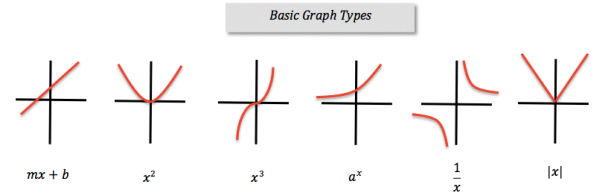


Tuesday, Jan. 23rd

Plan For Today:

1. Any general questions about course?
2. Any questions about material from Ch1?
 - * Do Ch1: Geometric Sequences & Series Test ~45min
 - * Hand-in Ch1 Project
3. Review basic graphing for Chapter 2
 - * **2.0 Graphing Review**
 - * **2.4 Horizontal and Vertical Translations**
 - * **2.4 Reflections and Stretches**
 - * 2.5 Inverse of a Relation
 - * 2.6 Combining Transformations
6. Work on Graphing Review Handout.



$$f(x) = af(b(x - c)) + d$$

Plan Going Forward:

1. Work on practice questions from 2.1 and part of 2.4 in the workbook.
 - * **2.1 & PART OF 2.4 TRANSFORMATIONS CHECK-IN QUIZ ON THURSDAY, JAN. 25TH**
2. We will finish 2.4 and do 2.5 Inverse Functions with Combining in 2.6 on Thursday.
 - * **CH2 TEST ON TUESDAY, JAN. 30TH**
 - * **CH2 ONLINE DESMOS PROJECT DUE TUESDAY, JAN. 30TH**

Please let me know if you have any questions or concerns about your progress in this course. The notes from today will be posted at anurita.weebly.com after class.

Anurita Dhiman = adhiman@sd35.bc.ca

2.4 Translations + Reflections.

general base function. \longrightarrow horizontal translation

$$y = f(x) \longrightarrow y = f(x-h)$$

= h units right/left

ex: $y = f(x+2) \Rightarrow 2$ left

$y = f(x-2) \Rightarrow 2$ right

\longrightarrow vertical translation.

$\longrightarrow y = f(x) + k.$

k units up/down

ex: $y = f(x) + 5 \Rightarrow 5$ up

$y = f(x) - 5 \Rightarrow 5$ down.

\longrightarrow reflections

$$y = -f(x) \quad \text{or} \quad y = f(-x)$$

\downarrow
reflection over
x-axis b/c
multiply y-coordinate
by -1

\downarrow
reflection over
y-axis b/c
multiply
x-coordinate
by -1

Ex: Graph $y = \sqrt{x+5} - 3$

① Base
 $y = \sqrt{x}$

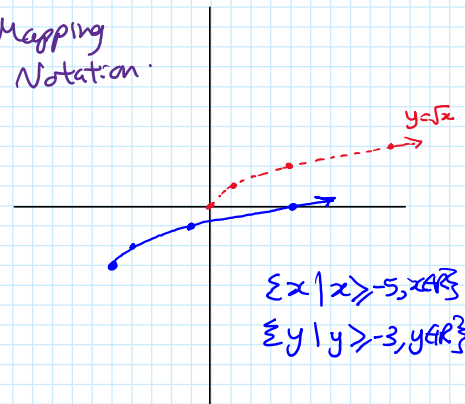
x	y
0	0
1	1
4	2
9	3

② Translations
= 5 left, 3 down.

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

} Mapping
Notation.

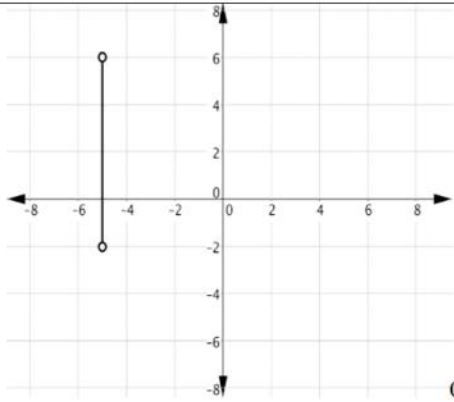
③ Graph.



#1-10 2.4 Practice.

Function Practice

<p style="text-align: right;">A</p>	<p>Domain: $\{-6 \leq x \leq 6\}$</p> <p>Range: $\{0 \leq y \leq 6\}$</p> <p>Function: YES</p> <p style="text-align: right;">1</p>	<p style="text-align: right;">E</p>
<p style="text-align: right;">B</p>	<p>Domain: $\{-4 \leq x \leq 2\}$</p> <p>Range: $\{-2 \leq y \leq 4\}$</p> <p>Function: YES</p> <p style="text-align: right;">2</p>	<p style="text-align: right;">F</p>
	<p>Domain: $\{x = -5\}$</p> <p>Range: $\{-2 < y < 6\}$</p> <p>Function: NO</p> <p style="text-align: right;">3</p>	
	<p style="text-align: right;">4</p>	



C

Domain: $\{-3 \leq x < 5\}$

Range: $\{y = -1\}$

Function: YES

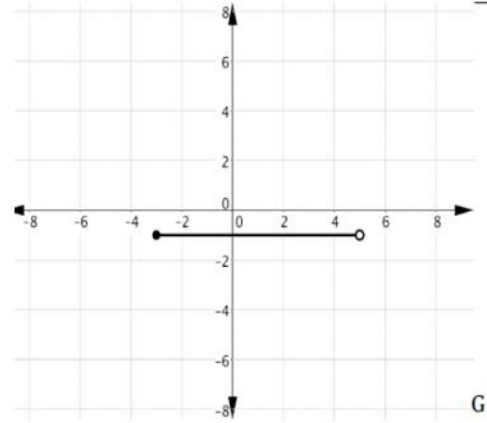
5

Domain: $\{x > 0\}$

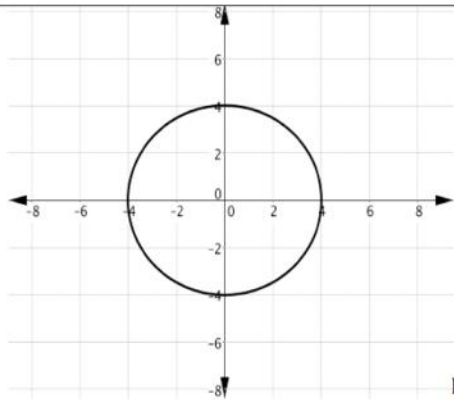
Range: $\{y = 4\}$

Function: YES

6



G



D

Domain: $\{x \geq 0\}$

Range: {all real numbers}

Function: NO

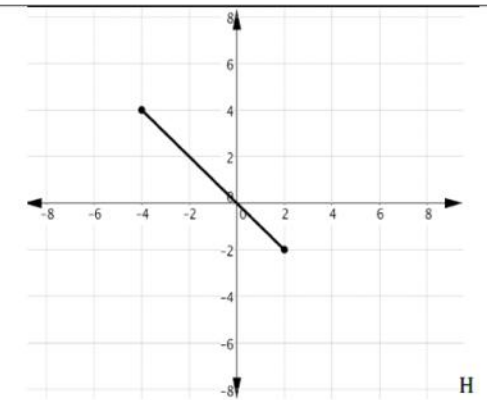
8

Domain: $\{-7 \leq x < 5\}$

Range: $\{-3 \leq y < 1\}$

Function: YES

11



H

Name: _____ Period: _____ Date: _____

DOMAIN AND RANGE MATCHING ACTIVITY

Read the attached page of notes first below beginning this activity. It gives you examples of domain and range problems just like these.

Match each domain and range given in this table with a graph labeled from **A to L** on the attached page. Only use Graphs A – L for this page. Write the letter of your answer in the blank provided for each problem.

_____ 1. Domain: $\{-4 \leq x \leq 4\}$ Range: $\{-4 \leq y \leq 4\}$ Function: NO	_____ 2. Domain: $\{-3 < x \leq 5\}$ Range: $\{y = -1\}$ Function: YES	_____ 3. Domain: $\{-4 \leq x \leq 2\}$ Range: $\{-2 \leq y \leq 4\}$ Function: YES
_____ 4. Domain: $\{x > 0\}$ Range: $\{y = 4\}$ Function: YES	_____ 5. Domain: $\{-6 \leq x \leq 6\}$ Range: $\{0 \leq y \leq 6\}$ Function: YES	_____ 6. Domain: $\{x = -5\}$ Range: $\{-2 < y < 6\}$ Function: NO
_____ 7. Domain: $\{x \geq 0\}$ Range: $\{\text{all real numbers}\}$ Function: NO	_____ 8. Domain: $\{-3 \leq x \leq 4\}$ Range: $\{-2 \leq y \leq 4\}$ Function: NO	_____ 9. Domain: $\{\text{all real numbers}\}$ Range: $\{\text{all real numbers}\}$ Function: YES
_____ 10. Domain: $\{-7 \leq x < 5\}$ Range: $\{-3 \leq y < 1\}$ Function: YES	_____ 11. Domain: $\{\text{all real numbers}\}$ Range: $\{y \geq 0\}$ Function: YES	_____ 12. Domain: $\{-3 < x < 4\}$ Range: $\{0 \leq y \leq 5\}$ Function: YES

CONTINUES ON THE BACK SIDE!

