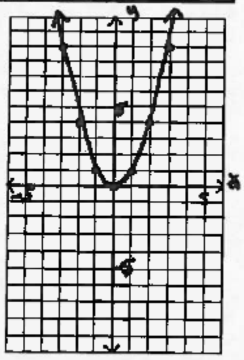
Unit 10 – Quadratic Equations and Functions

Intro Activity: Make a table and graph for each of the following quadratic equations:

1.

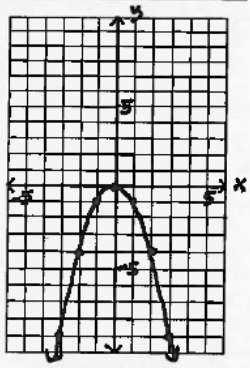
x	$y = x^2$	y
-3	$(-3)^2$	9
-2	$(-2)^2$	4
-1	$(-1)^2$	1
0	$(0)^2$	0
1	$(1)^2$	1
2	$(2)^2$	4
3	$(3)^2$	9



Domain all real numb.
Range $y \geq 0$

2.

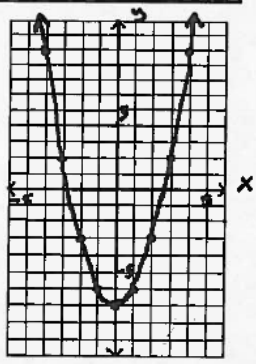
x	$y = -x^2$	y
-3	$-(-3)^2$	-9
-2	$-(-2)^2$	-4
-1	$-(-1)^2$	-1
0	$-(0)^2$	0
1	$-(1)^2$	-1
2	$-(2)^2$	-4
3	$-(3)^2$	-9



Domain all real numb.
Range $y \leq 0$

3.

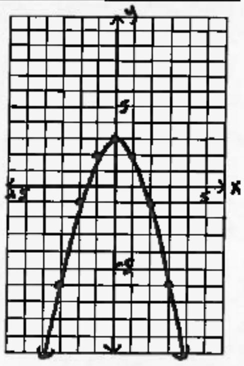
x	$y = x^2 - 7$	y
-3	$(-3)^2 - 7$	2
-2	$(-2)^2 - 7$	-3
-1	$(-1)^2 - 7$	-6
0	$(0)^2 - 7$	-7
1	$(1)^2 - 7$	-6
2	$(2)^2 - 7$	-3
3	$(3)^2 - 7$	2



Domain all real numb.
Range $y \geq -7$

4.

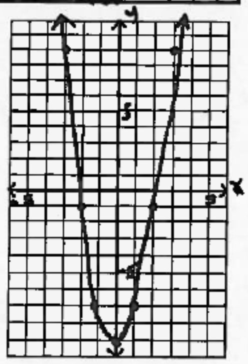
x	$y = -x^2 + 3$	y
-3	$-(-3)^2 + 3$	-6
-2	$-(-2)^2 + 3$	-1
-1	$-(-1)^2 + 3$	2
0	$-(0)^2 + 3$	3
1	$-(1)^2 + 3$	2
2	$-(2)^2 + 3$	-1
3	$-(3)^2 + 3$	-6



Domain all real numb.
Range $y \leq 3$

5.

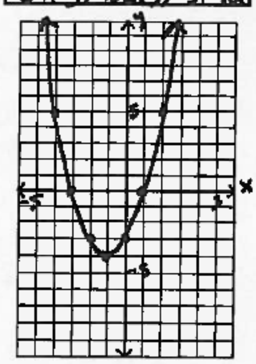
x	$y = 2x^2 - 9$	y
-3	$2(-3)^2 - 9$	9
-2	$2(-2)^2 - 9$	-1
-1	$2(-1)^2 - 9$	-7
0	$2(0)^2 - 9$	-9
1	$2(1)^2 - 9$	-7
2	$2(2)^2 - 9$	-1
3	$2(3)^2 - 9$	9



Domain all real numb.
Range $y \geq -9$

6.

x	$y = x^2 + 2x - 3$	y
-3	$(-3)^2 + 2(-3) - 3$	0
-2	$(-2)^2 + 2(-2) - 3$	-3
-1	$(-1)^2 + 2(-1) - 3$	-4
0	$(0)^2 + 2(0) - 3$	-3
1	$(1)^2 + 2(1) - 3$	0
2	$(2)^2 + 2(2) - 3$	5
3	$(3)^2 + 2(3) - 3$	12



Domain all real numb.
Range $y \geq -4$

10–1 Exploring the Properties of Quadratic Functions

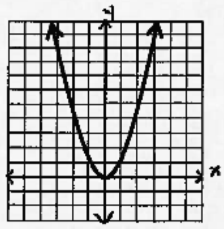
Standard Form of a Quadratic Function

The standard form of a quadratic function is any function written in the form: $y = ax^2 + bx + c$ (where a, b, and c are real numbers, and $a \neq 0$)

Examples: $y = 5x^2$ $y = x^2 + 3$ $y = 2x^2 + 4x - 7$

The simplest form of a quadratic function is: $\boxed{y = x^2}$

This is called the parent function.

