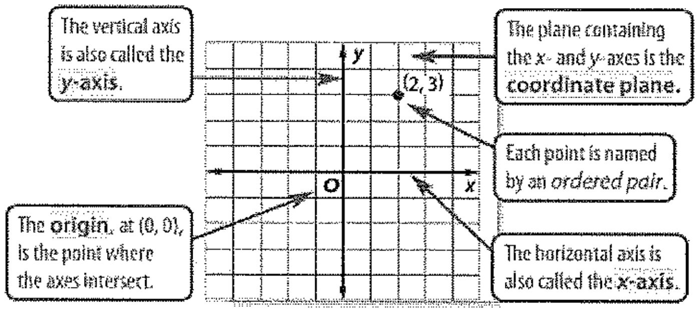
WIN Week 7 Notes Functions Day 1 – Relations
Learning Target – Students will represent and interpret relations.

A **coordinate system** is formed by the intersection of two number lines, the *hori. axis* and the *vertical axis*.

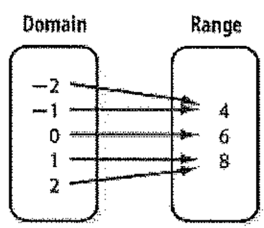


A point is represented on a graph using ordered pairs.

- An **ordered pair** is a set of numbers, or *coordinates*, written in the form (x, y).
- The x-value, called the **x-coordinate**, represents the horizontal placement of the point.
- The y-value, or **y-coordinate**, represents the vertical placement of the point.

A set of ordered pairs is called a **relation**. A relation can be represented in several different ways: as an equation, in a graph, with a table, or with a mapping.

A **mapping** illustrates how each element of the *domain* is paired with an element in the *range*. The set of the first numbers of the ordered pairs is the **domain**. The set of second numbers of the ordered pairs is the **range** of the relation. This mapping represents the ordered pairs $(-2, 4)$, $(-1, 4)$, $(0, 6)$ $(1, 8)$, and $(2, 8)$.



Study the different representations of the same relation below.

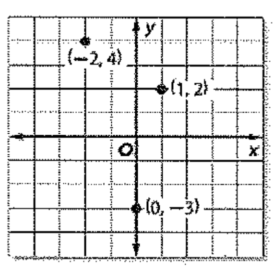
Ordered Pairs

$(1, 2)$
$(-2, 4)$
$(0, -3)$

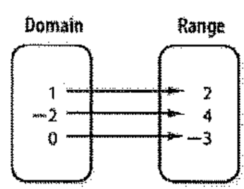
Table

x	y
1	2
−2	4
0	−3

Graph



Mapping



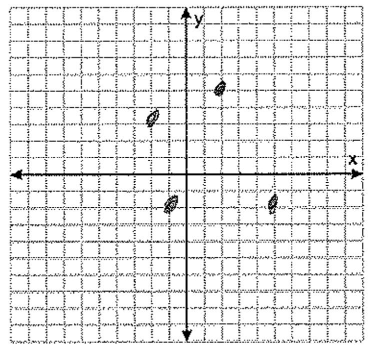
The x-values of a relation are members of the domain and the y-values of a relation are members of the range. In the relation above, the domain is $\{-2, 1, 0\}$ and the range is $\{-3, 2, 4\}$.

1. **Express {(2, 5), (−2, 3), (5, −2), (−1, −2)} as a table, a graph, and a mapping.**

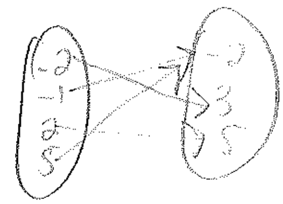
Table

x	y
−2	3
−1	−2
2	5
5	−2

Graph



Mapping



2. Determine the domain and range of the relation in question 1.

Domain {−2, −1, 2, 5}
Range {−2, 3, 5}

In a relation, the value of the variable that determines the output is called the **independent variable**. The variable with a value that is dependent on the value of the independent variable is called the **dependent variable**. The domain contains values of the independent variable. The range contains the values of the dependent variable.

Identify the independent and dependent variables for each relation.

a. DANCE The dance committee is selling tickets to the Fall Ball. The more tickets that they sell, the greater the amount of money they can spend for decorations. tickets sold = independent
money for decorations = dependent

b. MOVIES Generally, the average price of going to the movies has steadily increased over time.

time = independent
price of ticket = dependent

Practice

Identify the independent and dependent variables for each relation.

2A. The air pressure inside a tire increases with the temperature.

2B. As the amount of rain decreases, so does the water level of the river.

2A.
temperature = independent
air pressure = dependent

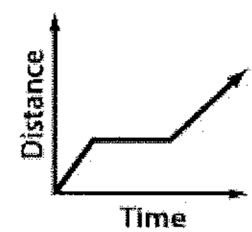
2B amount of rain = independent
water level of river = dependent

2 Graphs of a Relation

A relation can be graphed without a scale on either axis. These graphs can be interpreted by analyzing their shape.

