DAY 6: GRAPHING IN STANDARD FORM

Unit 3B: Quadratic Functions

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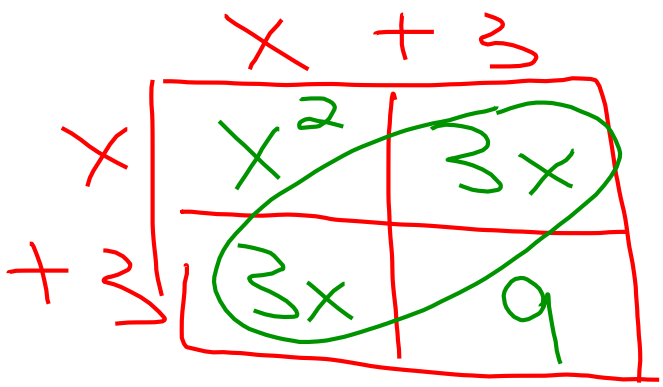
THINK ABOUT IT

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

1. Multiply $(x+3)(x+3)$
2. Add 1



$x^2 + 6x + 9 + 1$

$= x^2 + 6x + 10$

THINK ABOUT IT

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

1. Multiply $(x+2)(x+2)$
2. Distribute the 1st 3
3. Add the 2nd 3

STANDARD FORM

Standard Form of a Quadratic Function:

$y = Ax^2 + Bx + C$

A determines how the graph opens

&

(0, C) is the y-intercept.

V = (x, y)

FINDING THE VERTEX

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 = 1 b = 2 c = 7 y-int: (0, 7)

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

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

$x = -1$

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

$f(-1) = 1 - 2 + 7$

$f(-1) = 6$

Vertex = (-1, 6)

PRACTICE WITH FINDING VERTEX

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

$a=2\ b=8\ c=2$

1. $y = 2x^2 + 8x + 2$ Vertex = (−2, −6)

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

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

$x = -2$

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

$f(-2) = -6$

Graph opens up because a is +.

The y-intercept is (0, 2).

$a = -1, b = 2\ c = 7$

2. $y = -x^2 + 2x + 7$ Vertex = (1, 8)

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

$x = 1$

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

$f(1) = 8$

Graph opens down because a is negative.

The y-intercept is (0, 7).

FINDING THE VERTEX

a = -4 b = 24

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

$x = \frac{-(24)}{2(-4)}$ $x = \frac{-24}{-8}$ $x = 3$

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

$f(3) = -36 + 72$

$f(3) = 36$

Graph opens down because a is −.

The y-intercept: (0, 0)

a = 7 b = 0 c = 9

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

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

$x = 0$

$f(0) = 9$

Graph opens up because a is +.

The y-intercept: 0, 9

STEPS FOR GRAPHING IN STANDARD

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!

EXAMPLE 1

$a = 1 \quad b = -2 \quad c = -1$

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

$x = \frac{-b}{2a}$ $\quad x = +1$

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

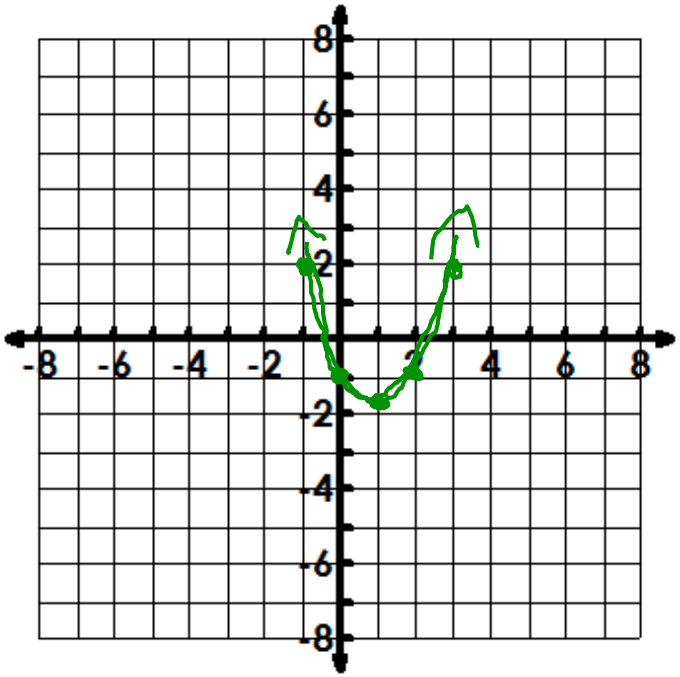
$f(+1) = (+1)^2 - 2(+1) - 1$

$f(-1) = -2$

Vertex = (+1 , −2)

x	-1	0	1	2	3
y	2	−1	-2	−1	2

y-int: (0, −1)



