Objective

Students will be able to represent relations and functions, explain whether the relation is a function or not, identify input and output as domain and range, and find the slope and rate of change of a line.

Represent Relations and Functions

A relation is a mapping, or pairing, of input values with output values. The set of input values is the domain, and the set of output values is the range.

Representing Relations

A relation can be represented in the following ways.

Ordered Pairs

(−2, 2)

(−2, −2)

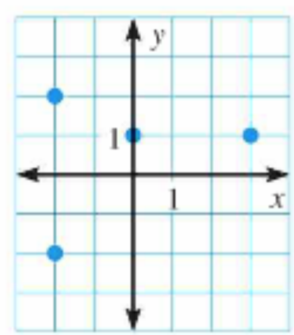
(0, 1)

(3, 1)

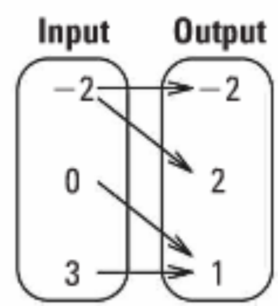
Table

x	*y*
−2	2
−2	−2
0	1
3	1

Graph



Mapping Diagram



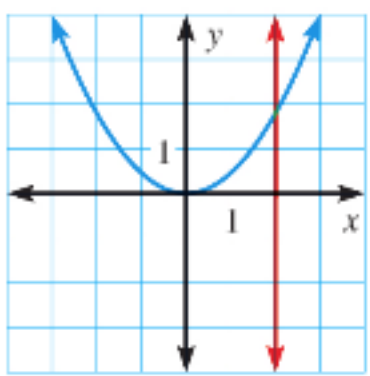
Function

A <u>function</u> is a relation for which each input has exactly one output. If any input of a relation has more than one output, the relation is *not* a function.

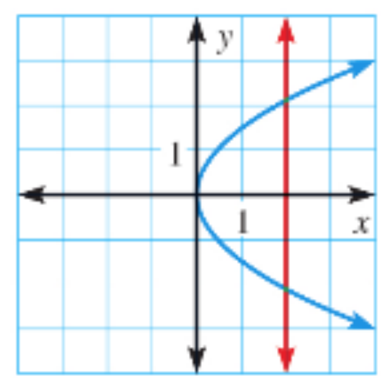
Vertical Line Test

A relation is a function if and only if no vertical line intersects the graph of the relation at more than one point.

Function



Not a function



Tell whether the following relations are functions or not.

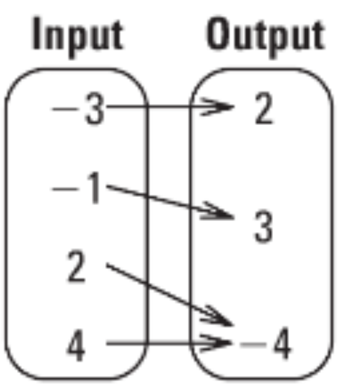
1) Identify the domain and range of the relation given by the ordered pairs: (-4, 3), (-2, 1), (0, 3), (1, 2) and (-2, 4). Is this relation a function?

D: {-4, -2, 0, 1}   R: {1, 2, 3, 4}

No; the input -2 has more than one output

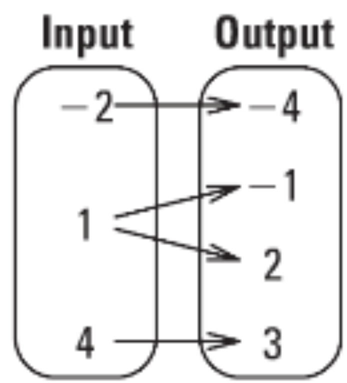
2) **Tell whether the relation is a function. Explain.**

a.



