Name:________________________ Hour: ____

Algebra 2A **Lesson: 2.1**

Graphing Quadratic Functions

	Learning Targets:

Vocabulary

Term	Picture/Formula	In your own words:
Quadratic Function	Standard Form:	
Parabola		
Vertex Max/Min		
x-coordinate of vertex		
Axis of symmetry		
y-intercept		

Instruction

Example 1: Graph ***f(x)*** = $3x^2 - 6x + 7$

Axis of symmetry:

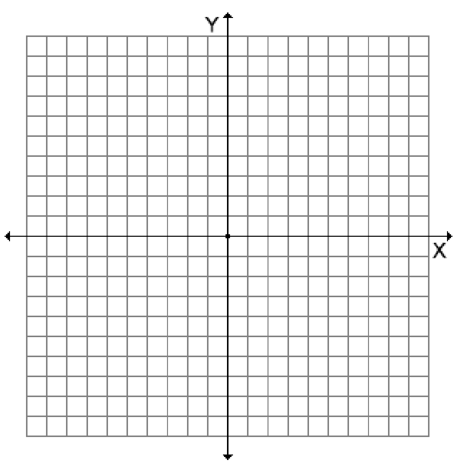
y-intercept:

Direction of opening: Up / down?

Maximum / Minimum? Value: ______________

Vertex:

x					
f(x)					



Example 2: Graph ***f(x)*** = $- x^2 + 6x - 4$

Axis of symmetry:

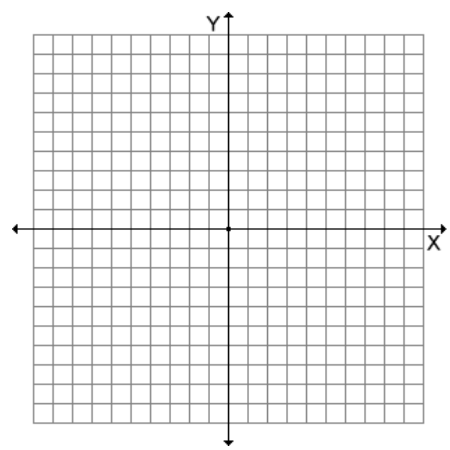
y-intercept:

Direction of opening: Up / down?

Maximum / Minimum? Value: _____________

Vertex:

x					
f(x)					

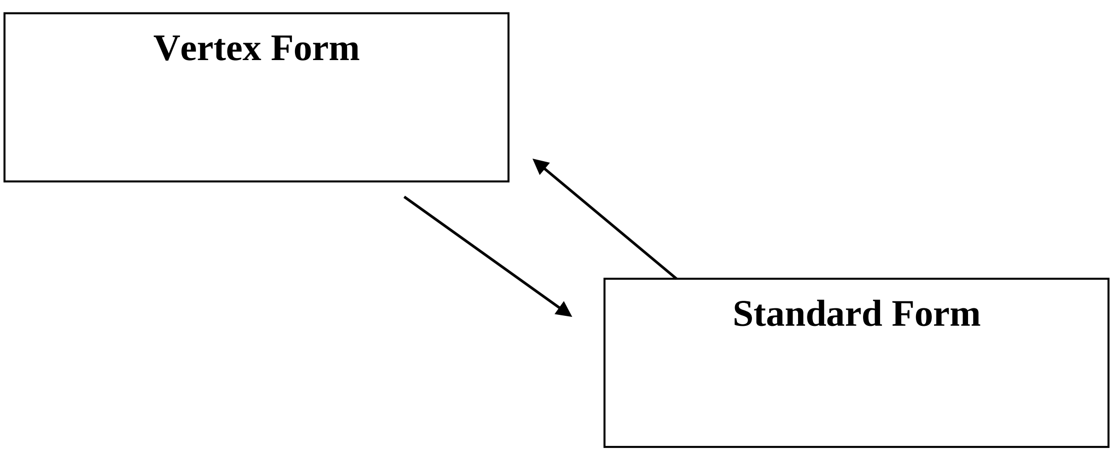


Analyzing Graphs of Quadratic Functions

Learning Targets:

Vocabulary

Term	**Picture/Formula**	**In your own words:**
Quadratic Function	Vertex Form:	
Vertex Max/Min		
x-coordinate of vertex		
Axis of symmetry		



Quadratic Functions Exploration

Introduction:

The function $y = ax^2 + bx + c$ is a quadratic function. In this activity, you will examine how the shape of the parabola changes as the values of *a*, *b*, and *c* are modified. You will also determine how this equation will help you find *x*- and *y*- intercepts on the graph.

