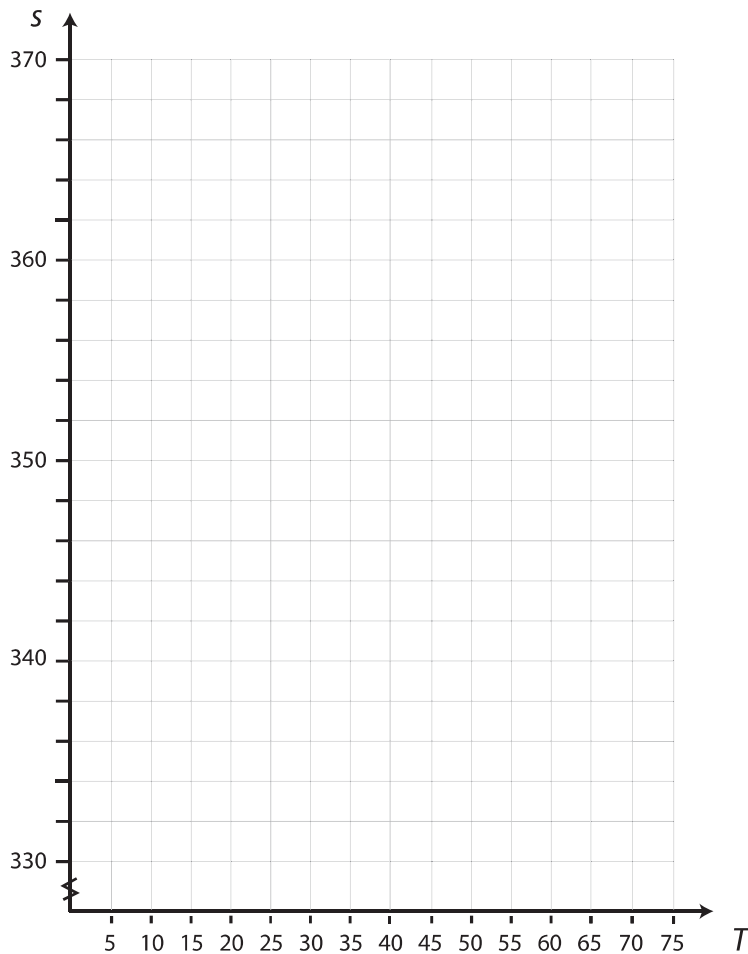
$$y = mx + b$$



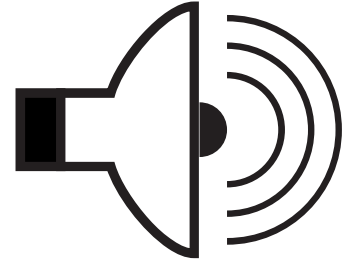
#### Example 3

The speed of sound at 0 °C is 331 m/s.  
At 15 °C, the speed increases to 340 m/s.

a) Draw a graph representing this data.



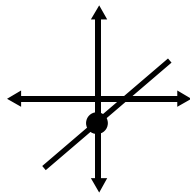
b) Write an equation for the speed of sound as a function of temperature.



c) What is the speed of sound at 35 °C?

d) At what temperature is the speed of sound 364 m/s?

$$y = mx + b$$



# Linear Functions

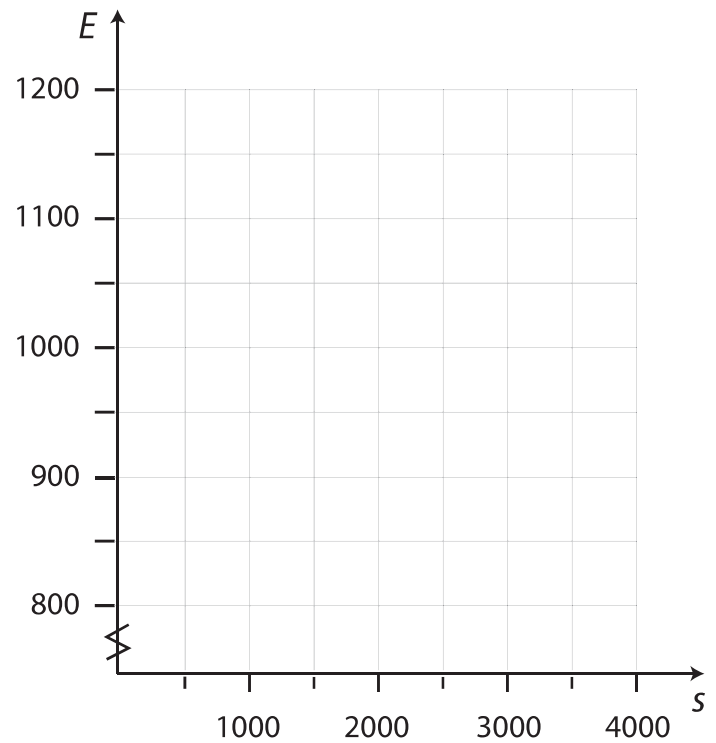
## *Slope-Intercept Form*

### Lesson Notes

#### Example 4

John is a salesman earning \$800 per week plus a 9% commission.

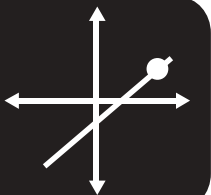
a) Write an equation for John's earnings as a function of sales. Graph the function.



b) If John sells \$2500 worth of product in a week, what does he earn?

c) How much did John sell if he earned \$1016 in a week?

