[Warm Up](#)

[Lesson Presentation](#)

[Lesson Quiz](#)

Warm Up

Solve each equation for *y*.

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

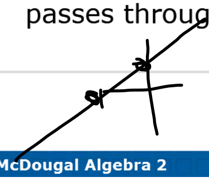
$y = -2x - 8$

1. $7x + 2y = 6$ $y = -\frac{7}{2}x + 3$

2. $\frac{1}{2}y + x = -4$ $y = -2x - 8$

3. If $3x = 4y + 12$, find y when $x = 0$. $y = -3$

4. If a line passes through (–5, 0) and (0, 2), then it passes through all but which quadrant.



Objectives

Determine whether a function is linear.

Graph a linear function given two points, a table, an equation, or a point and a slope.

Vocabulary

linear function

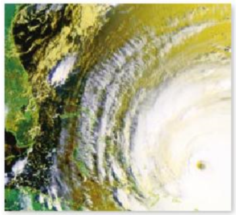
slope

y-intercept

x-intercept

slope-intercept form

Meteorologists begin tracking a hurricane's distance from land when it is 350 miles off the coast of Florida and moving steadily inland.



The meteorologists are interested in the rate at which the hurricane is approaching land.

+2

+1 +1 +1 +1

Ind.

dep.

−25 −25 −25 −25

−50

This rate can be expressed as $\dfrac{\text{change in distance}}{\text{change in time}} = \dfrac{-25 \text{ miles}}{1 \text{ hour}}$.

Notice that the rate of change is constant. The hurricane moves 25 miles closer each hour.

$\frac{3}{1}$

Functions with a constant rate of change are called linear functions. A linear function can be written in the form $f(x) = mx + b$, where x is the independent variable and m and b are constants. The graph of a linear function is a straight line made up of all points that satisfy $y = f(x)$.

$f(x)$ $f(h) = mh + b$

Example 1A: Recognizing Linear Functions

Determine whether the data set could represent a linear function.

+2 +2 +2

x	−2	0	2	4
$f(x)$	2	1	0	−1

−1 −1 −1

1

$f(x)$ $\frac{-1}{2}$

Example ... near Functions

Determine w... set could represent a linear function.

+1 +1 +1

x	2	3	4	5
$f(x)$	2	4	8	16

+2 +4 +8

Check It Out! Example 1A

Determine whether the data set could represent a linear function.

+7 +14 +49

x	4	11	25	74
$f(x)$	–6	–15	-33	-96

-9 -18 -63

$\frac{-9}{7} = \frac{-18}{14}$

$\frac{-9}{7}$

$\frac{-63}{49} = \frac{-9}{7}$

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

The constant rate of change for a linear function is its *slope*. The **slope** of a linear function is the ratio $\frac{\text{change in } f(x)}{\text{change in } x}$, or $\frac{\text{rise}}{\text{run}}$. The slope of a line is the same between any two points on the line. You can graph lines by using the slope and a point.

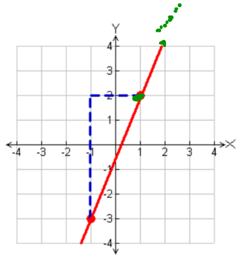
Example 2A: Graphing Lines Using Slope and a Point

Graph the line with slope $\frac{5}{2}$ that passes through (–1, –3).

Plot the point (–1, –3).

The slope indicates a rise of 5 and a run of 2. Move up 5 and right 2 to find another point.

Then draw a line through the points.



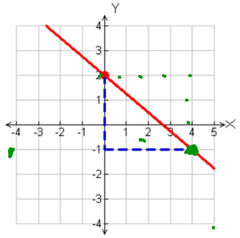
Example 2B: Graphing Lines Using Slope and a Point

Graph the line with slope $-\frac{3}{4}$ that passes through (0, 2).

Plot the point (0, 2).

The negative slope can be viewed as $\frac{-3}{4}$ or $\frac{3}{-4}$.

You can move down 3 units and right 4 units, or move up 3 units and left 4 units.

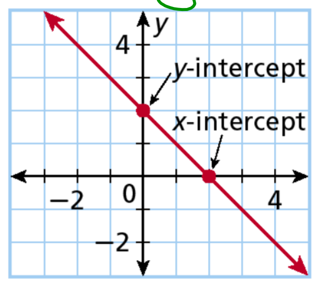


$Ax + By = C$

Recall from geometry that two points determine a line. Often the easiest points to find are the points where a line crosses the axes.

The ***y*-intercept** is the *y*-coordinate of a point where the line crosses the ~~*x*-axis.~~ y-axis

The ***x*-intercept** is the *x*-coordinate of a point where the line crosses the ~~*y*-axis~~. x-axis



Example 3: Graphing Lines Using the Intercepts

Find the intercepts of $4x - 2y = 16$, and graph the line.

y int $4(0) - 2y = 16$ $\frac{-8}{4}$

(0, -8)

x-int. $4x - 2(0) = 16$ $-\frac{b}{a}$

(4, 0)

Check It Out! Example 3

Find the intercepts of $6x - 2y = -24$, and graph the line.