Activity

The Meaning of *a, b,* and *c*

1. Graph $y = x^2$ on your calculator. Observe how the graph changes as you vary *a (The constant attached to the front of* x^2*)*. Try changing *a* to negative as well.

   a. How does the value of *a* affect the direction the parabola opens?

   b. What happens to the graph as *a* moves closer to zero?

   c. What happens to the graph as *a* moves away from zero?

   d. What happens to the graph when *a* = 0? Why?

   e. Which of the following parabolas will appear wider: $y = -2x^2 + x - 5$ or $y = 4x^2 - 2x + 2$? Why?

   f. Which of the following parabolas will open downward: $y = -2x^2 + x - 5$ or $y = 4x^2 - 2x + 2$? Why?

2. Set *a* = 1 and *c* = 0. Observe how the graph changes as you vary *b*.

   Remember: ax^2+bx+c

   a. How do changes in the value of *b* affect the shape of the parabola?

3. Set *a* = 1 and *b* = 0. Observe how the graph changes as you vary *c*. How do changes in the value of *c* affect the parabola?

***Vertex Form** is another way to display a quadratic function: $\boldsymbol{y = a(x - h)^2 + k}$

1. Graph $\mathbf{y = (x - 2)^2 + 1}$ on your calculator. Observe how the graph changes as you vary *a*. Try changing *a* to negative as well.

   a. How does the value of *a* affect the direction the parabola opens?

   b. What happens to the graph as you change the value of *h*? Try at least 3 equations

   with different *h* values.

   c. What do you notice about the *h* value as it relates to the x-value of your vertex?

   d. What happens to the graph as you change the value of *k*? Try at least 3 equations with different *k* values.

   e. What do you notice about the *k* value as it relates to the y-value of the vertex?

2. Given the equation $y = -3(x + 2)^2 - 5$, determine the direction of opening and the vertex.

   a. Direction of opening?

   b. Vertex?

   c. Verify your answers by graphing the equation.

The Vertex and Axis of Symmetry

Recall that the *x*-coordinate of the vertex can be calculated using the formula $\frac{-b}{2a}$.

Start with the equation: $y = x^2 + 3x + 5$

a. What happens to the graph when $a = 0$? Does the graph have a vertex?

b. Calculate $\frac{-b}{2a}$ when $a = 0$.

3. For what values of *a* is the vertex a minimum?

4. For what values of *a* is the vertex a maximum?

5. Set $a = 1$ and vary the values of *b* and *c*.

   a. For which values of *b* will the vertex lie on the *y*- axis?

   b. How does varying *c* affect the coordinates of the vertex? Which coordinates of the vertex (*x* or *y* or both?) change when you vary *c*?

The Intercepts of the parabola

6. Use your calculator to graph each equation below. Record *a*, *b*, and *c* and calculate $b^2 - 4ac$ for each equation. Then record the number of *x*-intercepts the graph has.

Equation	***a***	***b***	***c***	$b^2 - 4ac$	**# of *x*-intercepts**
$y = x^2 + 4x + 2$					
$y = x^2 + 4x + 3$					
$y = x^2 + 4x + 4$					
$y = x^2 + 4x + 5$					
$y = x^2 + 4x + 6$					

7. Complete each statement below with the number of x-intercepts:

   a. When $b^2 - 4ac$ positive, the graph has _______ *x*-intercepts.

   b. When $b^2 - 4ac$ is zero, the graph has _______ *x*-intercepts.

   c. When $b^2 - 4ac$ is negative, the graph has _______ *x*-intercepts.

8. Where have you seen $b^2 - 4ac$ before?

Instruction

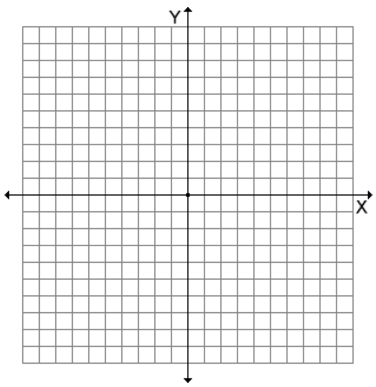
Example 1: Graph **$f(x) = (x - 3)^2 - 2$**

Direction of opening: Up / down ?

Vertex: ________ Max / Min ?

