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Linear Relations

Goals

SWBAT determine the differences between linear relationships and non-linear relationships.

SWBAT determine the slope of a line by using the slope formula and by using a graph.

SWBAT graph linear functions by using slope intercept form.

SWBAT create an equation given either 2 points, or a point and slope.

SWBAT convert from point-slope form to slope-intercept form.

Standards

Reasoning with Equations and Inequalities **A-REI**

Solve equations and inequalities in one variable

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Connections

Now we are learning how to create, graph, and solve linear equations.

Later we will learn what happens when two linear equations are multiplied, and it turns into a quadratic.

Linear Functions

What is a Linear Function?

How do we know something is a linear function?

1. there is 1 x without an exponent
2. this x is not in the denominator of a fraction
3. there is only 1 variable

Linear equations	**Nonlinear equations**
$4x - 5y = 16$	$2x + 6y^2 = -25$
$x = 10$	$y = \sqrt{x} + 2$
$y = \frac{1}{2}x$	$y = \frac{1}{x}$

You Try

State Whether each Function is a Linear Function *and why*

1. $f(x) = 8 - \frac{3}{4}x$

2. $g(x) = \frac{2}{x}$

3. $h(x) = 3x - 4$

Slope

What is Slope? – (Not the definition you see below)

Definition

$$Slope = \frac{\text{change in } y}{\text{change in } x}$$

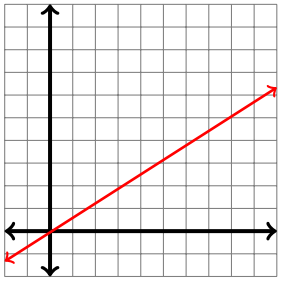
What does "change in" mean?

If we have 2 points we can find the slope between them

1. $(3, 2), (8, 12)$
2. $(-1, 4), (3, -8)$
3. $(-2, -5), (-7, 10)$
4. $(4, 4), (10, 12)$

You Try

1. Determine the rate of change of the graph

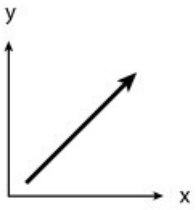


2. $(8, -3), (6, -2)$
3. $(-2, -5), (8, -15)$

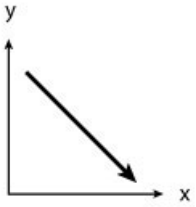
Types of Slope

There are 4 types of slope.

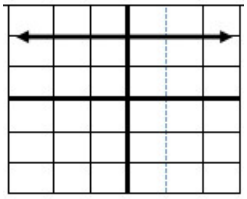
1. Positive



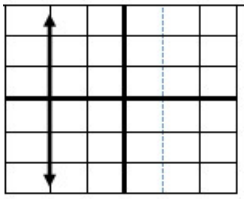
2. Negative



3. Zero



4. undefined



We can see how this works out in the equation of a graph.

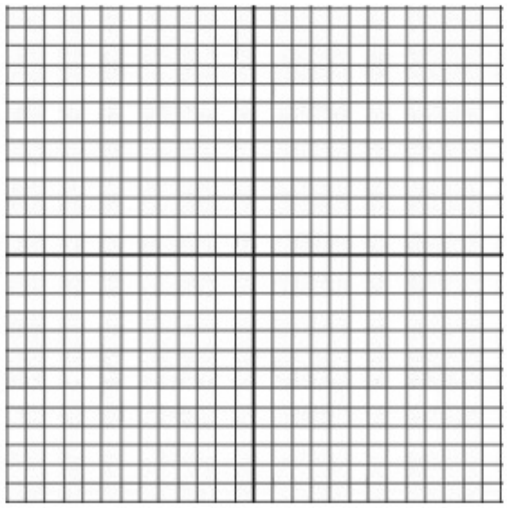
1. $y = 3x + 6$
2. $y = -\frac{4}{3}x + 2$
3. $x = 10$
4. $y = 10$

Graphs of Linear Functions

$y = mx + b$ is called *slope-intercept form.* This is the form that is most commonly used for graphing linear equations, although we'll see at least one other later on.

