Blizzard Bag Day #3
Review of Functions

Complete the following problems:

P10 #'s 1 and 2
P12 #'s 1-4
P16 #'s 1 and 2
P17 #'s 1 and 2
P18 #'s 1-4, 7, 8
P28 #'s 1 and 2
P29 #'s 1-6

Many of these concepts will be on your final exam so it is important to review.

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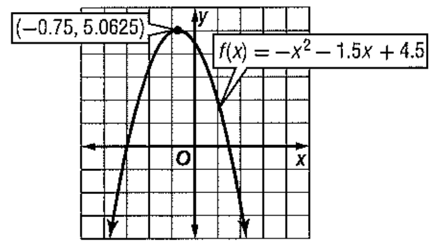
1-2 Study Guide and Intervention

Analyzing Graphs of Functions and Relations

Analyzing Function Graphs By looking at the graph of a function, you can determine the function's domain and range and estimate the x- and y-intercepts. The x-intercepts of the graph of a function are also called the **zeros** of the function because these input values give an output of 0.

Example **Use the graph of f to find the domain and range of the function and to approximate the y-intercept and zero(s). Then confirm the estimate algebraically.**



The graph is not bounded on the left or right, so the domain is the set of all real numbers.

$$\{x \mid x \in \mathbb{R}\}$$

The graph does not extend above 5.0625 or $f(-0.75)$, so the range is all real numbers less than or equal to 5.0625.

$$\{y \mid y \le 5.0625, y \in \mathbb{R}\}$$

The y-intercept is the point where the graph intersects the y-axis. It appears to be 4.5. Likewise, the zeros are the x-coordinates of the points where the graph crosses the x-axis. They seem to occur at -3 and 1.5.

To find the y-intercept algebraically, find $f(0)$.

$$f(0) = -(0)^2 - 1.5(0) + 4.5 = 4.5$$

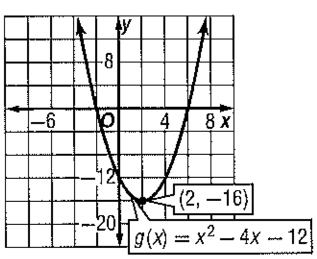
To find the zeros algebraically, let $f(x) = 0$ and solve for x.

$$-x^2 - 1.5x + 4.5 = 0$$
$$-1(x + 3)(x - 1.5) = 0$$
$$x = -3 \text{ or } x = 1.5$$

Exercises

Use the graph of g to find the domain and range of the function and to approximate its y-intercept and zero(s). Then find its y-intercept and zeros algebraically.

1.



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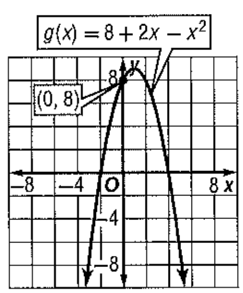

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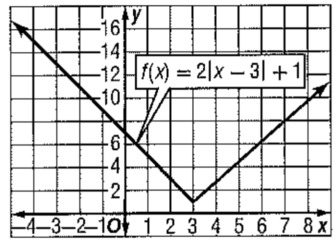
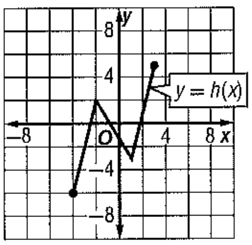
1-2 Practice

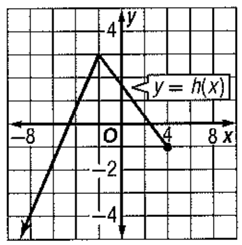
Analyzing Graphs of Functions and Relations

1. Use the graph of the function shown to estimate $f(-2.5)$, $f(1)$, and $f(7)$. Then confirm the estimates algebraically. Round to the nearest hundredth, if necessary.

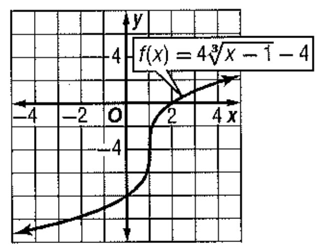


Use the graph of h to find the domain and range of each function.