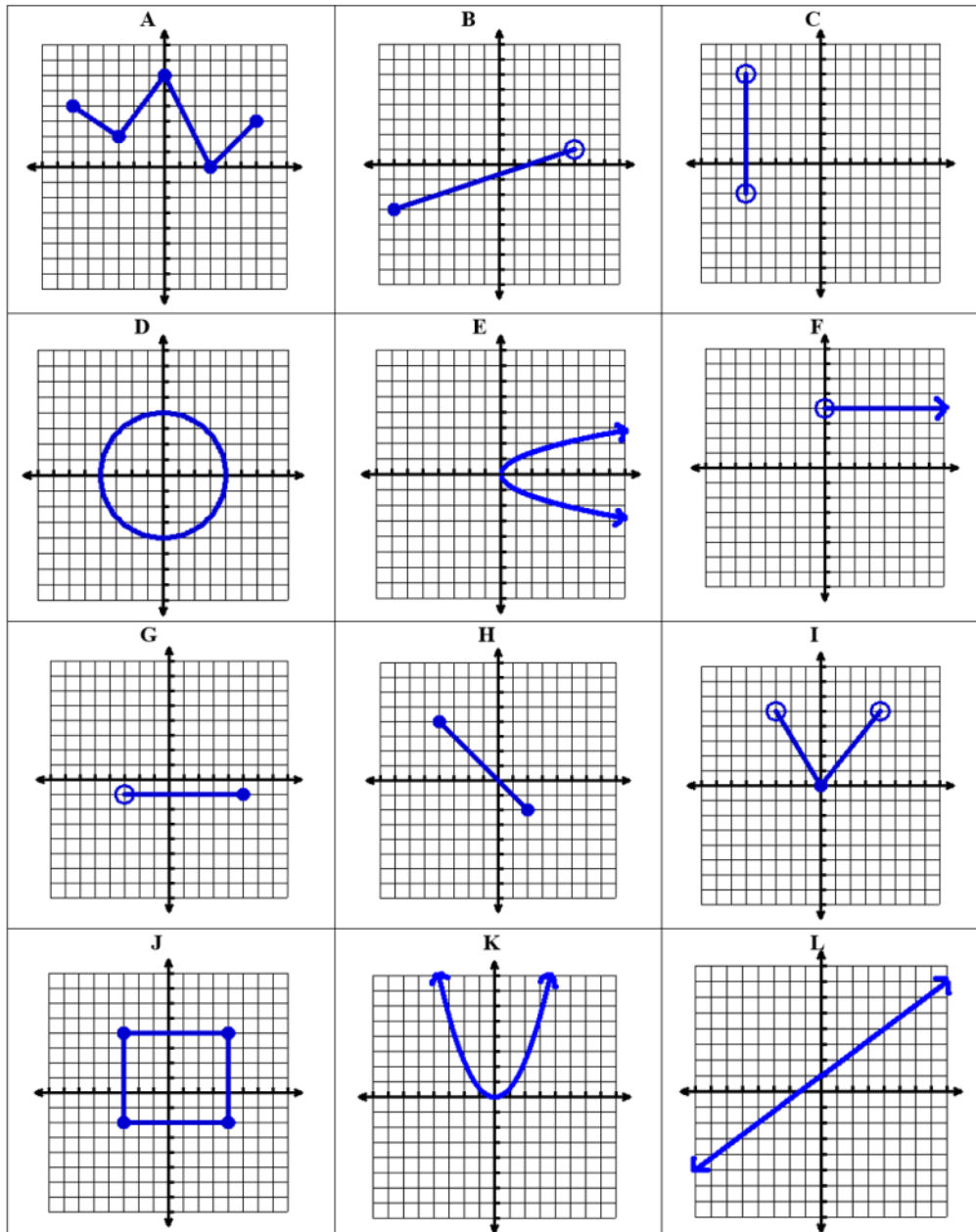
Name: _____ Period: _____ Date: _____

DOMAIN AND RANGE MATCHING ACTIVITY

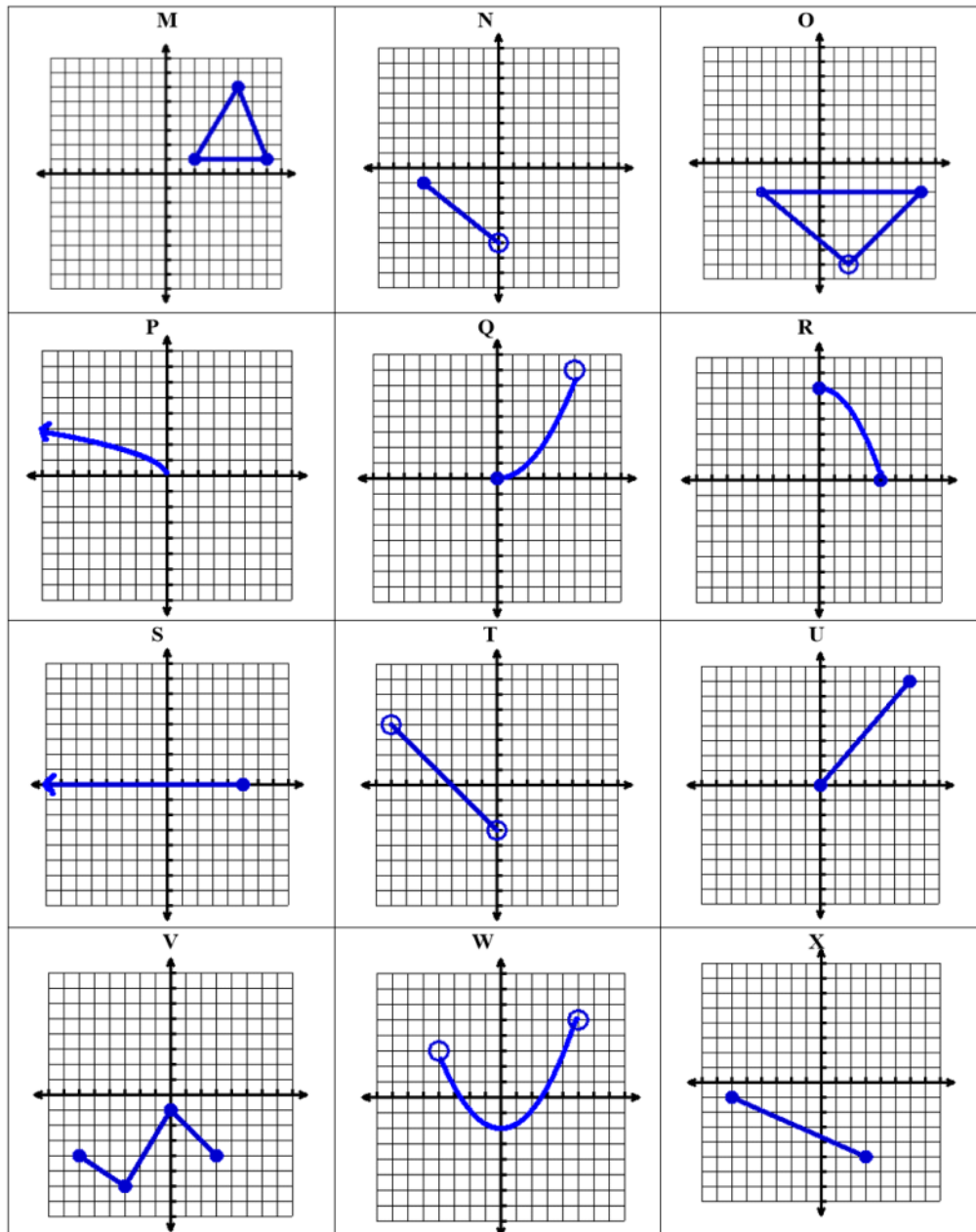
Match each domain and range given in this table with a graph labeled from M to X on the attached page. Only use Graphs M to X for this page. Write the letter of your answer in the blank provided for each problem.

<p>_____ 13.</p> <p>Domain: $\{-6 \leq x \leq 3\}$</p> <p>Range: $\{-6 \leq y \leq -1\}$</p> <p>Function: YES</p>	<p>_____ 14.</p> <p>Domain: $\{0 \leq x < 5\}$</p> <p>Range: $\{0 \leq y < 7\}$</p> <p>Function: YES</p>	<p>_____ 15.</p> <p>Domain: $\{-5 \leq x < 0\}$</p> <p>Range: $\{-5 < y \leq -1\}$</p> <p>Function: YES</p>
<p>_____ 16.</p> <p>Domain: $\{-6 \leq x \leq 3\}$</p> <p>Range: $\{-5 \leq y \leq -1\}$</p> <p>Function: YES</p>	<p>_____ 17.</p> <p>Domain: $\{0 \leq x \leq 6\}$</p> <p>Range: $\{0 \leq y \leq 7\}$</p> <p>Function: YES</p>	<p>_____ 18.</p> <p>Domain: $\{-4 \leq x \leq 7\}$</p> <p>Range: $\{-7 \leq y \leq -2\}$</p> <p>Function: NO</p>
<p>_____ 19.</p> <p>Domain: $\{x \leq 0\}$</p> <p>Range: $\{y \geq 0\}$</p> <p>Function: YES</p>	<p>_____ 20.</p> <p>Domain: $\{2 \leq x \leq 7\}$</p> <p>Range: $\{1 \leq x \leq 6\}$</p> <p>Function: NO</p>	<p>_____ 21.</p> <p>Domain: $\{0 \leq x \leq 4\}$</p> <p>Range: $\{0 \leq y \leq 6\}$</p> <p>Function: YES</p>
<p>_____ 22.</p> <p>Domain: $\{-4 < x < 5\}$</p> <p>Range: $\{-2 \leq y < 5\}$</p> <p>Function: YES</p>	<p>_____ 23.</p> <p>Domain: $\{x \leq 5\}$</p> <p>Range: $\{y = 0\}$</p> <p>Function: YES</p>	<p>_____ 24.</p> <p>Domain: $\{-7 < x < 0\}$</p> <p>Range: $\{-3 < y < 4\}$</p> <p>Function: YES</p>

USE THESE GRAPHS TO ANSWER QUESTIONS 1 – 12.



USE THESE GRAPHS TO ANSWER QUESTIONS 13 – 24.



Name: _____

KEY

Period: _____

Date: _____

DOMAIN AND RANGE MATCHING ACTIVITY

Read the attached page of notes first below beginning this activity. It gives you examples of domain and range problems just like these.

Match each domain and range given in this table with a graph labeled from **A to L** on the attached page. Only use Graphs A – L for this page. Write the letter of your answer in the blank provided for each problem.

