

# Quadratic Transformations Worksheet With Answers

## Transformations and Parent Functions

The "horizontal shift":  $c$

This transformation is very useful. (Similar to a vertical shift), the entire function is simply moved to the right (or left) along the x-axis, determined by the 'c' value.

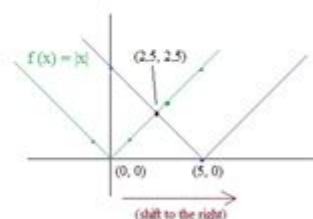
Compare:

$$f(x) = |x| \quad (\text{absolute value parent function})$$

$$g(x) = |x - 5|$$

x	f(x)	g(x)
-1	1	6
0	0	5
1	1	4
3	3	2
5	5	0
7	7	2
9	9	4

Note: the x-intercept of  $|x|$  is  $(0,0)$  and the x-intercept of  $|x - 5|$  is  $(5,0)$ , verifying a 5 space shift to the right

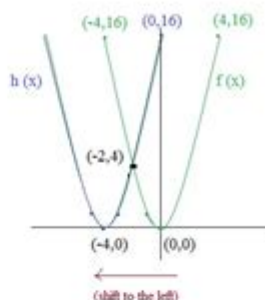


$$f(x) = x^2 \quad (\text{parabola parent function})$$

$$h(x) = (x + 4)^2$$

x	f(x)	h(x)
-4	16	0
-3	9	1
-2	4	4
-1	1	9
0	0	16
1	1	25
2	4	36
3	9	49
4	16	64

Note: The output values of  $h(x)$  would be the same as  $f(x)$  if the inputs were shifted by 4

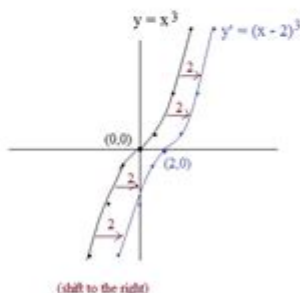


$$y = x^3 \quad (\text{cubic equation})$$

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

x	y	y'
-2	-8	-64
-1	-1	-27
0	0	-8
1	1	-1
2	8	0
3	27	1
4	64	8

Note: the table shows the  $y'$  values are the same as the  $y$  values when shifted by 2 rows



\*\*As you can see, if the c value is negative, the shift is to the right. And, when the c value is positive, the shift is to the left

**Quadratic transformations worksheet with answers** are essential tools for students and educators alike, as they help in understanding the transformations of quadratic functions. Quadratic functions, expressed in the form  $(y = ax^2 + bx + c)$ , can undergo various transformations that affect their shape, position, and orientation on the Cartesian plane. This article will explore the different types of quadratic transformations, provide a sample worksheet, and supply answers to enhance comprehension of the topic.

## Understanding Quadratic Functions

Quadratic functions are polynomial functions of degree two. Their graphs, known as parabolas, can

open upwards or downwards, depending on the coefficient  $(a)$ .

- If  $(a > 0)$ : The parabola opens upwards.
- If  $(a < 0)$ : The parabola opens downwards.

The vertex, which is the highest or lowest point of the parabola, plays a crucial role in determining the characteristics of the graph. The vertex can be found using the formula:

$$x = -\frac{b}{2a}$$

The vertex form of a quadratic function is expressed as:

$$y = a(x - h)^2 + k$$

where  $(h, k)$  is the vertex of the parabola.

## Types of Quadratic Transformations

Quadratic transformations involve changes to the graph's position, shape, and orientation. There are several types of transformations to consider:

### 1. Vertical Shifts

Vertical shifts occur when a constant is added or subtracted from the quadratic function. The general form is:

$$y = ax^2 + bx + (c + k)$$

- If  $(k > 0)$ : The graph shifts upwards by  $(k)$  units.
- If  $(k < 0)$ : The graph shifts downwards by  $(|k|)$  units.

### 2. Horizontal Shifts

Horizontal shifts occur when a constant is added or subtracted from the input variable. The general form is:

$$y = a(x - h)^2 + k$$

- If  $(h > 0)$ : The graph shifts to the right by  $(h)$  units.
- If  $(h < 0)$ : The graph shifts to the left by  $(|h|)$  units.

### 3. Stretching and Compressing

The value of the coefficient  $(a)$  affects the width of the parabola.

- If  $(|a| > 1)$ : The graph stretches vertically, making it narrower.
- If  $(0 < |a| < 1)$ : The graph compresses vertically, making it wider.