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



# Linear Functions

## Slope-Point Form

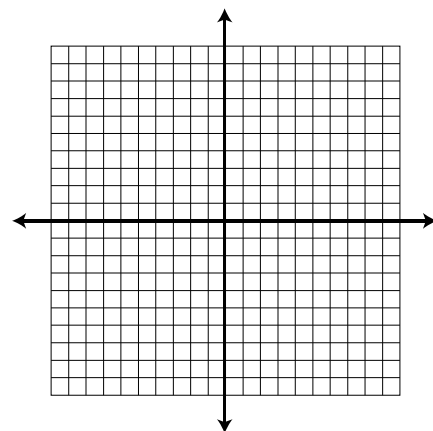
### Lesson Notes

#### Introduction

The equation of a line in slope-point form is  $y - 3 = -\frac{1}{2}(x + 5)$

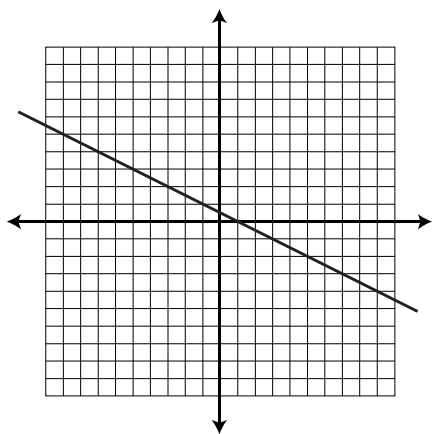
Equation  $\rightarrow$  Graph

a) Draw the graph of  $y - 3 = -\frac{1}{2}(x + 5)$



Graph  $\rightarrow$  Equation

b) Determine the slope-point equation of the line shown.



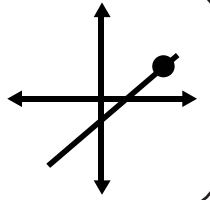
c) How can you tell if slope-intercept form or slope-point form should be used to find the equation of a line?

