Unit: Quadratic Functions

Learning increases when you have a goal to work towards. Use this checklist as guide to track how well you are grasping the material. In the center column, rate your understand of the topic from 1-5 with 1 being the lowest and 5 being the highest. Be sure to write down any questions you have about the topic in the last column so that you know what you have yet to learn. You can rate yourself again before the test to see what you need to focus on.

Outcomes	Understanding (1-5)	Questions?
11P.R.3. Analyze quadratic functions of the form $y=a(x-p)^2+q$ and determine the: • vertex • domain and range • direction of opening • axis of symmetry • *x*- and *y*-intercepts.		
11P.R.4. Analyze quadratic functions of the form $y=ax^2+bx+c$ to identify characteristics of the corresponding graph, including: • vertex • domain and range • direction of opening • axis of symmetry • *x*- and *y*-intercepts		
11P.R.5. Solve problems that involve quadratic equations.		
11P.R.6. Solve, algebraically and graphically, problems that involve systems of linear-quadratic and quadratic-quadratic equations in two variables.		

Lesson 4.1: Properties of a Quadratic Function

Review of Terms:

A ***relation*** is ________________________ (___ , ___).

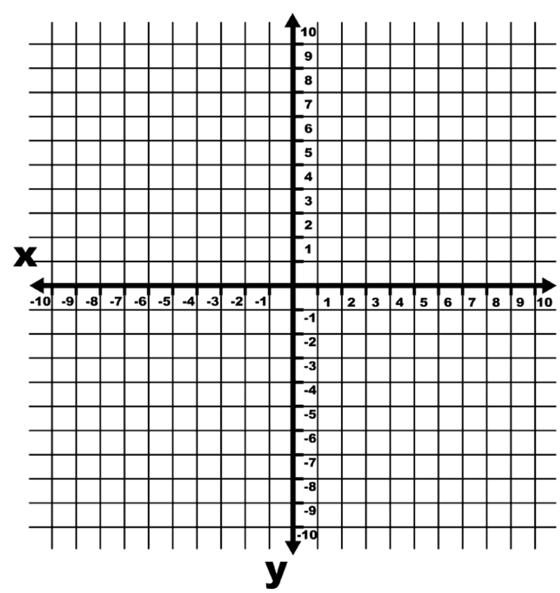
It can be expressed as:

a) ________________________ ex.

b) ________________________ ex.

c) ________________________ ex.

d) ________________________ ex.



e) ________________________

ex.

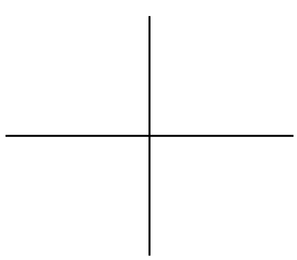
2) A __________ is a relation where only one unique ______ value (___) exists for each _____ value (___). (One input value (x) results in only one unique input value).

examples of functions:

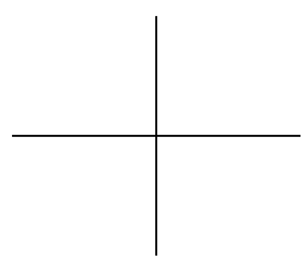
examples of relations that are NOT functions:

3) The ____________ test is a visual tool used for determining if a graphical relation is a _____________. If a vertical line touches a relation at ______________, it is not a function.

ex. 1



ex.2



4) The ____________ is the set of input values (__) for which a function or relation is defined or valid.

5) The _____________ is the set of output values (___) for which a function or relation is defined or valid

- There are many different ways of indicating domain and range:

Set Notation		**Interval Notation**
a) ____________	(x is part of the set of real numbers)	_______________
b) ____________	(x is greater than or equal to 6)	________________
c) ____________	(greater than -2 or less than 1) (between -2 and 1)	________________

$\{x|x \geq 6\}$

$\{x|x \in R, x \geq 6\}$

$x \geq 6$

Rules for what brackets to use:

- When simply listing numbers, use set brackets.