The graph represents the distance Francesca has ridden on her bike. Describe what happens in the graph.

Bike Ride

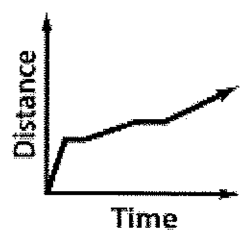


She rides her bike, then stops then starts riding again

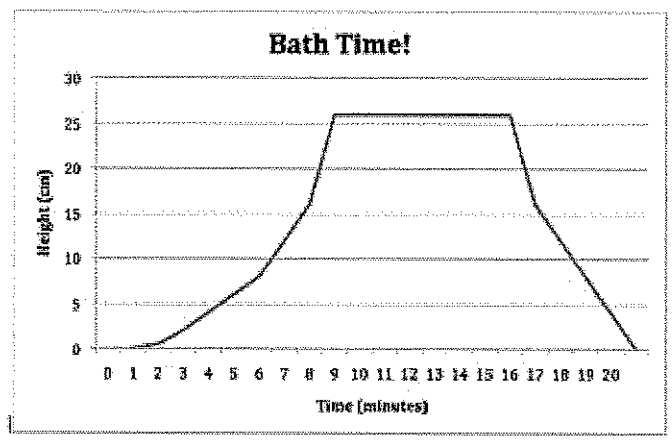
You try:

Describe what is happening in each graph.

3A. Driving to School



Drives very quickly then stops then drives slowly then stops then drives a medium speed.



The tub fills a lot slowly then quickly. Then it stops, then it drains quickly then slowly.

WIN Notes Functions Week 7 day 2 – Functions

Learning Target – Students will determine whether a relation is a function and find function values.

1 Identify Functions

A **function** is a relationship between input and output. In a function, there is exactly one output for each input.

1. Look at each example below. Compare the relation labeled "function" to the relation labeled "not a function". Determine why the relation labeled "not a function" isn't a function. Explain your answer.

Function

X	Y
1	2
2	4
3	6
4	8
5	10
6	12

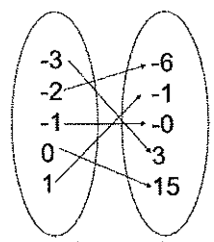
each x has exactly 1 y.

Not a Function

X	Y
1	2
2	4
1	5
3	8
4	4
5	10

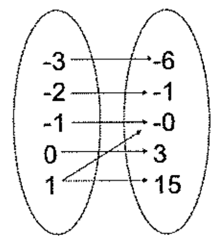
The X value of 1 has more then 1 y.

Function



each x has exactly 1 y.

Not a Function



The X value of 1 has more than 1 y.

Function

(4,12)
(5,15)
(6,18)
(7,21)
(8,24)

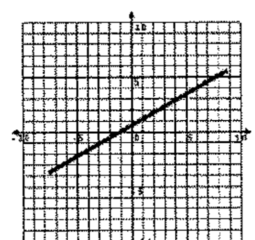
each x has exactly 1 y.

Not a Function

(4,12)
(4,15)
(5,18)
(5,21)
(6,24)

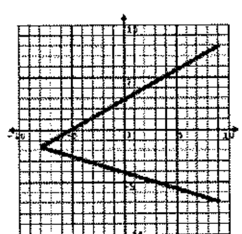
The x values of 4 and 5 have more than one y.

Function



each x has exactly 1 y.

Not a Function

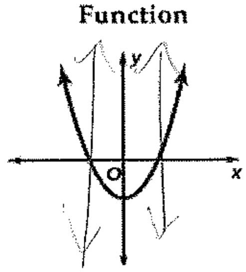


Several x values including 0, have more than 1 y

>You can use the **vertical line test** to see if a graph represents a function. If a vertical line intersects the graph more than once, then the graph is not a function. Otherwise, the relation is a function.

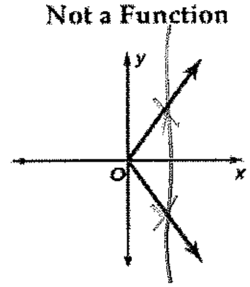
2.

Function



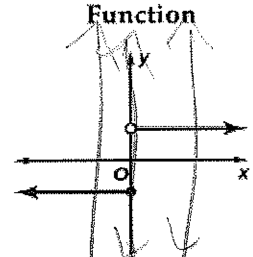
passes the VLT

Not a Function



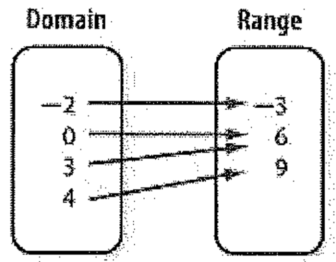
fails the VLT

Function



passes the VLT.

a.



