STARTER 1.3

Given $f(x) = 3x$ and $g(x) = x^2 - 1$, find each function.

1. $(f + g)(x)$ Answer: $x^2 + 3x - 1$
2. $(f - g)(x)$ Answer: $-x^2 + 3x + 1$
3. $[f \circ g](x)$ Answer: $3x^2 - 3$
4. $[g \circ f](x)$ Answer: $9x^2 - 1$

2

What does it mean to **INTERCEPT** a pass in football?

The path of the defender **crosses** the path of the thrown football.

In algebra, what are ***x***- and ***y***-intercepts?

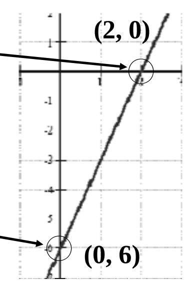
What are the ***x***- and ***y***-intercepts?

The ***x*-intercept** is where the graph crosses the x-axis.

The ***y***-coordinate is always **0**.

The ***y*-intercept** is where the graph crosses the ***y***-axis.

The ***x***-coordinate is always ***0***.



Find the ***x***- and ***y***-intercepts.

1) $x - 2y = 12$

x-intercept: Plug in **0** for ***y***.

$x - 2(\mathbf{0}) = 12$

$x = 12$; **(12, 0)**

y-intercept: Plug in **0** for *x*.

$\mathbf{0} - 2y = 12$

$y = -6$; **(0, -6)**

Find the *x*- and *y*-intercepts.

2) $-3x + 5y = 9$

x-intercept: Plug in **0** for ***y***.

$-3x - 5(\mathbf{0}) = 9$

$-3x = 9$

$x = -3$; **(-3, 0)**

y-intercept: Plug in **0** for ***x***.

$-3(\mathbf{0}) + 5y = 9$

$5y = 9$

$y = \frac{9}{5}$; **(0,** $\frac{9}{5}$ **)**

Slope

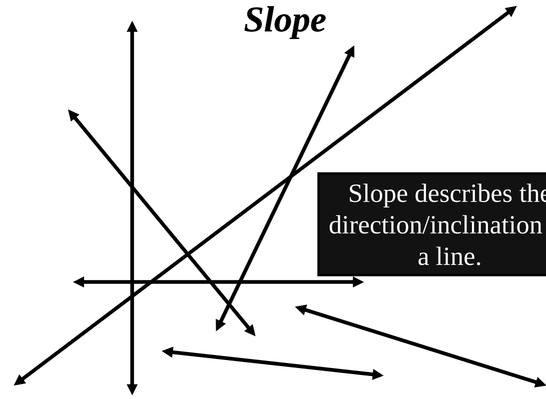
Why is this needed ?

If $x_1 \neq x_2$, the slope of the line through the distinct points (x_1, y_1) and (x_2, y_2) is

Guard against **0** in the denominator

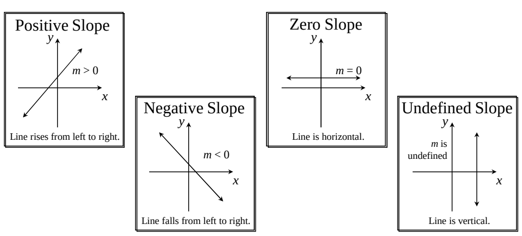
$$\frac{y_2 - y_1}{x_2 - x_1}$$

Slope

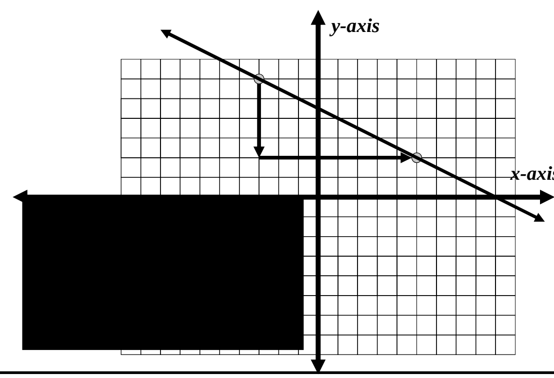


Slope describes the direction/inclination of a line.