  Ex: State the domain and range for the following relation: {(1,2), (-2, 3), (3, 4)}

- Square brackets includes the number.

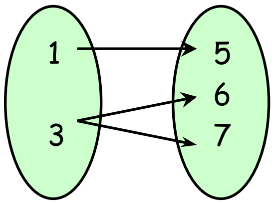
  Ex:

- Round brackets does **not** include the number.

  Ex:

Examples: State the *domain* and *range* of the following relation. Also, list the ordered pairs.

1)

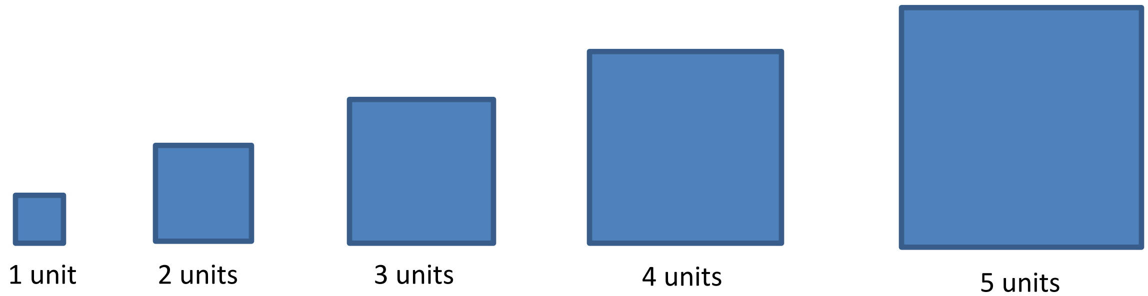


<u>Assignment</u>: "What did the baby porcupine say when it backed into a cactus?"

Lesson 4.1 – Properties of a Quadratic Function

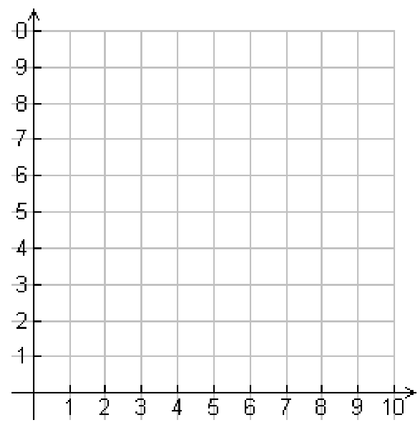
THINK:

You are given the following set of squares with various side lengths



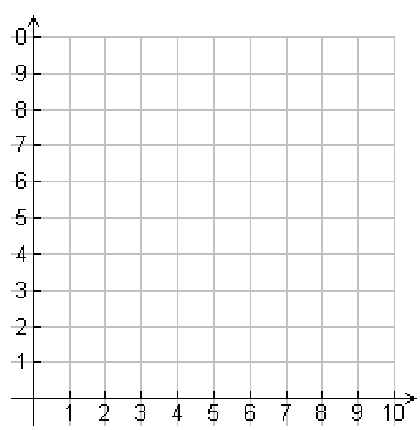
Create a table of values and graph the perimeter of each square:

Side length (x)	Perimeter (y)



Create a table of values and graph the area of each square:

Side length (x)	Area (y)



How are these two graphs the same? How are they different?

The above two graphs are the same in that they both deal with squares of different lengths. One graph shows the perimeter of a square as a straight line. The other graph shows the area of a square which we see as increasing _______________. How do we compare these two graphs mathematically?