Axis of symmetry: ___________

x					
f(x)					



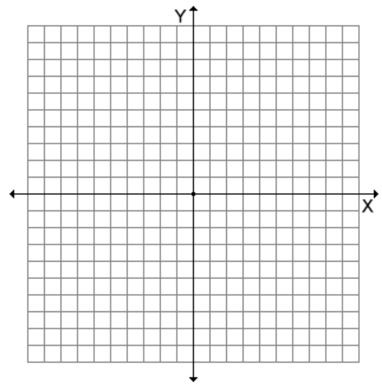
Example 2: Graph **$f(x) = \frac{1}{2}(x + 5)^2 + 3$**

Direction of opening: Up / down ?

Vertex: ________ Max / Min ?

Axis of symmetry: ____________

x					
f(x)					



Your Turn

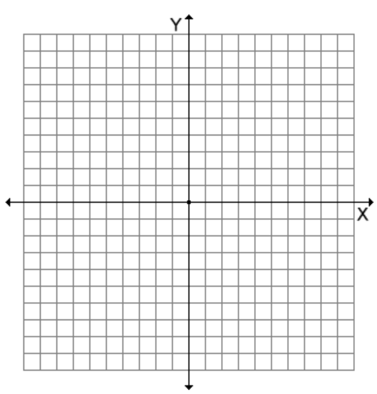
Your Turn 1: Graph **$f(x) = 4(x + 3)^2 - 2$**

Direction of opening: Up / down ?

Vertex: __________ Max / Min ?

Axis of symmetry: ____________

x					
f(x)					



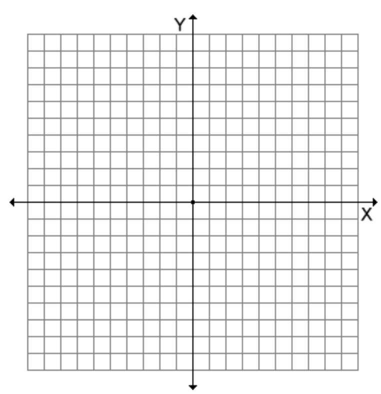
Your Turn 2: **$f(x) = -2(x + 1)^2 + 4$**

Direction of opening: Up / down ?

Vertex: __________ Max / Min ?

Axis of symmetry: _____________

x					
f(x)					



Instruction	
	Example 3: Write an equation for the parabola with the given vertex that passes through the given point. $y = a(x - h)^2 + k$ $y = ax^2 + bx + c$ vertex: $(4, -36)$ point: $(0, -20)$
	Example 4: Write an equation for a parabola with vertex at $(-3, -1)$ and y-intercept 2. $y = a(x - h)^2 + k$ $y = ax^2 + bx + c$

Your Turn	***Your Turn 3:*** Write an equation for the parabola with the given vertex (3, -1), that passes through the point (2, 0). $y = a(x-h)^2 + k$ $y = ax^2 + bx + c$
	Use your Graphing Calculator to solve the following problems: ***Word Problem 1***: An object is propelled upward from the top of a 500 foot building. The path that the object takes as it falls to the ground can be modeled by $h = -16t^2 + 100t + 500$ where t is the time (in seconds) and h is the corresponding height of the object. The velocity of the object is $v = -32t + 100$ where t is seconds and v is velocity of the object y = How high does the object go? ____________________ When is the object 550 ft high? ____________________ With what velocity does the object hit the ground? ____________________

I n s t r u c t i o n	***Word problem 2***: An astronaut standing on the surface of the moon throws a rock into the air with an initial velocity of 27 feet per second. The astronaut's hand is 6 feet above the surface of the moon. The height of the rock is given by $h=-2.7t^2+27t+6$. $y =$ How many seconds is the rock in the air? ______________________ How high did the rock go? ______________________

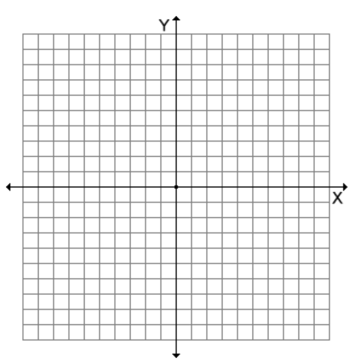
Solving Quadratic Equations by Graphing

Learning Targets:

