

# The Graphing Form of a Quadratic Function Part 2

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## PRE-CALCULUS 11 QUADRATIC FUNCTIONS THE GRAPHING FORM OF A QUADRATIC FUNCTION PART 2

### A. Definitions

1. **general form:** any quadratic function that can be written in the form:

$$y = ax^2 + bx + c \text{ or } f(x) = ax^2 + bx + c.$$

2. **standard form:** any quadratic function that can be written in the form:

$$y = a(x-p)^2 + q \text{ or } f(x) = a(x-p)^2 + q$$

3. **image:** the position of the point or graph after it has been translated/transformed.

### B. Translating Quadratic Functions

- 1) Describe how the graphs of the following functions relate to the graph of  $y = x^2$ .

a)  $y = -2x^2$

$$a = -2$$

$$p = 0$$

$$q = 0$$

- inverted & vertically expanded

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

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

$$a = 1$$

$$p = -1$$

$$q = 3$$

- vertex shifts to  $(-1, 3)$

c)  $y + 4 = (x-5)^2 - 7$

$$y = (x-5)^2 - 11$$

$$a = 1$$

$$p = 5$$

$$q = -11$$

- vertex shifts  $(5, -11)$

2) Write the coordinates of the **image** of the point  $(4, -1)$  after the following translation.

a) translation 3 units down. <sup>a. value</sup>

$$(4, -1)$$

$$(4, -4)$$

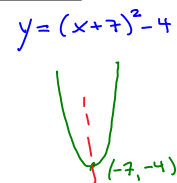
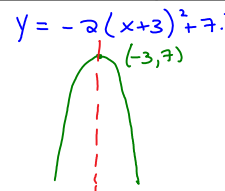
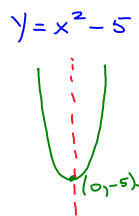
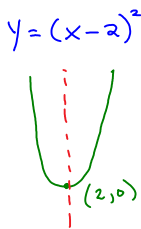
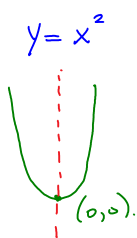
b) translation 1 unit right and 7 units up.

$$(4, -1)$$

$$(5, 6)$$

3) Complete the following table.

Function	Vertex	Max/Min	Axis of Sym	Domain	Range
$y = x^2$	$(0, 0)$	Min	$X = 0$	$X \in \mathbb{R}$	$y \geq 0$
$y = (x-2)^2$	$(2, 0)$	Min	$X = 2$	$X \in \mathbb{R}$	$y \geq 0$
$y = x^2 - 5$	$(0, -5)$	Min	$X = 0$	$X \in \mathbb{R}$	$y \geq -5$
$y = -2(x+3)^2 + 7$	$(-3, 7)$	Max.	$X = -3$	$X \in \mathbb{R}$	$y \leq 7$
$y = (x+7)^2 - 9$	$(-7, -4)$	Min	$X = -7$	$X \in \mathbb{R}$	$y \geq -4$



Assignment: Analyzing Quadratic Functions Assignment #1 - 10

1 Describe how the graphs of the following functions relate to the graph of  $y = x^2$ .

a)  $y = (x + 10)^2$

b)  $y = x^2 + 4$

c)  $y + 8 = (x - 5)^2$

2 The following transformation(s) are applied to the graph of  $y = x^2$ . Write the equation of the image function for each.

a) A horizontal translation of 5 units right.

b) A translation of 6 units down and 4 units left.

3 Write the coordinates of the image of the point (3, 9) on the graph  $y = x^2$  when a translation of two units up and seven units right is applied.

**Complete Assignment Questions #1 - #10**

## Assignment

1. Describe how the graphs of the following functions relate to the graph of  $y = x^2$ .

a)  $y = (x + 5)^2$

b)  $y = x^2 - 7$

c)  $y - 8 = x^2$

d)  $y = 5 + (x - 2)^2$

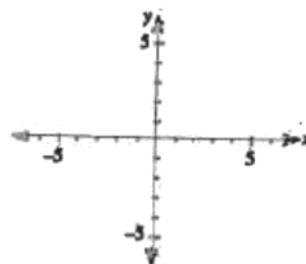
e)  $y + 7 = (x + 1)^2 - 10$

f)  $y = (x - a)^2 - b$

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2. Consider the graph of the function  $f(x) = (x - 2)^2 + 3$ .

- Without using a graphing calculator, sketch the graph on the grid.
- State the coordinate of the vertex.
- State the maximum or minimum value of the function.
- State the domain and range of the function.



3. The following transformation(s) are applied to the graph of  $y = x^2$ . Write the equation of the image function for each.

- A horizontal translation of 7 units right.
- A vertical translation of 2 units down.
- A translation 3 units left and 8 units up.
- A translation  $c$  units down and  $d$  units right.