- The perimeter graph shows a _________function. This means that there are _________________________ in the equation. Ex. y = 3x + 1
- The area graph shows a ____________ function. This means that there is an ____________ of _____ in the equation. Ex. $y = x^2$, $y = 3x^2 - 4$

<u>General Form of a Quadratic Equation</u>: $y = ax^2 + bx + c$ (2nd degree equation)

- where a , b , and c are real numbers and $a \neq 0$
- This is called the _______________ of the equation of a quadratic function

examples:

<u>Graphing</u>:

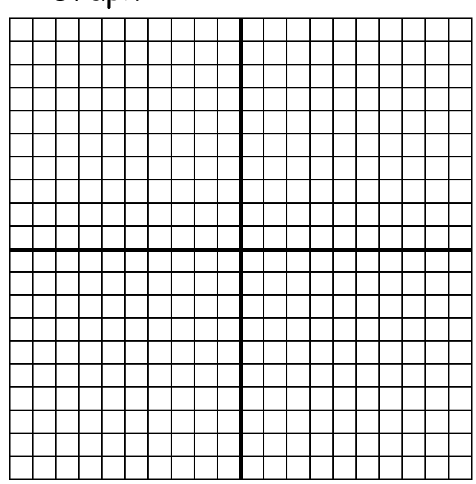
Graph the following equations by: (i) creating a table of values, (ii) plotting the coordinates, and (iii) joining the points with a smooth curve.

Ex.1 $y = x^2$

Table of values

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

Graph



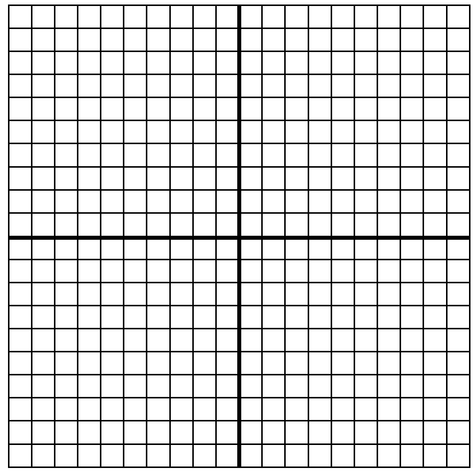
The shape of the graph of a quadratic function is called a _______________

Ex. 2	$y = (x-3)^2 - 7$

Table of values

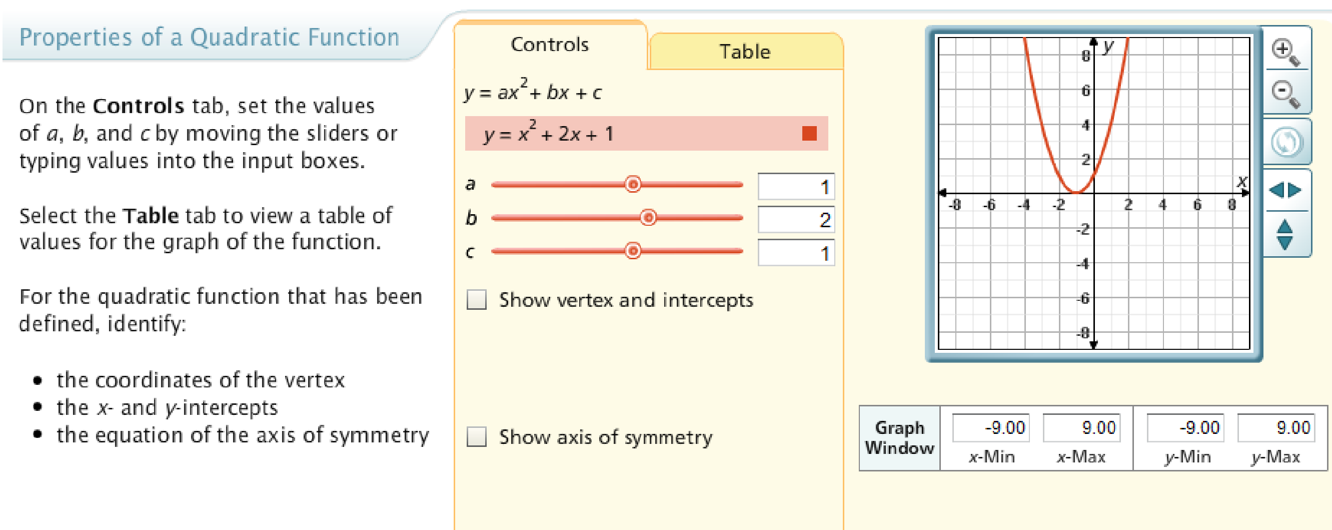
x	y

Graph



Characteristics of parabola discovery activity:

Pearson CD



The characteristics of a parabola are as follows:

i. The ________of a parabola is its highest or lowest point. The vertex may be a ______________ or a ____________________

ii. The __________________ intersects the parabola at the vertex. The parabola is _______________ about this line.

iii. When the coefficient of x^2 is _________, the parabola __________ and its vertex is a minimum point. When the coefficient of x^2 is __________, the parabola _____________ and its vertex is a maximum point.