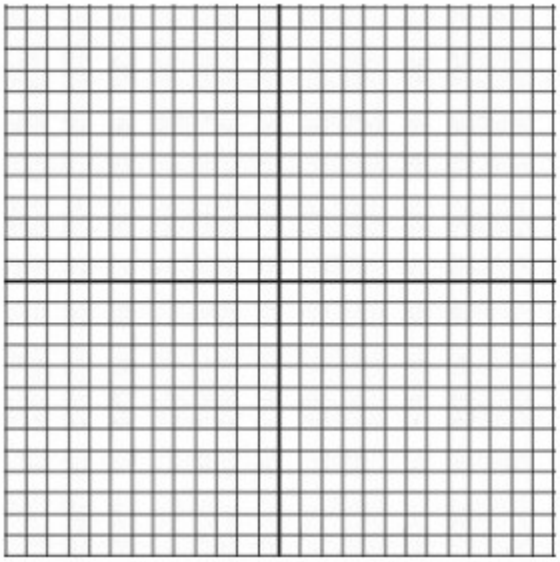
We can use a t-chart to graph the equation. $y = 3x - 7$

x									
f(x)									



The y-intercept is the b value. We just take this and graph it on the vertical axis. The slope is the m value. To graph we begin by finding the intercept, then graph the rest by using the slope.

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



Point-Slope Form

How to find the equation of a line that passes through two different points.

This is a job for *Point-Slope Form*!

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

All that is needed is 2 points, or 1 point and a slope. Either way the slope is going to be discovered. y_1, and x_1 are from the point (x_1, y_1).

If I need a line to pass through the point $(3, 5)$ and has slope of 4, then I just need to plug my pieces into the form.

$x_1 = 3$
$y_1 = 5$
$m = 4$

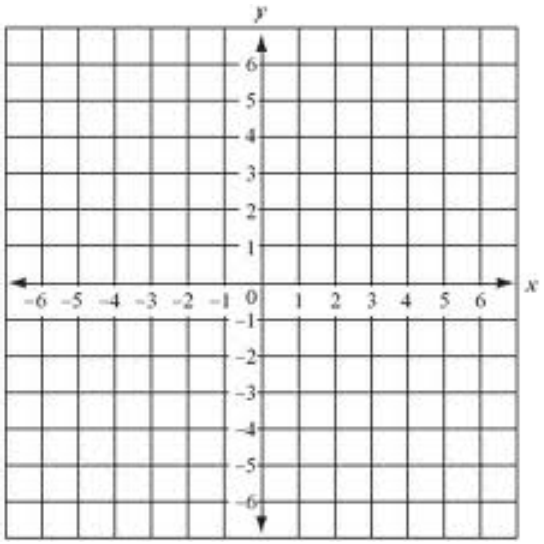
so my equation looks like...

$$y - 5 = 4(x - 3)$$

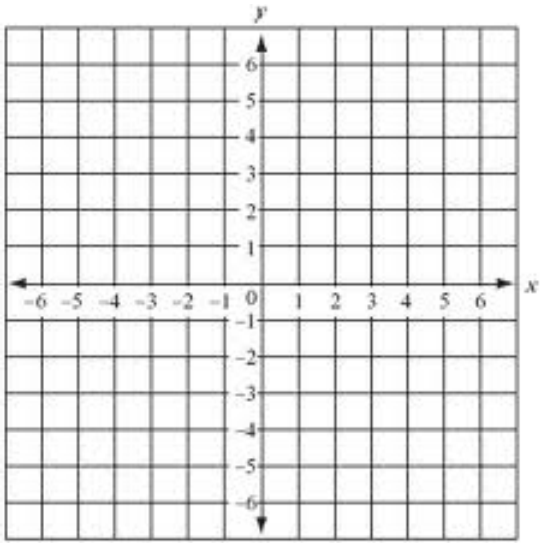
That's it!

You Try: Write an equation that goes through the indicated point, with the indicated slope, then graph.

$(-1, 3)$ slope$= \frac{1}{2}$



$(3, -4)$ slope$= \frac{4}{3}$



With 2 Points

The process is exactly the same with 2 points, except that the slope needs to be calculated.

Step 1: Calculate the slope $\frac{y_1-y_2}{x_1-x_2}$

Step 2: Pick which point you like better.

Step 3: Use slope from step 1, your favorite point, then plug in to point-slope form.

Find the equation of the line passing through the points $(1, 1)$, and $(-3, 5)$

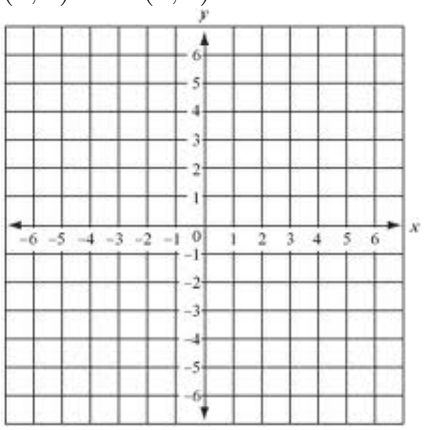
Step 1: $\frac{1--3}{1-5} = \frac{2}{-4} = -\frac{1}{2}$

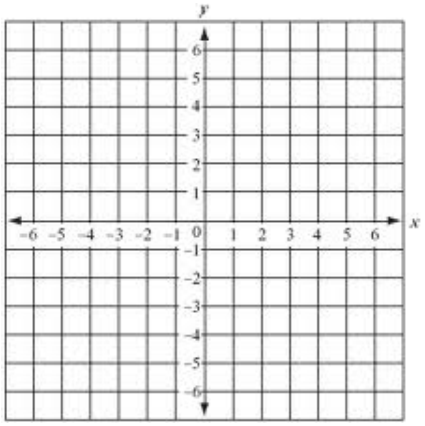
Step 2: I think $(1, 1)$ is a fine looking point, so I'm going to use it!