Function
each x has exactly 1 y

b.

Domain	1	3	5	1
Range	4	2	4	−4

function,
each x has exactly 1 y.

GuidedPractice

1. {(2, 1), (3, −2), (3, 1), (2, −2)}

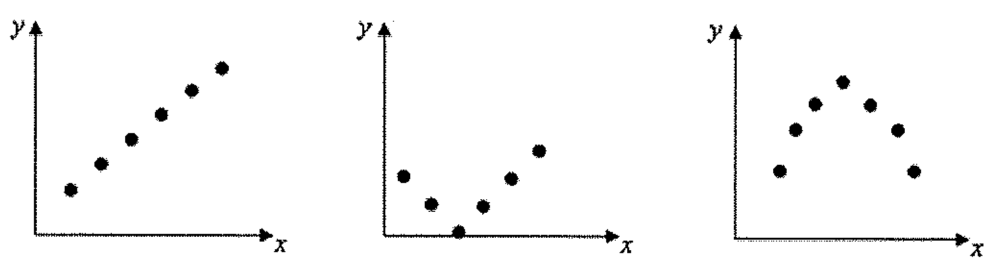
not a function,
two x values of 2 and 3
have more than 1 y value.

A graph that consists of points that are not connected is a **discrete function**. A function graphed with a line or smooth curve is a **continuous function**.

Discrete vs. Continuous

Functions that have smooth graphs, with no breaks in the domain or range, are called **continuous** functions.

Functions that are not continuous often involve quantities—such as people, cars, or stories of a building—that are counted or measured in whole numbers. Such functions are called **discrete** functions. Below are some examples of discrete functions:



3.

ICE SCULPTING **At an ice sculpting competition, each sculpture's height was measured to make sure that it was within the regulated height range of 0 to 6 feet. The measurements were as follows: Team 1, 4 feet; Team 2, 4.5 feet; Team 3, 3.2 feet; Team 4, 5.1 feet; Team 5, 4.8 feet.**

a. Make a table of values showing the relation between the ice sculpting team and the height of their sculpture.

x	y
1	4
2	4.5
3	3.2
4	5.1
5	4.8

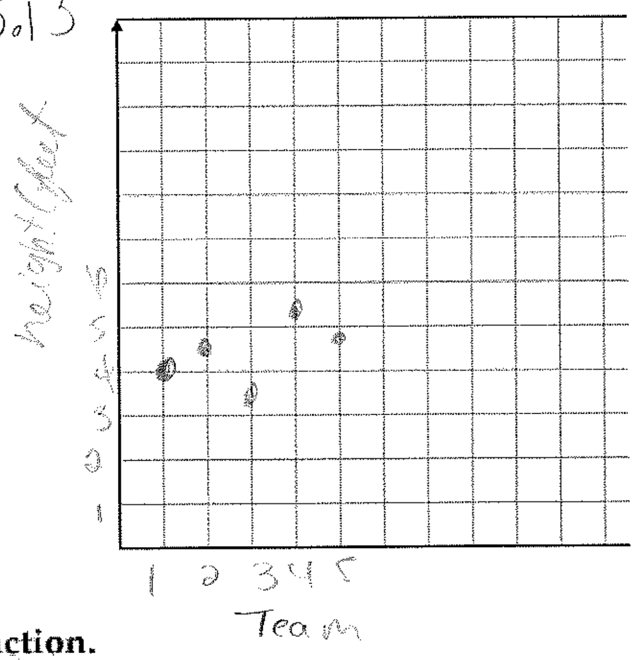
b. Determine the domain and range of the function.

Domain {1, 2, 3, 4, 5}

Range {3.2, 4, 4.5, 4.8, 5.1}

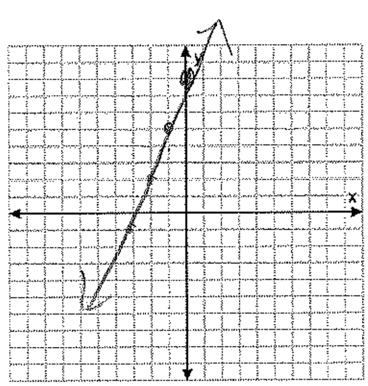
c. Write the data as a set of ordered pairs. Then graph the data.

(1, 4) (2, 4.5) (3, 3.2) (4, 5.1) (5, 4.8)

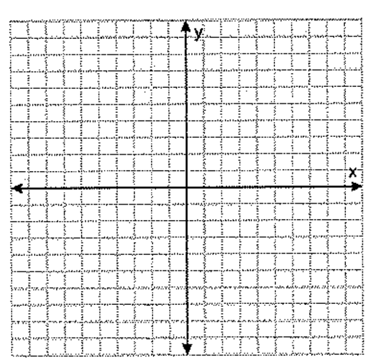


d. State whether the function is *discrete* or *continuous*. Explain your reasoning.