<u>D</u> 1. Domain: $\{-4 \leq x \leq 4\}$ Range: $\{-4 \leq y \leq 4\}$ Function: NO	<u>G</u> 2. Domain: $\{-3 < x \leq 5\}$ Range: $\{y = -1\}$ Function: YES	<u>H</u> 3. Domain: $\{-4 \leq x \leq 2\}$ Range: $\{-2 \leq y \leq 4\}$ Function: YES
<u>F</u> 4. Domain: $\{x > 0\}$ Range: $\{y = 4\}$ Function: YES	<u>A</u> 5. Domain: $\{-6 \leq x \leq 6\}$ Range: $\{0 \leq y \leq 6\}$ Function: YES	<u>C</u> 6. Domain: $\{x = -5\}$ Range: $\{-2 < y < 6\}$ Function: NO
<u>E</u> 7. Domain: $\{x \geq 0\}$ Range: $\{\text{all real numbers}\}$ Function: NO	<u>J</u> 8. Domain: $\{-3 \leq x \leq 4\}$ Range: $\{-2 \leq y \leq 4\}$ Function: NO	<u>L</u> 9. Domain: $\{\text{all real numbers}\}$ Range: $\{\text{all real numbers}\}$ Function: YES
<u>B</u> 10. Domain: $\{-7 \leq x < 5\}$ Range: $\{-3 \leq y < 1\}$ Function: YES	<u>K</u> 11. Domain: $\{\text{all real numbers}\}$ Range: $\{y \geq 0\}$ Function: YES	<u>I</u> 12. Domain: $\{-3 < x < 4\}$ Range: $\{0 \leq y \leq 5\}$ Function: YES

CONTINUES ON THE BACK SIDE!

Name: _____ Period: _____ Date: _____

DOMAIN AND RANGE MATCHING ACTIVITY

Match each domain and range given in this table with a graph labeled from **M to X** on the attached page. Only use Graphs M to X for this page. Write the letter of your answer in the blank provided for each problem.

<p style="text-align: center;"><u>X</u> 13.</p> <p>Domain: $\{-6 \leq x \leq 3\}$</p> <p>Range: $\{-6 \leq y \leq -1\}$</p> <p>Function: YES</p>	<p style="text-align: center;"><u>Q</u> 14.</p> <p>Domain: $\{0 \leq x < 5\}$</p> <p>Range: $\{0 \leq y < 7\}$</p> <p>Function: YES</p>	<p style="text-align: center;"><u>N</u> 15.</p> <p>Domain: $\{-5 \leq x < 0\}$</p> <p>Range: $\{-5 < y \leq -1\}$</p> <p>Function: YES</p>
<p style="text-align: center;"><u>V</u> 16.</p> <p>Domain: $\{-6 \leq x \leq 3\}$</p> <p>Range: $\{-5 \leq y \leq -1\}$</p> <p>Function: YES</p>	<p style="text-align: center;"><u>U</u> 17.</p> <p>Domain: $\{0 \leq x \leq 6\}$</p> <p>Range: $\{0 \leq y \leq 7\}$</p> <p>Function: YES</p>	<p style="text-align: center;"><u>O</u> 18.</p> <p>Domain: $\{-4 \leq x \leq 7\}$</p> <p>Range: $\{-7 \leq y \leq -2\}$</p> <p>Function: NO</p>
<p style="text-align: center;"><u>P</u> 19.</p> <p>Domain: $\{x \leq 0\}$</p> <p>Range: $\{y \geq 0\}$</p> <p>Function: YES</p>	<p style="text-align: center;"><u>M</u> 20.</p> <p>Domain: $\{2 \leq x \leq 7\}$</p> <p>Range: $\{1 \leq x \leq 6\}$</p> <p>Function: NO</p>	<p style="text-align: center;"><u>R</u> 21.</p> <p>Domain: $\{0 \leq x \leq 4\}$</p> <p>Range: $\{0 \leq y \leq 6\}$</p> <p>Function: YES</p>
<p style="text-align: center;"><u>W</u> 22.</p> <p>Domain: $\{-4 < x < 5\}$</p> <p>Range: $\{-2 \leq y < 5\}$</p> <p>Function: YES</p>	<p style="text-align: center;"><u>S</u> 23.</p> <p>Domain: $\{x \leq 5\}$</p> <p>Range: $\{y = 0\}$</p> <p>Function: YES</p>	<p style="text-align: center;"><u>T</u> 24.</p> <p>Domain: $\{-7 < x < 0\}$</p> <p>Range: $\{-3 < y < 4\}$</p> <p>Function: YES</p>

(3-)

Basic Graphing Review

Basic Graphing Review – Know these base functions and their graphs so you are able to apply transformations on them in the course.

- Label the x - and y - axis
- Make a table of values
- Plot the point on your grid
- Draw a line or smooth curve
- Domain: the set of x values valid in the equation
- Range: the set of y values valid in the equation

Use Set Notation for writing domain and range:

$\{x | x \in \mathbb{R}\}$ means x is in the set of real numbers

$\{y | y \in \mathbb{R}\}$ means y is in the set of real numbers

Use the following symbols:

\leq for less than and equal to; $<$ for only less than

\geq for greater than and equal to; $>$ for only greater than

\neq for not equal to

When graphing, start with a table of values. Look at restrictions and use your graphing calc to verify.

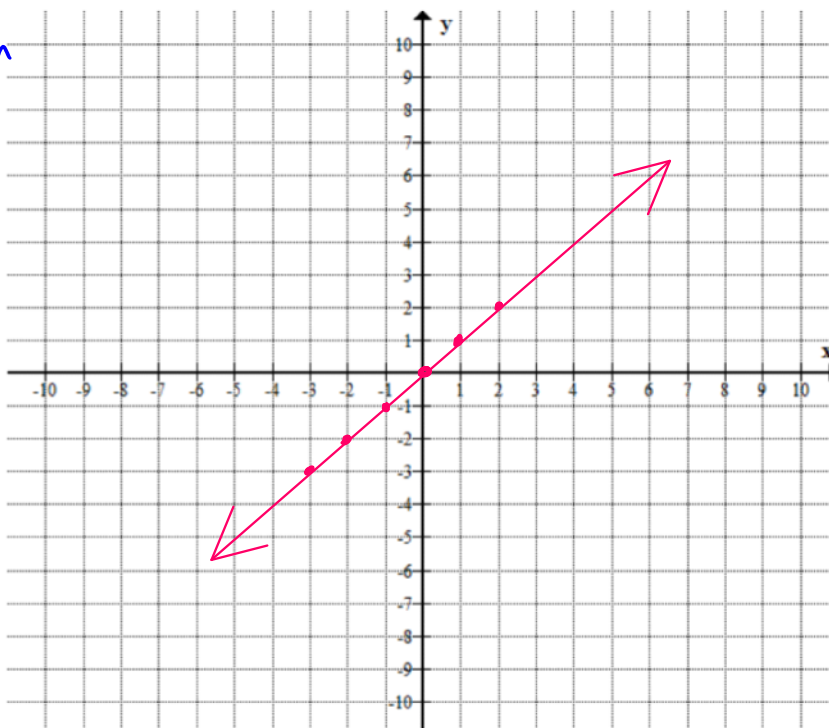
1. Graph: $y = x$

Linear function

$y = mx + b$
 $m = \frac{\text{rise}}{\text{run}}$ $b = \text{y-int}$

x	y
-3	-3
-2	-2
-1	-1
0	0
1	1
2	2
3	3

(x, y)
coordinates

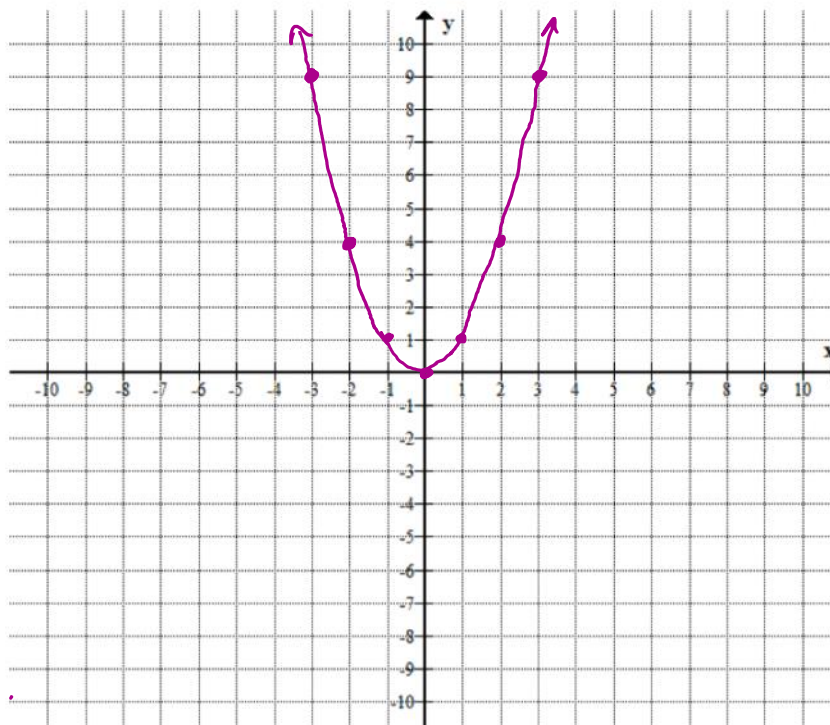


Domain: $\{x | x \in \mathbb{R}\}$
 Range: $\{y | y \in \mathbb{R}\}$

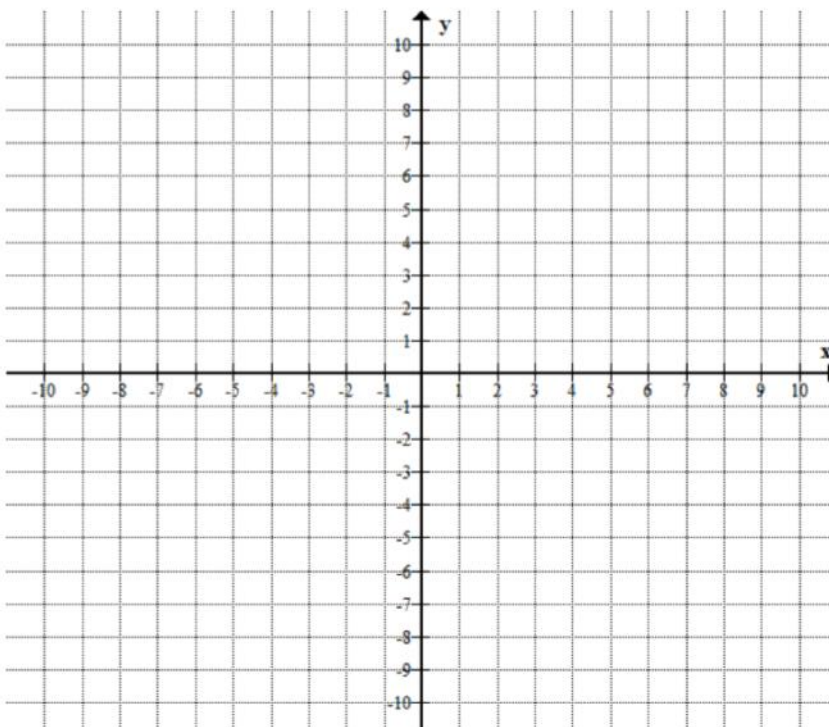
2. Graph: $y = x^2$
 quadratic function
 (shape = parabola)