The Possibilities for a Line's Slope



Find the slope between (-3, 6) and (5, 2)



Find the slope between (-3, 6) and (5, 2)

Find the slope.

Yellow

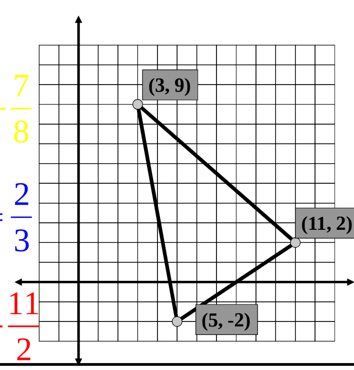
$$m_1 = \frac{2-9}{11-3} = -\frac{7}{8}$$

Blue

$$m_2 = \frac{2-(-2)}{11-5} = \frac{2}{3}$$

Red

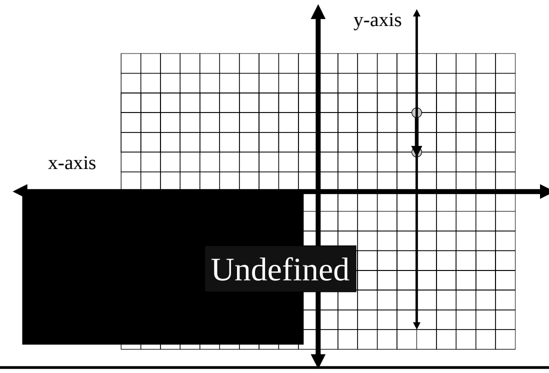
$$m_3 = \frac{-2-9}{5-3} = -\frac{11}{2}$$



Find the slope between (5, 4) and (5, 2).

The slope is undefined.

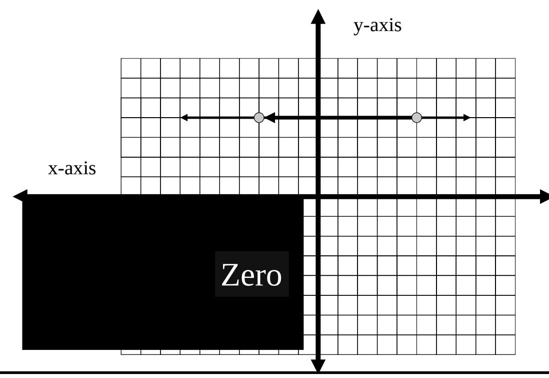
Find the slope between (5, 4) and (5, 2).



Find the slope between (5, 4) and (-3, 4).

This slope is zero.

Find the slope between (5, 4) and (-3, 4).



From these results we can see...

- The slope of a ***vertical line*** is undefined.
- The slope of a ***horizontal line*** is 0.

1.3 Graphing Linear Equations

- Graphing lines
- Finding x and y-intercepts
- Finding slope given two points
- Finding zeros of linear functions

We have used 3 different methods for graphing equations.

1) **using a *t*-table**
2) **using slope-intercept form**
3) **using *x*- and *y*-intercepts**

The goal is to determine which method is the easiest to use for each problem!

Here's your cheat sheet!

- If the equation is in STANDARD FORM (Ax + By = C), graph using the intercepts.
- If the equation is in SLOPE-INTERCEPT FORM (y = mx + b), graph using slope and intercept or a t-table (whichever is easier for you).
- If the equation is in neither form, rewrite the equation in the form you like the best!

Graph $y = \frac{-1}{3}x + 2$

Which graphing method is easiest?
Using slope and y-intercept (or t-table)!