EXAMPLE 2

$a = 3 \quad b = -6 \quad c = 0$

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

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

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

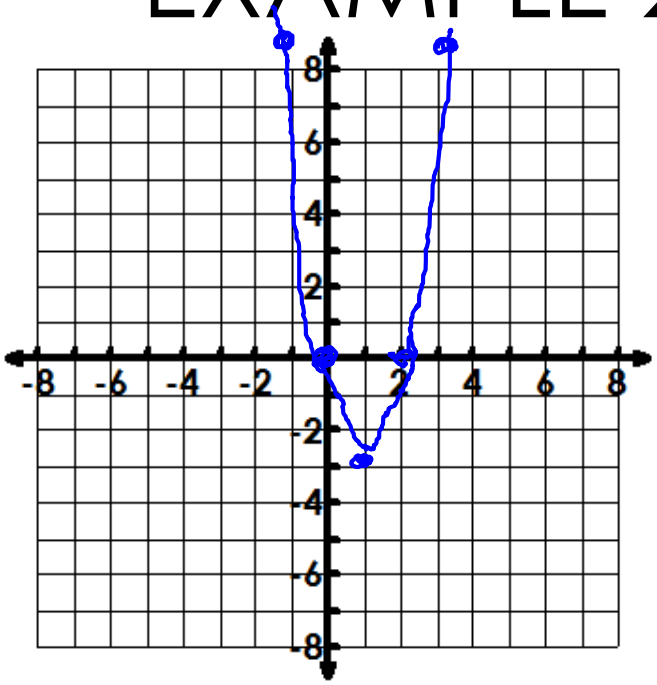
$f(1) = 3(1)^2 - 6(1)$

$f(1) = -3$

Vertex = (1 , −3)

x	−1	0	1	2	3
y	9	0	−3	0	9

y-int: (0, 0)



EXAMPLE 3

$a = 2 \quad b = 0 \quad c = 3$

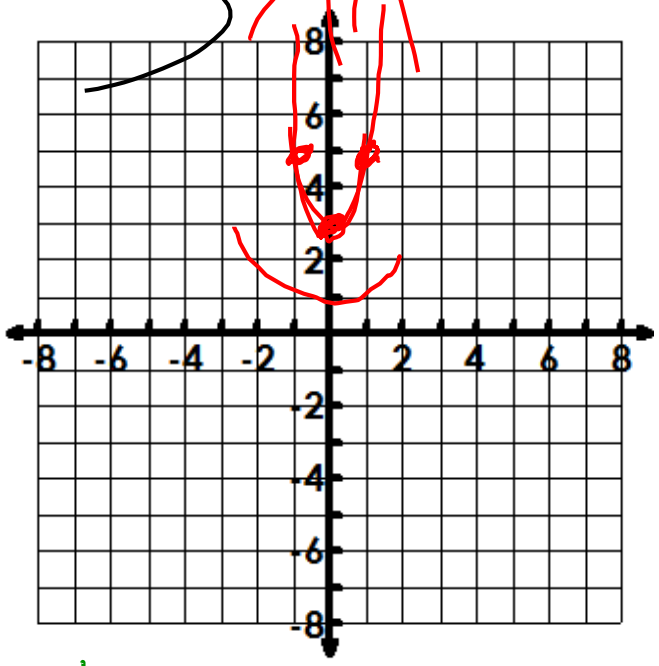
Example 3: Graph $y = 2x^2 + 3$.

$x = \frac{-b}{2a} \quad x = \frac{-(0)}{2(2)} \quad x = 0$

Vertex = (0 , 3)

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

y-int = (0, 0)



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EXAMPLE 4

$a = -1 \quad b = 6 \quad c = -9$

Example 4: Graph: $y = -x^2 + 6x - 9$.

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

$F(3) = -(3)^2 + 6(3) - 9$

$F(3) = 0$

Vertex = (3 , 0)

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