x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

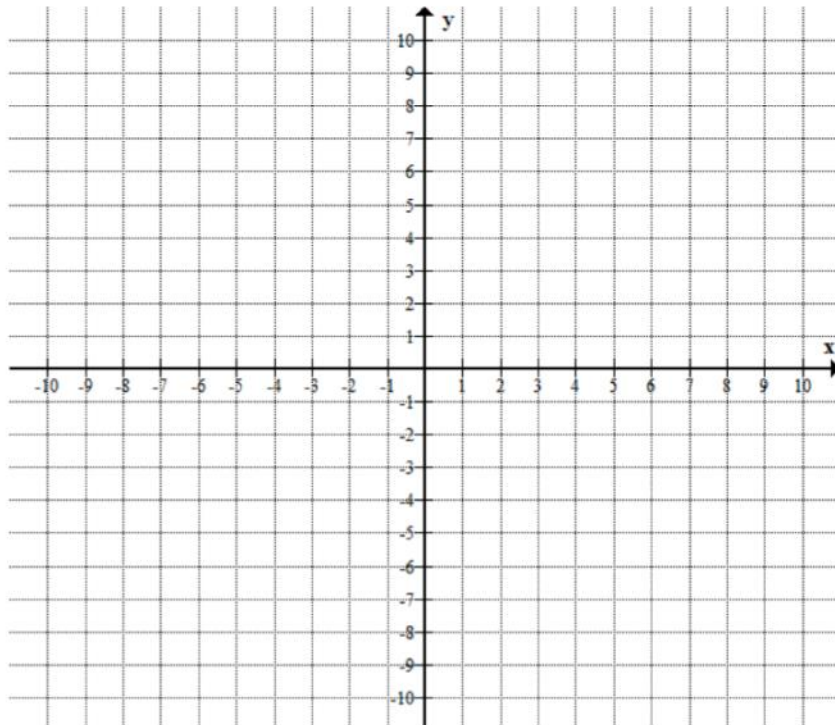
$\{x \mid x \in \mathbb{R}\}$
 $\{y \mid y \geq 0, y \in \mathbb{R}\}$



3. Graph: $y = \sqrt{x}$



4. Graph: $y = x^3$



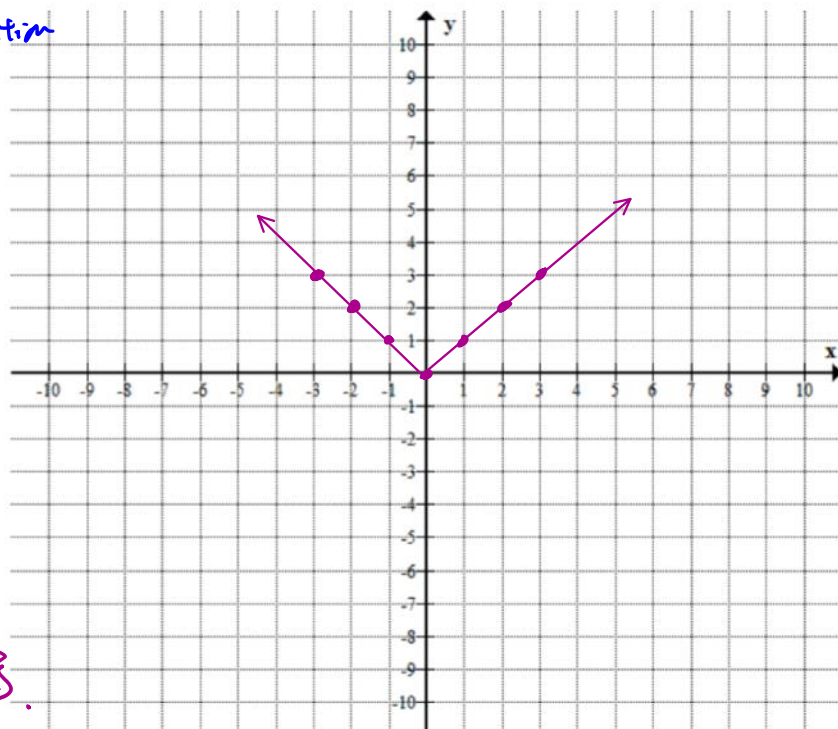
5. Graph: $y = |x|$

Absolute Value Function

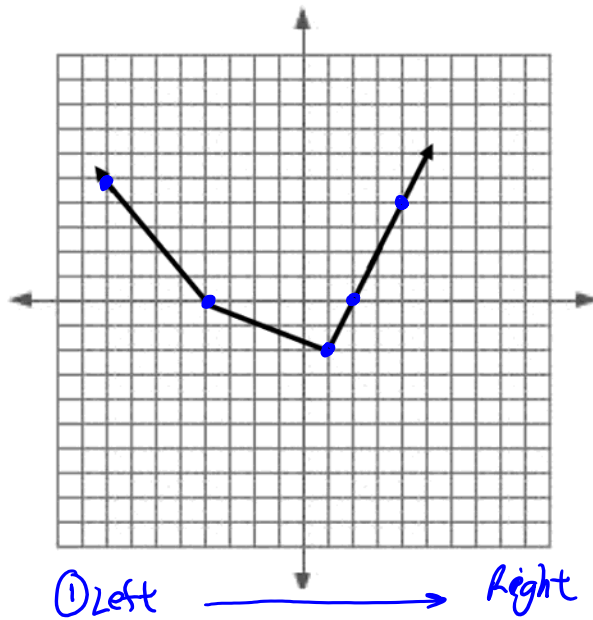
x	y
-3	3
-2	2
-1	1
0	0
1	1
2	2
3	3

$D: \{x \mid x \in \mathbb{R}\}$

$R: \{y \mid y \geq 0, y \in \mathbb{R}\}$



6. This is the graph of $y = f(x)$. List 4 or 5 points on this graph in the table of values.



Left ①

x	y
-8	5
-4	0
1	-2
2	0
4	4

end Right

KEY

Basic Graphing Review – Know these base functions and their graphs so you are able to apply transformations on them in the course.

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- Make a table of values
- Plot the point on your grid
- Draw a line or smooth curve
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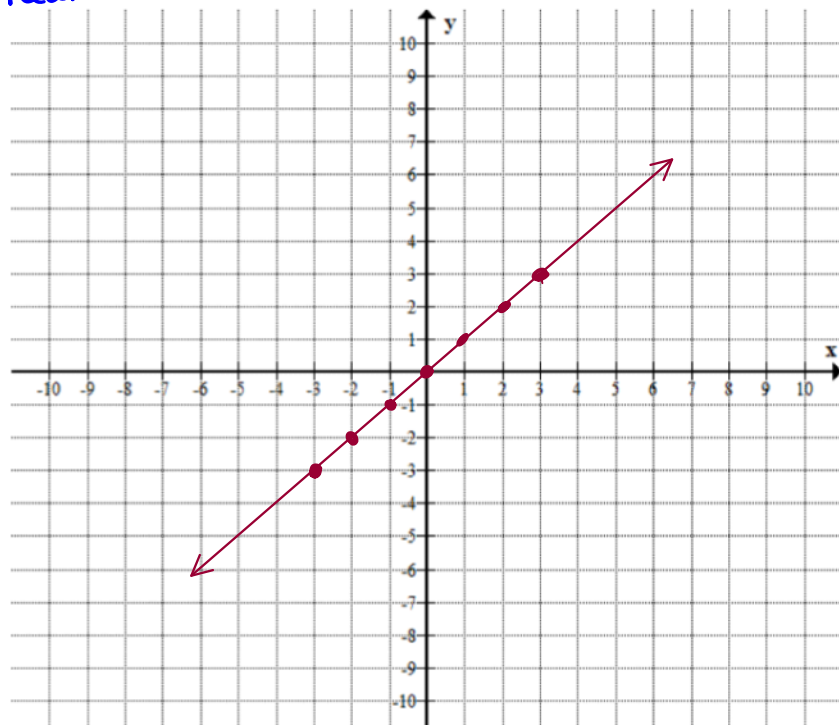
When graphing, start with a table of values. Look at restrictions and use your graphing calc to verify.