Yes; each input is mapped onto exactly one output

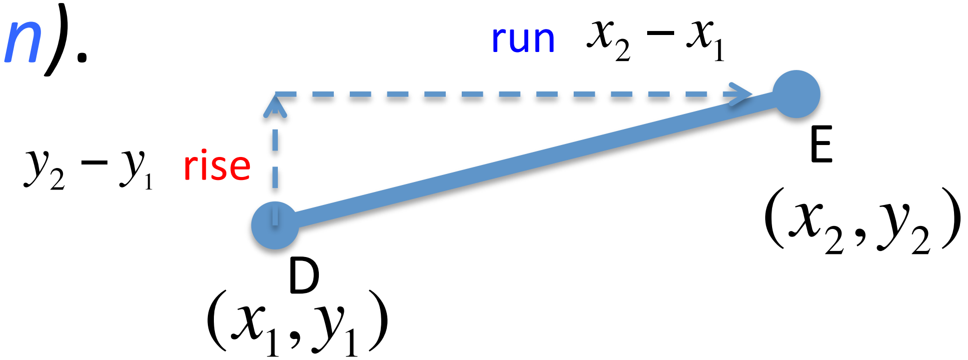
b.



No; the input 1 is mapped onto both -1 and 2

Slope

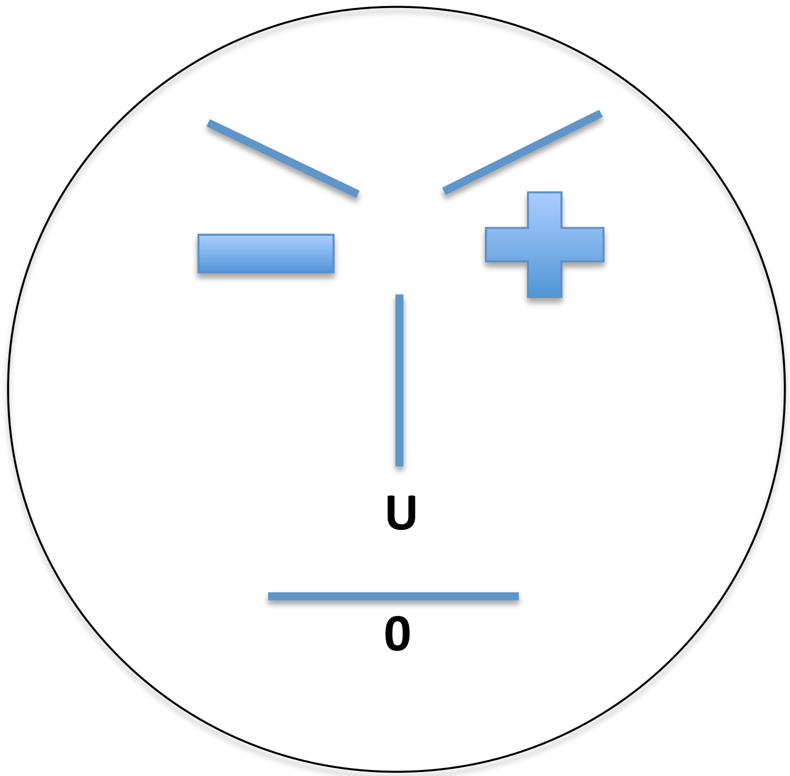
The slope m of a nonvertical line is the ratio of vertical change *(the rise)* to horizontal change *(the run)*.



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

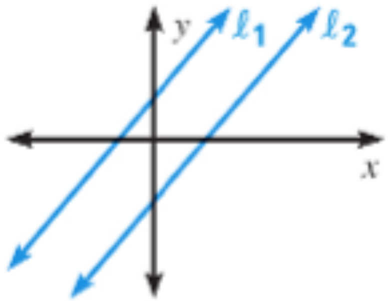
Slope Man!

Classification of Lines by Slope

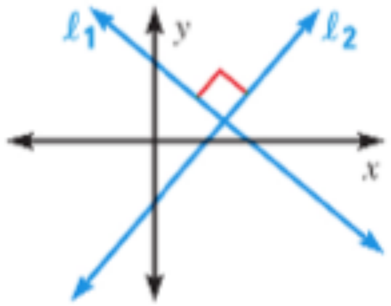


Slopes of Parallel and Perpendicular Lines

Parallel Lines



Perpendicular Lines



What do we know about the slopes of parallel and perpendicular lines?

If given <u>parallel lines</u>, then they have the same slope.

If given <u>perpendicular lines</u>, then they have opposite reciprocal slopes.