Positive: 

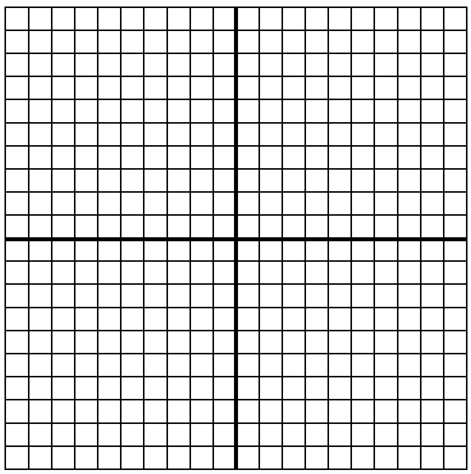
Negative: 

iv. The _____________ of a quadratic function is all possible x-values. The domain is $x \epsilon \mathbb{R}$

v. The ___________ of a quadratic function is all possible y-values. It depends on the position of the vertex.

For the following graphs of quadratic functions, state the following characteristics:

Graph #1 $y = -2x^2 - 6x + 20$



Vertex: ______________________________

Axis of Symmetry:____________________

Min / Max at: _________________

Domain: ______________________________

Range: _______________________________

X-intercept(s): ______________________

Y-intercept: _______________________

Solution:

i) Substitute each value of x in $y = -2x^2 - 6x + 20$, then determine the corresponding value of y.

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

Since each y-value is a multiple of 4, use a scale of 1 square to 4 units on the y-axis. (use the graph above)

ii) From the table, the x-intercepts are -5 and 2. The y-intercept is 20.

- From the graph, the coordinates of the vertex are the coordinates of the maximum point. They appear to be: ____________

- Draw a vertical line through the vertex. The line appears to pass through -1.5 on the x-axis. So, the equation of the axes of symmetry appears to be: ____________

- The domain is all possible x-values. The domain is ________

- The range is all possible y-values. The greatest y-value is the y-coordinate of the vertex. So, the range is: ____________

If the x-intercepts cannot be identified from the table or graph, they can be determined by solving the related quadratic equation; that is, the x-intercepts are the values of x when y=0.

For Graph #1, solve $0 = -2x^2 - 6x + 20$

______________ Divide each term by the common factor – 2

______________ Solve by factoring

____

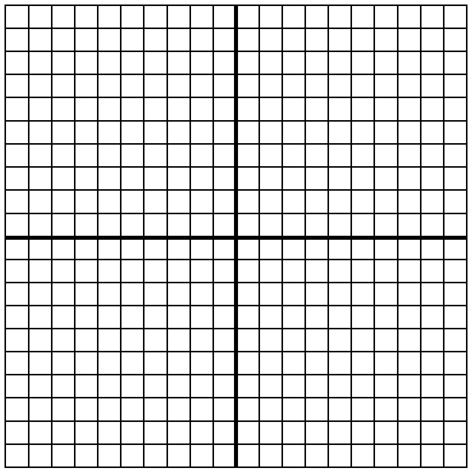
____

The x-intercepts of the graph of a quadratic function y = ax^2 + bx + c are called the ____________________.

The zeros of the function are the ___________of the related quadratic equation ax^2 + bx + c = 0.

