Algebra 1 Unit 8: Quadratic Functions Notes

Unit 8: Quadratic Functions

Learning Goal 8.2 - Graphs of Quadratic Functions

After completion of this unit, you will be able to…

- Graph quadratics in vertex, standard, and factored form
- Convert functions between standard, factored, and vertex form
- Calculate the vertex of a function
- Compare equations in multiple forms

Timeline for Unit 8

Monday	Tuesday	Wednesday	Thursday	Friday
20 ***No School***	**21** Day 1 – Transformations of Quadratic Functions	**22** Day 2 – Characteristics of Quadratic Functions	**23** Day 3 – Characteristics of Quadratic Functions	**24** Day 4 – **8.1 Learning Assessment**
27 Day 5 – Graphing in Vertex Form Graphing in Standard Form	**28** Day 6 – Graphing in Factored Form Practice	**29** Day 7 – Writing Equations of Parabolas	**30** Day 8 – Comparing Different Forms of Quadratics	**31** Day 9 – **8.2 Learning Assessment**
3 Day 10 – Average Rate of Change	**4** Day 11 – Applications of the Vertex	**5** Day 12 – Comparing Different Quadratic Functions	**6** Day 13 – Comparing Different Quadratic Functions	**7** Day 14 – **8.3 Learning Assessment**

Tutoring Times

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	Mrs. Jackson 7:45 – 8:15 Room 1210	Mr. Phillips 7:45 – 8:15 Room 1206	Mrs. Jackson & Mr. Webb 7:45 – 8:15 Room 1210 Room 1205	Mr. Watson & Mr. Phillips 7:45 – 8:15 Room 1208 Room 1206	Mr. Watson 7:45 – 8:15 Room 1208
PM	NONE	Mrs. Petersen 3:30 – 4:30 Room 1210	NONE	NONE	NONE

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Algebra 1 Unit 8: Quadratic Functions Notes

Day 5 - Graphing Quadratics in Vertex Form

Vertex Form of a Quadratic Function:
$y = a(x - h)^2 + k$

a determines how the graph opens

positive **a**, graph opens Up

negative **a**, graph opens Down (reflect)

&

(h, k) is our vertex.

~~NOTE: Our vertex is at (h, k), NOT (-h, -k).~~

Identifying the Vertex Practice

Find the vertex of the following:

1) $y = (x - 18)^2 + 9$ Vertex = (18, 9)
2) $y = 4(x + 6)^2 - 7$ Vertex = (-6, -7)
3) $y = (x - 2)^2 - 2$ Vertex = (2, -2)

Find the vertex for each of the following quadratics and determine whether the graph opens up or down:

a) $y = (x - 1)^2 - 2$ Vertex = (1, -2) Graph Opens Up because a is +
b) $y = -3(x + 4)^2 + 1$ Vertex = (-4, 1) Graph Opens Down because a is −
c) $y = 2x^2 + 3$ Vertex = (0, 3) Graph Opens Up because a is +
d) $y = -(x - 3)^2$ Vertex = (3, 0) Graph Opens Down because a is −

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

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Steps for Graphing in Vertex Form

1) Find the vertex (h, k).

2) Use your vertex as the center for your table and determine two x values to the left and right of your h value and substitute those x values back into the equation to determine the y values.

- Using practice problem number 3, let's practice filling in our table.

$y = (x - 2)^2 - 2$

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

h k Vertex

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

3) Plot your points and connect them from left to right!

Graphing in Vertex Form Examples

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

Vertex = (1, -2)

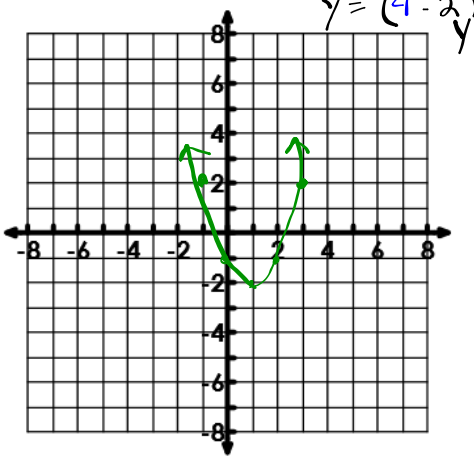
$y = (x-1)^2 - 2$
$y = (3-1)^2 - 2$
$y = 2$

$y = (x-1)^2 - 2$
$y = (2-1)^2 - 2$
$y = -1$

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

Vertex

$y = (x-1)^2 - 2$
$y = (0-1)^2 - 2$
$y = -1$

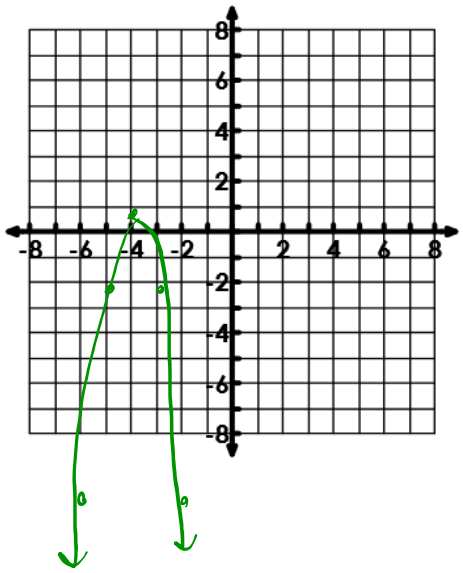


Example 2: Graph: $y = -3(x+4)^2 + 1$.