# Linear Functions

## *Slope-Point Form*

### Lesson Notes

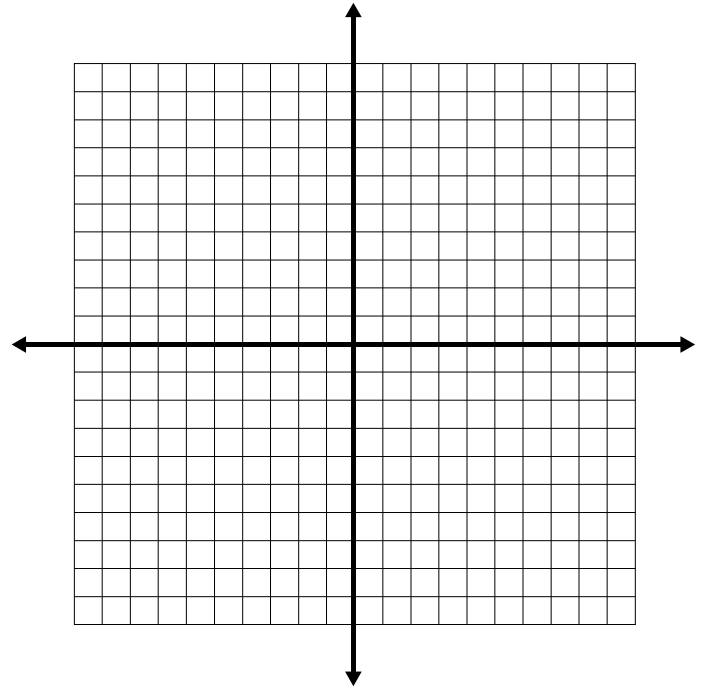
$$y - y_1 = m(x - x_1)$$



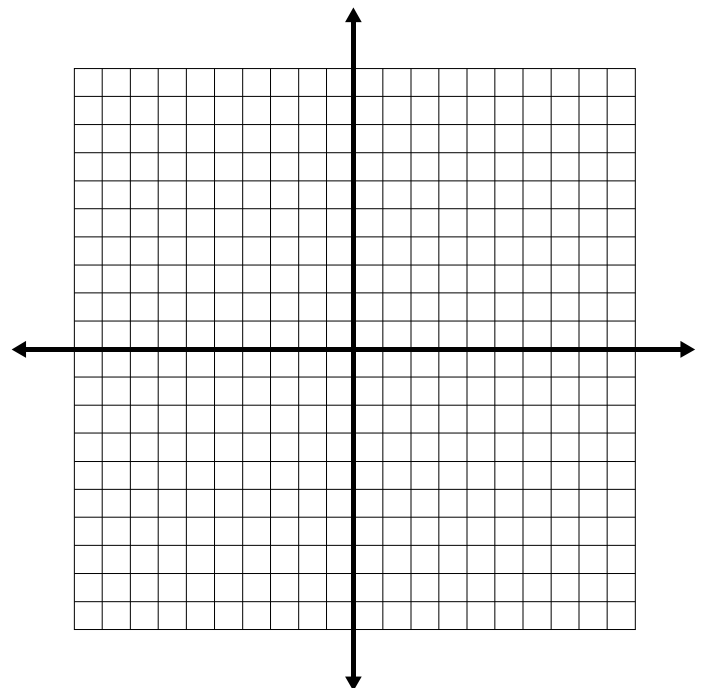
#### Example 1

Graph each of the following lines

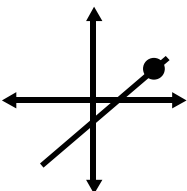
a)  $y + 4 = -\frac{1}{2}(x - 1)$



b)  $y = \frac{4}{3}(x + 5)$



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



# Linear Functions

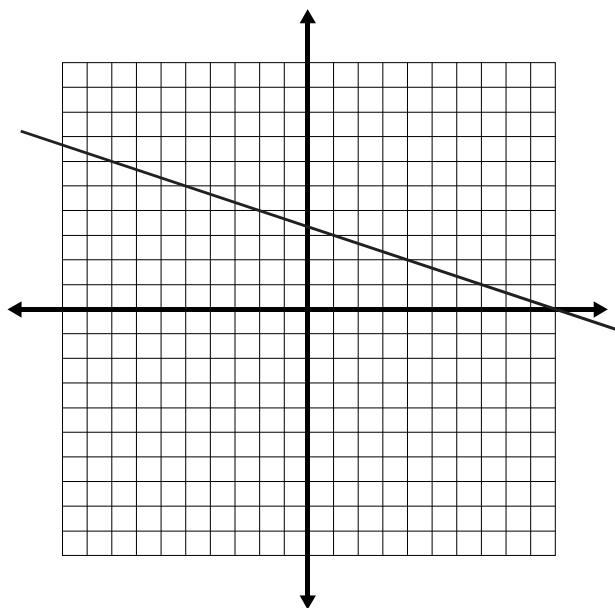
## *Slope-Point Form*

### Lesson Notes

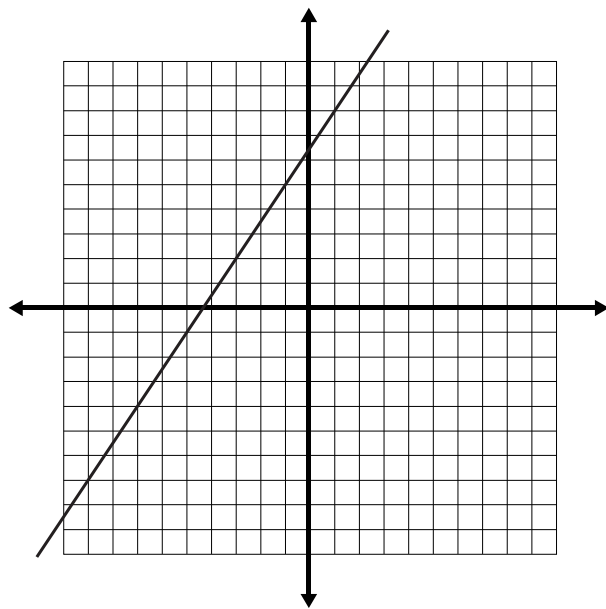
### Example 2

Find the slope-point equation for each of the following lines.

a)



b)

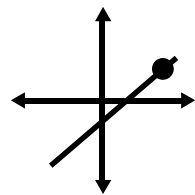


# Linear Functions

## *Slope-Point Form*

### Lesson Notes

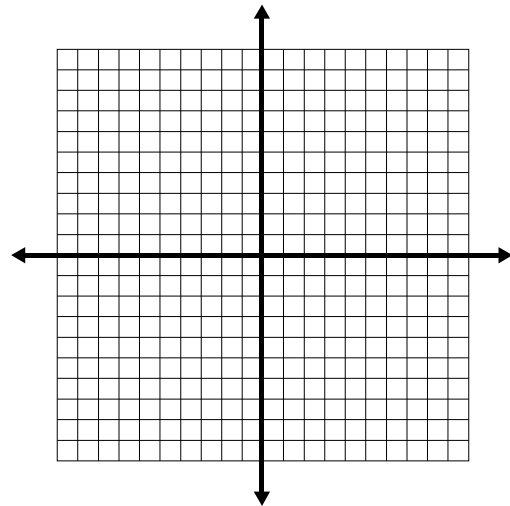
$$y - y_1 = m(x - x_1)$$



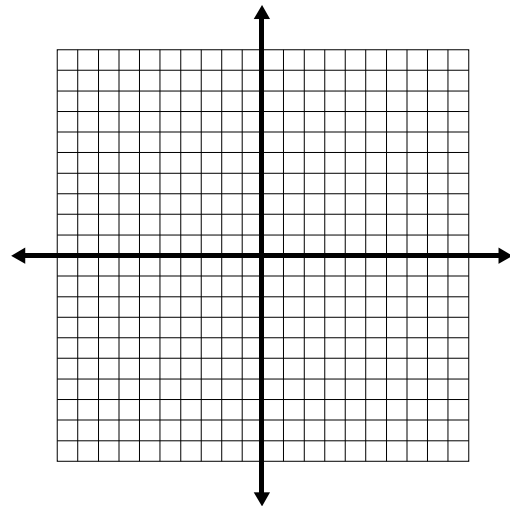
### Example 3

Draw each line and determine its equation.

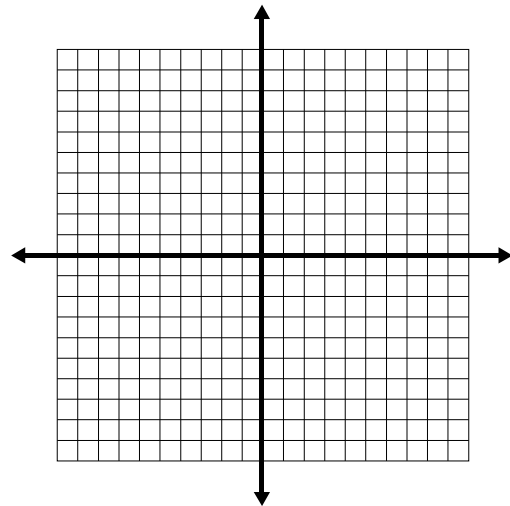
a) A line passes through the points  $(-3, -1)$  and  $(2, -6)$ .



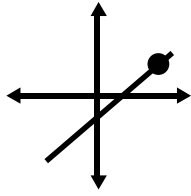
b) A line passes through the points  $(-4, 7)$  and  $(5, -3)$ .



c) A line passes through the points  $(-9, -7)$  and  $(-9, -4)$ .



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



# Linear Functions

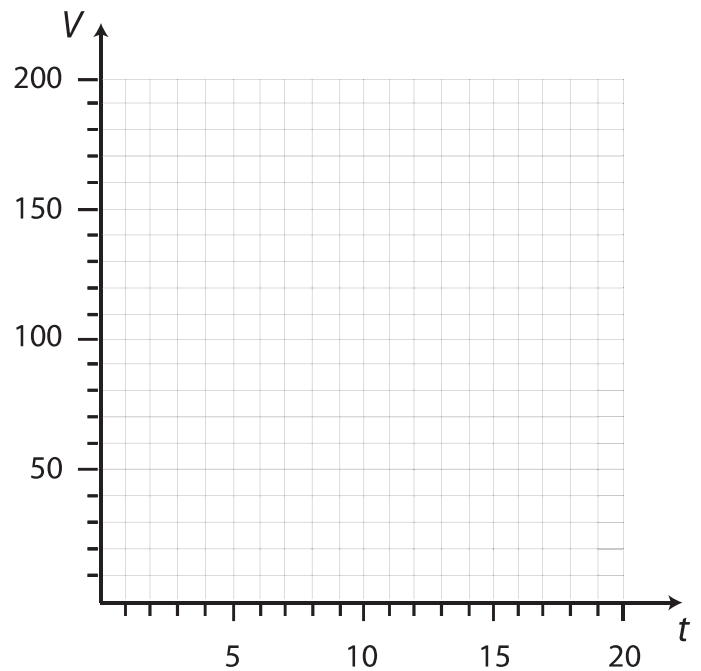
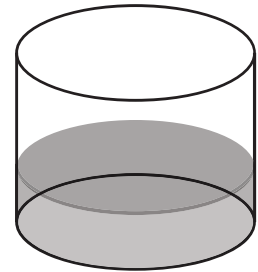
## *Slope-Point Form*