- The above example was modified from Pearson's PreCalculus 11 myWORKTEXT

Graph #2 – Try it on your own: $y = 2x^2 + 4x - 6$



Vertex: ______________________

Axis of Symmetry: _________________

Min / Max at: _____________

Domain: ______________________

Range: _______________________

X-intercept(s): ________________

Y-intercept: ________________

Graphing Quadratic Example 3 p. 255 - 256

Exercises: p. 257 – 261 #1, 3, 4, 5, 7, 8, 9, 11.

Multiple Choice: p. 261 #1-2

Attachment 10.2

Three-Point Approach for Words and Concepts

Definition	Word or Concept	Diagram
	vertex	
	Synonym/Example	

Definition	Word or Concept	Diagram
	Axis of symmetry	
	Synonym/Example	

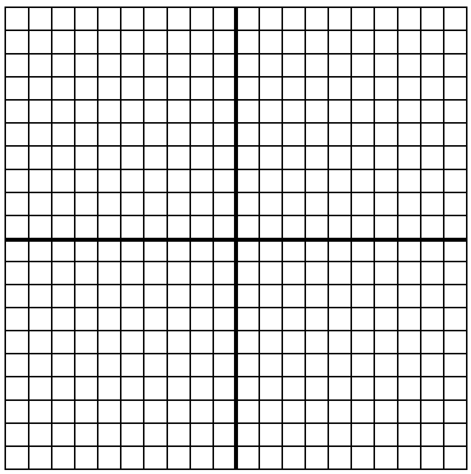
Definition	Word or Concept	Diagram
	intercepts	
	Synonym/Example	

Definition	Word or Concept	Diagram
	parabola	
	Synonym/Example	

4.2/4.3 – Solving a Quadratic Equation Graphically

For the following graphs of quadratic functions, state the following characteristics:

Graph #1 $y = x^2$



Vertex: ____________________

Axis of Symmetry: ________________

Min / Max at: __________________

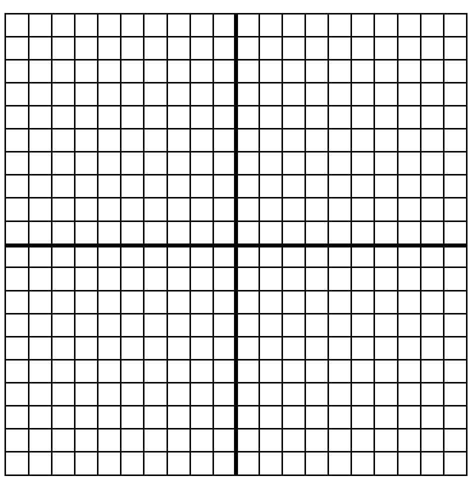
Domain: ____________________

Range: _____________________

X-intercept(s): __________________

Y-intercept: ____________________

Graph #2 $y = 2x^2 + 2$



Vertex: ____________________

Axis of Symmetry: ________________

Min / Max at: __________________

Domain: ____________________

Range: _____________________

X-intercept(s): __________________

Y-intercept: ____________________

Do: Quadratic Functions on the Graphing Calculator
Exercise 2 and 3

Quadratic Functions on the Graphing Calculator

Keys On The Graphing Calculator

Y=	This is where you will enter the equation that you want to graph
GRAPH	This button will show any graphs that have been highlighted from Y=
WINDOW	This button allows you to change the scales on your graph
TRACE	This button places a cursor on your graph to locate certain points
X,T, θ, n	This button enters your variable (usually x) into your equation to be graphed
^	This button allows you to enter an exponent. For example x^2 can be entered as x^2

Graphing Quadratic Functions

Press Y= and clear any equations by highlighting the equation and then pressing CLEAR
Enter the equation $y = x^2$. Select WINDOW and set Xmin to -9.4 and Xmax to 9.4.
Select GRAPH to see the graph of $y = x^2$.

Use the TRACE button to do the following:

a) Find the value of y when x = 7. ____________________________

b) Find the value of y when x = -0.2. ____________________________

c) Find the value of y when x = -3.4. ____________________________

d) Describe how these values could have been found algebraically.

GROUP A

Go back to the equation screen by selecting **Y=**. Enter the equation $y = x^2 + 4$. Look at the graph by selecting **GRAPH**.