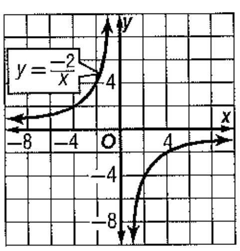
2. 

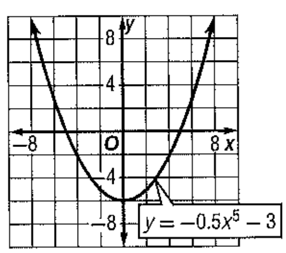
3. 

4. Use the graph of the function to find its y-intercept and zeros. Then find these values algebraically.



Use the graph of each equation to test for symmetry with respect to the x-axis, y-axis, and the origin. Support the answer numerically. Then confirm algebraically.

5. 

6. 

7. Graph $g(x) = \frac{1}{x^2}$ using a graphing calculator. Analyze the graph to determine whether the function is *even*, *odd*, or *neither*. Confirm algebraically. If odd or even, describe the symmetry of the graph of the function.

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1-3 Study Guide and Intervention

Continuity, End Behavior, and Limits

Continuity A function $f(x)$ is **continuous** at $x = c$ if it satisfies the following conditions.

(1) $f(x)$ is defined at c; in other words, $f(c)$ exists.

(2) $f(x)$ approaches the same function value to the left and right of c; in other words, $\lim_{x \to c} f(x)$ exists.

(3) The function value that $f(x)$ approaches from each side of c is $f(c)$; in other words, $\lim_{x \to c} f(x) = f(c)$.

Functions that are not continuous are **discontinuous.** Graphs that are discontinuous can exhibit **infinite discontinuity**, **jump discontinuity**, or **removable discontinuity** (also called **point discontinuity**).

Example **Determine whether each function is continuous at the given x-value. Justify using the continuity test. If discontinuous, identify the type of discontinuity as *infinite, jump,* or *removable.***

a. $f(x) = 2|x| + 3$; $x = 2$

(1) $f(2) = 7$, so $f(2)$ exists.

(2) Construct a table that shows values for $f(x)$ for x-values approaching 2 from the left and from the right.

x	y = f(x)
1.9	6.8
1.99	6.98
1.999	6.998

x	y = f(x)
2.1	7.2
2.01	7.02
2.001	7.002

The tables show that y approaches 7 as x approaches 2 from both sides.

It appears that $\lim_{x \to 2} f(x) = 7$.

(3) $\lim_{x \to 2} f(x) = 7$ and $f(2) = 7$.

The function is continuous at $x = 2$.

b. $f(x) = \dfrac{2x}{x^2 - 1}$; $x = 1$

The function is not defined at $x = 1$ because it results in a denominator of 0. The tables show that for values of x approaching 1 from the left, $f(x)$ becomes increasingly more negative. For values approaching 1 from the right, $f(x)$ becomes increasingly more positive.

x	y = f(x)
0.9	−9.5
0.99	−99.5
0.999	−999.5

x	y = f(x)
1.1	10.5
1.01	100.5
1.001	1000.5

The function has infinite discontinuity at $x = 1$.

Exercises

Determine whether each function is continuous at the given x-value. Justify your answer using the continuity test. If discontinuous, identify the type of discontinuity as *infinite, jump,* or *removable.*

1. $f(x) = \begin{cases} 2x + 1 \text{ if } x > 2 \\ x - 1 \text{ if } x \le 2 \end{cases}$; $x = 2$

2. $f(x) = x^2 + 5x + 3$; $x = 4$

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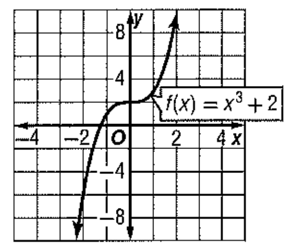
1-3 Study Guide and Intervention *(continued)*

Continuity, End Behavior, and Limits

End Behavior The **end behavior** of a function describes how the function behaves at either end of the graph, or what happens to the value of $f(x)$ as x increases or decreases without bound. You can use the concept of a limit to describe end behavior.