Scavenger Hunt

With a partner, pick a place to start in the room. Copy down the question that needs to be answered and then go back to your seat and solve the problem. Find the answer around the room and write down the letter that corresponds to that answer. Copy down the new problem on that sheet and solve. Continue doing so until you have solved all of the problems around the room and have "decoded" the message.

Homework

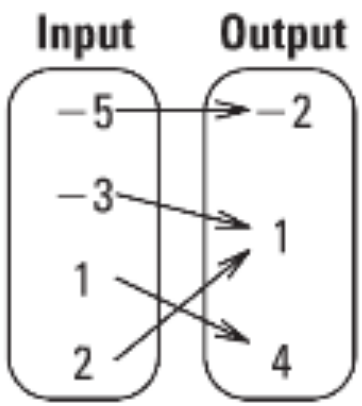
p. 77: 11-12, 18-19, 22-23

p. 86: 11-13, 21-22, 39

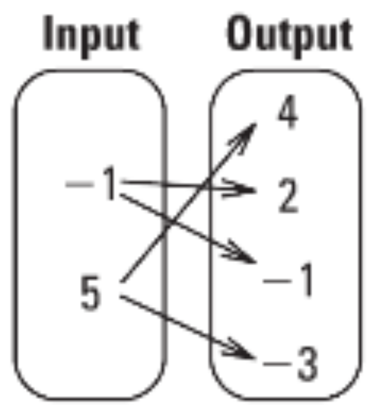
p. 77: 11-12, 18-19, 22-23

IDENTIFYING FUNCTIONS Tell whether the relation is a function. *Explain.*

11.



12.

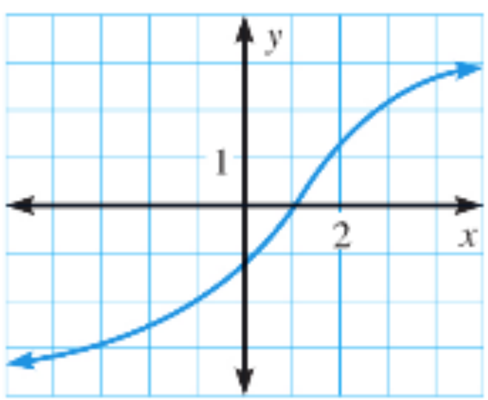


18. $(0, 1), (1, 0), (2, 3), (3, 2), (4, 4)$

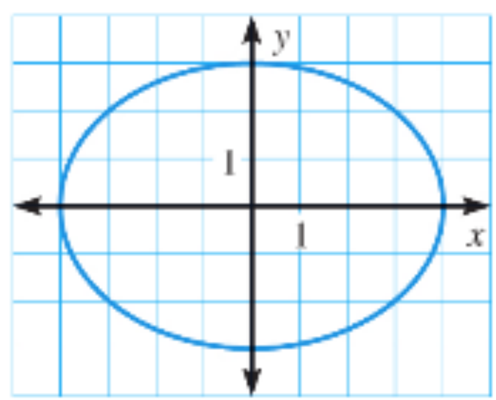
19. $(-1, -1), (2, 5), (4, 8), (-5, -9), (-1, -5)$

VERTICAL LINE TEST Use the vertical line test to tell whether the relation is a function.

22.



23.



Homework Contin.

p. 77: 11-12, 18-19, 22-23

p. 86: 11-13, 21-22, 39

p. 86: 11-13, 21-22, 39

FINDING SLOPE **Find the slope of the line passing through the given points. Then tell whether the line *rises*, *falls*, *is horizontal*, or *is vertical*.**

11. $(4, 4), (4, 9)$ **12.** $(5, 5), (7, 3)$ **13.** $(0, -3), (4, -3)$

CLASSIFYING LINES **Tell whether the lines are *parallel*, *perpendicular*, or *neither*.**

21. Line 1: through $(5, 8)$ and $(7, 2)$
Line 2: through $(-7, -2)$ and $(-4, -1)$

22. Line 1: through $(-3, 2)$ and $(5, 0)$
Line 2: through $(-1, -4)$ and $(3, -3)$

CHALLENGE **Find the value of k so that the line through the given points has the given slope. Check your solution.**