1. Graph: $y = x$

x	y
-3	-3
-2	-2
-1	-1
0	0
1	1
2	2
3	3

Start
↓
end

Coordinates
(x, y)



Domain: $\{x | x \in R\}$ = x in the set of real numbers.
Range: $\{y | y \in R\}$ = y " " "

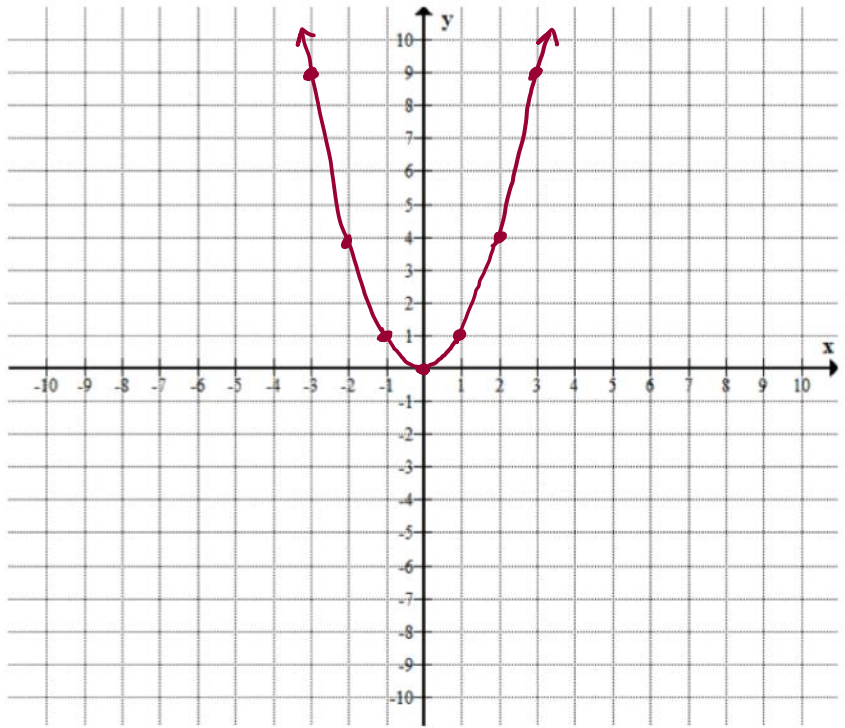


Quadratic (parabola)

2. Graph: $y = x^2$

①

x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9



$$\{x \mid x \in \mathbb{R}\}$$

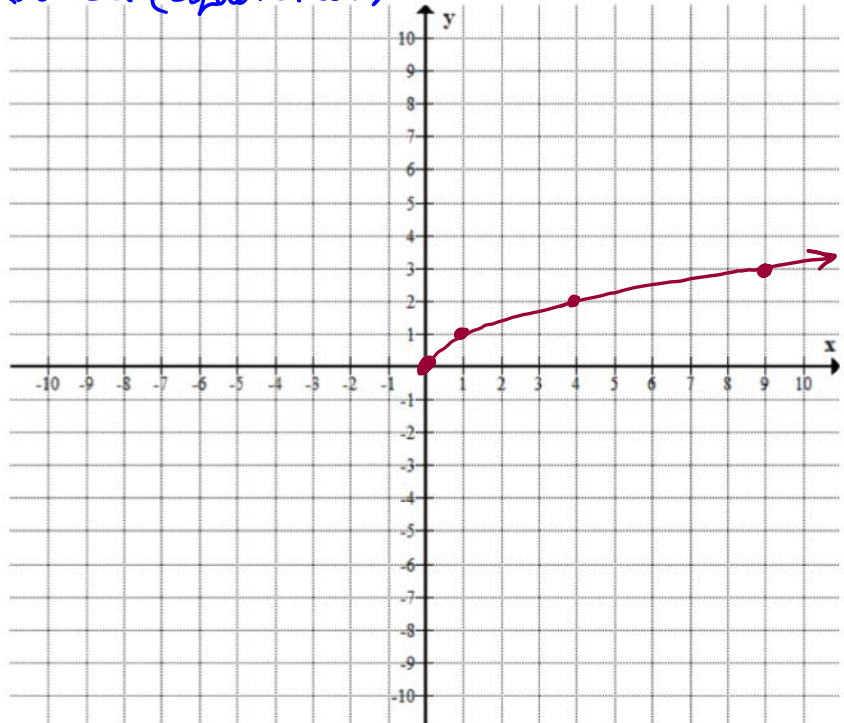
$$\{y \mid y \geq 0, y \in \mathbb{R}\}$$

3. Graph: $y = \sqrt{x}$

~~$\frac{-3}{-1}$~~

x	y
0	0
1	1
4	2
9	3
16	4

Radical (SquareRoot)



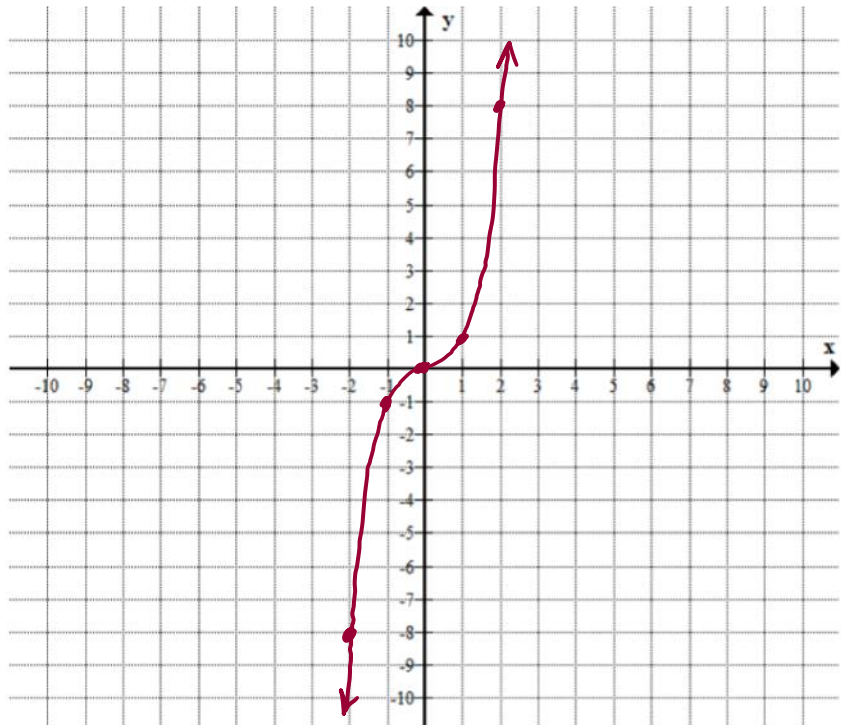
$$\{x \mid x \geq 0, x \in \mathbb{R}\}$$

$$\{y \mid y \geq 0, y \in \mathbb{R}\}$$

4. Graph: $y = x^3$

x	y
-3	-27
-2	-8
-1	-1
0	0
1	1
2	8
3	27

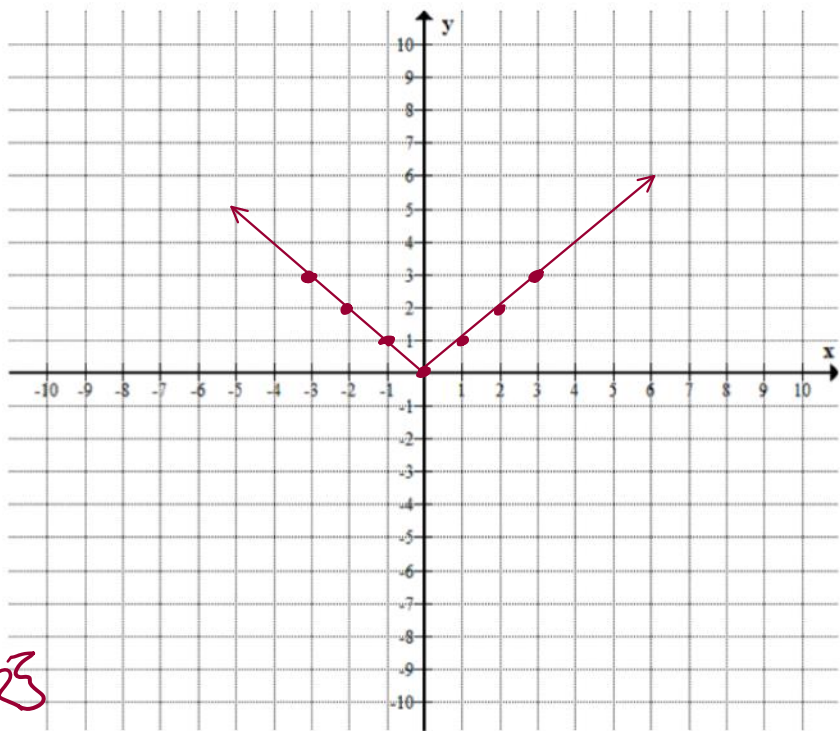
$\{x \mid x \in \mathbb{R}\}$
 $\{y \mid y \in \mathbb{R}\}$



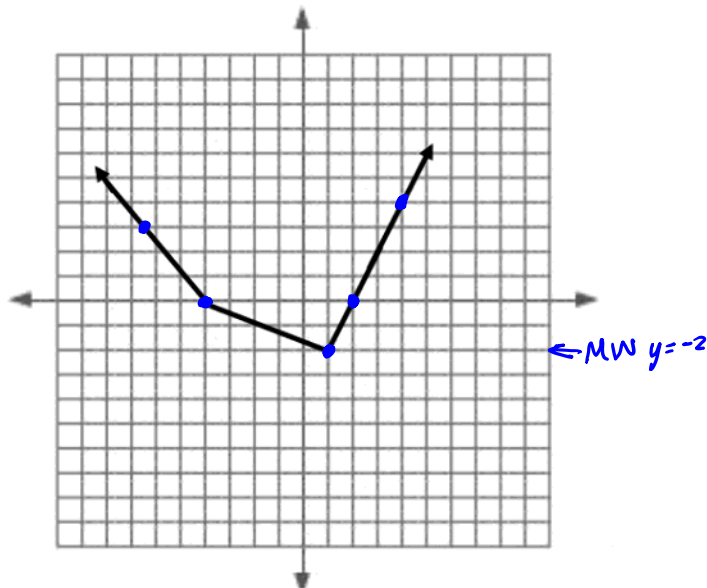
5. Graph: $y = |x|$

x	y
-3	3
-2	2
-1	1
0	0
1	1
2	2
3	3

$\{x \mid x \in \mathbb{R}\}$
 $\{y \mid y \geq 0, y \in \mathbb{R}\}$



6. This is the graph of $y = f(x)$. List 4 or 5 points on this graph in the table of values.



x	y
-6.5	3
-4	0
1	-2
2	0
4	4

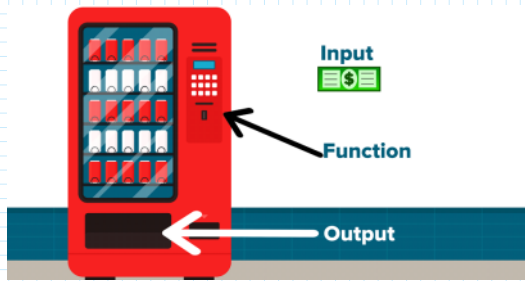
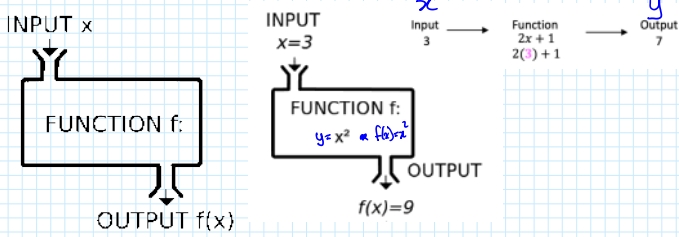
left

