**1.** *f*(*x*) = $\left\{\begin{array}{c}2x+1 if x>2\\x-1 if x\leq 2\end{array}\right.$; *x* = 2

**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*.**

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.

**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.

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

**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**).

**Study Guide and Intervention**

***Continuity, End Behavior, and Limits***

6.998

1.999

6.98

1.99

6.8

1.9

***y* = *f*(*x*)**

***x***

7.002

2.001

7.02

2.01

7.2

2.1

***y* = *f*(*x*)**

***x***

–999.5

0.999

–99.5

0.99

–9.5

0.9

***y* = *f*(*x*)**

***x***

1000.5

1.001

100.5

1.01

10.5

1.1

***y* = *f*(*x*)**

***x***

*Glencoe Precalculus*

Chapter 1

**16**

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

The function has infinite discontinuity

at *x* = 1.

***x*-value. Justify using the continuity test. If discontinuous, identify the type of**

**discontinuity as *infinite*, *jump*, or *removable*.**

**Determine whether each function is continuous at the given**

**Example**

**1-3**

NAME DATE PERIOD







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

It appears that $\lim\_{x\to 2}=7$.

(3) $\lim\_{x\to 2}=7$ and *f*(2) = 7.

The function is continuous at *x* = 2.

**1.** *f*(*x*) = $\left\{\begin{array}{c}2x+1 if x>2\\x-1 if x\leq 2\end{array}\right.$; *x* = 2

**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*.**

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.

**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.

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

**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**).

**Study Guide and Intervention**

***Continuity, End Behavior, and Limits***

6.998

1.999

6.98

1.99

6.8

1.9

***y* = *f*(*x*)**

***x***

7.002

2.001

7.02

2.01

7.2

2.1

***y* = *f*(*x*)**

***x***

–999.5

0.999

–99.5

0.99

–9.5

0.9

***y* = *f*(*x*)**

***x***

1000.5

1.001

100.5

1.01

10.5

1.1

***y* = *f*(*x*)**

***x***

*Glencoe Precalculus*

Chapter 1

**16**

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

The function has infinite discontinuity

at *x* = 1.

***x*-value. Justify using the continuity test. If discontinuous, identify the type of**

**discontinuity as *infinite*, *jump*, or *removable*.**

**Determine whether each function is continuous at the given**

**Example**

**1-3**

NAME DATE PERIOD







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

It appears that $\lim\_{x\to 2}=7$.

(3) $\lim\_{x\to 2}=7$ and *f*(2) = 7.

The function is continuous at *x* = 2.

$$f\left(x\right)=\frac{5x}{x-2}$$

*f*(*x*) **= –***x*4 **–** 2*x*

**Exercises**

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

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

As *x* increases without bound, the *y*-values increase without bound. It appears the limit is positive infinity:

$\lim\_{x\to \infty }f\left(x\right)=\infty $.

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

**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\left(x\right)=-\infty $

*f* (*x*) **=** *x*3 **+** 2

**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.

**Study Guide and Intervention** *(continued)*

***Continuity, End Behavior, and Limits***

4 ***x***

2

***O***

**−**

**−**4

***y***

1,000,000,002

1,000,002

1002

2

–998

–999,998

–999,999,998

*f***(***x***)**

1000

100

10

0

–10

–100

–1000

***x***

**−**8

**−**4

4 ***x***

2

***O***

**−**2

**−**4

***y***

16***x***

8

***O***

**−**8

4

***y***

**Lesson 1-3**

*Glencoe Precalculus*

Chapter 1

**17**

**−**8

**−**4

**−**16

4

8

8

**2.**

**1.**

**−**8

**−**4

**−**2

4

8

**Use the graph of *f*(*x*) = *x*3 + 2 to describe**

**Example**

**1-3**

NAME DATE PERIOD







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.

$$f\left(x\right)=\frac{5x}{x-2}$$

*f*(*x*) **= –***x*4 **–** 2*x*

**Exercises**

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

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

As *x* increases without bound, the *y*-values increase without bound. It appears the limit is positive infinity:

$\lim\_{x\to \infty }f\left(x\right)=\infty $.

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

**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\left(x\right)=-\infty $

*f* (*x*) **=** *x*3 **+** 2

**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.

**Study Guide and Intervention** *(continued)*

***Continuity, End Behavior, and Limits***

4 ***x***

2

***O***

**−**

**−**4

***y***

1,000,000,002

1,000,002

1002

2

–998

–999,998

–999,999,998

*f***(***x***)**

1000

100

10

0

–10

–100

–1000

***x***

**−**8

**−**4

4 ***x***

2

***O***

**−**2

**−**4

***y***

16***x***

8

***O***

**−**8

4

***y***

**Lesson 1-3**

*Glencoe Precalculus*

Chapter 1

**17**

**−**8

**−**4

**−**16

4

8

8

**2.**

**1.**

**−**8

**−**4

**−**2

4

8

**Use the graph of *f*(*x*) = *x*3 + 2 to describe**

**Example**

**1-3**

NAME DATE PERIOD







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.

$$f\left(x\right)=\frac{5x}{x-2}$$

*f*(*x*) **= –***x*4 **–** 2*x*

**Exercises**

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

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

As *x* increases without bound, the *y*-values increase without bound. It appears the limit is positive infinity:

$\lim\_{x\to \infty }f\left(x\right)=\infty $.

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

**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\left(x\right)=-\infty $

*f* (*x*) **=** *x*3 **+** 2

**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.

**Study Guide and Intervention** *(continued)*

***Continuity, End Behavior, and Limits***

4 ***x***

2

***O***

**−**

**−**4

***y***

1,000,000,002

1,000,002

1002

2

–998

–999,998

–999,999,998

*f***(***x***)**

1000

100

10

0

–10

–100

–1000

***x***

**−**8

**−**4

4 ***x***

2

***O***

**−**2

**−**4

***y***

16***x***

8

***O***

**−**8

4

***y***

**Lesson 1-3**

*Glencoe Precalculus*

Chapter 1

**17**

**−**8

**−**4

**−**16

4

8

8

**2.**

**1.**

**−**8

**−**4

**−**2

4

8

**Use the graph of *f*(*x*) = *x*3 + 2 to describe**

**Example**

**1-3**

NAME DATE PERIOD







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.

$$f\left(x\right)=\frac{5x}{x-2}$$

*f*(*x*) **= –***x*4 **–** 2*x*

**Exercises**

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

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

As *x* increases without bound, the *y*-values increase without bound. It appears the limit is positive infinity:

$\lim\_{x\to \infty }f\left(x\right)=\infty $.

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

**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\left(x\right)=-\infty $

*f* (*x*) **=** *x*3 **+** 2

**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.

**Study Guide and Intervention** *(continued)*

***Continuity, End Behavior, and Limits***

4 ***x***

2

***O***

**−**

**−**4

***y***

1,000,000,002

1,000,002

1002

2

–998

–999,998

–999,999,998

*f***(***x***)**

1000

100

10

0

–10

–100

–1000

***x***

**−**8

**−**4

4 ***x***

2

***O***

**−**2

**−**4

***y***

16***x***

8

***O***

**−**8

4

***y***

**Lesson 1-3**

*Glencoe Precalculus*

Chapter 1

**17**

**−**8

**−**4

**−**16

4

8

8

**2.**

**1.**

**−**8

**−**4

**−**2

4

8

**Use the graph of *f*(*x*) = *x*3 + 2 to describe**

**Example**

**1-3**

NAME DATE PERIOD







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.