These notes will graph using **m** and **b**

$\mathbf{m} = \frac{-1}{3}$, **b = 2**

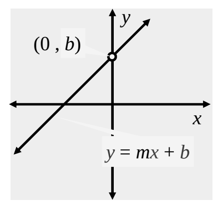
SLOPE-INTERCEPT FORM

If the graph of an equation intersects the *y*-axis at the point (0, *b*), then the number *b* is the *y*-intercept of the graph. To find the *y*-intercept of a line, let *x* = 0 in an equation for the line and solve for *y*.

The slope intercept form of a linear equation is $y = mx + b$.

m is the slope

b is the y-intercept



SLOPE-INTERCEPT FORM

GRAPHING EQUATIONS IN SLOPE-INTERCEPT FORM

The slope-intercept form of an equation gives you a quick way to graph the equation.

STEP 1 Write equation in slope-intercept form by solving for ***y***.

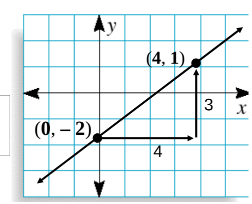
STEP 2 Find ***y***-intercept, use it to plot point where line crosses ***y***-axis.

STEP 3 Find slope, use it to plot a second point on line.

STEP 4 Draw line through points.

EXAMPLE **Graphing with the Slope-Intercept Form**

Graph $y = \frac{3}{4}x - 2$



SOLUTION

The equation is already in slope-intercept form.

The *y*-intercept is –2, so plot the point (0, – 2) where the line crosses the *y*-axis.

The slope is $\frac{3}{4}$, so plot a second point on the line by moving **4 units** to the right and **3 units** up. This point is (4, 1).

Draw a line through the two points.

EXAMPLE **Using the Slope-Intercept Form**

In a real-life context the *y*-intercept often represents an initial amount and the slope often represents a rate of change.

You are buying an $1100 computer on layaway. You make a $250 deposit and then make weekly payments according to the equation $a = 850 - 50t$ where a is the amount you owe and t is the number of weeks.

What is the original amount you owe on layaway?

What is your weekly payment?

Graph the model.

EXAMPLE **Using the Slope-Intercept Form**

What is the original amount you owe on layaway?

SOLUTION

First rewrite the equation as $a = -50t + 850$ so that it is in slope-intercept form.

Then you can see that the a-intercept is 850.

So, the original amount you owe on layaway (the amount when $t = 0$) is **$850**.

EXAMPLE **Using the Slope-Intercept Form**

$a = -50t + 850$

What is your weekly payment?

SOLUTION

From the slope-intercept form you can see that the slope is $m = -50$.

This means that the amount you owe is changing at a rate of **– 50** per week.

In other words, your weekly payment is **$50**.

EXAMPLE **Using the Slope-Intercept Form**

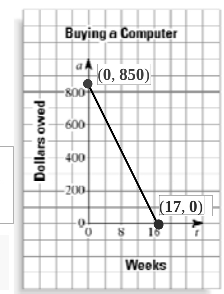
$a = -50t + 850$

Graph the model.

SOLUTION

Notice that the line stops when it reaches the t-axis (at $t = 17$).

The computer is completely paid for at that point.

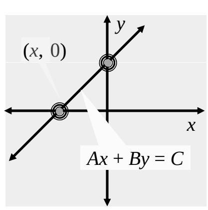


STANDARD FORM

Standard form of a linear equation is $Ax + By = C$. A and B are not both zero. A quick way to graph this form is to plot its intercepts (when they exist).

Draw a line through the two points.

The x-intercept is the x-coordinate of the point where the line intersects the x-axis.



STANDARD FORM

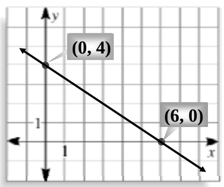
GRAPHING EQUATIONS IN STANDARD FORM

The standard form of an equation gives you a quick way to graph the equation.