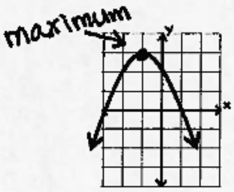


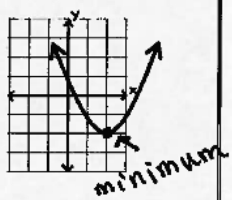
The shape of the graph of a quadratic function is called a parabola.

Properties of Quadratic Functions (Part 1):

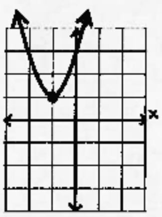
You can fold a parabola so that the two sides match exactly. This property is called symmetry. The fold or line that divides the parabola into two matching halves is called the axis of symmetry.

The highest point on a parabola (maximum) or lowest (minimum) point of a parabola is its vertex, which is on the axis of symmetry.

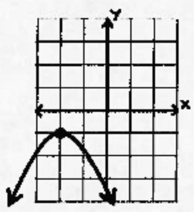




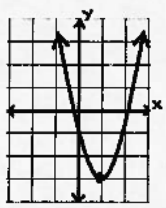
Identify each vertex. Then decide if each vertex is a maximum or minimum point in the parabola.



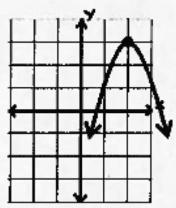
vertex (-1,1)
max or min?
minimum



vertex (-2,-1)
max or min?
maximum



vertex (1,-3)
max or min?
minimum



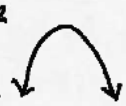
vertex (2,3)
max or min?
maximum

Properties of Quadratic Functions (Part 2):

In any parabola $y = ax^2 + bx + c$, if a is greater than zero, the parabola opens up. If a is less than zero, the parabola opens down.

$y = x^2$ ↑ positive

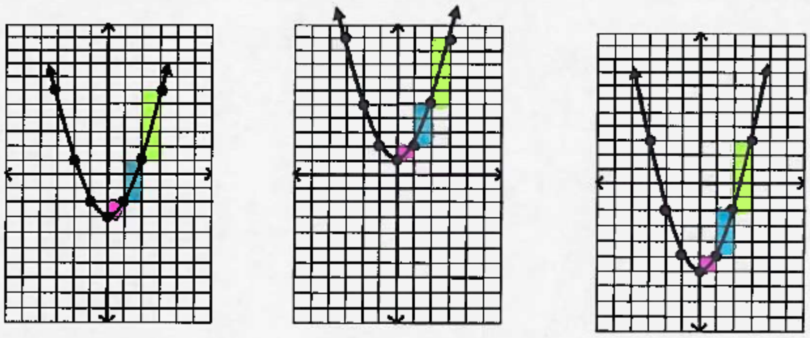
$y = -x^2$ ↑ negative



Properties of Quadratic Functions (Part 3): Graphing $y = x^2$ (The Parent Graph)

The parent graph has a pattern that is reliable. By memorizing the pattern, you can graph any quadratic with x^2 more quickly.

Study the following three graphs, see if you can find the pattern.



The basic pattern for the **parent graph** is from the (vertex),
count out one box, up one box
then out one box, up three boxes
then out one box, up five boxes
then out one box, up seven boxes and so on

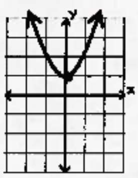
* parent graph is $y = 1x^2$ ↑ one!

Properties of Quadratic Functions (Part 4): y-intercepts of $y = x^2 + c$

The graph of a parabola in the form $y = x^2 + c$, will center on the y-axis.
The letter c represents the y-intercept
For graphs in this form the vertex and the y-intercept will be the same.

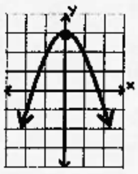
Name the vertex and y-intercept of each graph:

$y = x^2 + 1$



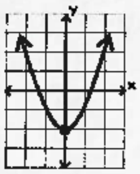
vertex: (0, 1)
y-int: (0, 1)

$y = -x^2 + 3$



vertex: (0,3)
y-int: (0,3)

$y = x^2 - 2$

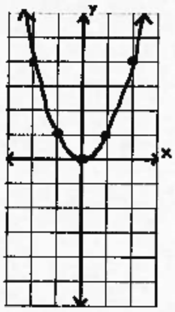


vertex: (0,-2)
y-int: (0,-2)

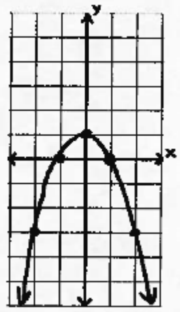
165

Example 1: Graph each parabola quickly by using the properties of quadratic functions: * Begin from the vertex and follow the 1, 3, 5 pattern.