### Lesson Notes

#### Example 5

A cylindrical tank contains an unknown amount of water. If water is added to the tank at a rate of 5 L/min for 12 minutes, the volume of the water will be 89 L.

a) Write an equation for the volume of the tank as a function of time. Draw the graph.



b) What is the volume of water in the tank after 17 minutes?

c) The maximum volume of the tank is 134 L. How long can the tank be filled before it overflows?

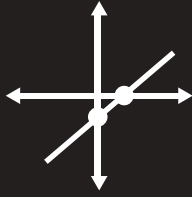


# Linear Functions

## General Form

### Lesson Notes

$$Ax + By + C = 0$$

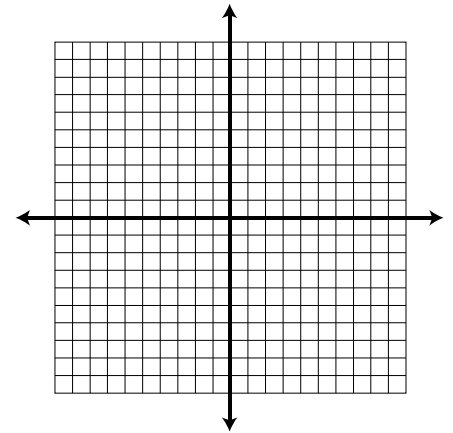


### Introduction

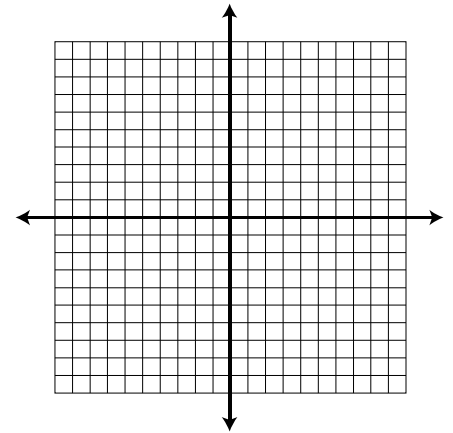
The equation of a line is  $3x + y + 3 = 0$ .

Equation  $\rightarrow$  Graph

a) Write  $3x + y + 3 = 0$  in slope-intercept form and draw the graph.

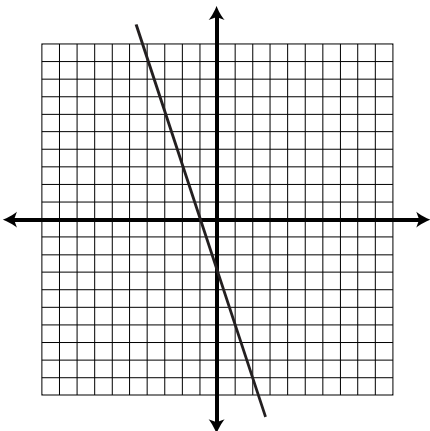


b) Find the intercepts of  $3x + y + 3 = 0$  and draw the graph.



Graph  $\rightarrow$  Equation

c) Determine the general form equation of the line shown.