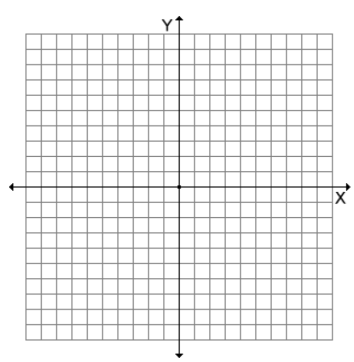
Vocabulary

Term	Picture/Formula	In your own words:
Quadratic Equation		
Zeros		
Roots		

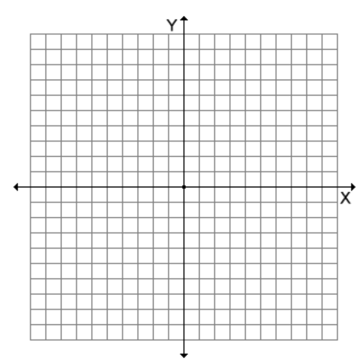
Cases:



two real roots



one real root

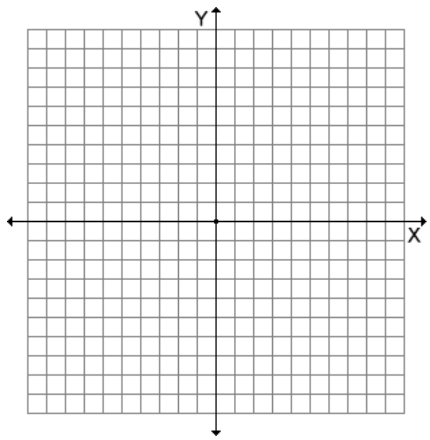


no real roots

Instruction

Part 1 : Exact roots

Example 1: Solve $x^2 + x - 6 = 0$ by graphing.



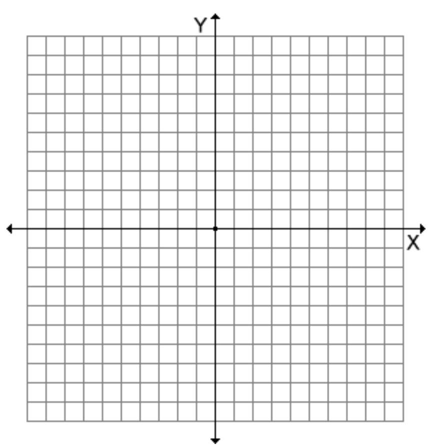
Vertex: ________

x					
f(x)					

Exact Roots of the equation (or zeros of the function): ____________ & ____________

Your Turn

Your Turn 1: Solve $x^2 - 4x - 5 = 0$ by graphing.



Vertex: ________

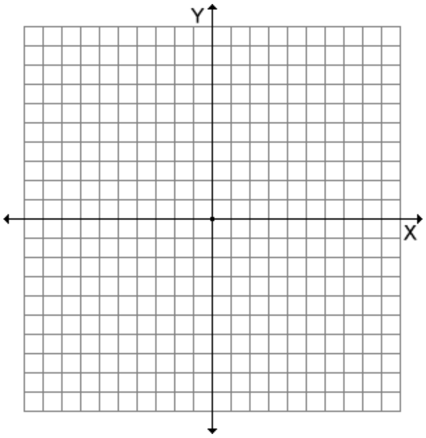
x					
f(x)					

Exact Roots of the equation (or zeros of the function): ____________ & ____________

Instruction

Part 2 : Approximate roots

Example 2: Solve $x^2 - 2x - 2 = 0$ by graphing.



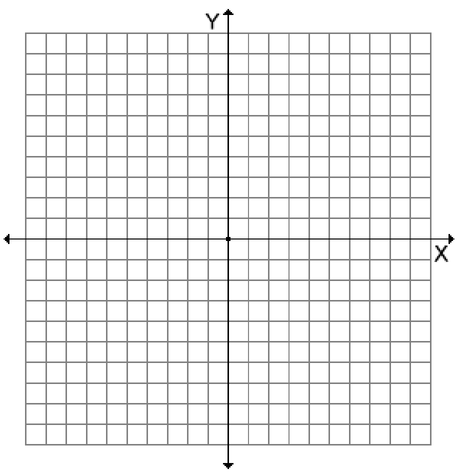
Vertex: ________

x					
f(x)					

Approximate roots: ______________________________

Your Turn

Your Turn 2: Solve $x^2 - 4x + 4 = 0$ by graphing.



Vertex: ________

x					
f(x)					

Approximate roots: ___________________________

Instruction

Use a quadratic equation and its graph to find two real numbers that satisfy each situation, or show that no such numbers exist.

Their sum is 4, and their product is -12.