↓
right

$\{x \mid x \in \mathbb{R}\}$
 $\{y \mid y \geq -2, y \in \mathbb{R}\}$

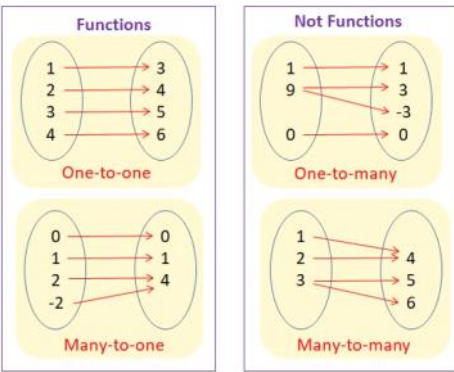
Review: Functions and Graphs

What is a function? $y = f(x)$
 Vertical line test
 Domain and Range



Relations

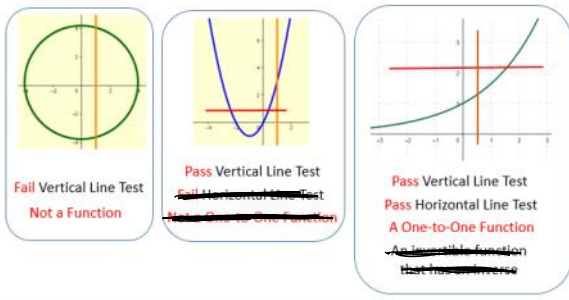
A relation shows a relationship between two values.
 A function is a relation where each input has only one output.

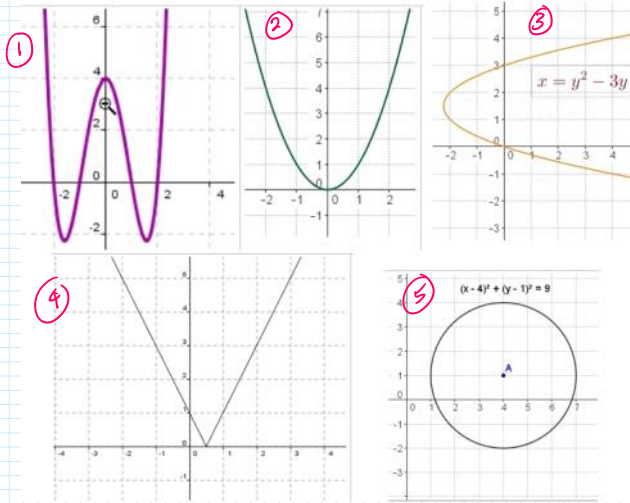


Vertical and Horizontal Line Tests

Pass Vertical Line Test: Any vertical line drawn will intersect the graph at only one point.

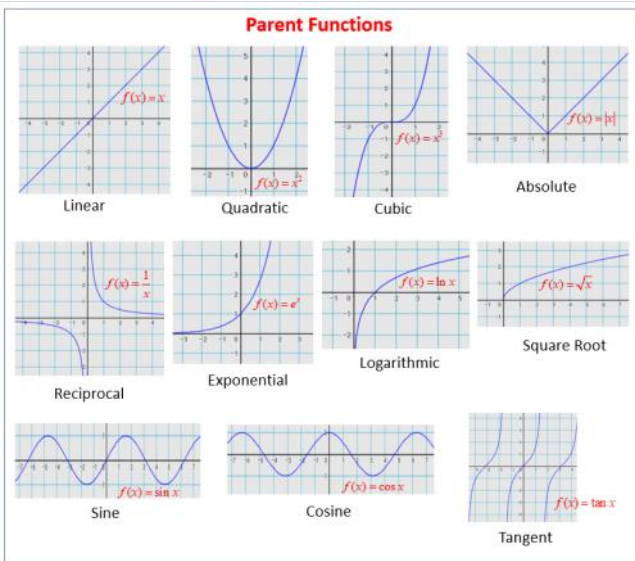
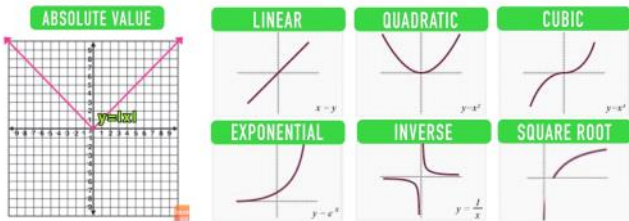
Pass Horizontal Line Test: Any horizontal line drawn will intersect the graph at only one point.



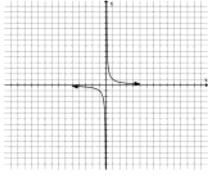


WHAT ARE THE PARENT FUNCTION GRAPHS?

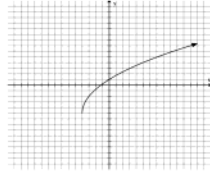
+ TRANSFORMATIONS



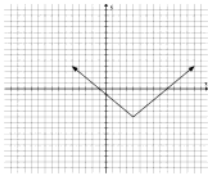
Rational - base $y = \frac{1}{x}$



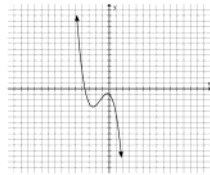
Radical $y = \sqrt{x}$ ($f(x) = \sqrt{x}$)



Absolute Value $y = |x|$
 $f(x) = |x|$

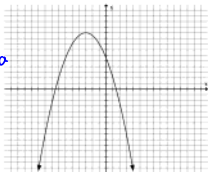


Cubic $f(x) = x^3$
($y = x^3$)

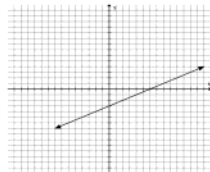


Quadratic $f(x) = x^2$
($y = x^2$)

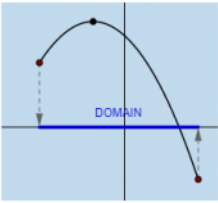
parabola



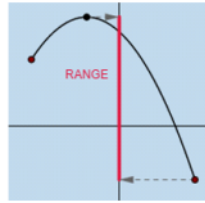
Linear $y = x$ ($f(x) = x$)



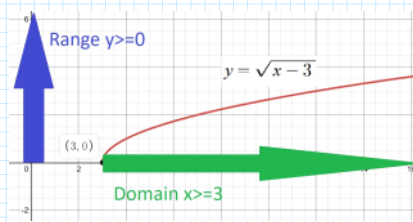
Domain and Range



Domain is all the possible x values of a function.



Range is all the possible y values of a function.



<p style="text-align: right;">A</p>	<p>Domain: $\{-6 \leq x \leq 6\}$ Range: $\{0 \leq y \leq 6\}$ Function: YES</p>	<p style="text-align: right;">E</p>
<p style="text-align: right;">B</p>	<p>Domain: $\{-4 \leq x \leq 4\}$ Range: $\{-4 \leq y \leq 4\}$ Function: NO</p>	<p style="text-align: right;">F</p>
<p style="text-align: right;">C</p>	<p>Domain: $\{-3 \leq x < 5\}$ Range: $\{y = -1\}$ Function: YES</p>	<p style="text-align: right;">G</p>
<p style="text-align: right;">D</p>	<p>Domain: $\{x \geq 0\}$ Range: $\{y = 4\}$ Function: YES</p>	<p style="text-align: right;">H</p>

2.4 Translations

A **transformation** of a function alters the equation and any combination of the location, shape, and orientation of the graph.

Points on the original graph correspond to points on the transformed, or image, graph. The relationship between these sets of points can be called a **mapping**.

Mapping notation can be used to show a relationship between the coordinates of a set of points, (x, y) , and the coordinates of a corresponding set of points, $(x, y + 3)$, for example, as $(x, y) \rightarrow (x, y + 3)$.

Did You Know?

Mapping notation is an alternate notation for function notation. For example, $f(x) = 3x + 4$ can be written as $f: x \rightarrow 3x + 4$. This is read as "f is a function that maps x to 3x + 4."