1. Write equation in standard form.
2. Find x-intercept by letting $y = 0$. Solve for x. Use x-intercept to plot point where line crosses x-axis.
3. Find y-intercept by letting $x = 0$. Solve for y. Use y-intercept to plot point where line crosses y-axis.
4. Draw line through points.

EXAMPLE **Drawing Quick Graphs**

Graph $2x + 3y = 12$



SOLUTION

METHOD 1: USE STANDARD FORM

$2x + 3y = 12$ Standard form.

$2x + 3(\mathbf{0}) = 12$ Let $y = \mathbf{0}$.

$x = 6$ Solve for $\boldsymbol{x}$.

The $\boldsymbol{x}$-intercept is 6, so plot the point **(6, 0)**.

$2(\mathbf{0}) + 3y = 12$ Let $x = \mathbf{0}$.

$y = 4$ Solve for y.

The $\boldsymbol{y}$-intercept is 4, so plot the point **(0, 4)**.

Draw a line through the two points.

STANDARD FORM

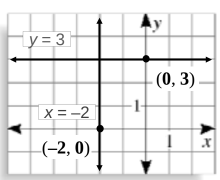
The equation of a vertical line cannot be written in slope-intercept form because the slope of a vertical line is not defined. Every linear equation, however, can be written in standard form—even the equation of a vertical line.

HORIZONTAL AND VERTICAL LINES

HORIZONTAL LINES	The graph of $y = \boldsymbol{c}$ is a horizontal line through $(0, \boldsymbol{c})$.
VERTICAL LINES	The graph of $x = \boldsymbol{c}$ is a vertical line through $(\boldsymbol{c}, 0)$.

EXAMPLE **Graphing Horizontal and Vertical Lines**

Graph $y = 3$ and $x = -2$



SOLUTION

The graph of $\mathbf{y = 3}$ is a horizontal line that passes through the point $(\mathbf{0}, \mathbf{3})$. Notice that every point on the line has a y-coordinate of 3.

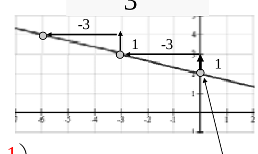
The graph of $\mathbf{x = -2}$ is a vertical line that passes through the point $(-\mathbf{2}, \mathbf{0})$. Notice that every point on the line has an x-coordinate of -2.

Review: Graphing with slope-intercept

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

1. Start by graphing the y-intercept (b = 2).
2. From the y-intercept, apply "rise over run" using your slope. rise = 1, run = -3
3. Repeat this again from your new point.
4. Draw a line through your points.

$$\left(m = -\frac{1}{3}\right)$$



Graph -2x + 3y = 12

Which graphing method is easiest?

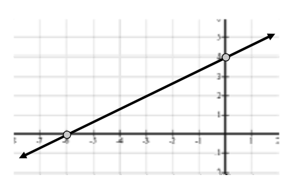
Using x- and y-intercepts!
(The equation is in standard form)

Remember, plug in "0" to find the intercepts.

Review: Graphing with intercepts:

-2x + 3y = 12

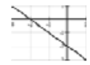
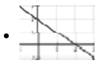
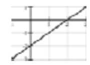
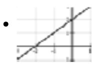
1. Find your x-intercept:
   Let y = 0
   -2x + 3(0) = 12
   x = -6; (-6, 0)
2. Find your y-intercept:
   Let x = 0
   -2(0) + 3y = 12
   y = 4; (0, 4)
3. Graph both points and draw a line through them.



Which method is easiest to graph -3x + 6y = 2?

1. T-table
2. Slope and intercept
3. X- and Y-intercepts
4. Graphing calculator

Which is the graph of y = x + 2?

1. 
2. 
3. 
4.  ✓

Lesson 1.3

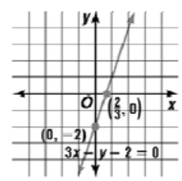
Lesson Essential Question:
Graphing Linear Equations

Given a linear equation, how do you graph it?