4. **Determine whether $-3x + y = 8$ is a function.**



$y = 3x + 8$



2 Find Function Values

Find Function Values Equations that are functions can be written in a form called **function notation**. For example, consider $y = 3x - 8$.

Equation	**Function Notation**
$y = 3x - 8$	$f(x) = 3x - 8$

In a function, x represents the elements of the domain, and $f(x)$ represents the elements of the range. The graph of $f(x)$ is the graph of the equation $y = f(x)$. Suppose you want to find the value in the range that corresponds to the element 5 in the domain. This is written $f(5)$ and is read *f of 5*. The value $f(5)$ is found by substituting 5 for x in the equation.

5.

For $f(x) = -4x + 7$, find each value.

a. $f(2)$ $= -4(2)+7 = -8$

b. $f(-3) + 1$ $(-4(-3)+7)+1 = 12+7+1 = 20$

6. **For $f(x) = 2x - 3$, find each value.**

4A. $f(1)$ $= 2(1) - 3 = -1$

4C. $f(-2)$ $= 2(-2) - 3 = -7$

4B. $6 - f(5)$ $6 - [2(5) - 3] = 6 - [10 - 3] = 6 - 7 = -1$

4D. $f(-1) + f(2)$ $[2(-1) - 3] + [2(2) - 3]$

$[-2 - 3] + [4 + 3]$

$[-5] + 7$

$= 2$

7.

If $h(t) = -16t^2 + 68t + 2$, find each value.

a. $h(4)$

$= -16(4)^2 + 68(4) + 2 = -256 + 272 + 4 = 18$

b. $2[h(g)]$ $2(-16g^2 + 68g + 2) = -32g^2 + 136g + 4)$

WIN week 7 notes Functions Day 4 – Interpreting Graphs of Functions

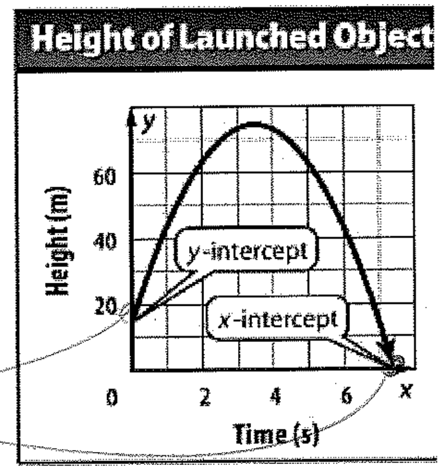
Learning Target – Students will interpret graphs of functions.

1 Interpret Intercepts and Symmetry To interpret the graph of a function, estimate and interpret key features. The **intercepts** of a graph are points where the graph intersects an axis. The y-coordinate of the point at which the graph intersects the y-axis is called a **y-intercept**. Similarly, the x-coordinate of the point at which a graph intersects the x-axis is called an **x-intercept**.

PHYSICS The graph shows the height y of an object as a function of ~~time x~~. Identify the function as *linear* or *nonlinear*. Then estimate and interpret the intercepts.

(0,20) The object started at 20 feet high

x intercept: (7,0) 7 seconds for the height of the object to be 0.

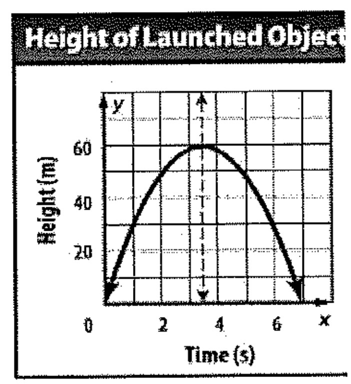


1. Sort all your graphs by Linear verses non linear.

The graphs of some functions exhibit another key feature: symmetry. A graph possesses **line symmetry** in the y-axis or some other vertical line if each half of the graph on either side of the line matches exactly.

PHYSICS An object is launched. The graph shows the height y of the object as a function of time x. Describe and interpret any symmetry.

at $x = 3.5$ seconds the object reaches its max height & begins to fall. $x = 3.5$ is the line of symmetry



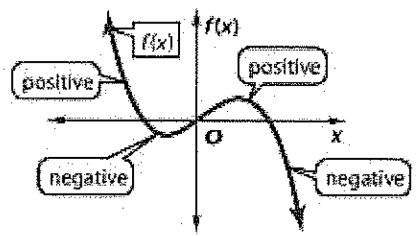
2. Sort your graphs by those with and without an axis of symmetry.