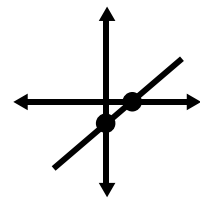


# Linear Functions

## General Form

## Lesson Notes

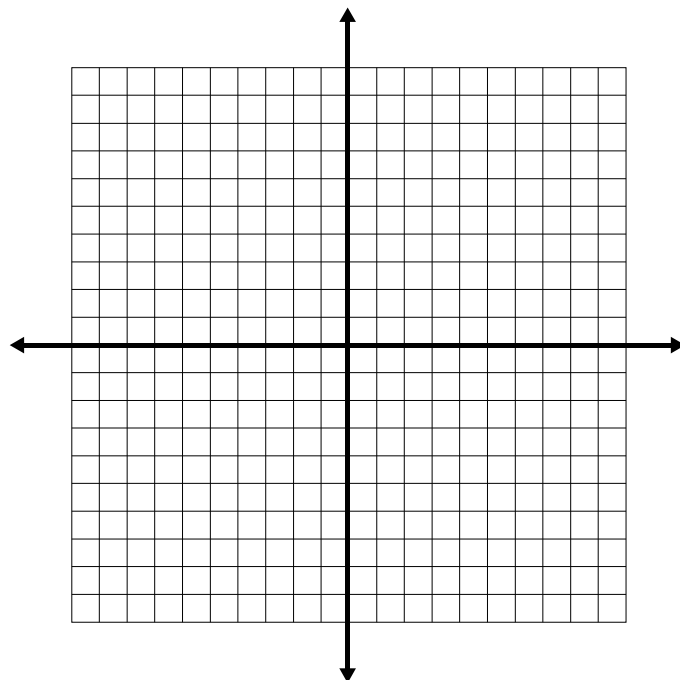
$$Ax + By + C = 0$$



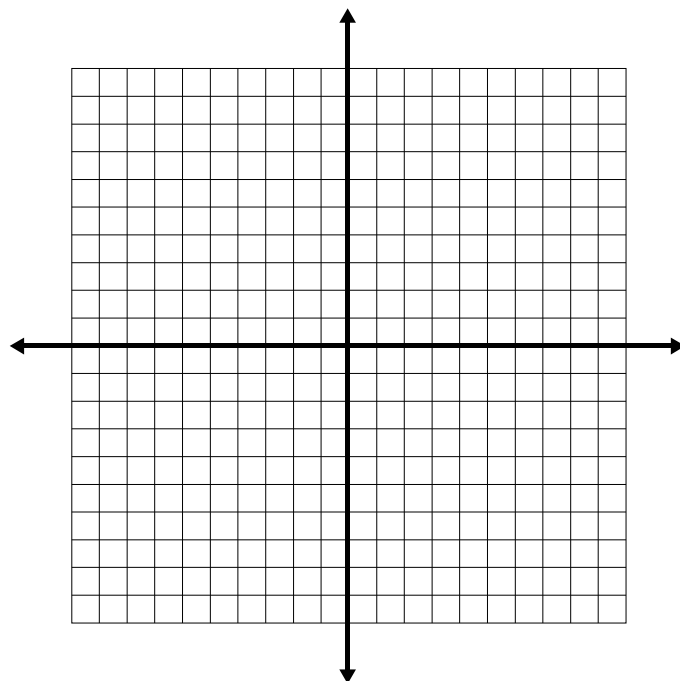
### Example 1

Write each equation in slope-intercept form and graph the line.

a)  $2x - y + 3 = 0$



b)  $\frac{3}{4}x - \frac{3}{2}y - 6 = 0$

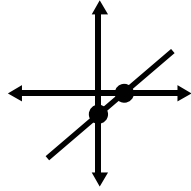


# Linear Functions

## General Form

### Lesson Notes

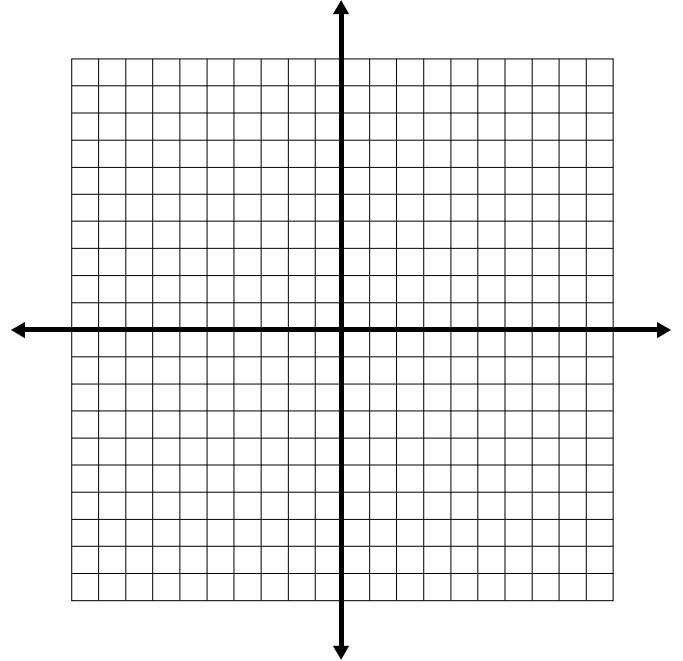
$$Ax + By + C = 0$$



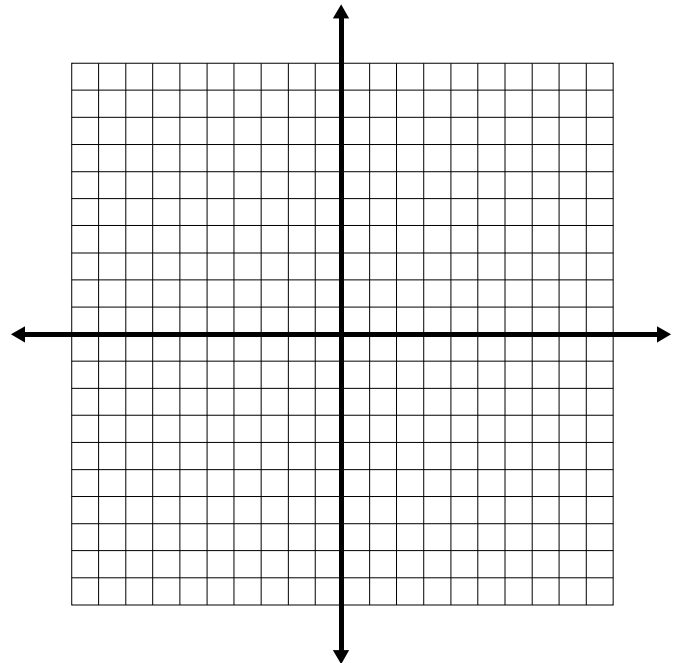
### Example 2

Graph each equation using x & y intercepts.