Vertex = (-4, 1)

x	-6	-5	-4	-3	-2
y	-11	-2	1	-2	-11

Vertex



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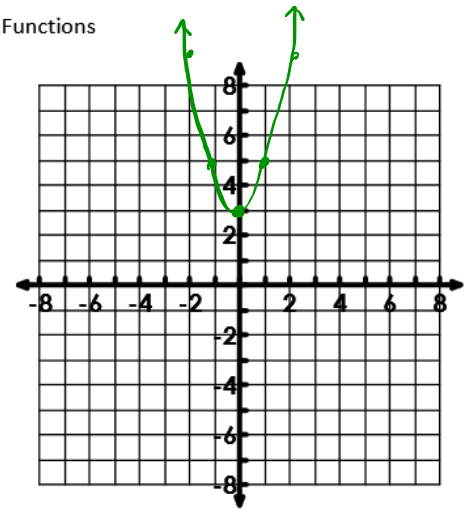
Example 3: Graph $y = 2x^2 + 3$.

Vertex = (0, 3)

Vertex

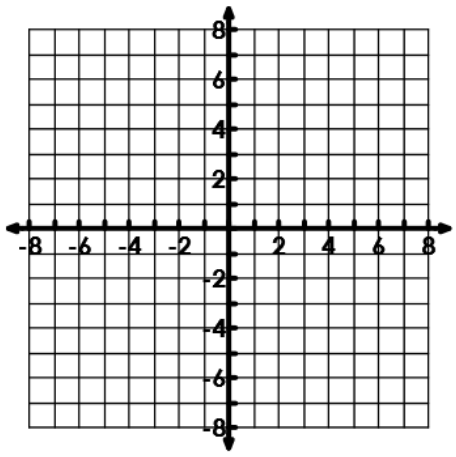
x	-2	-1	0	1	2
y	11	5	3	5	11



Example 4: Graph: $y = -(x - 3)^2$.

Vertex = (_____, _____)

x					
y					



Using a Graphing Calculator to Graph Quadratics in Vertex Form

Use a graphing calculator to graph our last example problem, example 4: $y = -(x - 3)^2$

1. Hit **Y =** and enter the equation into y_1.

2. Hit **Graph** (Hit **Zoom,** then **6** to get back to a standard viewing window, if necessary).

3. You can also use the table on the graphing calculator to compare to your table and note the symmetry along the vertex. Hit **2nd** followed by **Graph** (you really want the Table feature). Scroll through the table until you find where the y_1 values stop decreasing and begin increasing, the point it switches at is our vertex.

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Day 5 - Graphing Quadratics in Standard Form

Given the following equation, $y = (x + 3)^2 + 1$, how could we go from that form to $y = x^2 + 6x + 10$?

$y=(x+3)(x+3)+1$ $(x+3)(x+3)$

$y=x^2+3x+3x+9+1$

$y=x^2+6x+10$ same yes!

What about $y = 3(x + 2)^2 + 3$ to $y = 3x^2 + 12x + 15$?

This is how we arrive to the standard form of a quadratic function!

$y=mx+b$

$(0, b)$

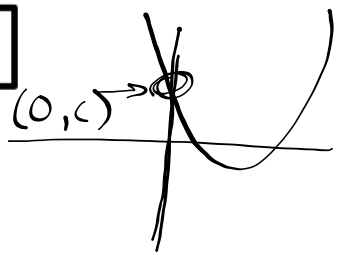
y-int.

Standard Form of a Quadratic Function:
$y = Ax^2 + Bx + C$

A determines how the graph opens

&

(0, C) is the y-intercept.



Finding the Vertex in Standard Form

Graphing in standard form is similar to graphing in vertex form, but the way we find our vertex is different. We use a special formula to find the x-coordinate of our vertex, and substitute that value in our equation to determine the y - coordinate of our vertex.

The formula is: $x = \frac{-b}{2a}$, then substitute x into equation for y.

For example, say we have $y = x^2 + 2x + 7$, how would we find our vertex?

A B C

A: 1
B: 2
C: 7

$x = \frac{-b}{2a}$

$x = \frac{-2}{2(1)}$

$x = -1$

$y = x^2 + 2x + 7$

$y = (-1)^2 + 2(-1) + 7$

$y = 1 - 2 + 7$

$y = -1 + 7$

$y = 6$

VERTEX:

$(-1, 6)$

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Algebra 1 Unit 8: Quadratic Functions Notes

Identifying the Vertex Practice

Find the vertex for each of the following quadratics, determine whether the graph opens up or down, and find the y intercept:

$x = \frac{-b}{2a}$

1. $y = 2x^2 + 8x + 2$ (A B C) Vertex = (-2, -6)

A: 2 B: 8 C: 2

$x = \frac{-b}{2a}$

$x = \frac{-8}{2(2)}$

$x = -2$

$y = 2(-2)^2 + 8(-2) + 2$

$y = 2 \cdot 4 + 8(-2) + 2$

$y = 8 - 16 + 2$

$y = 8 + 2$

$y = -6$

Graph opens up because a is +.