How does this graph compare to the graph of $y = x^2$?

Predict how each of the following graphs will compare to the graph of $y = x^2$.

i) $y = x^2 - 5$ ______________________________

ii) $y = x^2 + 2$ ______________________________

Graph each of these separately to check your prediction.

In general, given the graph of $y = x^2 + k$:

a) Describe the transformations that take place in comparison to $y = x^2$.

b) State the vertex. ______________________________

c) State the axis of symmetry ______________________________

d) State the domain. ______________________________

e) State the range. ______________________________

Group B

Go back to the equation screen by selecting **Y=**.

Enter the equation $y = 3x^2$. Look at the graph by selecting **GRAPH**.

How does this graph compare to the graph of $y = x^2$?

Enter the equation $y = \frac{1}{3}x^2$. How does this graph compare to the graph of $y = x^2$?

Enter the equation $y = -x^2$. How does this graph compare to the graph of $y = x^2$?

Predict how each of the following graphs will compare to the graph of $y = x^2$.

i) $y = 4x^2$ ____________________________

ii) $y = \frac{1}{5}x^2$ ____________________________

iii) $y = -2x^2$ ____________________________

Graph each of these separately to check your prediction.

In general, given the graph of $y = ax^2$:

f) Describe the transformations that take place in comparison to $y = x^2$.

g) State the vertex. ____________________________

h) State the axis of symmetry ____________________________

i) State the domain. ____________________________

j) State the range. ____________________________

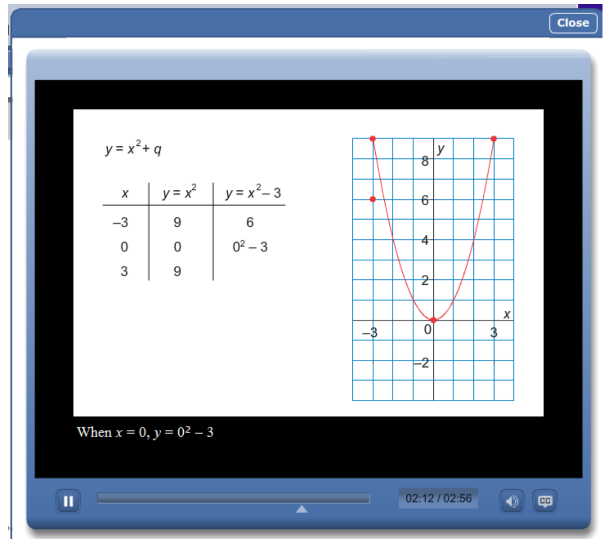
Complete this table for the graph of each function:

Function	**Direction of opening**	**Vertex**	**Axis of Symmetry**	**Congruent to $y=x^2$**
$y = x^2$	Up	(0,0)	x=0	yes
$y = (x - 7)^2$				
$y = (x + 8)^2$				
$y = x^2 + 6$				
$y = x^2 - 7$				
$y = 6x^2$				
$y = -6x^2$				

4.4 – Analyzing Quadratic Functions of the form $y = a(x-p)^2 + q$

What have we learned about graphing quadratic functions so far?

See animations from p. 277 of the Pearson Workbook:

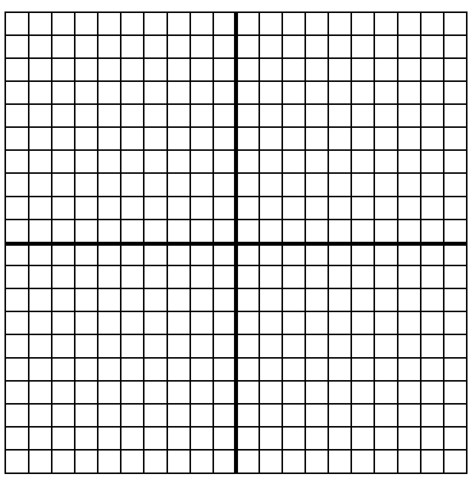


1) Changing _____ in ____________

The graph of $y = x^2 + q$ is the image of the graph of $y = x^2$ after a __________ ____________________ of q units

- When q is _____________the graph moves __________.
- When q is _____________, the graph moves __________.