39. $(-4, 2k)$ and $(k, -5)$; $m = -1$

Objectives

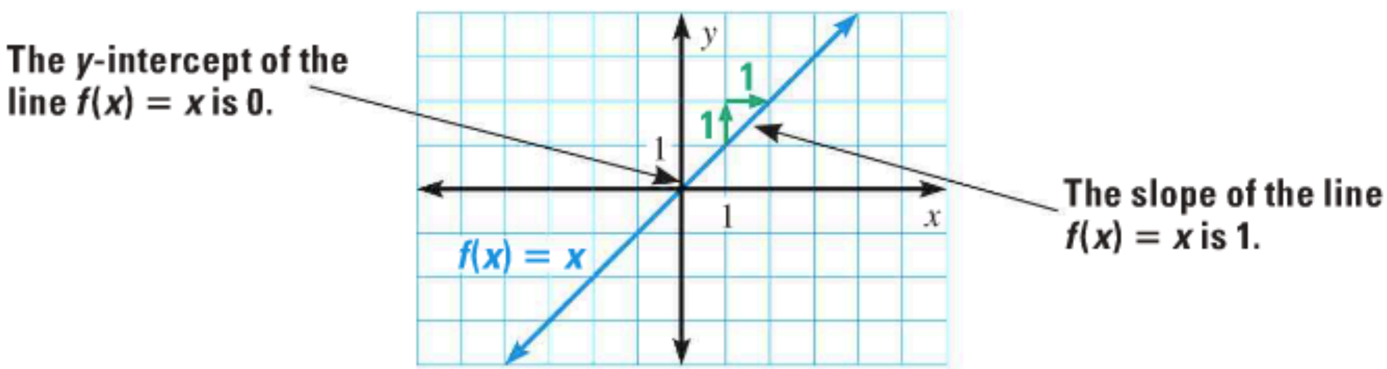
Students will be able to graph and write equations of lines.

Graphing Equations of Lines

A *family* of functions is a group of functions with shared characteristics. The <u>parent function</u> is the most basic function in a family.

Parent Function for Linear Functions

The parent function for the family of all linear functions is $f(x) = x$. The graph of $f(x) = x$ is shown.



In general, a **y-intercept** of a graph is the y-coordinate of a point where the graph intersects the y-axis.

Slope-Intercept Form

$$y = mx + b$$

Using Slope-Intercept Form to Graph an Equation

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

STEP 2 **Identify** the y-intercept b and use it to plot the point $(0, b)$ where the line crosses the y-axis.

STEP 3 **Identify** the slope m and use it to plot a second point on the line.

STEP 4 **Draw** a line through the two points.

Slope-Intercept Form Example

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

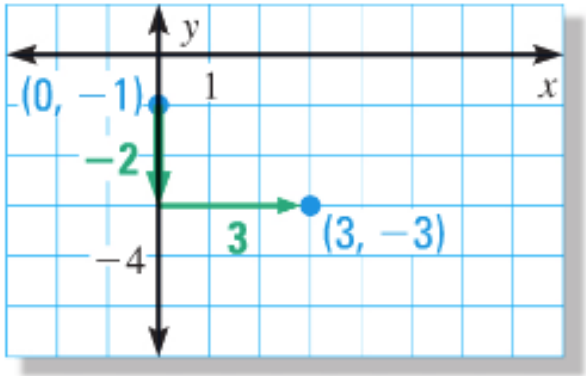
Solution

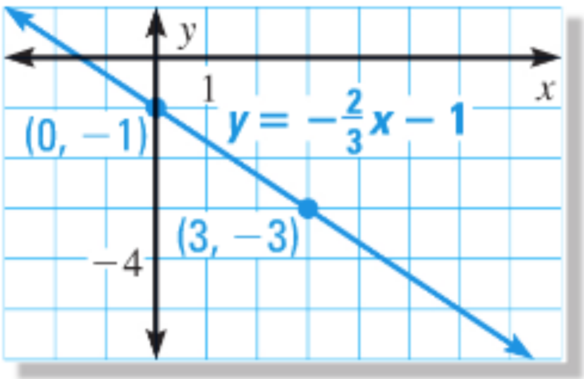
STEP 1 The equation is already in slope-intercept form.