One type of transformation is a **translation**. A translation can move the graph of a function up, down, left, or right. A translation occurs when the location of a graph changes but not its shape or orientation.

transformation

- a change made to a figure or a relation such that the figure or the graph of the relation is shifted or changed in shape

mapping

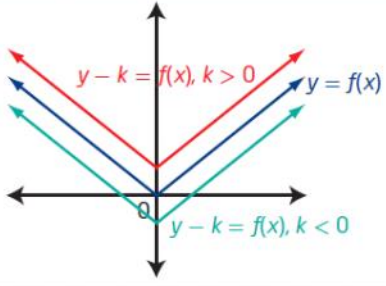
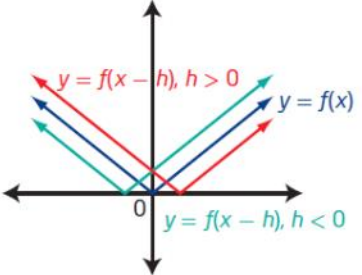
- the relating of one set of points to another set of points so that each point in the original set corresponds to exactly one point in the image set

translation

- a slide transformation that results in a shift of a graph without changing its shape or orientation
- vertical and horizontal translations are types of transformations with equations of the forms $y - k = f(x)$ and $y = f(x - h)$, respectively
- a translated graph is congruent to the original graph

Key Ideas

- Translations are transformations that shift all points on the graph of a function up, down, left, and right without changing the shape or orientation of the graph.
- The table summarizes translations of the function $y = f(x)$.

Function	Transformation from $y = f(x)$	Mapping	Example
$y - k = f(x)$ or $y = f(x) + k$	A vertical translation If $k > 0$, the translation is up. If $k < 0$, the translation is down.	$(x, y) \rightarrow (x, y + k)$	
$y = f(x - h)$	A horizontal translation If $h > 0$, the translation is to the right. If $h < 0$, the translation is to the left.	$(x, y) \rightarrow (x + h, y)$	

- A sketch of the graph of $y - k = f(x - h)$, or $y = f(x - h) + k$, can be created by translating key points on the graph of the base function $y = f(x)$.

$$y = f(x) \rightarrow y = f(x - h) + k$$

horizontal translation
 $h > 0$: move to the right
 $h < 0$: move to the left
 $h = 0$: don't move

$$f(x) = f(x - h) + k$$

horizontal translation
 $h > 0$: move to the right
 $h < 0$: move to the left
 $h = 0$: don't move

$$f(x) = f(x - h) + k$$

vertical translation
 $k > 0$: move upward
 $k < 0$: move downward
 $k = 0$: don't move

The following table shows the coordinates of the point on the different curves after translation:

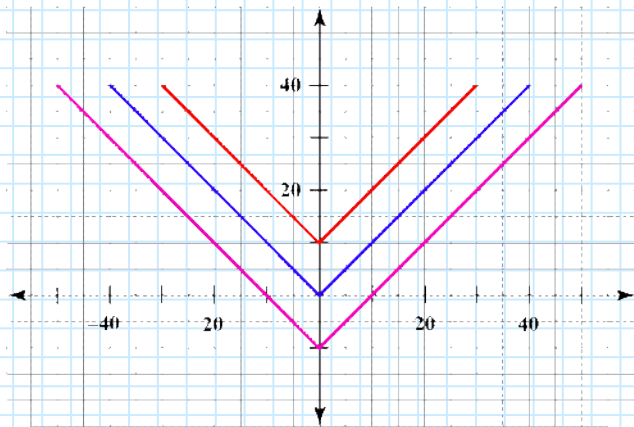
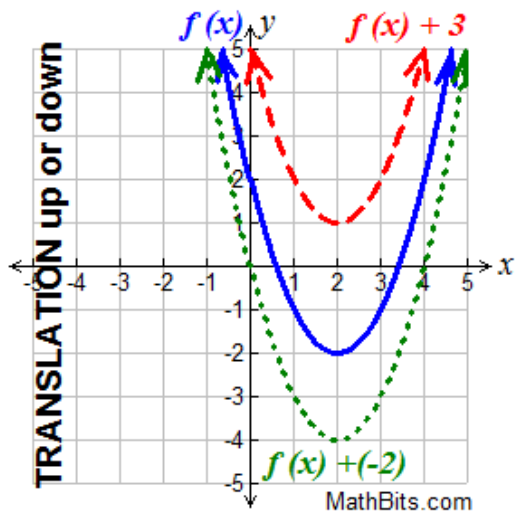
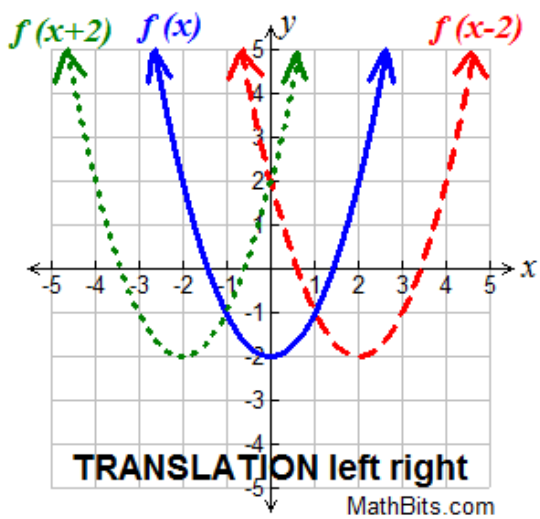
The point on $f(x)$	The point on $f(x + k)$	The point on $f(x - k)$
(x, y)	$(x - k, y)$	$(x + k, y)$

Meanwhile, the shape of the function and domain of the function remains the same.

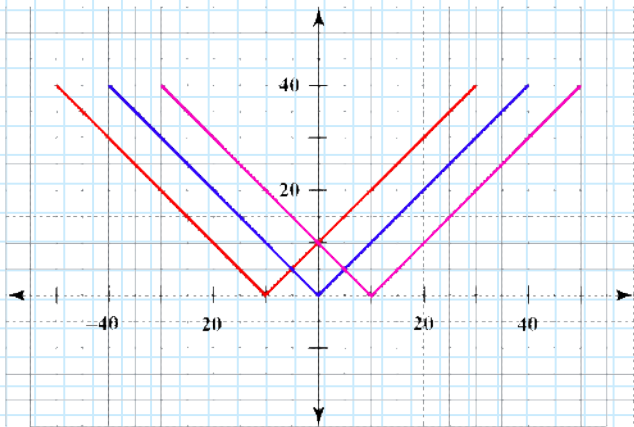
The following table shows the coordinates of the point on the different curves after translation:

The point on $f(x)$	The point on $f(x) + C$	The point on $f(x) - C$
(x, y)	$(x, y + C)$	$(x, y - C)$

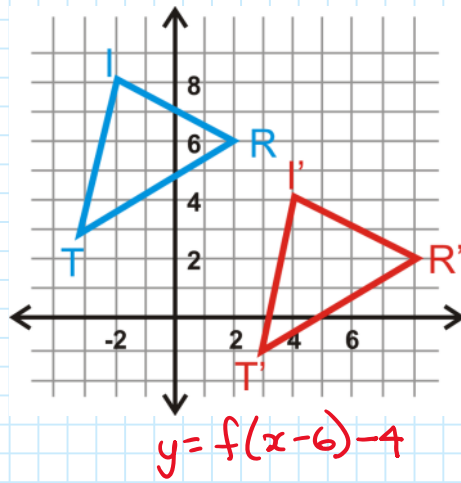
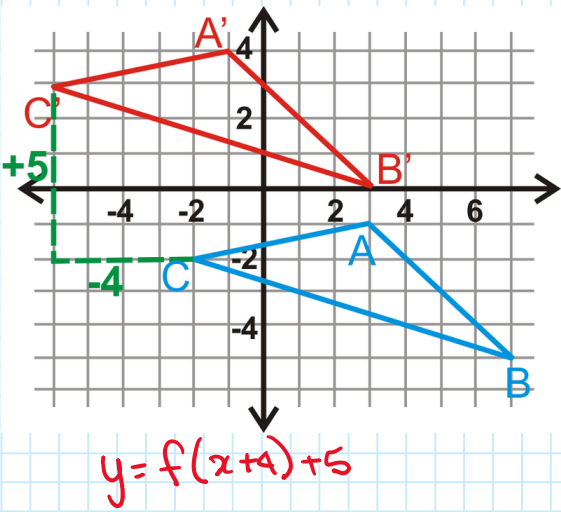
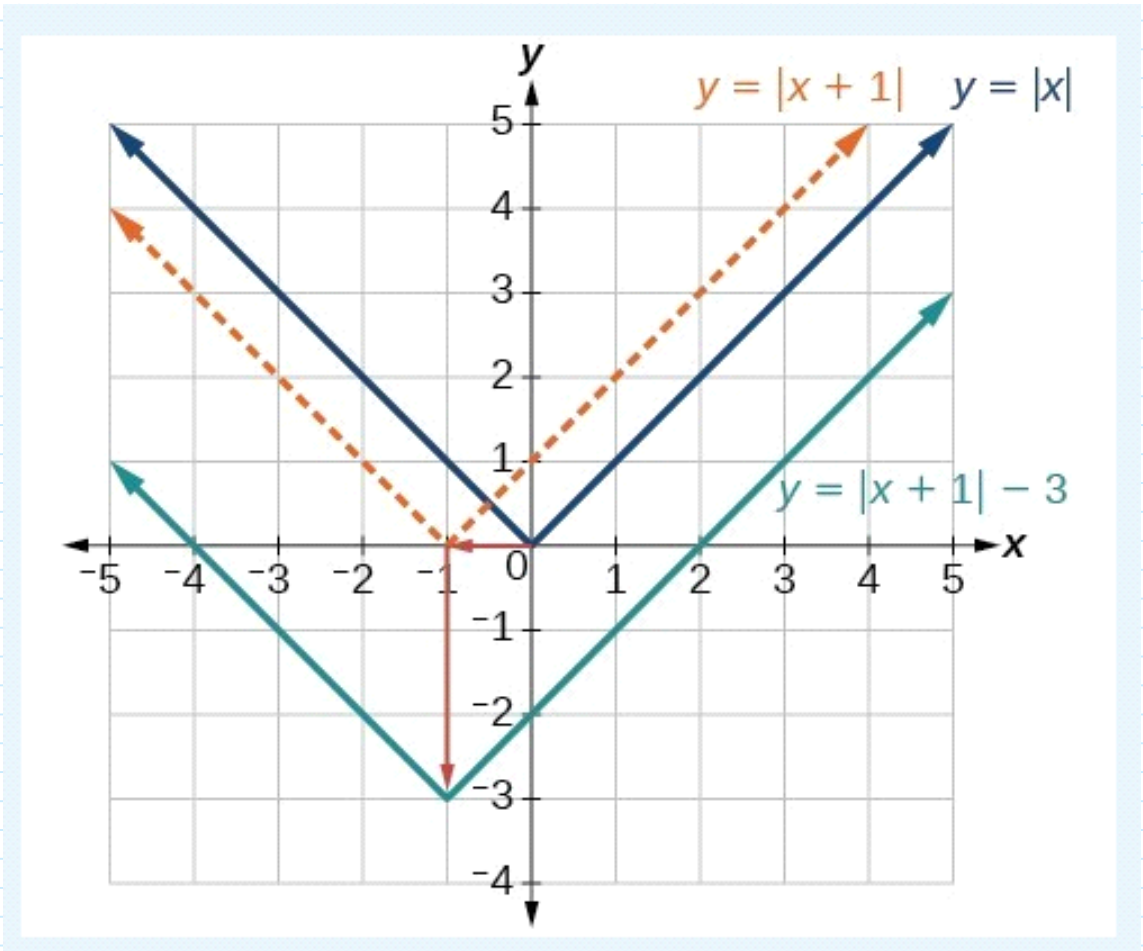
Meanwhile, the shape of the function and domain of the function remains the same.