The y-intercept is (0, 2).

(0, C)

2. $y = -x^2 + 2x + 7$ (A B C) Vertex = (____, ____)

A: -1 B: 2 C: 7

Graph opens down because a is −.

The y-intercept is (0, 7).

3. $y = -4x^2 + 24x + 0$ Vertex = (3, 36)

A: -4 B: 24 C: 0

$x = \frac{-b}{2a}$

$x = \frac{-24}{2(-4)}$

$x = 3$

$y = -4(3)^2 + 24(3)$

$y = -36 + 72$

$y = 36$

Graph opens down because a is −.

The y-intercept: (0, 0)

(0, C)

4. $y = 7x^2 + 9$ Vertex = (0, 9)

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

A: 7 B: 0 C: 9

$x = \frac{-b}{2a}$

$x = \frac{0}{2(7)}$

$x = 0$

$y = 7(0)^2 + 9$

$y = 9$

Graph opens up because a is +.

The y-intercept: (0, 9)

Steps for Graphing in Standard Form

1) Find the vertex. After using the formula $x = \frac{-b}{2a}$ to find our x- coordinate of our vertex, we substitute that x back into our equation, and our solution is the y-coordinate of our vertex.

2) Use your vertex as the center for your table and determine two x values to the left and right of your x-coordinate and substitute those x values back into the equation to determine the y values.

3) Plot your points and connect them from left to right!

Algebra 1 Unit 8: Quadratic Functions Notes

Graphing in Standard Form Examples

Example 1: Graph $y = x^2 - 2x - 1$.

A: 1 B: -2 C: -1

$x = \frac{-b}{2a}$ $x = \frac{2}{2(1)}$ $x = 1$

$y = (1)^2 - 2(1) - 1$ $y = -2$

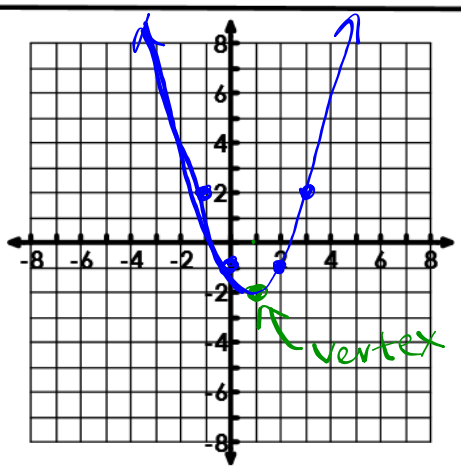
Vertex = (1, -2)

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

vertex

$(-1)^2 - 2(-1) - 1$ $1 + 2 - 1 = 2$

$(0)^2 - 2(0) - 1$ -1



Example 2: Graph: $y = 3x^2 - 6x$.

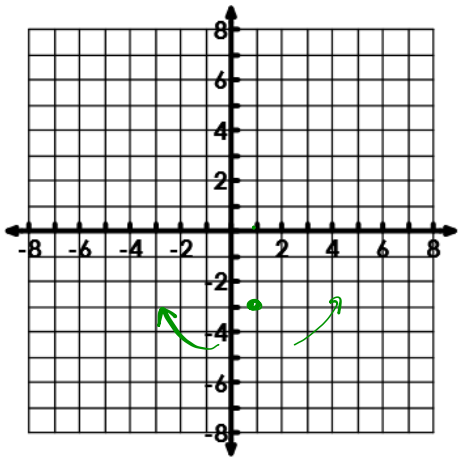
A: 3 B: -6 C: 0

$x = \frac{-b}{2a}$ $x = \frac{6}{2(3)}$ $x = 1$

$y = 3(1)^2 - 6(1)$ $y = 3 - 6$ $y = -3$

Vertex = (1, -3)

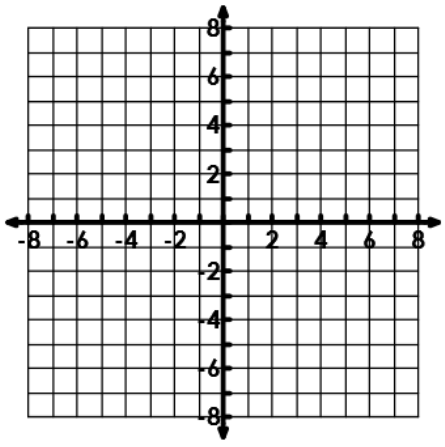
x			1		
y	9	0	-3	0	9



Example 3: Graph $y = 2x^2 + 3$.

Vertex = (____, ____)

x					
y					



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