STEP 2 **Identify** the y-intercept. The y-intercept is -1, so plot the point $(0, -1)$ where the line crosses the y-axis.

STEP 3 **Identify** the slope. The slope is $-\frac{2}{3}$, or $\frac{-2}{3}$, so plot a second point on the line by starting at $(0, -1)$ and then moving down 2 units and right 3 units. The second point is $(3, -3)$.

STEP 4 **Draw** a line through the two points.





Standard Form

$$Ax + By = C$$

Using Standard Form to Graph an Equation

STEP 1 **Write** the equation in standard form.

STEP 2 **Identify** the x-intercept by letting $y = 0$ and solving for x. Use the x-intercept to plot the point where the line crosses the x-axis.

STEP 3 **Identify** the y-intercept by letting $x = 0$ and solving for y. Use the y-intercept to plot the point where the line crosses the y-axis.

STEP 4 **Draw** a line through the two points.

Standard Form Example

Graph $5x + 2y = 10$.

Solution

STEP 1 The equation is already in standard form.

STEP 2 **Identify** the x-intercept.

$5x + 2(0) = 10$ **Let $y = 0$.**

$x = 2$ **Solve for x.**

The x-intercept is 2. So, plot the point (2, 0

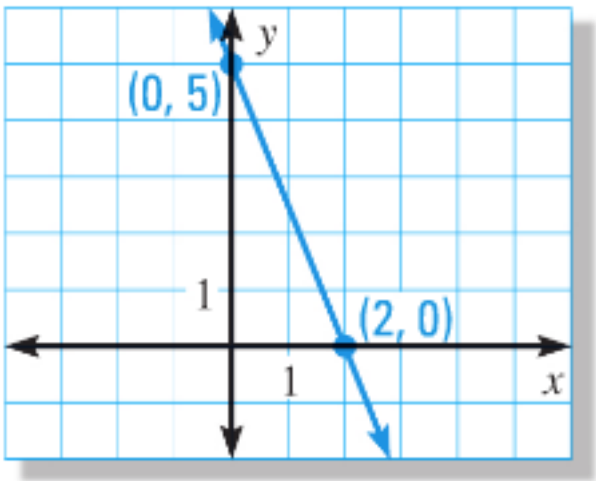
STEP 3 **Identify** the y-intercept.

$5(0) + 2y = 10$ **Let $x = 0$.**

$y = 5$ **Solve for y.**

The y-intercept is 5. So, plot the point (0, 5).

STEP 4 **Draw** a line through the two points.



Horizontal and Vertical Lines

Horizontal Lines: The graph of $y = c$ is the horizontal line through $(0, c)$

Vertical Lines: The graph of $x = c$ is the vertical line through $(c, 0)$

Forms of Linear Equations

Form	Equation	Key Facts
Slope-Intercept Form	$y = mx + b$	The graph is a line with slope *m* and y-intercept *b*
Standard Form	$Ax + By = C$ ***A*, *B*, and *C* cannot be fractions and *A* must be positive	The graph is a line with intercepts $x = C/A$ and $y = C/B$
Point-Slope Form	$y - y_1 = m(x - x_1)$	The graph is a line that has slope *m* and passes through (x_1, y_1).

1) Write the equation of the line that passes through (3, 6) and has slope $m = 2/3$.

$y = 2/3x + 4$

2) Write the equation of the line that passes through (-2, 3) and is:

a) parallel to $y = -4x + 1$

$y = -4x - 5$

b) perpendicular to $y = -4x + 1$

$y = 1/4x + 7/2$

Forms of Linear Equations

Write the equation of the line in standard form, point-slope form, and slope-intercept form that passes through the points (0, 6) and (2, 3).