a)  $7x - 8y - 56 = 0$



b)  $\frac{1}{5}x - \frac{1}{2}y - 1 = 0$

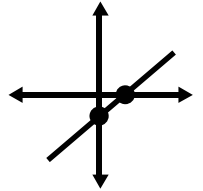


# Linear Functions

## General Form

### Lesson Notes

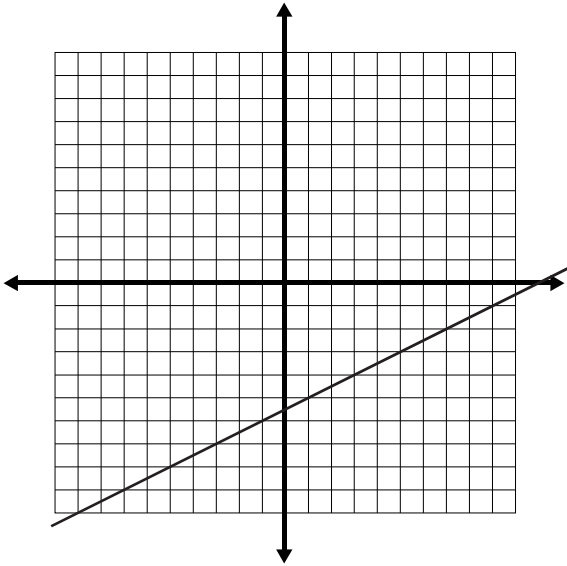
$$Ax + By + C = 0$$



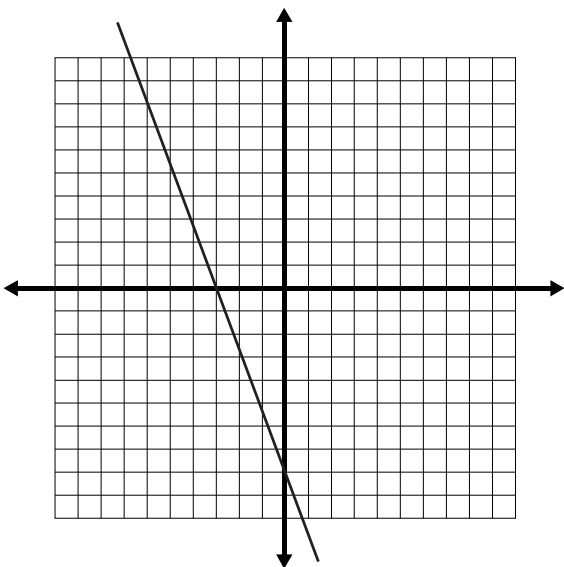
#### Example 3

Determine the general form equation of each line shown below.

a)



b)



$$m_{\parallel} = m_{\text{original}}$$

$$m_{\perp} = -\frac{1}{m_{\text{original}}}$$



# Linear Functions

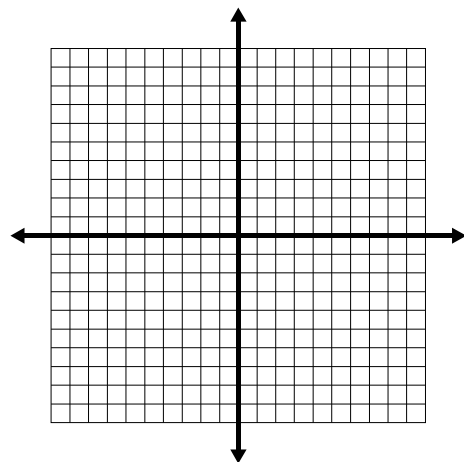
## Parallel and Perpendicular Lines

### Lesson Notes

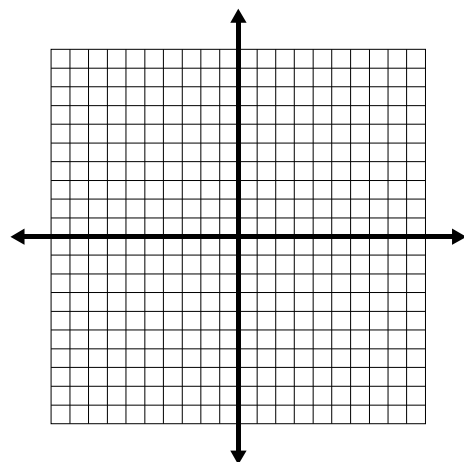
#### Introduction

Graph each pair of lines and calculate the slope of each line. State if the pair of lines is parallel, perpendicular, or neither.

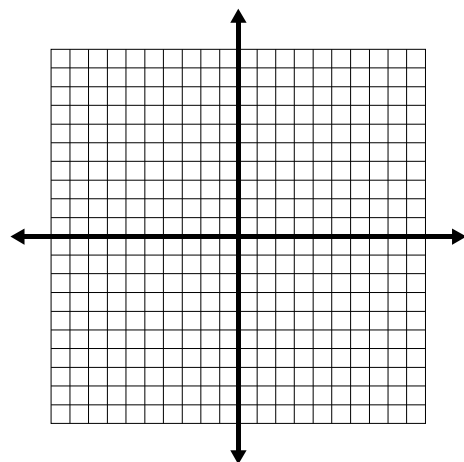
- a) Points on Line 1: (-9, -9) & (-4, -1)  
Points on Line 2: (1, 1) & (6, 9)



- b) Points on Line 1: (-5, 6) & (1, -1)  
Points on Line 2: (-4, 0) & (3, 6)



- c) Points on Line 1: (-5, -5) & (4, 10)  
Points on Line 2: (4, -5) & (8, 0)



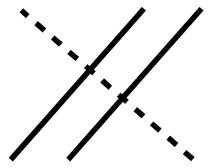
# Linear Functions

## Parallel and Perpendicular Lines

### Lesson Notes

$$m_{\parallel} = m_{\text{original}}$$

$$m_{\perp} = -\frac{1}{m_{\text{original}}}$$



#### Example 1

For each pair of slopes, find the value of  $a$ .

- i) if the slopes are parallel to each other
- ii) if the slopes are perpendicular to each other

a)  $\frac{5}{4}, \frac{a}{8}$

parallel

perpendicular

b)  $-\frac{2}{a}, 3$

parallel

perpendicular

c) undefined,  $a$

parallel

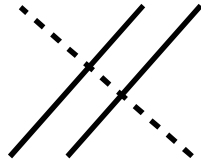
perpendicular

# Linear Functions

## Parallel and Perpendicular Lines

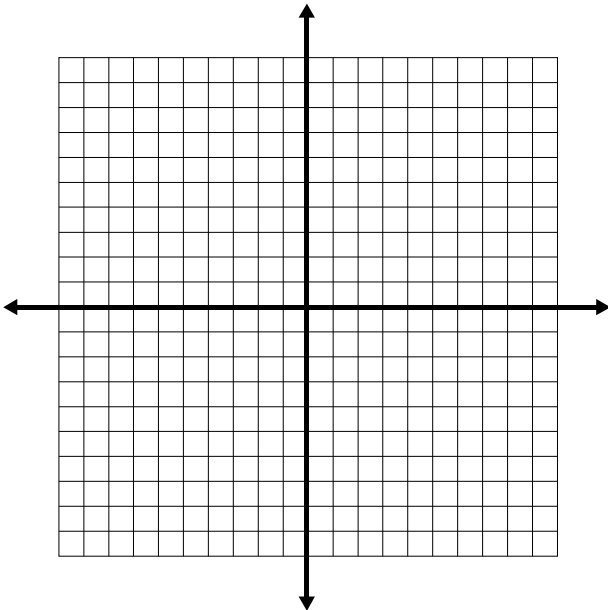
### Lesson Notes

$$m_{\parallel} = m_{\text{original}}$$
$$m_{\perp} = -\frac{1}{m_{\text{original}}}$$