Step 3: $(y - 1) = \frac{1}{2}(x - 1)$

You Try: Write the equation of the line passing through the points, the graph.

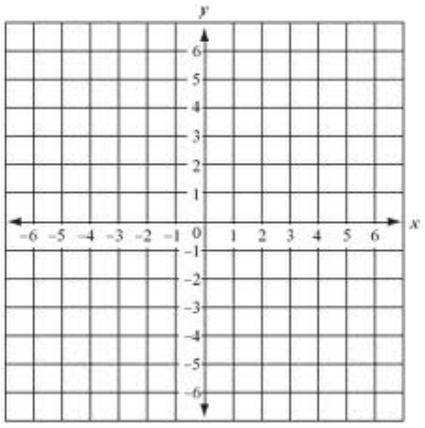
1. $(2, 3)$ and $(4, 4)$



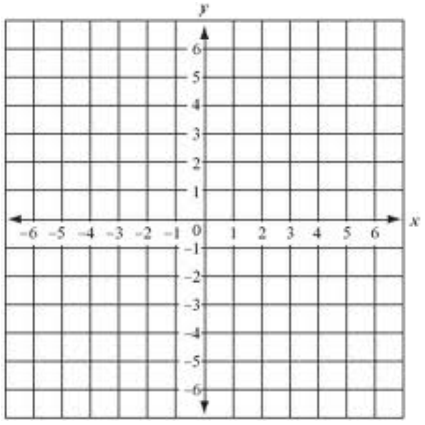


2. $(-1, -5)$ and $(1, -3)$

3. $(-12, -20)$ and $(-30, -40)$


y
x
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6
6 5 4 3 2 1 -1 -2 -3 -4 -5 -6

4. $(-14, -5)$ and $(-8, 3)$


y
x
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6
6 5 4 3 2 1 -1 -2 -3 -4 -5 -6

Converting Forms

$ax + by = c$ is called standard form.

Convert $2y + 3x = 6$ to slope-intercept form. Do it by solving for y.

$2y = 6 - 3x$

$y = \frac{6-3x}{2}$

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

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

You Try Convert $4y + 3x = 12$ to slope-intercept form.

Converting to slope-intercept form.

Convert $y - 7 = \frac{3}{4}(x + 20)$ to slope-intercept form

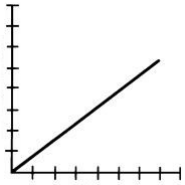
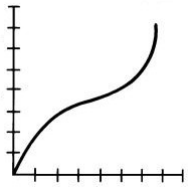
$y - 7 = \frac{3}{4}x + 15$ ****distribute the $\frac{3}{4}$****

$y = \frac{3}{4}x + 22$

1. $(y - 1) = \frac{1}{2}(x - 4)$
2. $(y - 3) = \frac{10}{9}(x - 9)$
3. $(y + 1) = 4(x + 1)$
4. $(y - 8) = \frac{5}{9}(x - 18)$

Review of Linear Equations

Identify the function as linear or nah – Circle the linear equations

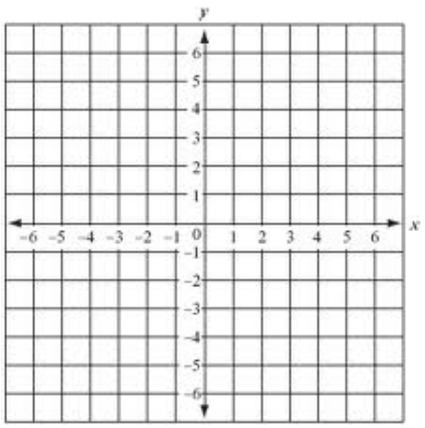
1. $y = 2x - 1$
2. $3x + 6y = 4$
3. $y = x^2$
4. $y = \frac{1}{x}$
5. 
6. $xy = 13$
7. $\frac{x}{y} = 10$
8. $\frac{y}{x} = 10$
9. $3x - y = 10$
10. 

