7 Vertex Form of a Quadratic

September 20, 2020 3:32 PM

FOM 11 Ch 7 Day 7: Vertex Form of a Quadratic Function

Goals:

- Use the *vertex form* of a quadratic function to sketch its graph
- *Find the equation* in vertex form of a quadratic function given its graph.

A QUADRATIC FUNCTION can be written in:

STANDARD form $\Leftrightarrow$ FACTORED form $\Leftrightarrow$ VERTEX FORM

a pos/neg

$y = ax^2 + bx + c$ (c: y-int) $\quad y = a(x-r)(x-s)$ (r/s are x-intercepts) $\quad y = a(x-p)^2 + q$ (Vertex is (p, q))

The **VERTEX FORM** of a quadratic function is $y = a(x - p)^2 + q$

"opposite"

Example 1: What is the vertex in

a) $y = -3(x-2)^2 + 5$? $(2, 5)$

b) $y = (x+4)^2 - 1$? $x - (-4)$ $(-4, -1)$ not $(4, -1)$!!

Example 2: Sketch a graph for the function $y = 2(x-3)^2 - 4$

Does the parabola open **UP** or **DOWN**? $a = 2$

What is the **vertex**? $(3, -4)$ (p, q)

What is the **axis of symmetry**? $x = p$ $x = 3$

What is the **y-intercept**? (Hint: Let $x =$ 0).

Plug $y = 0$ into

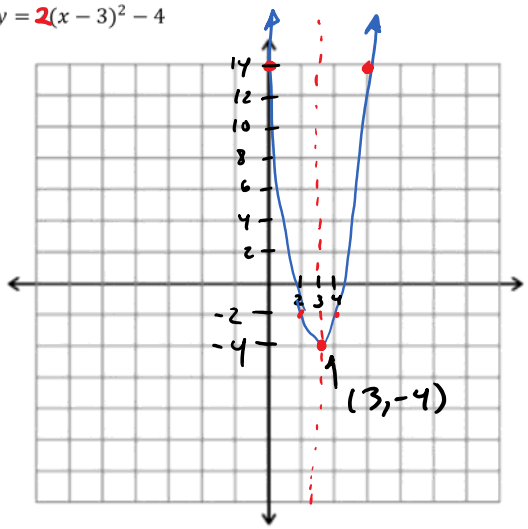
$y = 2(x-3)^2 - 4$

$= 2(0-3)^2 - 4$

$= 2(9) - 4$

$= 18 - 4$

$y = 14$



Plot another point that is the mirror image of the y-intercept (use the symmetry!)

What is the **domain**? $\mathbb{R}$

What is the **range**? $y \geq q$ $\quad y \geq -4$

Characteristics of vertex form:

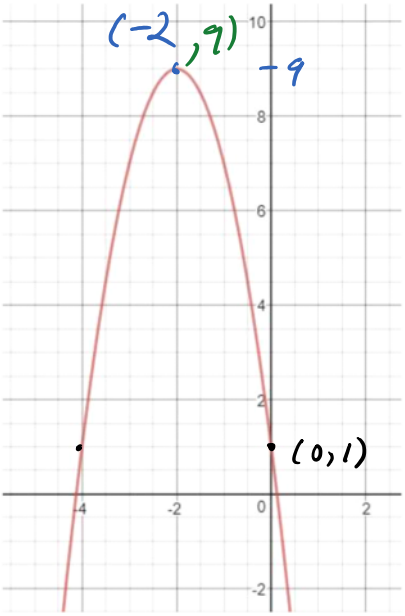
gives us optimal value, q, which occurs at $x = p$

Example 3: Write the equation for the given parabola.

Step 1: What is the vertex, *(p, q)*?

Step 2: To find *a*, identify a point *(x,y)* on the parabola. Plug the *(x, y)* and *(p, q)* into $y = a(x-p)^2 + q$ to solve for *a*.

Step 3: Write $y = a(x-p)^2 + q$ using the actual numbers for *a*, *p* and *q* only. (Leave *x* and *y* as variables).



1) Vertex: $(-2, 9)$ (p, q)

2) pick a point that you can see clearly!

$(x, y) = (0, 1)$

3) $y = a(x-p)^2 + q$

plug in p, q, x + y to solve for a!

$1 = a(0-(-2))^2 + 9$

$1 = a(2)^2 + 9$

$1 = 4a + 9$

$-9 \quad\quad -9$

$-8 = 4a$

$\frac{-8}{4} = \frac{4a}{4}$

$-2 = a$

$a = -2$

(4) Write equation but leave x + y as variables!

$y = a(x-p)^2 + q$

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

Example 4: Determine the equation of parabola with vertex (6, -2) that is congruent to the graph $y = 2x^2$ and opens down.

