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# Algebra II

## Quadratic Functions

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## Key Terms

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## Key Terms

**Quadratic Equation:** An equation that can be written in the standard form  $ax^2 + bx + c = 0$ . Where  $a$ ,  $b$  and  $c$  are real numbers and  $a$  does not equal 0.

$$\text{ex: } 3x^2 + 5x - 12 = 0$$

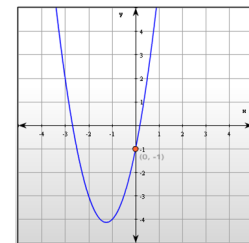
**Quadratic Function:** Any function that can be written in the form  $y = ax^2 + bx + c$ . Where  $a$ ,  $b$  and  $c$  are real numbers and  $a$  does not equal 0.

$$\text{ex: } y = -2x^2 + 10x + 7$$

## Key Terms

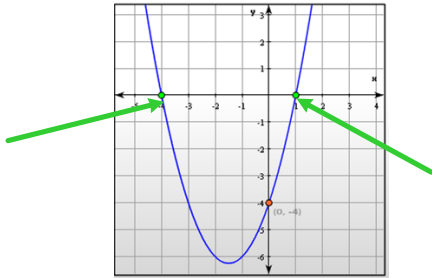
**Parabola:** The curve result of graphing a quadratic equation

$$y = 2x^2 + 5x - 1$$



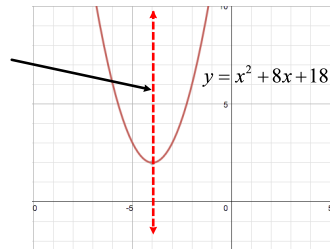
## Key Terms

Zero(s) of a Function: An x value that makes the function equal zero. Also called a "root," "solution" or "x-intercept"



## Key Terms

Axis of symmetry: The vertical line that divides a parabola into two symmetrical halves



## Characteristics of Quadratics

Remember: A quadratic equation is any equation that can be written in the form  $ax^2 + bx + c = 0$   
Where a, b, and c are real numbers and  $a \neq 0$

Question 1: Is  $2x^2 = x + 4$  a quadratic equation?

Question 2: Is  $3x - 4 = x + 1$  a quadratic equation?

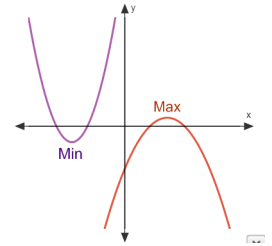
ANSWER

## Key Terms

Vertex: The highest or lowest point on a parabola.

Minimum Value: The y-value of the vertex if  $a > 0$  and the parabola opens upward

Maximum Value: The y-value of the vertex if  $a < 0$  and the parabola opens downward



## Explain Characteristics of Quadratic Functions

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## Characteristics of Quadratics

The form  $ax^2 + bx + c = 0$  is called the standard form of a quadratic equation.

The standard form is not unique.

For example,

$$x^2 - x + 1 = 0 \text{ can also be written } -x^2 + x - 1 = 0.$$

Also,

$$4x^2 - 2x + 2 = 0 \text{ can be written } 2x^2 - x + 1 = 0.$$

**Standard Form**

Practice writing quadratic equations in standard form:  
(Simplify if possible.)

Write  $2x^2 = x + 4$  in standard form:

Answer

**Standard Form**

Write  $3x = -x^2 + 7$  in standard form, if possible:

Answer

**Standard Form**

Write  $6x^2 - 6x = 12$  in standard form and simplify, if possible:

Answer

**Standard Form**

Write  $3x - 2 = 5x$  in standard form:

Answer

**Standard Form**

Similar to Quadratic Equations, the standard form of a Quadratic Function is  $y = ax^2 + bx + c$ , where  $a \neq 0$ .

Notice,  $a$  can be positive or negative.

$$y = -3x^2 + 4x - 10$$

$$y = 5x^2 - 9$$

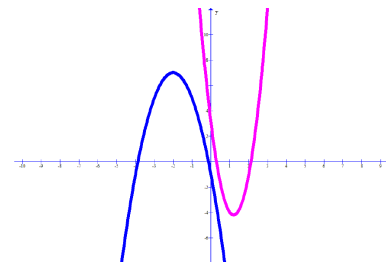
$$y = x^2$$

$$y = \frac{1}{4}x^2 + 5x - 20$$

**Graph**

When graphed, a quadratic function will make the shape of a parabola.

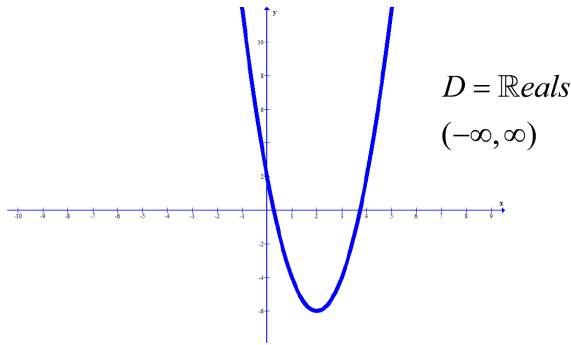
The parabola will open upward if  $a > 0$  or downward if  $a < 0$ .



