

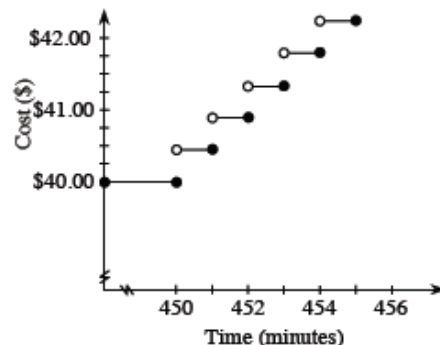
2.2.5 Can I combine functions?

Transforming Piecewise-Defined Functions



Often the equation for a single familiar function describes a part of a situation, but then is not a good description for the rest of the situation. A step graph is one kind of **piecewise-defined function**. The graphs of these situations are functions, but a single equation is not sufficient to describe them. Describing them requires two (or more) different equations for different inputs. Today you will build new functions by using pieces of familiar functions. Phone plans and water rates are situations that can be modeled using step functions.

2-153. The Horizon Phone Company offers a basic monthly voice phone plan where you pay \$40.00 for the first 450 minutes and then \$0.45 per minute after that. The graph at right shows how the plan works.

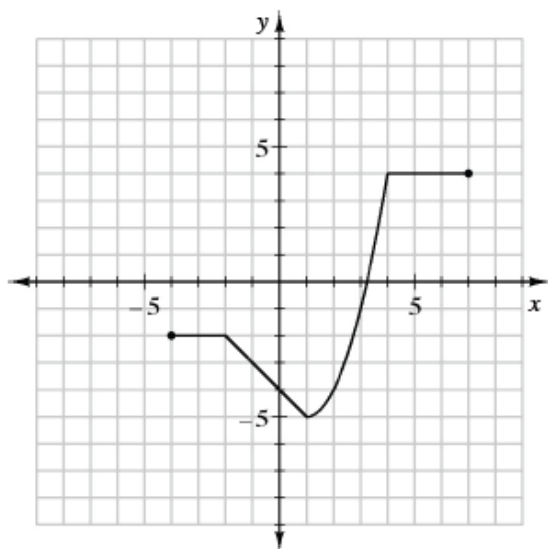


- This is a piecewise-defined function with many pieces. Describe each piece and the domain and range for the function overall. Then describe the domain and range for the first few pieces.
- Write an equation for each part of the domain.

2-154. With your team, create a piecewise-defined function with at least three “pieces.”

The function does not need to be a step-function with horizontal line segments, but it needs to meet the definition of a function. Make a table and a graph for your function, and write an equation for each part. Be sure to state the domain for each part, as well as the domain for the whole function. Alternatively, your team could complete 2-154 using [Desmos GC](#) saving the file you make with your table, graph, and equations.

2-155. Here is another piecewise-defined function $F(x)$ defined in the domain $-4 \leq x \leq 7$ by the graph below.



- Because there is no single equation that represents the whole graph, it is often useful to make a more complete table than you might usually make. On your paper, fill in a table for the function like the one below.

x	-4	-3	-2	-1	0	1	2	3	4	5	6	7
$F(x)$												

- b. Use the graph and the table that you made to write equations for each part of the piecewise-defined function. Be sure to state the domain for each part.

2-156. TEAM TRANSFORMATION CHALLENGE

Obtain the [Lesson 2.2.5A Resource Page](#). Use the resource page to show the graph, the table, and the equations for each of the following transformations of the piecewise-defined function in problem 2-155. Alternatively, students may prefer to use the [2-156 Student eTool](#) (html5) saving their work.

- $y = -F(x)$
- $y = \frac{1}{2} F(x)$
- $y = F(x) + 4$
- $y = F(x - 4)$

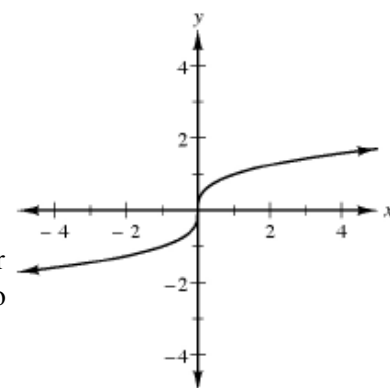
2-157. GRAPHS OF ODD AND EVEN FUNCTIONS

Your goal in this investigation is to determine whether a function is odd or even by looking at its graph.

- Use your graphing calculator to graph the following functions, and make a quick sketch of each graph on your paper. Be sure to label each graph.

$f(x) = x^2$	$f(x) = (x + 5)^2$	$f(x) = x^2 + 5$
$f(x) = x^3$	$f(x) = (x + 5)^3$	$f(x) = x^3 + 5$
$f(x) = \frac{1}{x}$	$f(x) = -2.5x$	

- Determine which of the functions above are odd, even, or neither. Can you find an efficient way to do this with your graphing calculator?
- How can you tell by looking at the graph whether a function is odd, even, or neither?
- Classify the function at right as odd, even, or neither. Explain.



2-158. Write an equation for an even function of your own. Now write another function of your own that is odd. Show that your functions meet the even/odd criteria. The functions you use do not have to be parent functions.

2-159. Write an equation for a function that is neither even nor odd. Show that it is neither.