Slope-intercept: $y = -3/2\ x + 6$

Point-slope form: $y – 3 = -3/2(x – 2)$

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

Homework

p. 94: 44-47

p. 101: 7, 16, 23, 30, 43

p. 94: 44-47

CHOOSING A METHOD **Graph the equation using any method.**

44. $-3 + x = 0$

45. $y + 7 = -2x$

46. $4y = 16$

47. $8y = -2x + 20$

p. 101: 7, 16, 23, 30, 43

SLOPE-INTERCEPT FORM **Write an equation of the line that has the given slope and *y*-intercept.**

7. $m = -\frac{5}{4}, b = 7$

POINT-SLOPE FORM **Write an equation of the line that passes through the given point and has the given slope.**

16. $(-4, 2), m = \frac{3}{2}$

PARALLEL AND PERPENDICULAR LINES **Write an equation of the line that passes through the given point and satisfies the given condition.**

23. $(4, 1)$; perpendicular to $y = \frac{1}{3}x + 3$

WRITING EQUATIONS **Write an equation of the line that passes through the given points.**

30. $(-1, 3), (2, 9)$

STANDARD FORM **Write an equation in standard form $Ax + By = C$ of the line that satisfies the given conditions. Use integer values for A, B, and C.**

43. $m = \frac{4}{5}$, passes through $(2, 3)$

Objective

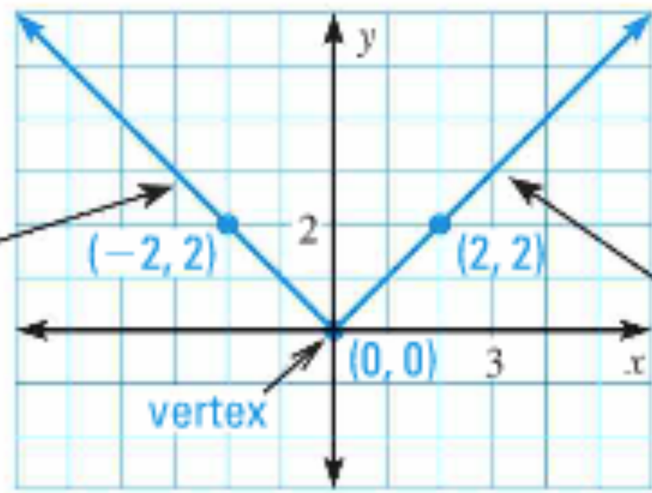
Students will be able to graph and write absolute value equations.

Absolute Value Functions

Parent Function for Absolute Value Functions

The parent function for the family of all absolute value functions is $f(x) = |x|$. The graph of $f(x) = |x|$ is V-shaped and is symmetric about the y-axis. So, for every point (x, y) on the graph, the point $(-x, y)$ is also on the graph.

To the left of $x = 0$, the graph is given by the line $y = -x$.



To the right of $x = 0$, the graph is given by the line $y = x$.

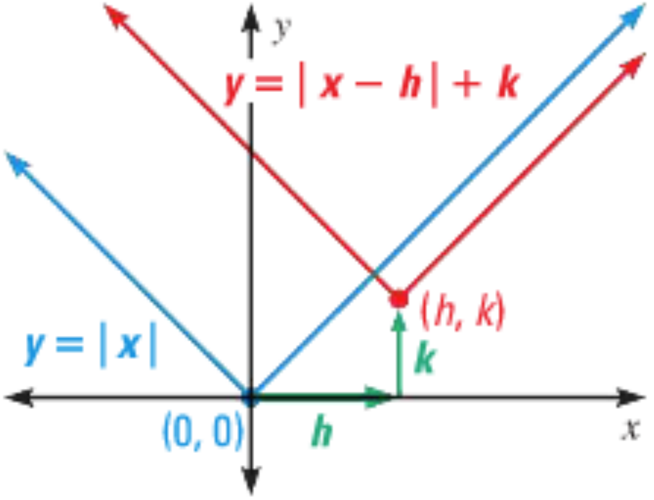
The highest or lowest point on the graph of an absolute value function is called the **vertex**. The vertex of the graph of $f(x) = |x|$ is $(0, 0)$.

D: $(-\infty, \infty)$ R: $[0, \infty)$

Translations

A <u>transformation</u> changes a graph's size, shape, position, or orientation. A <u>translation</u> is a transformation that shifts a graph horizontally, and/or vertically, but does not change its size, shape, or orientation.

The graph of $y = a|x - h| + k$ is the graph of $y = |x|$ translated *h* units horizontally and *k* units vertically. The vertex of $y = a|x - h| + k$ is (*h*, *k*).



