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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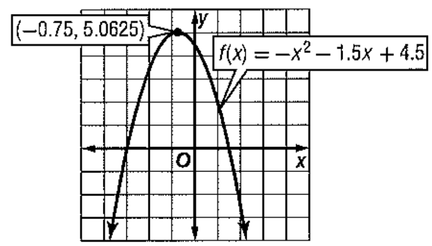
# 1-2 Study Guide and Intervention

## *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 $f(0)$.

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

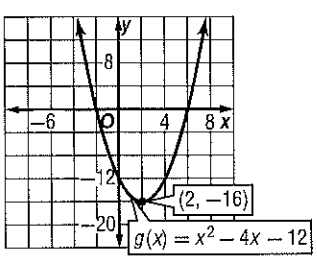
To find the zeros algebraically, let $f(x) = 0$ and solve for $x$.

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

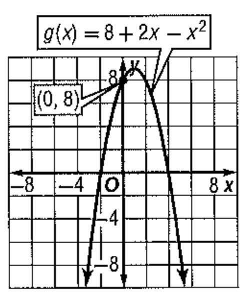
## Exercises

**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.**




**2.**



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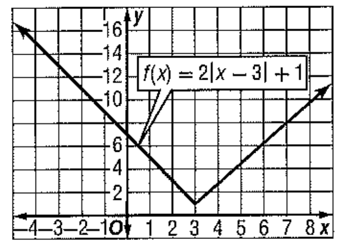
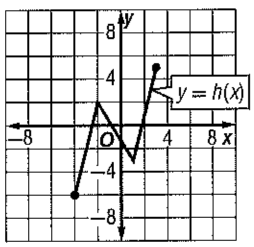
# 1-2 Practice

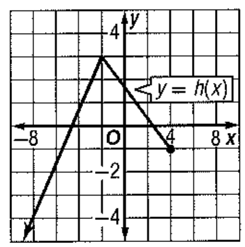
## *Analyzing Graphs of Functions and Relations*

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.

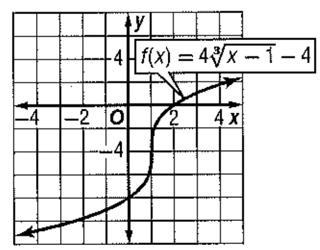



**Use the graph of $h$ to find the domain and range of each function.**

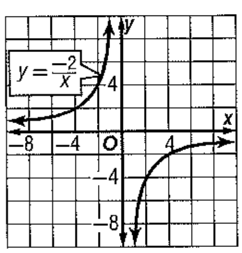
2. 

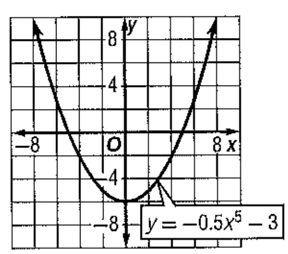

3. 


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

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

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

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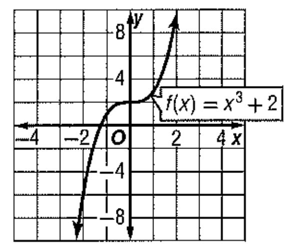
# 1-3 Study Guide and Intervention *(continued)*

## *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.

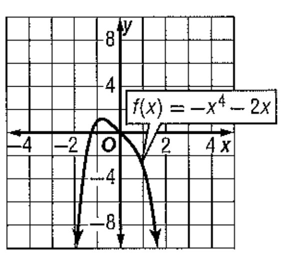
| $x$ | −1000 | −100 | −10 | 0 | 10 | 100 | 1000 |
|---|---|---|---|---|---|---|---|
| $f(x)$ | −999,999,998 | −999,998 | −998 | 2 | 1002 | 1,000,002 | 1,000,000,002 |

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

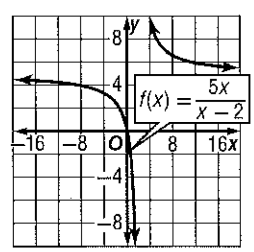
## Exercises

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

**1.**




**2.**




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 $x = -2$

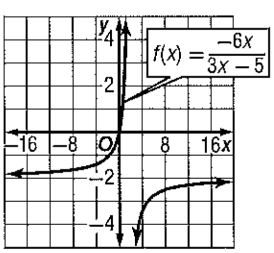
**Determine between which consecutive integers the real zeros of each function are located on the given interval.**

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

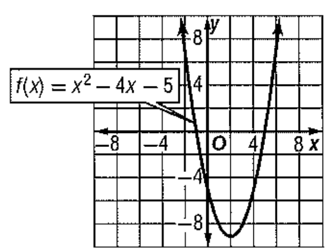
**6.** $g(x) = x^4 + 10x - 6$; $[-3, 2]$

**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)*

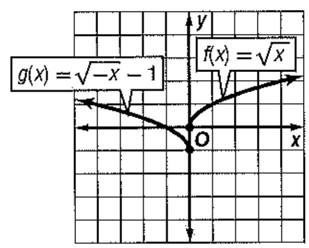
## *Parent Functions and Transformations*

**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.**

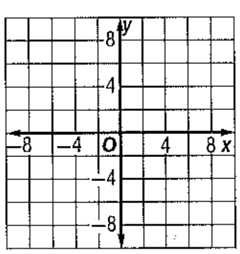
The graph of $g(x)$ is the graph of the square root function $f(x) = \sqrt{x}$ reflected in the $y$-axis and then translated one unit down.



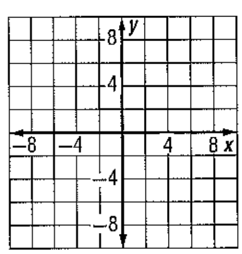

## Exercises

**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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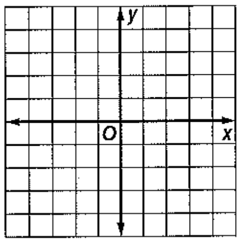
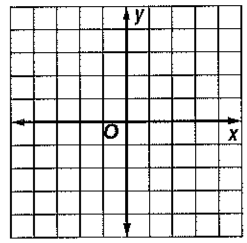
# 1-5 Practice

## *Parent Functions and Transformations*

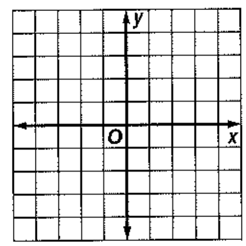
**1.** Use the graph of $f(x) = \sqrt{x}$ to graph $g(x) = \sqrt{x + 3} + 1$.



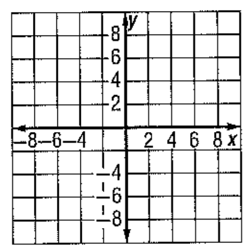

**2.** Use the graph of $f(x) = |x|$ to graph $g(x) = -|2x|$.



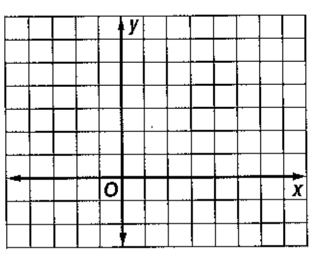

**3.** Describe how the graph of $f(x) = x^2$ and $g(x)$ are related. Then write an equation for $g(x)$.




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




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