

2.2.4 How can I transform circles?

Transforming Non-Functions



In this lesson, you consider two new parent equations that are different from the ones you have seen in the past because they are not functions. You will investigate them and apply the knowledge you have gained in this chapter to transform them. You will identify ways in which these new equations are different from the functions with which you have been working.

2-132. Begin by fully investigating $x = y^2$ and $x^2 + y^2 = 25$ as follows.

- Without using your graphing calculator, make a table and a graph for each equation.
- Marabel and Lissa were working on this problem. Marabel was making a table for $x = y^2$. For an x -value of 4, she found a y -value of 2. Lissa was watching and said, “Wait! When x is 4, there is also another possible value for y .” What did Lissa mean? Look back at your tables and decide if there are more points you could add.
- Now describe $x = y^2$ and $x^2 + y^2 = 25$ completely. This includes finding the domain and range of each equation, finding the important points such as intercepts, and describing what happens to y as x increases.
- How are these relationships different from others you have been working with?



2-133. Rewrite $x = y^2$ and $x^2 + y^2 = 25$ so that you can graph them with your graphing calculator. When you have rewritten both equations, try graphing them using your calculator. Do they look like the graphs you made in problem 2-132? [2-133 Parabola eTool](#) (Desmos) [2-133 Circle eTool](#) (Desmos)

2-134. TRANSFORMATIONS OF NON-FUNCTIONS

In order to graph the equation of the circle on your graphing calculator, you had to express the non-function as two functions. Now apply your knowledge of transforming functions to learn about transforming circles.

Your Task: As a team, transform the graphs of $y = \pm\sqrt{25 - x^2}$ horizontally and vertically. Then find a general equation for this family of circles using h , and k . Be prepared to share your findings and your strategies with the class.

Discussion Points

How did we change the equation in other families so that the graph moves vertically? So that it moves horizontally?

How can we rewrite the two functions for a circle the same way?

2-135. Write your general equations for a circle in standard form by rewriting the equation

$y = \pm\sqrt{-(x-h)^2 + 25} + k$ to isolate 25 on one side of the equation. What information does the locator point (h, k) give about the graph of the circle?

2-136. A circle has a special characteristic, its radius, which defines its size.

- Refer back to the graph of $x^2 + y^2 = 25$. What is the radius? How is the radius of the circle related to the equation?
- What would be the equation of a circle that has its center at $(5, -7)$ with radius 10? With radius 12?
- Now generalize the connection between the radius and the equation of a circle. Write a general equation for a circle with any center (h, k) and radius r .
- Given the equation $(x - 3)^2 + (y + 7)^2 = 169$, how can you find the radius of the circle?

2-137. Consider the equation $(x - 4)^2 + (y + 1)^2 = 16$.

- What is the shape of the graph? How can you tell?
- What information can you learn about the graph just by looking at the equation?
- Sketch a graph of $(x - 4)^2 + (y + 1)^2 = 16$.

2-138. Look at your work from problem 2-133. The non-function $x = y^2$ had a graph that is called a “sleeping parabola.”

- How could you transform the equation $y = \pm\sqrt{x}$ to move the graph horizontally and vertically? How could you transform the equation to stretch or compress the graph, or to “flip” it vertically?
- Write a general equation for transforming the sleeping parabola family $y = \pm\sqrt{x}$ by using a , h , and k .
- Write the equation for a sleeping parabola in standard form by isolating x on one side of the equation.



2-139. Write the equation $y = x^2 + 7x - 8$ in graphing form. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

2-140. You are standing outside the school, waiting to cross the street, when you hear booming music coming from an approaching car. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

- Sketch a graph that shows the relationship between how far away from you the car is and the loudness of

the music.

- b. Which is the dependent variable and which is the independent variable?

2-141. The Green Streak Taxi Company charges a \$3.00 base fee plus \$2.50 per mile. The cab driver sets his meter at \$3.00 and the meter adds \$0.25 each one-tenth of a mile. Draw a graph to represent this fare structure. Describe the domain and range of your graph. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

2-142. Write an equation for a function that is odd, and explain how you can tell it is odd from its graph, its table and its equation. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

2-143. Explain the difference between the graphs of $y = \frac{1}{x}$ and $y = 4(\frac{1}{x+5}) + 7$. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

2-144. Multiply the expressions in parts (a) through (c) to remove the parentheses. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

a. $(x - 1)(x + 1)$

b. $2(x + 1)(x + 1)$

c. $(x - 1)(x + 1)(x - 2)$

- d. Find the x- and y-intercepts of $y = x^3 - 2x^2 - x + 2$. The factors in part (c) should be useful.

2-145. Solve the following systems of equations. In other words, find values of a and b that make each system true. Be sure to show your work or explain your thinking clearly. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

a. $2 = a \cdot b^0$

$$\frac{1}{2} = a \cdot b^2$$

b. $\frac{1}{2} = a \cdot b^0$

$$2 = a \cdot b^2$$

2-146. A parabola has vertex (3, 5) and contains the point (0, 0). [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

- a. If this parabola is a function, find its equation.

- b. Suppose this parabola is not a function, but is a “sleeping” parabola. Find its equation.

2-147. Sketch the graph of $y = 2(x - 1)^2 + 4$. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

- a. Now rewrite the equation $y = 2(x - 1)^2 + 4$ without parentheses.

- b. What would the difference be between the graphs of the two equations above? This is sort of a trick question, but explain your reasoning.

- c. What is the parent function of $y = 2(x - 1)^2 + 4$?

d. What is the parent function of $y = 2x^2 - 4x + 6$?

2-148. Consider the equation $(x - 5)^2 + (y - 8)^2 = 49$. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

a. What can you tell about the graph just by looking at the equation?

b. Sketch a graph of $(x - 5)^2 + (y - 8)^2 = 49$.

2-149. A line passes through the points $(0, 2)$ and $(1, 0)$. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

a. Find the slope of the line.

b. Find the slope of a line parallel to the given line.

c. Find the slope of a line perpendicular to the given line.

d. Find the product of the slopes you found in parts (b) and (c).

e. Make a conjecture about the product of the slopes of any two perpendicular lines. Test your conjecture by creating more examples.

2-150. Give the equations of two functions, $f(x)$ and $g(x)$, so that $f(x)$ and $g(x)$ intersect at exactly: [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

a. One point.

b. Two points.

c. No points.

2-151. Find the x - and y -intercepts for the following parabolas. [Help \(Html5\)](#) \Leftrightarrow [Help \(Java\)](#)

a. $y = (x + 12)^2 - 144$

b. $y = (x - 8)^2 - 4$

2-152. This problem is a checkpoint for solving linear systems in two variables. It will be referred to as Checkpoint 2B.



Solve the system of linear equations at right.

$$5x - 4y = 7$$

$$2y + 6x = 22$$

Check your answers by referring to the [Checkpoint 2B materials](#).

If you needed help solving these problems correctly, then you need more practice. Review the [Checkpoint 2B materials](#) and try the practice problems. Also, consider getting help outside of class time. From this point on, you will be expected to do problems like these quickly and easily.