2 Interpret Extrema and End Behavior

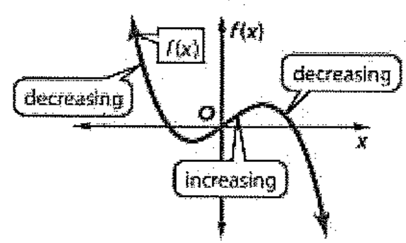
Interpreting a graph also involves estimating and interpreting where the function is increasing, decreasing, positive, or negative, and where the function has any extreme values, either high or low.

KeyConcepts Positive, Negative, Increasing, Decreasing, Extrema, and End Behavior

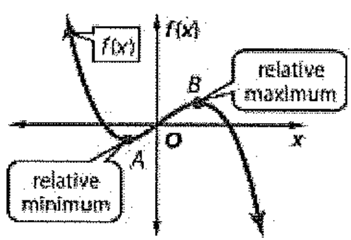
A function is **positive** where its graph lies *above* the x-axis, and **negative** where its graph lies *below* the x-axis.



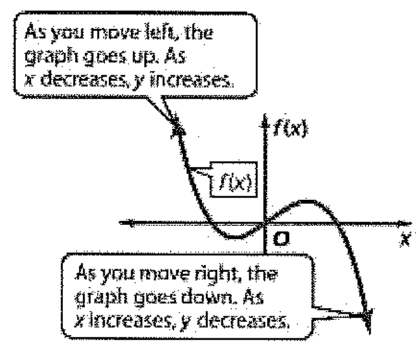
A function is **increasing** where the graph goes *up* and **decreasing** where the graph goes *down* when viewed from left to right.



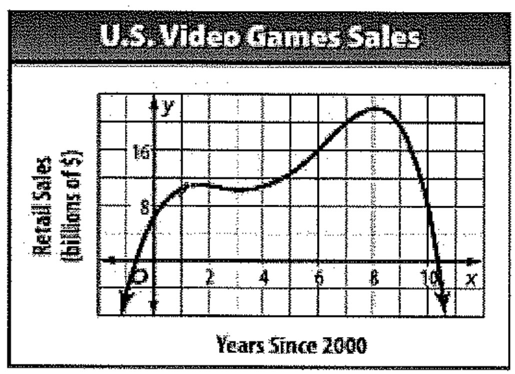
The points shown are the locations of relatively high or low function values called **extrema**. Point A is a **relative minimum**, since no other nearby points have a lesser y-coordinate. Point B is a **relative maximum**, since no other nearby points have a greater y-coordinate.



End behavior describes the values of a function at the positive and negative extremes in its domain.



VIDEO GAMES **U.S. retail sales of video games from 2000 to 2009 can be modeled by the function graphed at the right. Estimate and interpret where the function is positive, negative, increasing, and decreasing, the x-coordinates of any relative extrema, and the end behavior of the graph.**



end behavior
left → falling
right → falling

positive from x = -.5 to x = 10.2
negative before x = -.5 and after x = 10.2
increasing (-∞, 1) (3, 8)
decreasing (1, 3) (8, ∞)
relative max @ x=1 and x = 8 relative min @ x = 3

3. Sort your graphs by increasing, decreasing, constant or combination.

4. Sort your graphs into those with maximums, minimums, neither, or both.

5. Sort your graphs by those with similar end behavior.

6. Sort your graphs as discrete and continuous.

7. Sort your graphs by functions and non functions.

8. Save your graphs to use next class period.

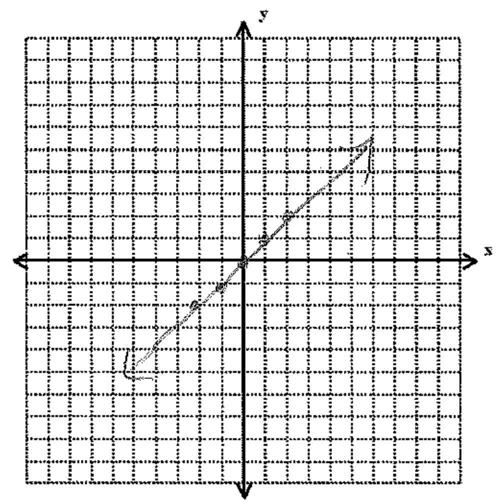
WIN Functions Week 8 Day 1 Notes – Graphing

A parent graph is a graph that is transformed to create other members in a family of graphs. A **FAMILY OF GRAPHS** that displays one or more similar characteristics. In the parent graph of each family (with the exception of the constant function) the coefficient of x is 1.

For each parent function below fill in the missing information. You can use your textbook and the internet as a resource.