### 4. Reflections

Reflections occur when the coefficient  $(a)$  is negative. This flips the parabola over the x-axis, resulting in:

$$y = -ax^2 + bx + c$$

## Quadratic Transformations Worksheet

The following worksheet contains a series of problems designed to apply the concepts of quadratic transformations. Students can practice identifying transformations and sketching the resulting graphs.

Instructions: For each quadratic function provided, identify the transformations applied to the basic quadratic function  $(y = x^2)$  and sketch the graph.

- $(y = (x - 3)^2 + 2)$
- $(y = -2x^2 + 1)$
- $(y = \frac{1}{2}(x + 4)^2 - 3)$
- $(y = x^2 - 5)$
- $(y = -\frac{1}{3}(x - 1)^2 + 4)$

## Answers to the Quadratic Transformations Worksheet

Here are the answers to the worksheet problems, including the transformations and expected graph characteristics.

### 1. $y = (x - 3)^2 + 2$

- Transformations:
- Horizontal shift to the right by 3 units.
- Vertical shift upwards by 2 units.
- Graph Characteristics: The vertex is at (3, 2).

### 2. $y = -2x^2 + 1$

- Transformations:
- Vertical stretch by a factor of 2 (narrower).
- Reflection over the x-axis.
- Vertical shift upwards by 1 unit.
- Graph Characteristics: The vertex is at (0, 1).

### 3. $y = \frac{1}{2}(x + 4)^2 - 3$

- Transformations:
- Horizontal shift to the left by 4 units.
- Vertical compression by a factor of 1/2 (wider).
- Vertical shift downwards by 3 units.
- Graph Characteristics: The vertex is at (-4, -3).

### 4. $y = x^2 - 5$

- Transformations:
- Vertical shift downwards by 5 units.
- Graph Characteristics: The vertex is at (0, -5).

### 5. $y = -\frac{1}{3}(x - 1)^2 + 4$

- Transformations:
- Horizontal shift to the right by 1 unit.
- Vertical compression by a factor of 1/3 (wider).
- Reflection over the x-axis.
- Vertical shift upwards by 4 units.
- Graph Characteristics: The vertex is at (1, 4).

## Conclusion

Quadratic transformations are a fundamental aspect of algebra that enhances students' understanding of functions and their graphical representations. By working through problems and understanding the effects of various transformations, students can gain confidence in their ability to manipulate and analyze quadratic equations effectively. The provided worksheet and answers serve as a valuable resource for both practice and self-assessment. Through continued practice and

exploration of these concepts, students will be well-equipped to tackle more complex mathematical challenges in the future.

## Frequently Asked Questions

### What are quadratic transformations and why are they important?

Quadratic transformations refer to the various ways in which the graph of a quadratic function can be altered through shifts, stretches, compressions, and reflections. They are important for understanding the behavior of quadratic functions and solving real-world problems modeled by these equations.

### How can I create a quadratic transformations worksheet?

To create a quadratic transformations worksheet, start by including a variety of quadratic functions in vertex form. Then, design problems that require identifying transformations such as vertical/horizontal shifts, reflections, and stretches/compressions. Include answer keys for each problem.

### What types of problems are typically found on a quadratic transformations worksheet?

Common problems include identifying the vertex after a transformation, determining the direction of opening after a reflection, and graphing transformed functions based on given parameters.

### How do I solve a problem involving shifting a quadratic function?

To solve a shifting problem, recognize that adding or subtracting a value to/from the x-variable shifts the graph horizontally, while adding or subtracting a value to/from the output shifts it vertically. For example,  $f(x) = (x - 3)^2 + 2$  shifts the graph 3 units right and 2 units up.

### What is the vertex form of a quadratic function?

The vertex form of a quadratic function is expressed as  $f(x) = a(x - h)^2 + k$ , where  $(h, k)$  is the vertex of the parabola, 'a' determines the direction and width of the parabola.

### Can you explain how to reflect a quadratic function over the x-axis?

To reflect a quadratic function over the x-axis, simply multiply the entire function by -1. For example, if the original function is  $f(x) = x^2$ , the reflected function will be  $f(x) = -x^2$ .

### Where can I find quadratic transformations worksheets with answers?

Quadratic transformations worksheets with answers can be found on educational websites, math

resource platforms, and in math textbooks. Websites like Teachers Pay Teachers, Khan Academy, and various math blogs often provide free downloadable resources.

## What is the significance of understanding quadratic transformations in real-life applications?

Understanding quadratic transformations is significant because many real-world phenomena, such as projectile motion and profit maximization in business, can be modeled using quadratic functions. Mastering these transformations allows for better analysis and prediction of outcomes in various fields.

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