1) Graph $y = |x+4| - 2$. Compare the graph with the graph of $y = |x|$.

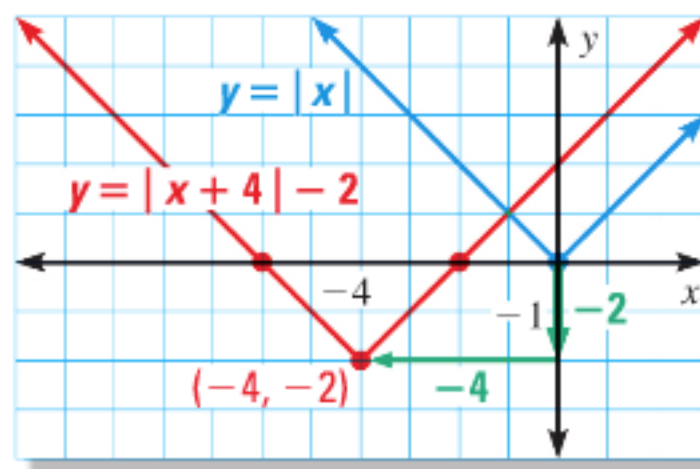
Step 1: **Identify** and plot the vertex, $(h, k) = (-4, -2)$

Step 2: **Plot** another point on the graph (you can plug in any value for x and see what you get y equal to; make sure to use one x value is to the right and to the left of vertex), such as (-2, 0). Use symmetry to plot a third point, (-6, 0).

Step 3: **Connect** the points with a V-shaped graph.

Step 4: **Compare** the graphs.

The graph of $y = |x+4| - 2$ is the graph $y = |x|$ translated down 2 units and left 4 units



D: $(-\infty, \infty)$ R: $[-2, \infty)$

Stretches, Shrinks, and Reflections

STRETCHES, SHRINKS, AND REFLECTIONS When $|a| \neq 1$, the graph of $y = a|x|$ is a vertical *stretch* or a vertical *shrink* of the graph of $y = |x|$, depending on whether $|a|$ is less than or greater than 1.

For $|a| > 1$	For $|a| < 1$
• The graph is vertically *stretched*, or elongated. • The graph of $y = a|x|$ is *narrower* than the graph of $y = |x|$.	• The graph is vertically *shrunk*, or compressed. • The graph of $y = a|x|$ is *wider* than the graph of $y = |x|$.

When $a = -1$, the graph of $y = a|x|$ is a **reflection** in the x-axis of the graph of $y = |x|$. When $a < 0$ but $a \neq -1$, the graph of $y = a|x|$ is a vertical stretch or shrink with a reflection in the x-axis of the graph of $y = |x|$.

a is like the "slope" of an absolute value; start at vertex and move to the right like it's the slope and reflect to the other side

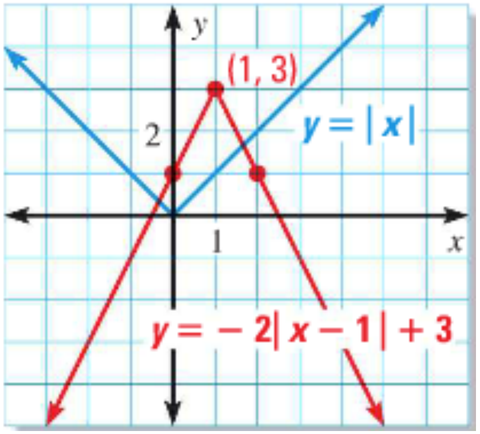
2) Graph $y = -2|x-1|+3$.

Step 1: **Identify** and plot the vertex, $(h, k) = (1, 3)$

Step 2: **Plot** another point on the graph (you can plug in any value for x and see what you get y equal to; make sure to use one x value is to the right and to the left of vertex), such as (0, 1). Use symmetry to plot a third point, (2, 1).

Can also use *a* value like the "slope" of an absolute value; start at vertex and move to the right like it's the slope and reflect to the other side

Step 3: **Connect** the points with a V-shaped graph.



D: $(-\infty, \infty)$

R: $(-\infty, 3]$

Homework

Graphing Absolute Value Equations WS