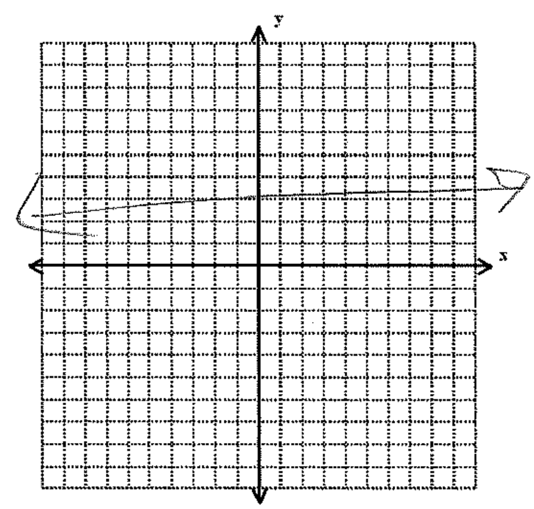
Function Name: Linear Function (The Identity Function)
General Equation: y=x
Domain: $\mathbb{R}$
Range: $\mathbb{R}$
x-intercept(s): (0,0)
y-intercept(s): (0,0)

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



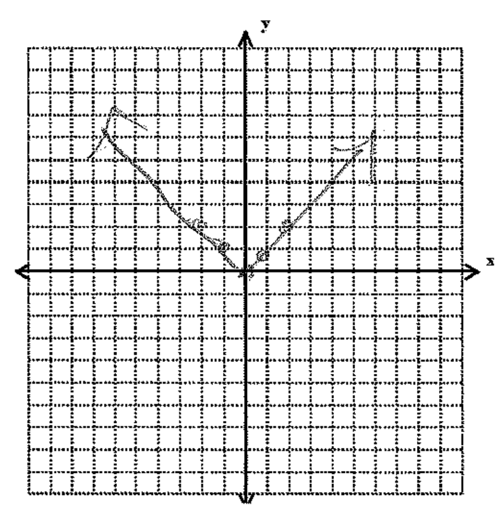
Function Name: Constant Function
General Equation: y=c, where c is a constant
Domain: $\mathbb{R}$
Range: c
x-intercept(s): none
y-intercept(s): (0,c)

x	y
-2	c
-1	c
0	c
1	c
2	c



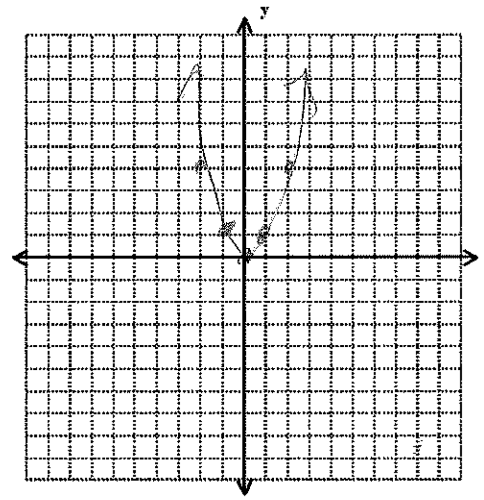
Function Name: Absolute Value Function
General Equation: $y = |x|$
Domain: $\mathbb{R}$
Range: $y \geq 0$
x-intercept(s): (0,0)
y-intercept(s): (0,0)

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



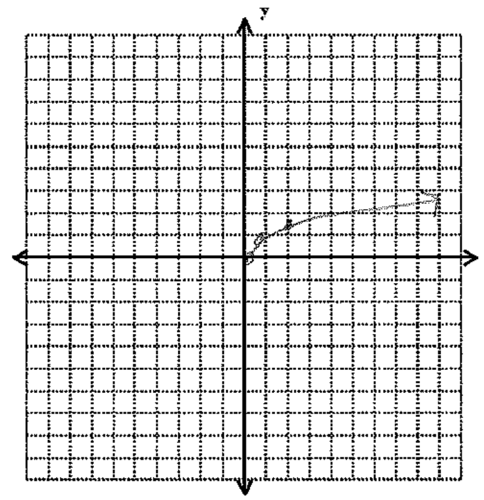
Function Name: Quadratic Function
General Equation: $y = x^2$
Domain: $\mathbb{R}$
Range: $y \geq 0$
x-intercept(s): (0, 0)
y-intercept(s): (0, 0)

x	y
-2	4
-1	1
0	0
1	1
2	4



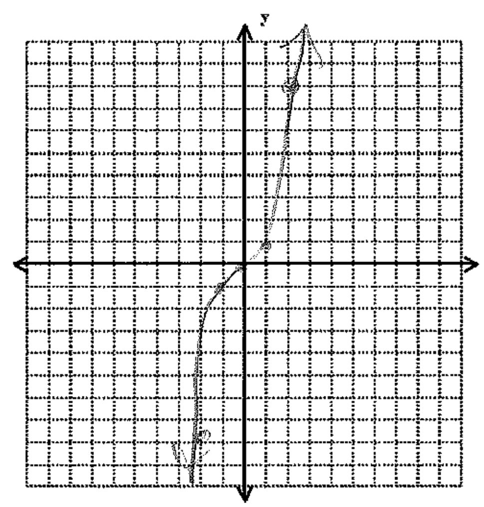
Function Name: The square Root Function
General Equation: $y = \sqrt{x}$
Domain: $x \geq 0$
Range: $y \geq 0$
x-intercept(s): (0, 0)
y-intercept(s): (0, 0)

