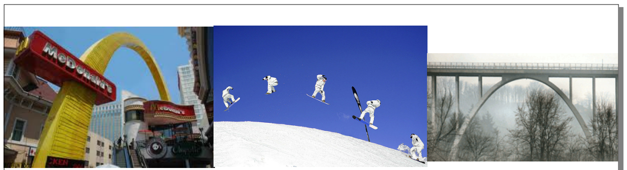


Unit 3- Quadractics Functions and Equations

Lesson 3.1: Quadratic Equations in Vertex Fo

Specific Outcome **1.** Analyze quadratic functions of the form $y = a(x - p)^2 + q$ and determine the:

- vertex
- domain and range
- direction of opening
- axis of symmetry
- x- and y-intercepts

This section of the course has a lot of terminology that we will use. It is expected that you will be able to use and understand the terminology given when answering questions. As such, it is important that you can use these terms throughout this unit.

Oct 2-12:25 PM

1) Quadratic Functions in Vertex form – Terminology

Definition:

Quadratic function : a function f whose value of f(x)at x is given by a polynomial of degree two. For example $f(x)=x^2$ is the simplest form of a quadratic function.

The symmetrical curve of a quadratic function is better known a ***parabola.*** The parabola is symmetrical about the line called the ***Axis of Symmetry.***

The y – coordinate of the vertex is called the ***minimum value*** if the graph opens upward or the ***maximum value*** if the parabola opens downward.

Oct 2-12:29 PM

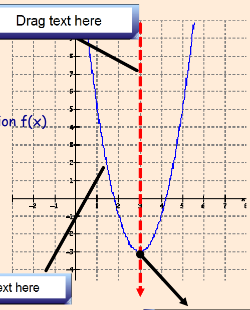
Parts of a Quadratic Function

Drag text here

Vertex

Quadratic Function f(x)

Axis of Symmetry



Drag text here

Drag text here

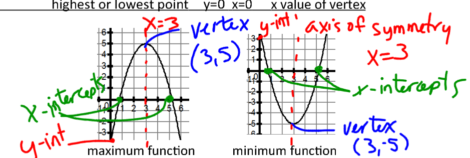
Mar 19-7:45 AM

Quadratic Function y= or f(x)= x^2

Vertex form : $y = f(x) = a(x - p)^2 + q; a \neq 0$

The graph is a parabola. (label vertex, x-int, y-int, axis of symmetry x = p)

highest or lowest point y=0 x=0 x value of vertex



From our investigation a quadratic function is **f (x) = a(x – p)² + q where:**

In general:

- The sign of *a* defines the direction of opening of the parabola.
  Where ***a* > 0** the graph opens **upward** and when ***a* < 0**, the graph opens **downward.**
- The parameter *a* also defines how wide or narrow the graph is compared to the graph of $f(x) = x^2$ (the larger the $|a|$ is, the narrower the graph)
- The point (p, q) defines the vertex of the parabola.
- The equation x = p defines the axis of symmetr

Oct 1-10:21 PM

Example 1: Sketch graphs of Quadratic Functions in Vertex form

Find:

- vertex — 2nd calc max or min
- equation of axis of symmetry — x = value from vertex
- direction of opening
- width compared to $y = x^2$ — Same, Wider or Narrower
- domain & range — always $x \in R$, $y \leq$ or $y \geq$ value from vertex
- max. or min. and value — vertex

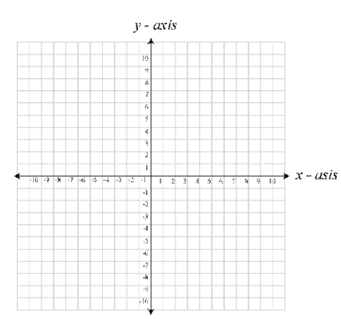
$y=a(x-p)^2+q$	Vertex (p,q)	Axis of Sym. x=p	a – → down Direction Of opening a+ → up	Width Compared to $y=x^2$	Domain And Range	Max or Min Value
1. $y = 2(x+1)^2 - 3$	(-1,-3)	x=-1	up	narrower	x∈R	min = -3
					y≥-3	
2. $y = 3x^2$	(0,0)	x=0	up	narrower	x∈R	min=0
					y≥0	
3. $y = -2x^2 - 4$	(0,-4)	x=0	down	narrower	x∈R	max=-4
					y≤-4	
4. $y = (x-2)^2$	(2,0)	x=2	up	Same	x∈R	min=0
					y≥0	
5. $y = -\frac{1}{2}(x+3)^2$	(-3,0	x=-3	down	wider	x∈R y≤0	max=0