> Left-End Behavior (as x becomes more and more negative): $\lim_{x \to -\infty} f(x)$
>
> Right-End Behavior (as x becomes more and more positive): $\lim_{x \to \infty} f(x)$
>
> The $f(x)$ values may approach negative infinity, positive infinity, or a specific value.

Example **Use the graph of $f(x) = x^3 + 2$ to describe its end behavior. Support the conjecture numerically.**



As x decreases without bound, the y-values also decrease without bound. It appears the limit is negative infinity: $\lim_{x \to -\infty} f(x) = -\infty$.

As x increases without bound, the y-values increase without bound. It appears the limit is positive infinity: $\lim_{x \to \infty} f(x) = \infty$.

Construct a table of values to investigate function values as $|x|$ increases.

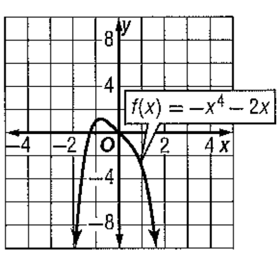
x	−1000	−100	−10	0	10	100	1000
$f(x)$	−999,999,998	−999,998	−998	2	1002	1,000,002	1,000,000,002

As $x \to -\infty$, $f(x) \to -\infty$. As $x \to \infty$, $f(x) \to \infty$. This supports the conjecture.

Exercises

Use the graph of each function to describe its end behavior. Support the conjecture numerically.

1.



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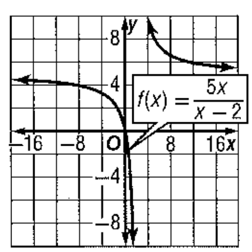

Lesson 1-3

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1-3 Practice

Continuity, End Behavior, and Limits

Determine whether each function is continuous at the given x-value(s). Justify using the continuity test. If discontinuous, identify the type of discontinuity as *infinite*, *jump*, or *removable*.

1. $f(x) = -\frac{2}{3x^2}$; at $x = -1$

2. $f(x) = \frac{x-2}{x+4}$; at $x = -4$

3. $f(x) = x^3 - 2x + 2$; at $x = 1$

4. $f(x) = \frac{x+1}{x^2+3x+2}$; at $x = -1$ and $x = -2$

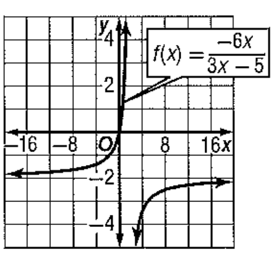
Determine between which consecutive integers the real zeros of each function are located on the given interval.

5. $f(x) = x^3 + 5x^2 - 4$; $[-6, 2]$

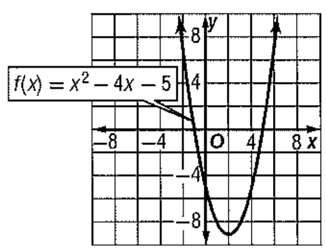
6. $g(x) = x^4 + 10x - 6$; $[-3, 2]$

Use the graph of each function to describe its end behavior. Support the conjecture numerically.

7.



8.



9. ELECTRONICS Ohm's Law gives the relationship between resistance R, voltage E, and current I in a circuit as $R = \frac{E}{I}$. If the voltage remains constant but the current keeps increasing in the circuit, what happens to the resistance?

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1-5 Study Guide and Intervention *(continued)*

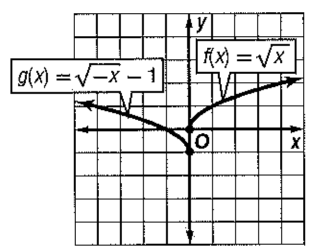
Parent Functions and Transformations

Transformations of Parent Functions Parent functions can be transformed to create other members in a family of graphs.