x	y
-2	undefined
-1	undefined
0	0
1	1
2	1.4



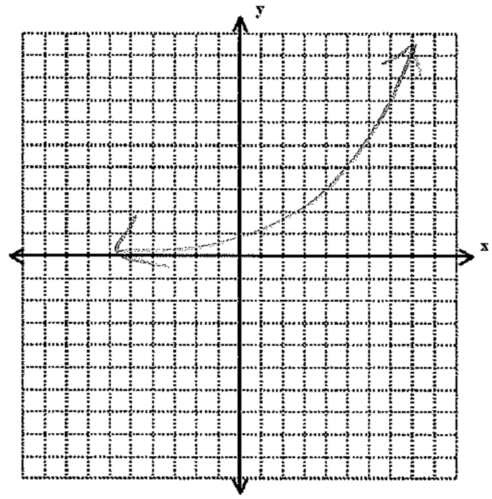
Function Name: The cubic Function
General Equation: $y = x^3$
Domain: $\mathbb{R}$
Range: $\mathbb{R}$
x-intercept(s): (0, 0)
y-intercept(s): (0, 0)

x	y
-2	-8
-1	-1
0	0
1	1
2	8



Function Name: The exponential Function
General Equation: $y = c^x$, where c is a constant
Domain: R $y=2^x$
Range: $y > 0$
x-intercept(s): none
y-intercept(s): (0,1)

x	y
-2	1/4
-1	2
0	1
1	2
2	4



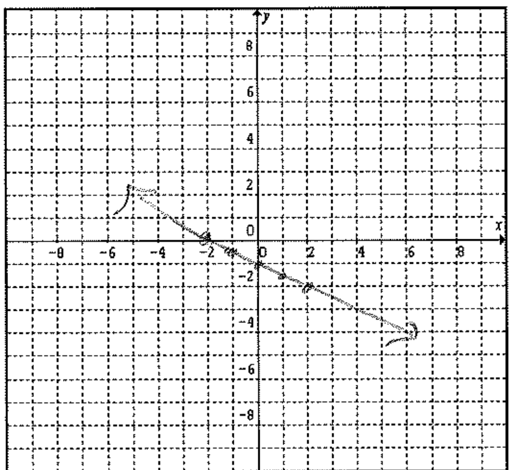
Now use the graphs from last class period and sort them by parent function. If there are any that do not match explain why.

WIN functions Notes Graph Functions Week 8 day 2

Examples- Graph each function rule and name each function by its correct mathematical name. Then state the domain, range, increasing intervals, decreasing intervals, x and y intercepts and any symmetry that you observe.

Learning Target – Students will graph linear, absolute value, exponential, square root, cubic, and quadratic functions.

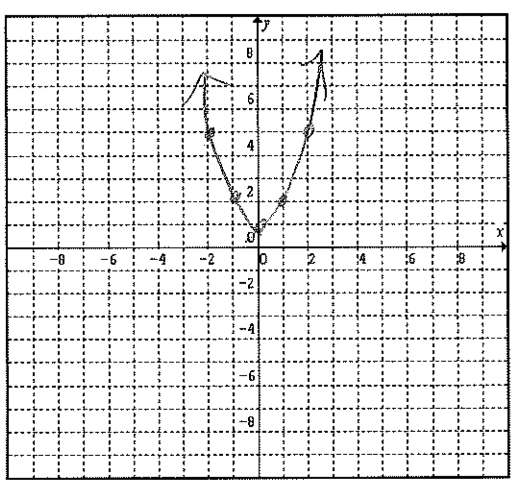
1. $y = -\frac{1}{2}x - 1$



Mathematical name:	Domain:	Range:
linear	$\mathbb{R}$	$\mathbb{R}$
Increasing Interval:	**Decreasing interval:**	**X - intercept:**
never	$(-\infty, \infty)$	$(-2, 0)$
Y-intercept:	**Symmetry:**	
$(0, -1)$	none	