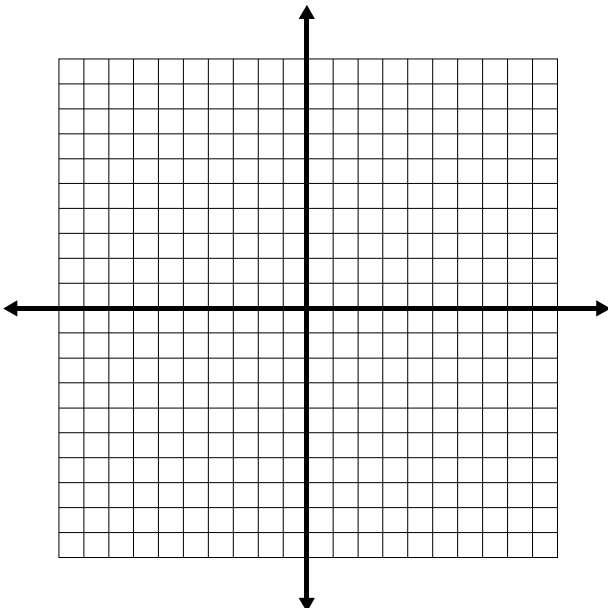


### Example 2

a) A line with points at  $(-9, 5)$  and  $(-4, 8)$  is parallel to a line with points at  $(-4, -5)$  and  $(a, 1)$ . Determine the value of  $a$  using a graphical approach first, then use an algebraic approach.



b) A line with points at  $(-7, 3)$  and  $(1, -3)$  is perpendicular to a line with points at  $(-1, -3)$  and  $(a, 5)$ . Determine the value of  $a$  using a graphical approach first, then use an algebraic approach.



# Linear Functions

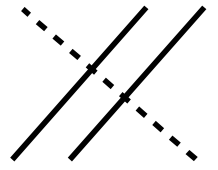
*Parallel and Perpendicular Lines*

## Lesson Notes

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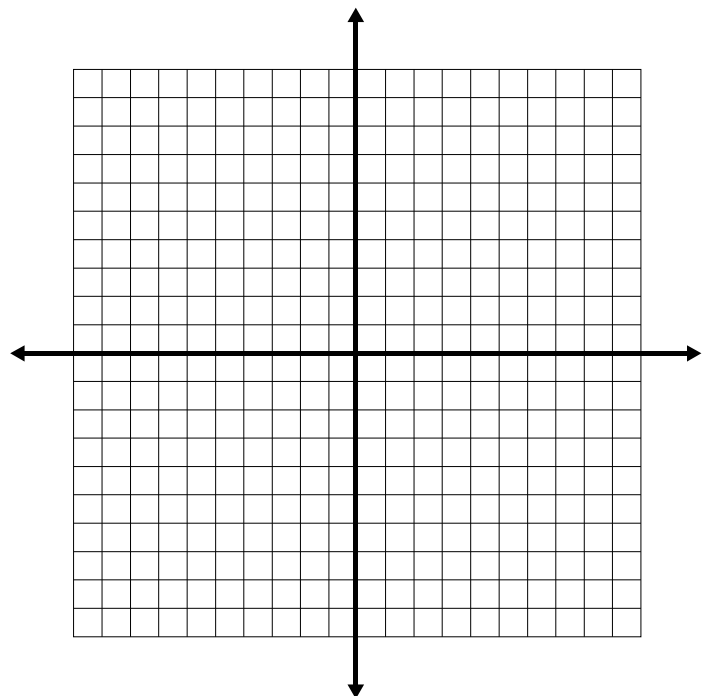
$$m_{\parallel} = m_{\text{original}}$$

$$m_{\perp} = -\frac{1}{m_{\text{original}}}$$



### Example 3

a) Given the equation  $6x - 2y + 10 = 0$ , find the slope-intercept equation of a parallel line passing through  $(-2, -7)$ . Graph the original line and the parallel line on the same coordinate grid.





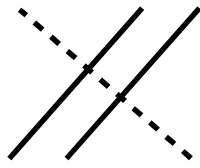
# Linear Functions

## *Parallel and Perpendicular Lines*

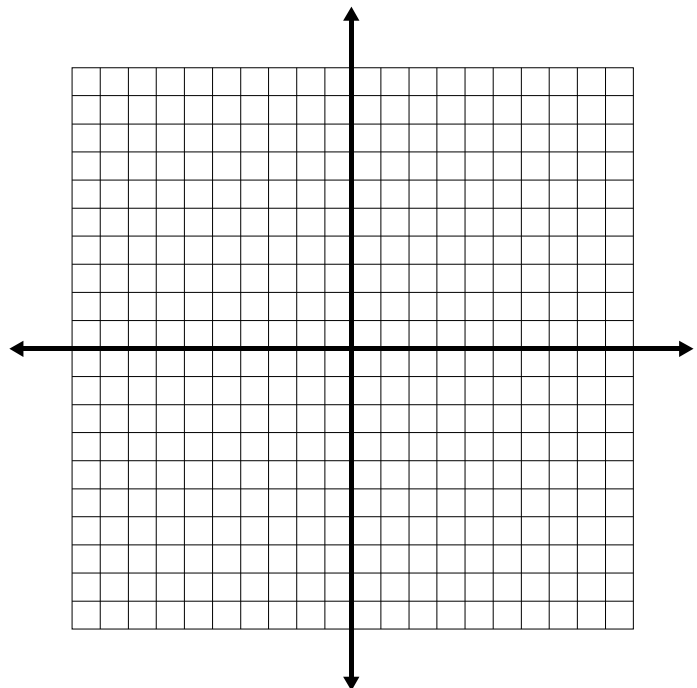
### Lesson Notes

$$m_{\parallel} = m_{\text{original}}$$

$$m_{\perp} = -\frac{1}{m_{\text{original}}}$$



b) Given the equation  $x + 6y - 18 = 0$ , find the slope-intercept equation of a perpendicular line passing through  $(4, -1)$ . Graph the original line and the perpendicular line on the same coordinate grid.