Translations	$g(x) = f(x) + k$ is the graph of $f(x)$ translated…	…k units up when $k > 0$.
		…k units down when $k < 0$.
	$g(x) = f(x - h)$ is the graph of $f(x)$ translated…	…h units right when $h > 0$.
		…h units left when $h < 0$.
Reflections	$g(x) = -f(x)$ is the graph of $f(x)$…	…reflected in the x-axis.
	$g(x) = f(-x)$ is the graph of $f(x)$…	…reflected in the y-axis.
Dilations	$g(x) = a \cdot f(x)$ is the graph of $f(x)$…	…expanded vertically if $a > 1$.
		…compressed vertically if $0 < a < 1$.
	$g(x) = f(ax)$ is the graph of $f(x)$…	…compressed horizontally if $a > 1$.
		…expanded horizontally if $0 < a < 1$.

Example **Identify the parent function $f(x)$ of $g(x) = \sqrt{-x} - 1$, and describe how the graphs of $g(x)$ and $f(x)$ are related. Then graph $f(x)$ and $g(x)$ on the same axes.**

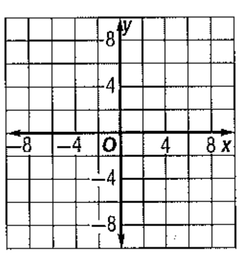
The graph of $g(x)$ is the graph of the square root function $f(x) = \sqrt{x}$ reflected in the y-axis and then translated one unit down.



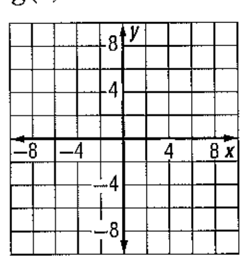
Exercises

Identify the parent function $f(x)$ of $g(x)$, and describe how the graphs of $g(x)$ and $f(x)$ are related. Then graph $f(x)$ and $g(x)$ on the same axes.

1. $g(x) = 0.5|x + 4|$



2. $g(x) = 2x^2 - 4$



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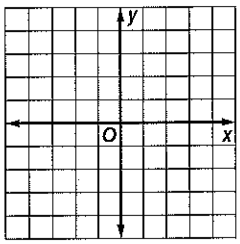
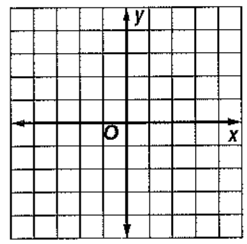
1-5 Practice

Parent Functions and Transformations

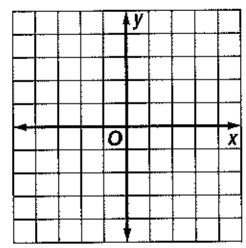
1. Use the graph of $f(x) = \sqrt{x}$ to graph $g(x) = \sqrt{x + 3} + 1$.



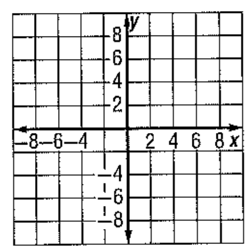
2. Use the graph of $f(x) = |x|$ to graph $g(x) = -|2x|$.



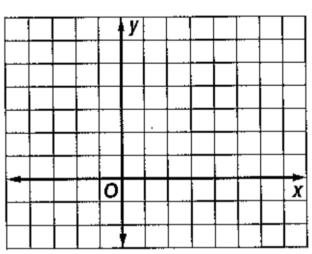
3. Describe how the graph of $f(x) = x^2$ and $g(x)$ are related. Then write an equation for $g(x)$.



4. Identify the parent function $f(x)$ of $g(x) = 2|x + 2| - 3$. Describe how the graphs of $g(x)$ and $f(x)$ are related. Then graph $f(x)$ and $g(x)$ on the same axes.



5. Graph $f(x) = \begin{cases} -1 \text{ if } x \leq -3 \\ 1 + x \text{ if } -2 < x \leq 2. \\ [\![x]\!] \text{ if } 4 \leq x \leq 6 \end{cases}$



6. Use the graph of $f(x) = x^3$ to graph $g(x) = |(x + 1)^3|$.