Teacher Notes

### Domain

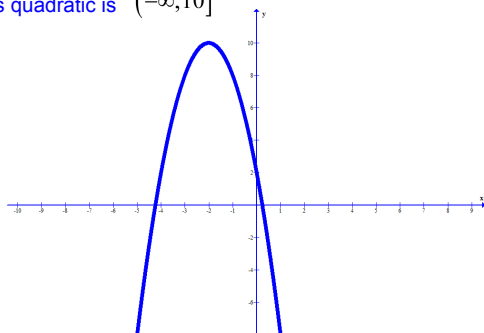
The domain of a quadratic function is all real numbers.



### Range

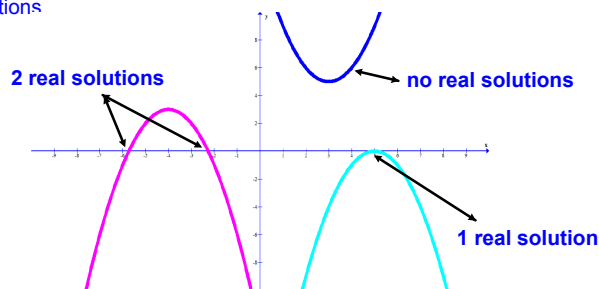
If the vertex is a maximum, then the range is all real numbers less than or equal to the y-value of the vertex.

The range of this quadratic is  $(-\infty, 10]$



### X-Intercepts

The x-intercepts are the points at which a parabola intersects the x-axis. These points are also known as zeros, roots or solutions and solution sets. Each quadratic function will have 0, 1, or 2 or real solutions



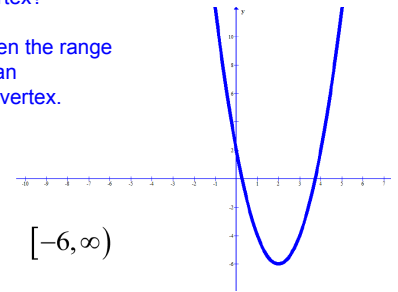
### Range

To determine the range of a quadratic function, ask yourself two questions:

Is the vertex a minimum or maximum?  
What is the y-value of the vertex?

If the vertex is a minimum, then the range is all real numbers greater than or equal to the y-value of the vertex.

The range of this quadratic is  $[-6, \infty)$



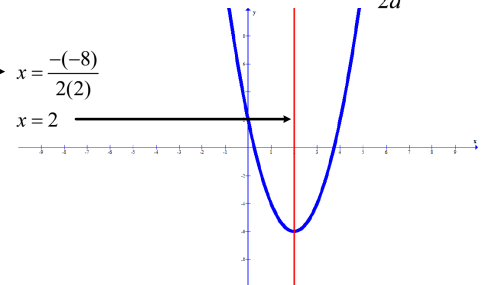
### Axis of Symmetry

An axis of symmetry (also known as a line of symmetry) will divide the parabola into mirror images.

The line of symmetry is always a vertical line of the form  $x = \frac{-b}{2a}$

$$y = 2x^2 - 8x + 2 \rightarrow x = \frac{-(-8)}{2(2)}$$

$$x = 2$$



1 If a parabola opens downward, the vertex is the highest value on the parabola.

- True
- False

2 If a parabola opens upward then...

- A  $a > 0$   
 B  $a < 0$   
 C  $a = 0$

Answer

3 The vertical line that divides a parabola into two symmetrical halves is called...

- A discriminant  
 B quadratic equation  
 C axis of symmetry  
 D vertex  
 E maximum

Answer

4 Which of the following shows a quadratic equation correctly written in standard form?

- A  $3x - 5x^2 + 8 = 0$   
 B  $3x - 5x + 8 = 0$   
 C  $-5x^2 + 8 = -3x$   
 D  $-5x^2 + 3x + 8 = 0$   
 E  $3x = 5x^2 - 8$

Answer

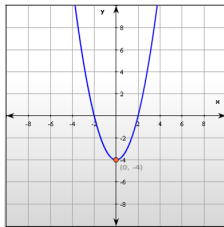
5 What is the equation for the axis of symmetry for the quadratic function  $y = 2x^2 + 12x - 7$ ?

- A  $x = 12$   
 B  $x = -6$   
 C  $x = 2$   
 D  $x = -3$   
 E  $x = -7$

Answer

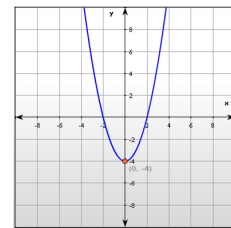
6 What is the domain of the quadratic function below?

- A  $[-4, \infty)$   
 B  $[-2, 2]$   
 C  $(-\infty, 4]$   
 D  $\mathbb{R}$



Answer

What is the range of the quadratic function below?



Answer