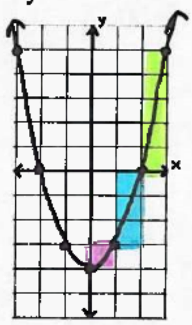
1. $y = x^2$



2. $y = -x^2 + 1$

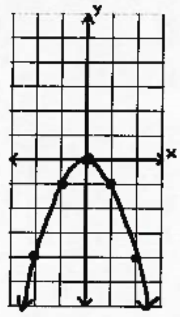


3. $y = x^2 - 4$

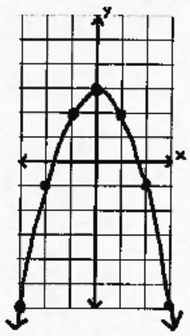


√ Understanding Check:

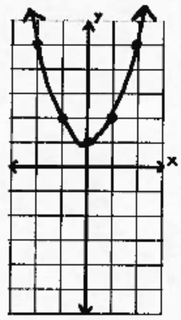
d. $y = -x^2$



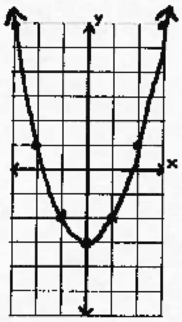
e. $y = -x^2 + 3$



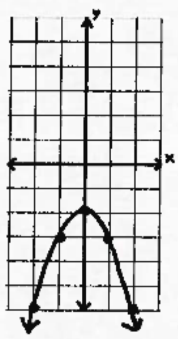
f. $y = x^2 + 1$



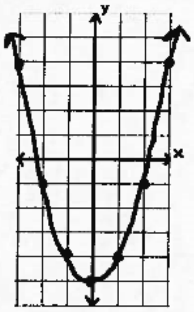
g. $y = x^2 - 3$



h. $y = -x^2 - 2$



i. $y = x^2 - 5$

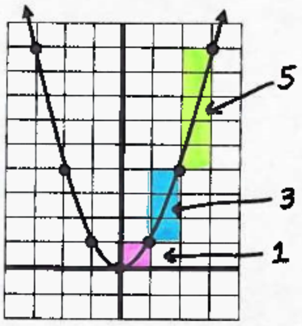


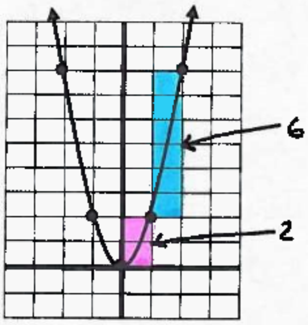
* I always play my quadratics BINGO game with this lesson. (Available on TpT)

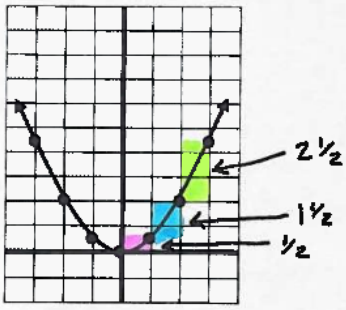
Properties of Quadratic Functions (Part 5)

Compare the shape and patterns of the following graphs.

a. Graph: $y = x^2$ b. Graph: $y = 2x^2$ c. Graph: $y = \frac{1}{2}x^2$







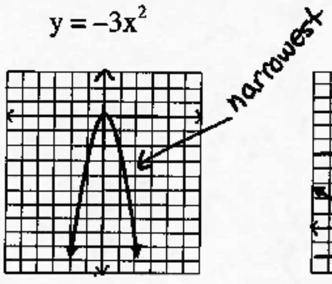
How does the graph of $y = 2x^2$ compare to the parent graph? Double

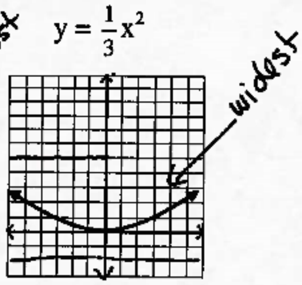
How does the graph of $y = \frac{1}{2}x^2$ compare to the parent graph? Half

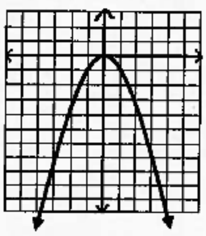
√ Understanding Check:

Look at the graphs below. Put the rules in order from widest to narrowest.

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







$y = \frac{1}{3}x^2$, $y = -x^2$, $y = -3x^2$

Write a general rule for telling whether the graph of a parabola will be narrower or wider: The closer the coefficient of x^2 is to zero, the wider the graph will be.

Put the following functions in order from widest to narrowest without graphing them:

$y = 4x^2$, $y = \frac{1}{2}x^2$, $y = -2x^2$, $y = -x^2$ $y = \frac{1}{2}x^2$, $y = -x^2$, $y = -2x^2$, $y = 4x^2$

$y = 3x^2$, $y = \frac{1}{2}x^2$, $y = \frac{3}{4}x^2$, $y = -5x^2$ $y = \frac{1}{2}x^2$, $y = \frac{3}{4}x^2$, $y = 3x^2$, $y = -5x^2$

* I always show students the "quadratic transformer" at http: seeingmath. concord. org/resources_files/quadratics General. html to help them see the patterns.