Oct 2-12:25 PM

Method 1: Sketch the using Transformations

Sketch the graph of $f(x) = 2(x + 1)^2 - 3$ by transforming the graph $f(x) = x^2$.

Apply the change in width

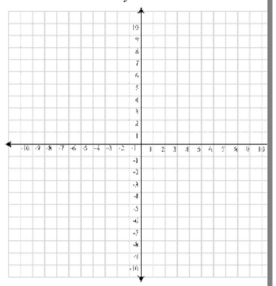


Translate the Graph

Oct 2-6:40 PM

Method 2: Sketch Using Points and Symmetry

- Plot the coordinates of the vertex, (-1, -3), and draw the axis of symmetry, x = -1
- Determine the coordinates of one other point on the parabola



The y - intercept is a good choice for another point.

Let x=0

$f(x) = 2(0+1)^2-3$

$f(x) = -1$

The point is (0, -1)

For any point other than the vertex, there is a corresponding point that is equidistant from the axis of symmetry. In this case, the correseponding point for (0, -1) is (-2, -1).

Plot these two additional points and complete the sketch of the parabola.

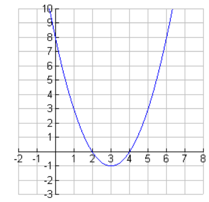
Oct 2-7:06 PM

Example 2: Determine a Quadratic Function in Vertex Form Given its Graph.

Method 1: Use points and Substitution
You can determine the equation of the function using the coordinates of the vertex and on other point.

Step 1: Express the function as
$f(x) = a(x-p)^2 + q$

Step 2: Choose one other point on the graph. Substitute the values of x, and y into the function and solve for ***a***.

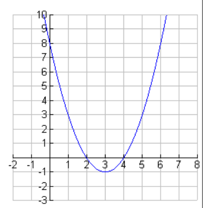


Oct 4-5:17 AM

Method 2:Compare with the graph of $f(x) = x^2$

What you know:
Vertex= the graph opens upward so:
p= The graph is wider so:
q= *a*=

To determine the value of *a*, undo the translations an compare the vertical distances of points on the non-translated parabola relative to the points on the graph of $f(x) = x^2$.



Substitute the values of *a*, p and q into the vertex form:
$f(x) = a(x-p)^2 + q$

Oct 4-5:31 AM

Example 3 Determine the Number of x-Intercepts Using *a* and

a) $f(x)= 0.8x^2 - 3$ b) $f(x) = 2(x - 1)^2$ c) $f(x) = -3(x + 2)^2 -1$

Determine the number of x - intercepts a quadratic function has by examining
- the value of a to determine if the graph opens upward or downward
- the value of q to determine if the vertex is above, below, or on the x-axis

a) $f(x)= 0.8x^2 - 3$

Value of a	Value of q	Visualize the Graph	Number of x-intercepts

b) $f(x) = 2(x - 1)^2$

Value of a	Value of q	Visualize the Graph	Number of x-intercepts

c) $f(x) = -3(x + 2)^2 -1$

Value of a	Value of q	Visualize the Graph	Number of x-intercepts

Oct 4-5:39 AM

Example 4: Determine the x- and y-intercepts of the following equations

a) $f(x) = 2(x + 1)^2 - 3$ b) $2(x - 1)^2$ c) $f(x) = -3(x + 2)^2 -1$

Feb 1-12:10 PM

Assignment: Pg 157- 158 #'s 1a,c, 2. b,c, 4.a, 5, 8. b,c 9 ad

Oct 4-5:52 AM