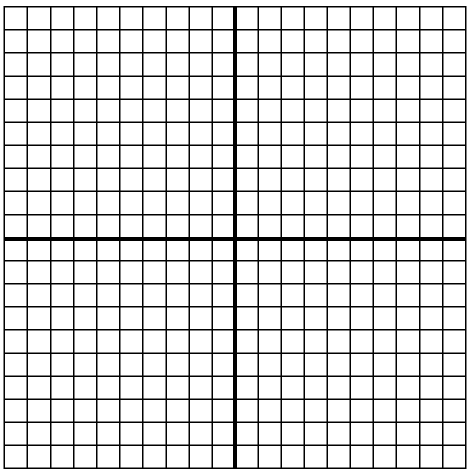
Graph $y = x^2$, $y = x^2 + 2$, and $y = x^2 - 2$



2) Changing _____ in _________

The graph of $y = (x-p)^2$ is the image of the graph of $y = x^2$ after a horizontal translation of p units.

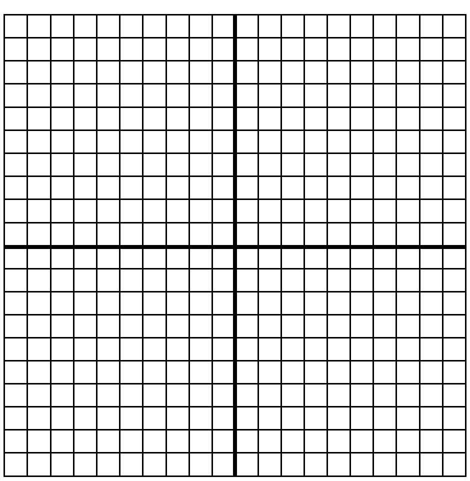
- A negative ______ moves the graph to the _________
- A positive _________ moves the graph to the ___________



Graph $y = x^2$, $y = (x-3)^2$, and $y = (x + 4)^2$

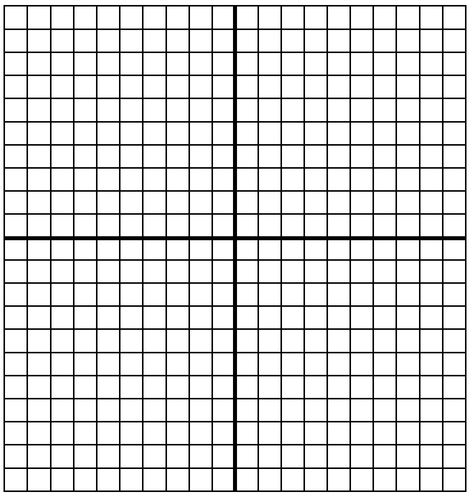
3) Changing a in $y = ax^2$

- The graph of $y = ax^2$ is the image of the graph of $y = x^2$ after a _______________________________ of factor a when ________.
- The graph of $y = ax^2$ is the image of the graph of $y = x^2$ after a ______________________________ of factor a when ____________.



Graph $y = x^2$, $y = 2x^2$, and $y = 0.5x^2$

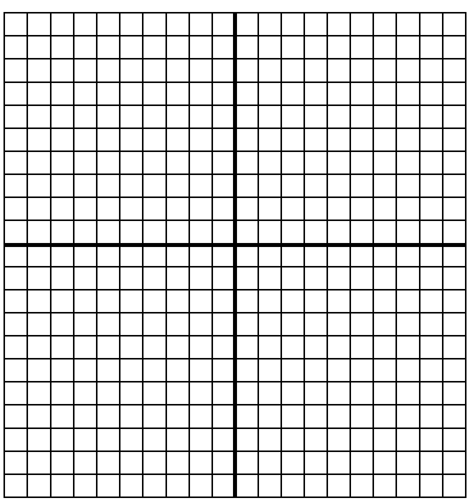
- The graph of $y = ax^2$ is the image of the graph of $y = x^2$ after a __________ _________________ of factor a and a reflection in the x-axis when ______
- The graph of $y = ax^2$ is the image of the graph of $y = x^2$ after a ___________ ________________ of factor a and a reflection in the x-axis when _______.