x	y
-2	0
-1	-1/2
0	-1
1	-1.5
2	-2

2. $y = x^2 + 1$



x	y
-2	5
-1	2
0	1
1	2
2	5

quadratic

Domain $\mathbb{R}$

Range $y \geq 1$

Inc. $(0, \infty)$

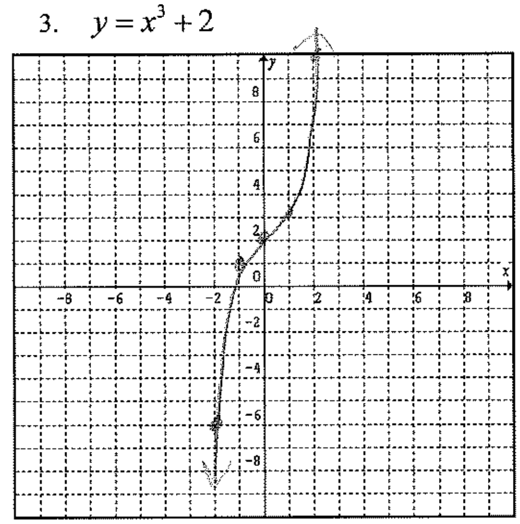
Dec $(-\infty, 0)$

x int none

y int $(0, 1)$

Symmetry about $x = 0$

3. $y = x^3 + 2$



x	y
-2	-6
-1	1
0	2
1	3
2	10

cubic

Domain $\mathbb{R}$

Range $\mathbb{R}$

Inc $(-\infty, \infty)$

Decreasing none

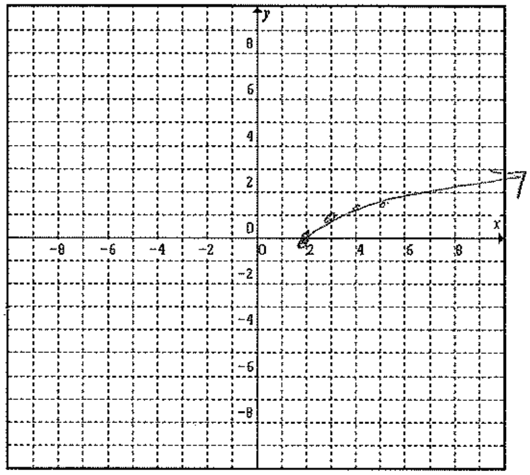
x int $(\sqrt[3]{-2}, 0)$

y int $(0, 2)$

Symmetry - none

4. $y=\sqrt{x-2}$

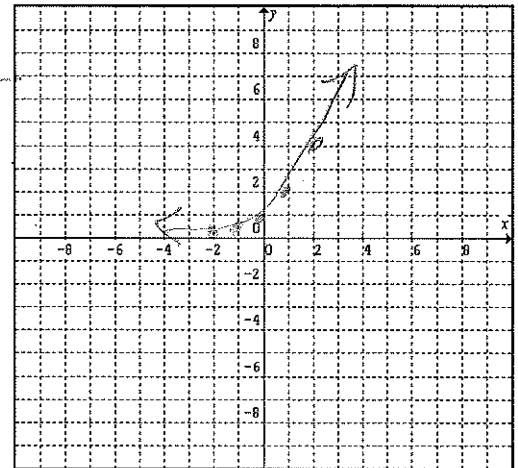
X	y
-2	und.
-1	unde
0	und
1	und
2	0
3	1
4	$\sqrt{2}$
5	$\sqrt{3}$



Square root
domain $x \geq 2$
Range $y \geq 0$
Inc $(2,\infty)$
dec never
xint $(2,0)$
yint (none
symmetry none

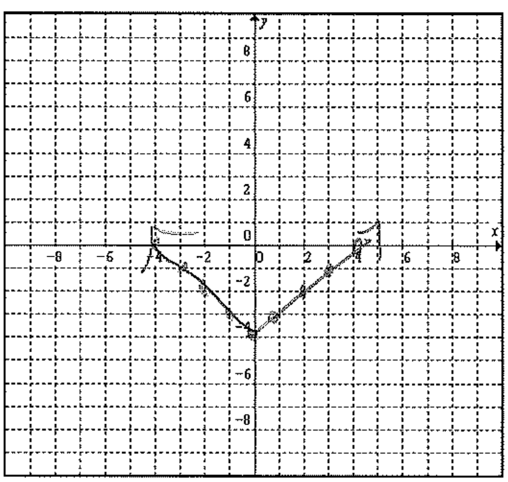
5. $y=2^x$

X	y
-2	1/4
-1	1/2
0	1
1	2
2	4



exponential
domain $\mathbb{R}$
Range $y > 0$
Inc $(-\infty,\infty)$
dec never
x int none
yint $(0,1)$
symmetry none

6. $y=|x|-4$



Mathematical name: absolute value	Domain: $\mathbb{R}$	Range: $y \geq -4$
Increasing Interval: $(0,\infty)$	Decreasing interval: $(-\infty,0)$	X - intercept: $(4,0)$ $(-4,0)$
Y-intercept: $(0,-4)$	Symmetry: $X=0$	

X	y
-2	-2
-1	-3
0	-4
1	-3
2	-2