Vertical Translation



Horizontal Translation



2.4 Reflections

reflection

- a transformation where each point of the original graph has an image point resulting from a reflection in a line
- may result in a change of orientation of a graph while preserving its shape

A **reflection** of a graph creates a mirror image in a line called the line of reflection. Reflections, like translations, do not change the shape of the graph. However, unlike translations, reflections may change the orientation of the graph.

- When the output of a function $y = f(x)$ is multiplied by -1 , the result, $y = -f(x)$, is a reflection of the graph in the x -axis.
- When the input of a function $y = f(x)$ is multiplied by -1 , the result, $y = f(-x)$, is a reflection of the graph in the y -axis.

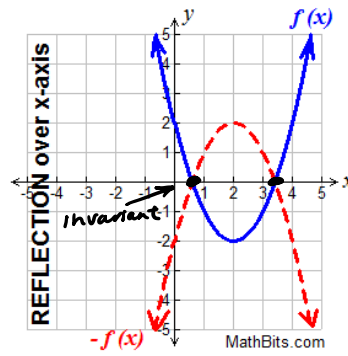
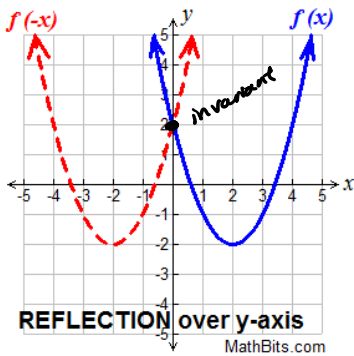
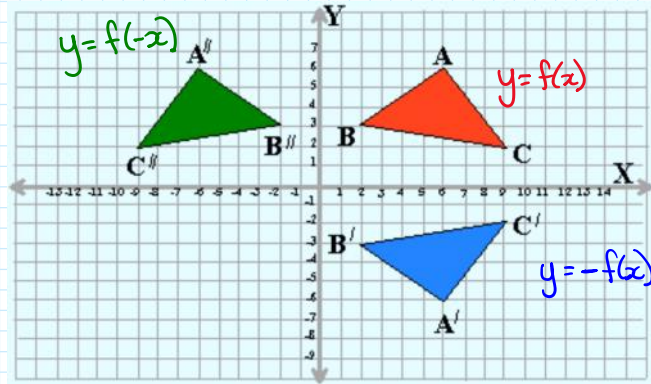
invariant point

- a point on a graph that remains unchanged after a transformation is applied to it
- any point on a curve that lies on the line of reflection is an invariant point

A GENERAL NOTE: REFLECTIONS

Given a function $f(x)$, a new function $g(x) = -f(x)$ is a **vertical reflection** of the function $f(x)$, sometimes called a reflection about (or over, or through) the x -axis.

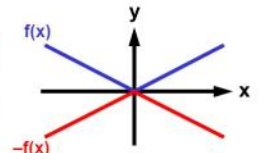
Given a function $f(x)$, a new function $g(x) = f(-x)$ is a **horizontal reflection** of the function $f(x)$, sometimes called a reflection about the y -axis.



Examples

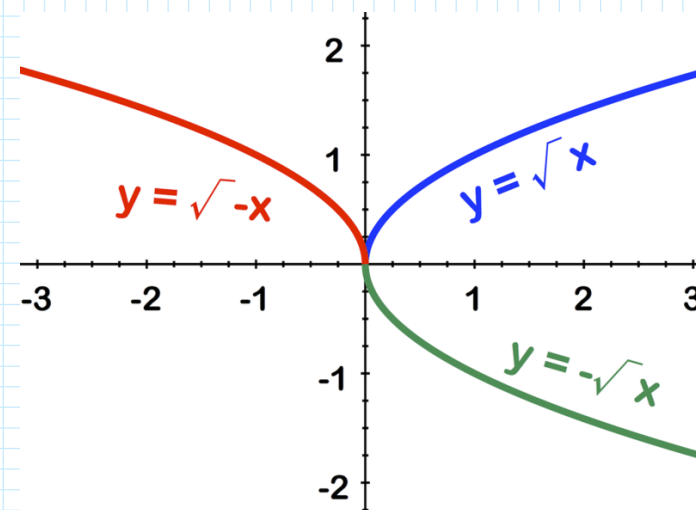
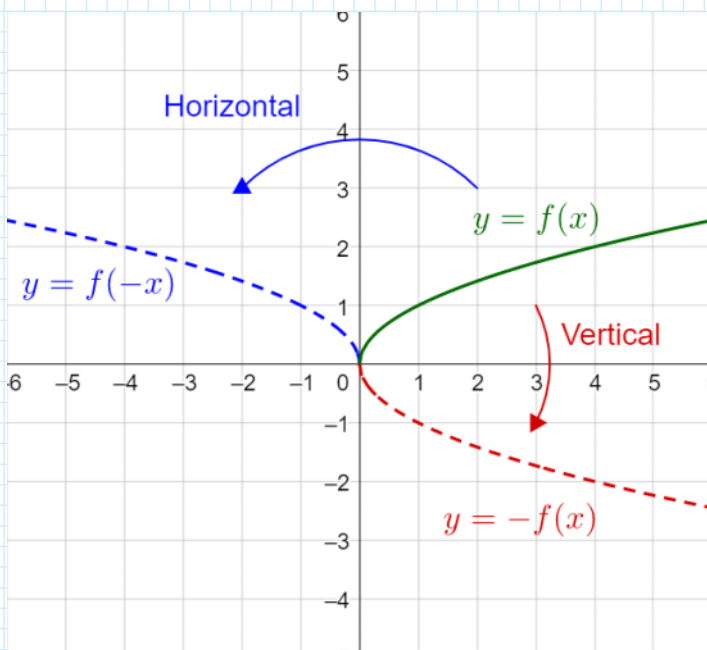
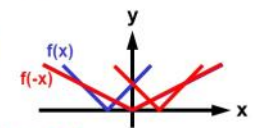
Vertical Reflection

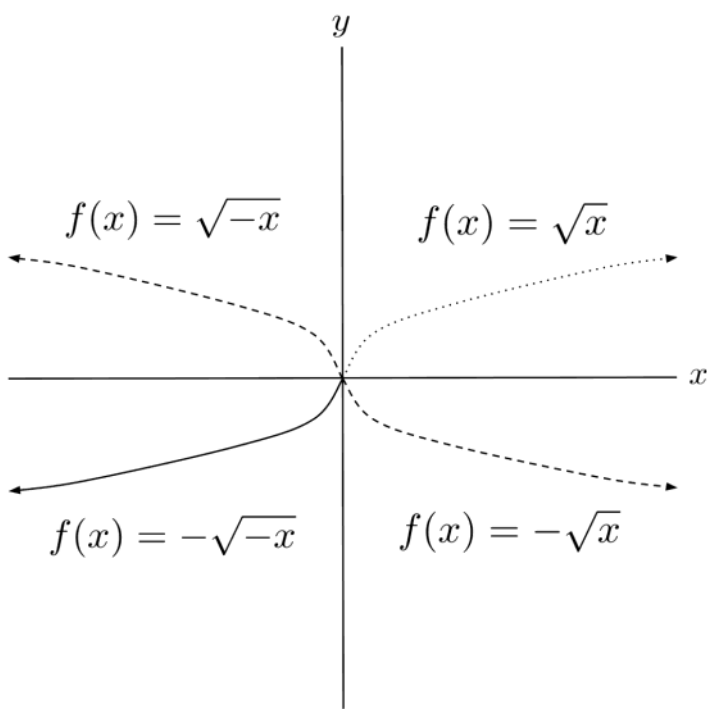
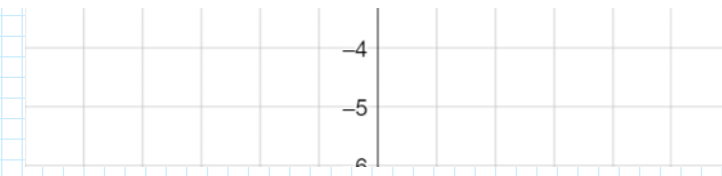
- $y = f(x) \rightarrow y = -f(x)$
- Example $y = |x| \rightarrow y = -|x|$



Horizontal Reflection

- $y = f(x) \rightarrow y = f(-x)$
- Example $y = |x + 1| \rightarrow y = |-x + 1|$





Reflection in **x-axis**

$$(x, y) \rightarrow (x, -y)$$

Reflection in **y-axis**

$$(x, y) \rightarrow (-x, y)$$

Reflection in **$y = x$**

$$(x, y) \rightarrow (y, x)$$

Reflection in **$y = -x$**

$$(x, y) \rightarrow (-y, -x)$$