2-160. AN ADDITIONAL CHALLENGE

In general, a transformation for the parent function $F(x)$ in problem 2-155 can be represented by $y = aF(x - h) + k$. With your team, choose your own values for a , h , and k and show the table, graph, and equations for your transformed $F(x)$.

2-161. LEARNING LOG

In the last few lessons, you have developed the ability to create a family of functions by transforming *any* parent function. Does the function you start with (the parent) affect how you will transform it? If so, how? If not, why not? Are there any parent graphs that are hard for you to transform? Why or why not? Write a Learning Log entry answering these questions. Title it “Transform Any Function” and label it with today’s date.



METHODS AND MEANINGS

MATH NOTES

Even and Odd Functions

When a function $f(-x) = f(x)$, the function f is called an **even function**. For example, for the function $f(x) = x^2$:

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

Thus, $f(x) = x^2$ is an even function.

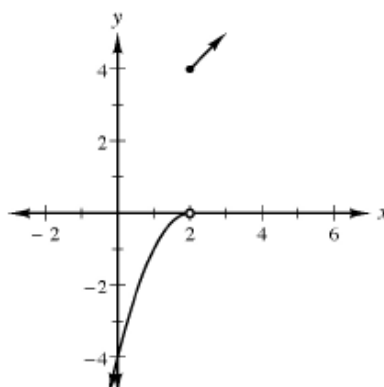
When $f(-x) = -f(x)$, the function f is called an **odd function**. For example for the function $f(x) = x^3$:

$$f(-x) = (-x)^3 = -x^3 = -f(x).$$

Therefore, $f(x) = x^3$ is an odd function.



2-162. Write a set of equations for the piecewise-defined function shown on the graph below. Be sure to include the domain for each part of the function. [Help \(Html5\)](#) ⇔ [Help \(Java\)](#)



2-163. Write an equation for a function that is even. Then explain how you can tell it is even from its graph, its table, and its

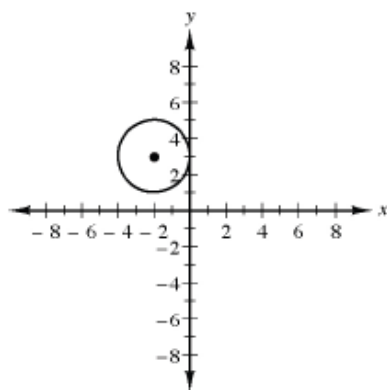
equation. [Help \(Html5\)](#) ⇔ [Help \(Java\)](#)

2-164. Use your knowledge of absolute value functions to find the equation of the graph at right. [Help \(Html5\)](#) ⇔ [Help \(Java\)](#)

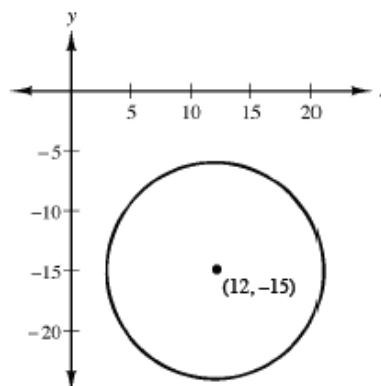


2-165. Write an equation for each of the circles shown in the graphs below. [Help \(Html5\)](#) ⇔ [Help \(Java\)](#)

a.



b.



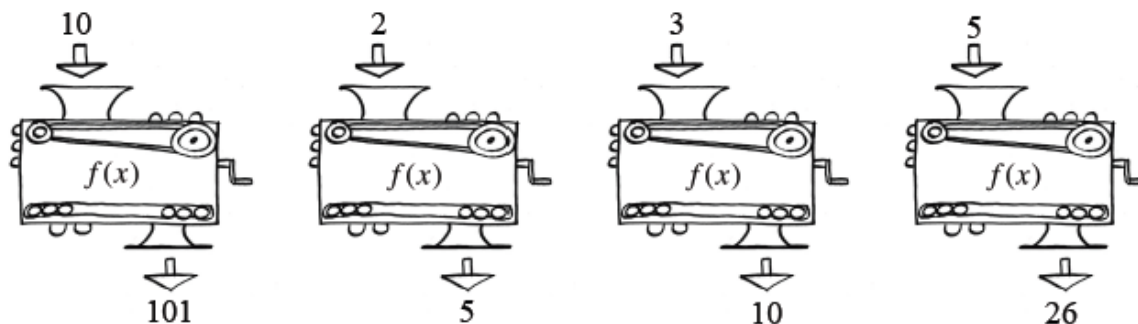
2-166. Use the technique of completing the square to express $y = x^2 - 5x + 7$ in graphing form and state the vertex. [Help \(Html5\)](#) ⇔ [Help \(Java\)](#)

2-167. Shortcut Shuneel claims he has a shortcut for finding the vertex of a parabola. While using his shortcut on $y = 2x^2 + 3x + 1$, he ended up with $y = 2(x + \frac{3}{4})^2 - \frac{7}{2}$. Is Shuneel's new equation correct?

Why or why not? [Help \(Html5\)](#) ⇔ [Help \(Java\)](#)



2-168. Remember function machines? Each of the following pictures shows how the same machine changes the given x -value into a corresponding $f(x)$ value. Find the equation for this machine. [Help \(Html5\)](#) ⇔ [Help \(Java\)](#)



2-169. If $x^2 + kx + 28$ is factorable, what are the possible values of k ? [Help \(Html5\)](#) ⇔ [Help \(Java\)](#)