Find the *x*-intercept: $6x - 2y = -24$

$6x - 2(0) = -24$ *Substitute 0 for y.*

$6x = -24$

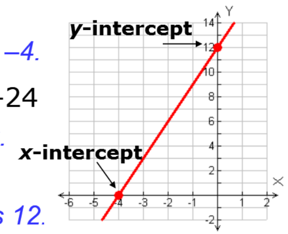
$x = -4$ *The x-intercept is –4.*

Find the *y*-intercept: $6x - 2y = -24$

$6(0) - 2y = -24$ *Substitute 0 for x.*

$-2y = -24$

$y = 12$ *The y-intercept is 12.*



Linear functions can also be expressed as linear equations of the form $y = mx + b$. When a linear function is written in the form $y = mx + b$, the function is said to be in **slope-intercept form** because m is the slope of the graph and b is the y-intercept. Notice that slope-intercept form is the equation solved for y.

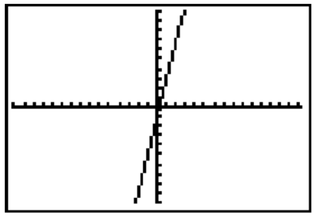
Example 4A: Graphing Functions in Slope-Intercept Form

Write the function $-4x + y = -1$ in slope-intercept form. Then graph the function.

$y = 4x - 1$

Example 4A Continued

You can also use a graphing calculator to graph. Choose the standard square window to make your graph look like it would on a regular grid. Press **ZOOM**, choose **6:ZStandard**, press **ZOOM** again, and then choose **5:ZSquare**.



Check It Out! Example 4A

Write the function $2x - y = 9$ in slope-intercept form. Then graph the function.

$-y = -2x + 9$

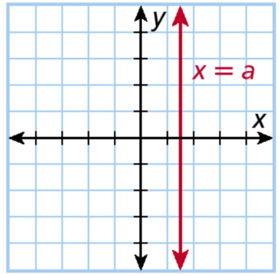
$(0, b)$

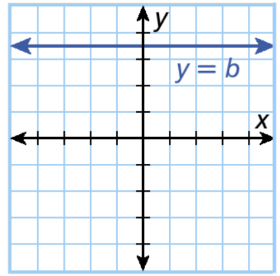
$y = 2x - 9$

An equation with only one variable can be represented by either a vertical or a horizontal line.

Vertical and Horizontal Lines

Vertical Lines	Horizontal Lines
The line $x = a$ is a vertical line at a.	The line $y = b$ is a vertical line at b.





The slope of a vertical line is undefined.

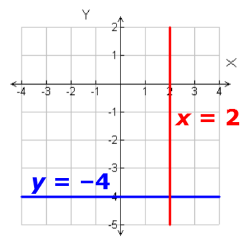
The slope of a horizontal line is zero.

Example 5: Graphing Vertical and Horizontal Lines

Determine if each line is vertical or horizontal.

A. $x = 2$

This is a vertical line located at the x-value 2. (Note that it is not a function.)



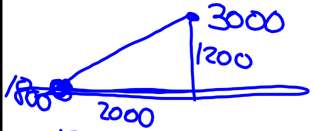
B. $y = -4$

This is a horizontal line located at the y-value −4.

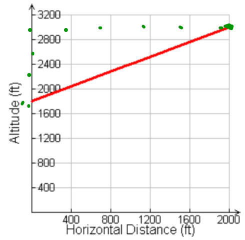
Example 6: Application

A ski lift carries skiers from an altitude of 1800 feet to an altitude of 3000 feet over a horizontal distance of 2000 feet. Find the average slope of this part of the mountain. Graph the elevation against the distance.

x = avg slope



$\frac{1200}{2000}$ $\frac{6}{10}$ $\frac{3}{5}$



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Check It Out! Example 6

A truck driver is at mile marker 624 on Interstate 10. After 3 hours, the driver reaches mile marker 432. Find his average speed. Graph his location on I-10 in terms of mile markers.

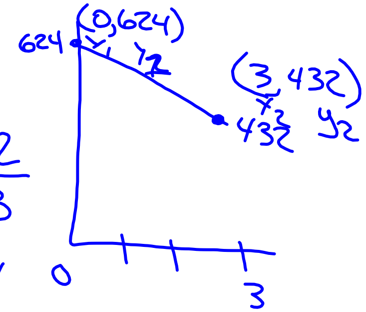
x = avg. speed $\boxed{x = -64}$

x	0	3
f(x)	624	432

-192

$\frac{-192}{3}$

-64



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