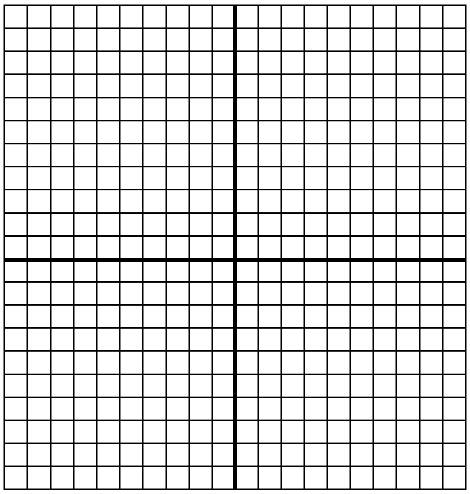
Graph $y = x^2$, $y = -2x^2$, and $y = 0.5x^2$

These three transformations combined to form the _________________ of the equation of a quadratic function: ____________________

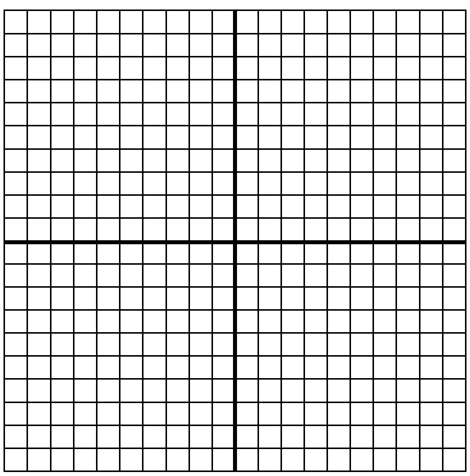
Example 1: Graph $y = 2(x-2)^2 + 2$



Example 2: Graph $y = -0.5x^2 - 6$



Example 3: Graph $y = 2/3\ (x + 2)^2$



Exercises 4.4 p. 284
Quadratic Functions Assignment

Quadratic Functions Assignment

For this assignment you will solve the questions labeled by the first **three** different letters of your last name.

For each question determine the: a) **vertex**; b) the *equation* of the **axis of symmetry**; c) **direction** of opening; d) **domain**; e) **range**; f) **relative width** (compared to $y = x^2$); g) **max** or **min** value; and h) draw a **sketch** of the graph.

Provide answers and work on the back of this sheet. Each question is worth **six** marks.

Due: ______________________________, at the beginning of class

A $y=\frac{1}{2}(x+1)^2-4$	**H** $y=3x^2+6$	**O** $y=-2(x-3)^2+1$	**U** $y=-\frac{1}{3}(x-1)^2+2$
B $y=2(x-1)^2-6$	**I** $y=3(x-2)^2+6$	**P** $y=-(x-5)^2$	**V** $y=x^2-1$
C $y=-2x^2+1$	**J** $y=-\frac{1}{2}x^2+1$	**Q** $y=-\frac{1}{2}(x-3)^2+2$	**W** $y=(x-2)^2+1$
D $y=(x-2)^2+1$	**K** $y=-3(x+5)^2-1$	**R** $y=3(x-2)^2-3$	**X** $y=2x^2+5$
E $y=-(x+5)^2+2$	**L** $y=-\frac{1}{2}x^2+3$	**S** $y=-(x+6)^2+1$	**Y** $y=x^2-25$
F $y=-\frac{1}{2}(x-5)^2+1$	**M** $y=-2(x-3)^2$	**T** $y=2(x-3)^2-8$	**Z** $y=-\frac{1}{3}(x+1)^2+3$
G $y=-(x-3)^2-1$	**N** $y=-3(x+4)^2+6$		