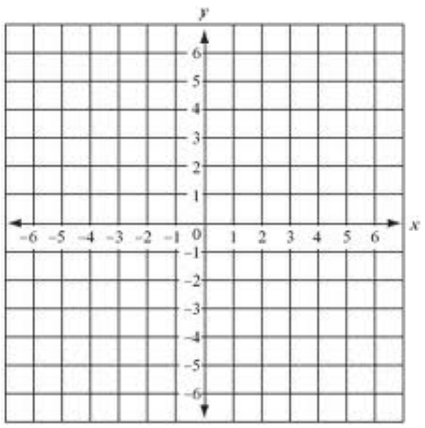
Calculate the slope $\frac{y_1 - y_2}{x_1 - x_2}$

11. $(-2, 7), (8, 13)$
12. $(0, 0), (0, 10)$
13. $(-6, -2), (-3, -4)$
14. $(5, 2), (9, 2)$

Graph the lines

15. $y = \frac{3}{2}x - 4$
16. $y = \frac{-1}{5}x + 3$





Write an equation in Point-Slope Form $y - y_1 = m(x - x_1)$

17. $(2, 3) m = 9$

18. $(-1, -6) m = \frac{4}{5}$

19. $(-3, -9), (2, 1)$

20. $(7, 0), (9, 2)$

Convert from Point-Slope to Slope-Intercept Form

21. $y - 3 = \frac{1}{2}(x - 6)$

22. $y + 16 = \frac{8}{3}(x - 3)$

23. $y - 10 = \frac{3}{4}(x + 20)$

24. $y + 212 = \frac{9}{5}(x - 100)$

Pre-assessment: This section for extra credit on quiz

Solve for x and y. Use substitution, elimination, or graphing.

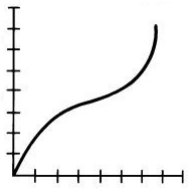
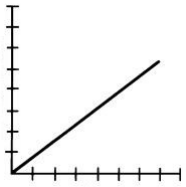
$$2x - 3y = -2$$

$$4x + y = 24$$

NAME:_____

Linear Equations Test

Identify the function as linear or not – Circle the linear equations

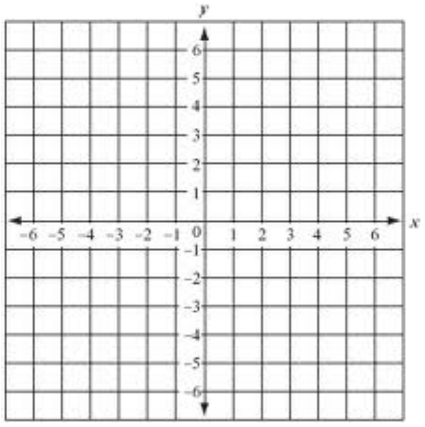
1. $xy = 12$
2. $\frac{x}{y} = 11$
3. $3x - y = 9$
4. 
5. $y = 2x - 3$
6. $x + 6y = 5$
7. $y = x^3$
8. 

Calculate the slope $\frac{y_1 - y_2}{x_1 - x_2}$

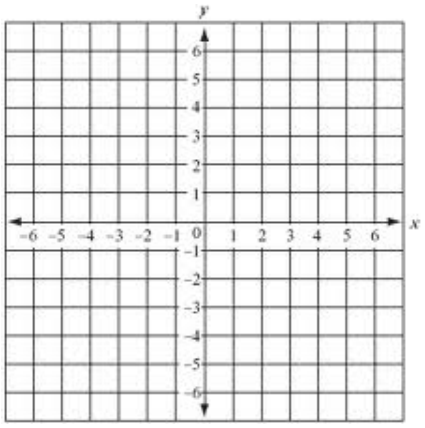
9. $(-3, 5), (7, 12)$
10. $(-1, -1), (-1, 9)$
11. $(-5, -1), (-2, -3)$
12. $(6, 3), (10, 3)$

Graph the lines

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



14. $y = \frac{-2}{5}x + 5$



Write an equation in Point-Slope Form $y - y_1 = m(x - x_1)$

15. $(7, 3) m = 3$

16. $(-2, -4) m = \frac{6}{11}$

17. $(-4, -9), (1, 1)$

18. $(-8, 3), (-3, 8)$

Convert from Point-Slope to Slope-Intercept Form

19. $y - 5 = \frac{1}{2}(x - 5)$

20. $y + 10 = \frac{9}{5}(x - 5)$

21. $y - 12 = \frac{4}{3}(x + 15)$

22. $y - 20 = \frac{5}{8}(x - 32)$

Extra Credit: Freezing is at $32°F$, which is also $0°C$. Boiling is at $212°F$ or $100°C$. Using this information, write a linear equation that converts between the two units of temperature.