3.3 Quadratic Functions and Their Properties

- KNOW how to get intercepts (solving quadratics)
- Graphing and Transformations
- Completing the square
- Quadratic Equations

Objectives
1.) Graph a quadratic functions using transformations
2.) Identify the vertex and axis of symmetry
3.) Graph a quadratic using Vertex, Axis, and intercepts
4.) Find Max and Min values

Quadratic Function Standard Form

$$f(x) = ax^2 + bx + c$$

$$a \neq 0 \ and \ domain \ is \ R$$

1.) Graph using transformations

Remember parent function $f(x) = x^2$

What happens when $f(x) = x^2 + 2$

Or, $f(x) = (x + 3)^2 + 2$

$f(x) = (x + 3)^2 + 2$ is in vertex form

vertex form $f(x) = a(x - h)^2 + k$

h= x value and k = y value of the vertex

a is the coefficient that stretches, compresses
and determines U shape up or down

if "a" is negative the parabola is :

if $|a|$ is >1 the parabola

if $0< |a| < 1$ the parabola

We get quadratics in vertex form by completing the square:
$$f(x) = a(x-h)^2 + k$$

1.) get into standard form $f(x) = ax^2 + bx + c$

2.) move all non x's to other side of equal sign
$$ax^2 + bx = c$$

3.) divide both sides by a   (want "a" term to be 1)

$$\frac{ax^2 + bx = c}{a}$$

4.) complete the square by adding $(b/2)^2$ to both sides:

$$x^2 + \frac{x}{a} + \left(\frac{b}{2a}\right)^2 = \frac{c}{a} + (b/2)^2$$

5.) now you can complete the square by changing left side to
$$\left(x + \frac{b}{2a}\right)^2 = \frac{c}{a} + (b/2)^2$$

6.) Put the equation into vertex form by moving the right hand side to the left side. If the number is a fraction just multiply by the denominator to turn it into a whole number

Now you can graph by transformation
Example $f(x) = 2x^2 + 8x + 5$

1.)

2.)

3.)

4.)

5.)

6.)

Graph quadratics by transformations:
- Graph parent x^2
- Multiply by "a" (stretch/compress if "a" is not $=$ to 1)
- Move horizontal
- Move vertical
- Your plot should be the vertex
- does parabola open up or down (is vertex min or max)
- the axis of symmetry is the x value of vertex

2.) Identify vertex and Axis of Symmetry when in standard form

Vertex form   Standard form

$f(x) = a(x - h) + k$ $f(x) = ax^2 + bx + c$

the vertex is: $\left(-\dfrac{b}{2a} , f\left(-\dfrac{b}{2a}\right) \right)$

remember example   f(x) = 2x² + 8x + 5

   a.Find and plot vertex
   b. Draw axis of symmetry
   c.Find one additional point
   d. Use axis of symmetry to draw another point (reflect over y axis)

3.)   Graph a quadratic by using vertex, axis and intercepts

     Find out how many solutions the function has by using

       Discriminant   b² – 4 ac

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

    *quadratic formula

       Example f(x) = x² – 6x + 9

       MUST Know :
       1.)   if parabola opens up or down
       2.)   find the domain and range
       3.)   where f is increasing and where it is decreasing

1.)   - plot vertex by finding x and y
    - find y intercept
   - use axis of symmetry to plot from y intercept

2.) what is domain and range

3.) is function increase and decreasing