$a = 2$ a neg $\Rightarrow a = -2$

P q

same shape

$y = a(x-p)^2 + q$

$y = -2(x-6)^2 - 2$

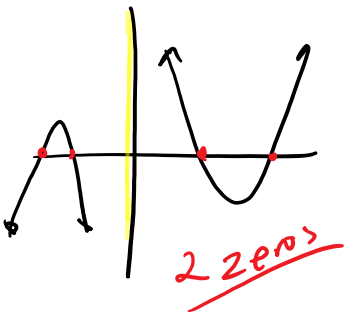
Number of Zeros that a Quadratic Function Can Have

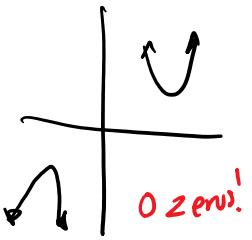
GRAPHS have X-INTERCEPTS

Functions have ZEROS

f(x)=(x-3)(x-5)
x=3, x=5 at y=0

Roots



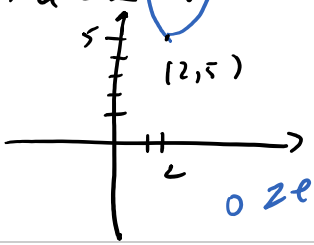


Example 5: Predict the number of zeros (roots) that each of the following quadratic functions has:

a) $y = 2(x-2)^2 + 5$ b) $y = -2(x+3)^2 + 4$ c) $y = x^2 + 0$

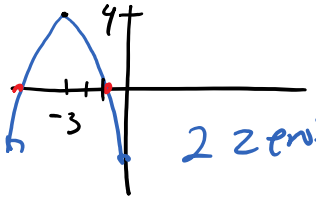
vertex (2, 5)

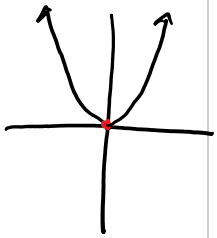
$a = 2$ ∪



↳ opens down

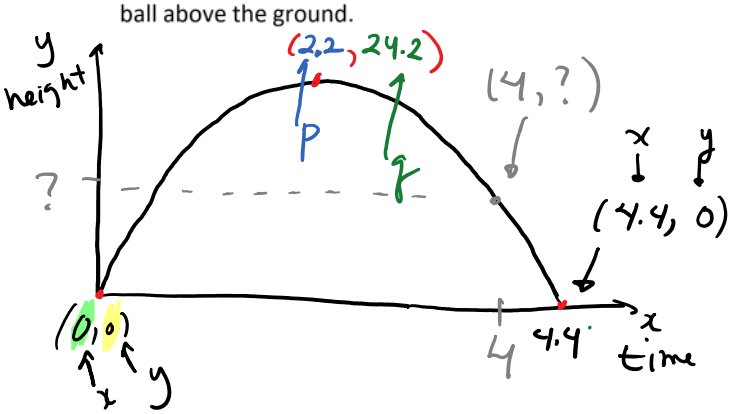
vertex (−3, 4)





Example 6 – Ball kick/toss: A goalie kicked a soccer ball from the ground. It reached it maximum height of 24.2 m after 2.2 s. The ball was in the air for 4.4 s.

a) Define the quadratic function that models the height of the ball above the ground.



$y = a(x-p)^2 + q$

Plug in p, q & x & y to find a.

$0 = a(0-2.2)^2 + 24.2$

$0 = 4.84a + 24.2$

$-24.2 \quad -24.2$

$\frac{-24.2}{4.84} = \frac{4.84a}{4.84}$

$a = -5$

$y = -5(x-2.2)^2 + 24.2$

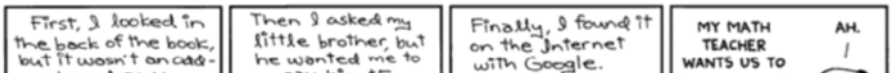
b) After 4 s, how high was the ball above the ground?

↳ plug in $x = 4$ to get height.

$= -5(4-2.2)^2 + 24.2$

$= -5(1.8)^2 + 24.2$

$= -5(3.24) + 24.2$



$= -5(3.24) + 24.2$

$= -16.2 + 24.2$

$= 8$ m

The ball will be 8 m above ground at 4 sec.

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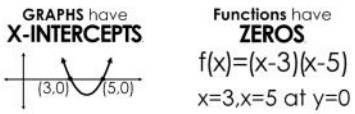
Number of Zeros that a Quadratic Function Can Have



Example 5: Predict the number of zeros (roots) that each of the following quadratic functions has:

a) $y = 2(x-2)^2 + 5$ b) $y = 2(x+3)^2 + 4$ c) $y = x^2$

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Assignment: Sec 7.6, p. 417, #1abd, 2be, 3, 7, 10, 11b, 14