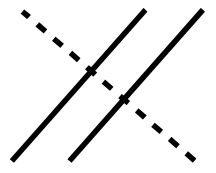
# Linear Functions

## Parallel and Perpendicular Lines

### Lesson Notes

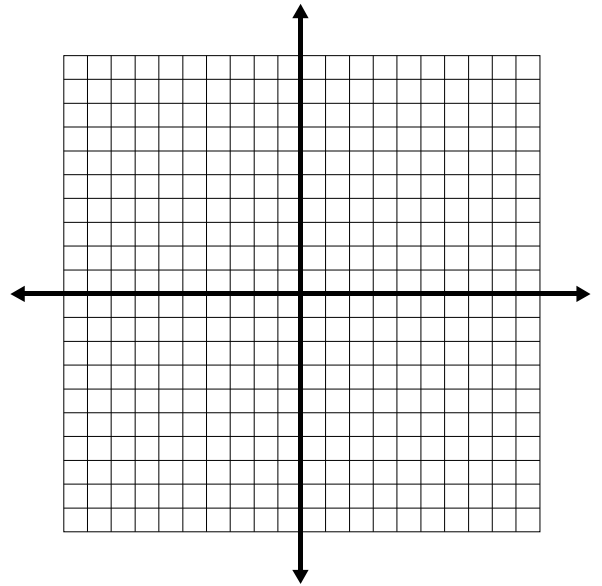
$$m_{\parallel} = m_{\text{original}}$$

$$m_{\perp} = -\frac{1}{m_{\text{original}}}$$

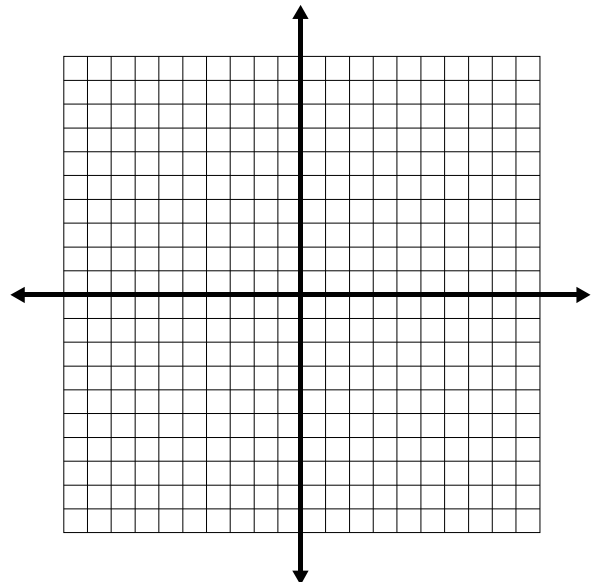


#### Example 4

a) Given the equation  $x - 2 = 0$ , find the equation of a parallel line passing through the point  $(-8, -5)$ . Graph the original line and the parallel line on the same coordinate grid.



b) Given the equation  $y + 4 = 0$ , find the equation of a perpendicular line passing through the point  $(-8, 9)$ . Graph the original line and the perpendicular line on the same coordinate grid.



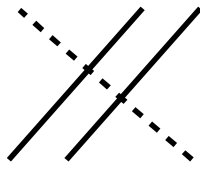
# Linear Functions

## Parallel and Perpendicular Lines

### Lesson Notes

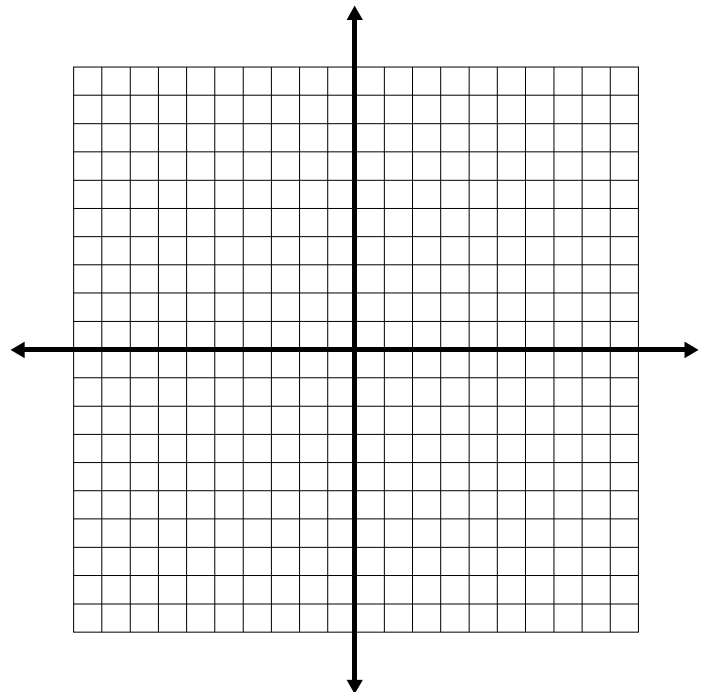
$$m_{\parallel} = m_{\text{original}}$$

$$m_{\perp} = -\frac{1}{m_{\text{original}}}$$



### Example 5

Two perpendicular lines intersect on the x-axis. The equation of one of the lines is  $x - 2y - 2 = 0$ . Find the equation of the other line. Graph the original line and the perpendicular line on the same coordinate grid.



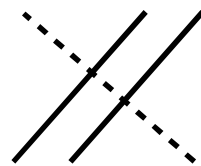
# Linear Functions

## Parallel and Perpendicular Lines

### Lesson Notes

$$m_{\parallel} = m_{\text{original}}$$

$$m_{\perp} = -\frac{1}{m_{\text{original}}}$$



#### Example 6

Given the equation  $2x - y + 5 = 0$ , find the slope-intercept equation of a perpendicular line with the same x-intercept as  $3x - 4y - 24 = 0$ . Graph the original line and the perpendicular line on the same coordinate grid.