Vocabulary
- Linear Equation
- X-intercept
- Y-intercept
- Slope
- Standard Form
- Slope-intercept form
- Zero of a function
- Constant function

Graphing equations of lines

- What would you do to graph the following equation? 3x -y – 2 = 0

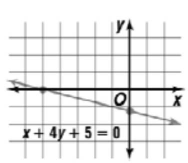


Example 1 Graph $x + 4y + 5 = 0$ using the x- and y-intercepts.

Step 1: Substitute 0 for y to find the x-intercept.
$x + 4y + 5 = 0$
$x + 4(0) + 5 = 0$
$x = -5$

Step 2: Substitute 0 for x to find the y-intercept.
$x + 4y + 5 = 0$
$0 + 4y + 5 = 0$
$y = -\frac{5}{4}$ or $-1\frac{1}{4}$

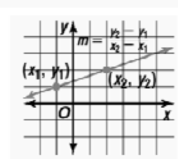
Step 3: Graph the intercepts and draw the line.



Slope of a line

The slope, m, of the line through (x_1, y_1) and (x_2, y_2) is given by the following equation, if $x_1 \neq x_2$.

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



Example 2 **Graph $2y - 3x = 9$ using the y-intercept and the slope.**

Step 1: Rewrite the equation in slope-intercept form.

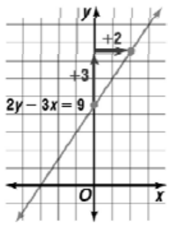
$2y - 3x = 9$

$y = \frac{3}{2}x + \frac{9}{2}$

Step 2: Identify the slope and y-intercept.

$m = \frac{3}{2}$, $b = \frac{9}{2}$ or 4.5

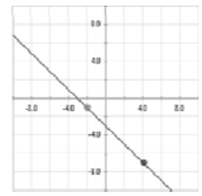
Step 3: Graph the y-intercept. Then use the slope to graph a second point. Connect the points to graph the line.



Finding zeros

- A zero of a function is when **f(x)= 0**.
- A zero is when a function crosses the ***x***-axis

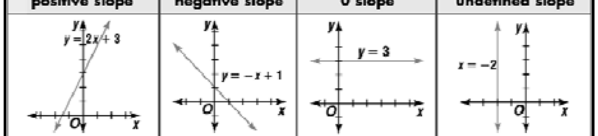
Example:
Find the zero of f(x) = - x - 3



Slopes of linear functions

- Sketch a sample graph for each of the following slopes : positive, negative, zero, undefined.

positive slope	negative slope	0 slope	undefined slope

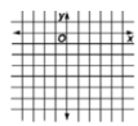


Are each of the graphs above functions?

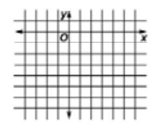
Graphing Linear Equations

Graph each equation using the x- and y-intercepts.

1. $2x - y - 6 = 0$

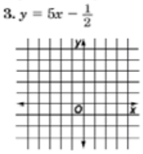


2. $4x + 2y + 8 = 0$

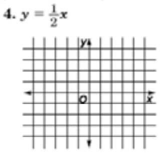


Graph each equation using the y-intercept and the slope.

3. $y = 5x - \frac{1}{2}$

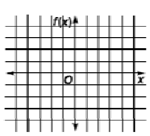


4. $y = \frac{1}{2}x$

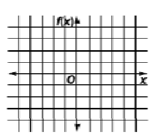


Find the zero of each function. Then graph the function.

5. $f(x) = 4x - 3$



6. $f(x) = 2x + 4$



7. ***Business*** In 1990, a two-bedroom apartment at Remington Square Apartments rented for \$575 per month. In 1999, the same two-bedroom apartment rented for \$850 per month. Assuming a constant rate of increase, what will a tenant pay for a two-bedroom apartment at Remington Square in the year 2000?