4. Complete the following table.

Function	$y = x^2 + 5$	$y = (x + 3)^2 - 4$	$y + 9 = (x - 6)^2 + 1$	$y - w = (x + r)^2$
Coordinates of Vertex				
Max/Min Value				
Eqn. of Axis of Symmetry				
Domain				
Range				

5. Write the coordinates of the image of the point  $(-2, 4)$  on the graph  $y = x^2$  when each of the following transformations are applied:

- a horizontal translation of 2 units to the left
- a translation of 3 units up and 11 units right.

6. After a combination of a horizontal and a vertical translation, the graph of  $y = x^2$  has an image graph with a vertex at  $(2, -6)$ . Describe the translations.



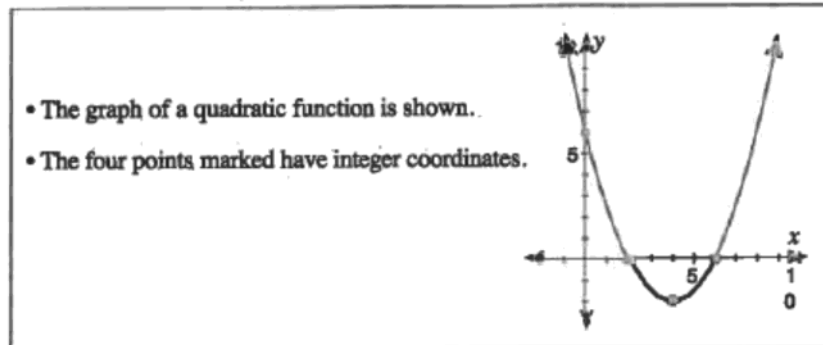
7. Which of the following transformations shifts the graph of  $y = x^2$  to the graph of  $y + a = (x - b)^2$ ?

- A.  $a$  units right and  $b$  units down.
- B.  $b$  units right and  $a$  units down.
- C.  $b$  units up and  $a$  units right.
- D.  $a$  units down and  $b$  units left.

8. The function defined by the equation  $y = x^2$  is transformed to  $y = (x + 2)^2 + 4$ . If the point  $(2, 4)$  lies on the graph of  $y = x^2$ , which of the following points must lie on the graph of  $y = (x + 2)^2 + 4$ ?

- A.  $(0, 0)$
- B.  $(4, 0)$
- C.  $(4, 8)$
- D.  $(0, 8)$

Use the following information to answer questions #9 and #10.



9. The domain and range, respectively, of the function are

- A.  $x \in \mathcal{R}$  and  $y \in \mathcal{R}$
- B.  $x \geq -2$  and  $y \in \mathcal{R}$
- C.  $x \in \mathcal{R}$  and  $y \geq -2$
- D.  $2 \leq x \leq 6$  and  $y \geq -2$



10. The sum of the  $x$  and  $y$ -intercepts is \_\_\_\_\_.

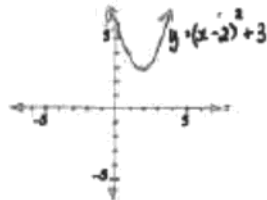
(Record your answer in the numerical response box from left to right)

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**Answer Key**

1. a) horizontal translation 5 units left      b) vertical translation 7 units down  
 c) vertical translation 8 units up      d) translation 2 units right and 5 units up  
 e) translation 1 unit left and 17 units down      f) translation  $a$  units right and  $b$  units down

2. a)



- b) (2, 3)      c) minimum value of 3      d) Domain:  $\{x | x \in \mathbb{R}\}$  Range:  $\{y | y \geq 3, y \in \mathbb{R}\}$

3. a)  $y = (x - 7)^2$       b)  $y = x^2 - 2$       c)  $y = (x + 3)^2 + 8$       d)  $y = (x - d)^2 - c$

4.

Function	$y = x^2 + 5$	$y = (x + 3)^2 - 4$	$y + 9 = (x - 6)^2 + 1$	$y - w = (x + r)^2$
Coordinates of Vertex	(0, 5)	(-3, -4)	(6, -8)	(-r, w)
Max/Min Value	min, 5	min, -4	min, -8	min, w
Eqn. of Axis of Symmetry	$x = 0$	$x = -3$	$x = 6$	$x = -r$
Domain	$\{x   x \in \mathbb{R}\}$	$\{x   x \in \mathbb{R}\}$	$\{x   x \in \mathbb{R}\}$	$\{x   x \in \mathbb{R}\}$
Range	$\{y   y \geq 5, y \in \mathbb{R}\}$	$\{y   y \geq -4, y \in \mathbb{R}\}$	$\{y   y \geq -8, y \in \mathbb{R}\}$	$\{y   y \geq w, y \in \mathbb{R}\}$

5. a) (-4, 4)      b) (9, 7)

6. horizontal translation 2 units right, vertical translation 6 units down.

7. B

8. D

9. C

10.

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