LESSON 2.7

TEACHER'S NAME _____ CLASS _____ ROOM _____ DATE _____

Lesson Plan for Block Scheduling

Half-day lesson (See *Pacing the Chapter,* TE pages 64C–64D) **For use with pages 114–121**

GOALS
1. **Represent piecewise functions.**
2. **Use piecewise functions to model real-life quantities.**

State/Local Objectives _____

_____

_____

CHAPTER PACING GUIDE	
Day	**Lesson**
1	2.1 (all); 2.2 (all)
2	2.3 (all)
3	2.4 (all)
4	2.5 (all); 2.6 (all)
5	**2.7 (all)**; 2.8 (all)
6	Review/Assess Ch. 2

✓ Check the items you wish to use for this lesson.

STARTING OPTIONS

____ Homework Check: TE page 111; Answer Transparencies
____ Warm-Up or Daily Homework Quiz: TE pages 114 and 113, CRB page 92, or Transparencies

TEACHING OPTIONS

____ Lesson Opener (Application): CRB page 93 or Transparencies
____ Graphing Calculator Activity with Keystrokes: CRB pages 94–95
____ Examples 1–6: SE pages 114–116
____ Extra Examples: TE pages 115–116 or Transparencies
____ Technology Activity: SE page 121
____ Closure Question: TE page 116
____ Guided Practice Exercises: SE page 117

APPLY/HOMEWORK

Homework Assignment (See also the assignment for Lesson 2.8.)

____ Block Schedule: 14–26 even, 27–43 odd, 50–52, 60, 61, 63–71 odd

Reteaching the Lesson

____ Practice Masters: CRB pages 96–98 (Level A, Level B, Level C)
____ Reteaching with Practice: CRB pages 99–100 or Practice Workbook with Examples
____ Personal Student Tutor

Extending the Lesson

____ Applications (Interdisciplinary): CRB page 102
____ Challenge: SE page 120; CRB page 103 or Internet

ASSESSMENT OPTIONS

____ Checkpoint Exercises: TE pages 115–116 or Transparencies
____ Daily Homework Quiz (2.7): TE page 120, CRB page 106, or Transparencies
____ Standardized Test Practice: SE page 120; TE page 120; STP Workbook; Transparencies

Notes _____

_____

_____

LESSON 2.7

NAME _____ DATE _____

Available as a transparency

WARM-UP EXERCISES

For use before Lesson 2.7, pages 114–121

1. Evaluate $f(x) = 3x - 2$ when $x = -2$.

2. Evaluate $h(x) = \frac{3}{2}x + \frac{5}{2}$ when $x = -5$.

3. Graph the lines $-x + y = -2$ and $y = \frac{1}{3}x - 2$ on the same coordinate grid.

DAILY HOMEWORK QUIZ

For use after Lesson 2.6, pages 108–113

Graph the inequality in a coordinate plane.

1. $2y \leq 6$

2. $x + 2y > 2$

3. $1.5x - 3y \leq -9$

Lesson 2.7

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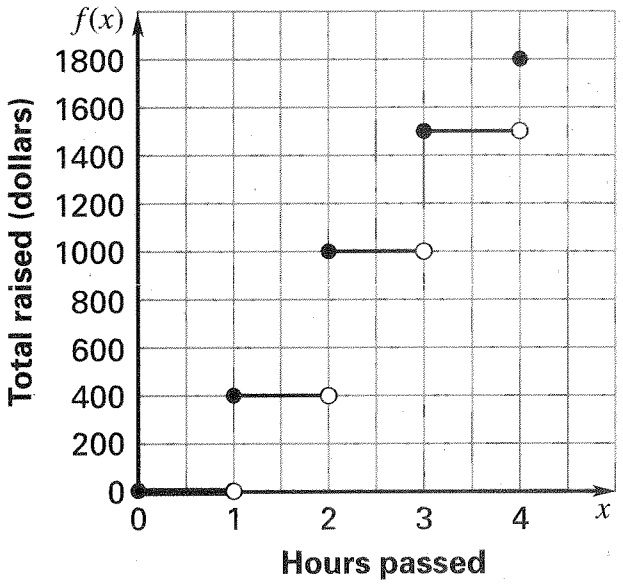
Available as a transparency

Application Lesson Opener

For use with pages 114–120

Center High School held a four-hour fundraising pledge drive. The students organizing the drive counted the total money raised at the end of each hour. The results are shown in the graph.



1. How much money had the students raised after 2 hours?
2. How much money did they raise in all?
3. If x is the number of hours of the drive that have passed, then the function $f(x)$ shown by the graph gives the number of dollars raised. What is $f(3.5)$?
4. On what interval does $f(x) = 400$?
5. What is the domain of the function?
6. What is the range of the function?

Lesson 2.7

LESSON 2.7

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Graphing Calculator Activity Keystrokes

For use with page 118

Keystrokes for Exercise 41

TI-82

Y= MATH ► 4 X,T,θ ENTER

MODE ▼ ▼ ▼ ▼ ► ENTER

WINDOW ENTER (-) 4 ENTER 4 ENTER

1 ENTER (-) 4 ENTER 4 ENTER 1 ENTER

GRAPH

TI-83

Y= MATH ► 5 X,T,θ,n) ENTER

MODE ▼ ▼ ▼ ▼ ► ENTER

WINDOW (-) 4 ENTER 4 ENTER 1 ENTER

(-) 4 ENTER 4 ENTER 1 ENTER GRAPH

SHARP EL-9600c

Insert function

Y= MATH [B] 5 X/θ/T/n ENTER

WINDOW (-) 4 ENTER 4 ENTER 1 ENTER

(-) 4 ENTER 4 ENTER 1 ENTER

GRAPH

CASIO CFX-9850GA PLUS

From the main menu, choose GRAPH.

SHIFT [SET UP] F2 EXIT

SHIFT F3 (-) 4 EXE 1 EXE (-) 4 EXE 4 EXE

1 EXE EXIT F6

Lesson 2.7

NAME _____ DATE _____

Graphing Calculator Activity Keystrokes

For use with page 121

TI-82

MODE

Choose the following.

Normal; Float; Degree; Function; Dot; Sequential; Full Screen.

Y= (3 X,T,θ − 1) (X,T,θ 2nd [TEST] 5 2) + (7) (2 2nd [TEST] 6 X,T,θ 2nd [TEST] ► 1 X,T,θ 2nd [TEST] 6 5) + (2 X,T,θ − 3) (X,T,θ 2nd [TEST] 3 5)

Adjust window and graph

WINDOW ENTER (-) 5 ENTER 15 ENTER 1 ENTER (-) 1 ENTER 20 ENTER 1 ENTER GRAPH

Press TRACE and use the left and right arrow keys to move the trace cursor. See that $f(4) \approx 7$ and $f(10) \approx 17$.

TI-83

MODE

Choose the following.

Normal; Float; Degree; Function; Dot; Sequential; Real; Full.

Y= (3 X,T,θ,n − 1) (X,T,θ,n 2nd [TEST] [5] 2) + (7) (2 2nd [TEST] [6] X,T,θ,n 2nd [TEST] ► [1] X,T,θ,n 2nd [TEST] [6] 5) + (2 X,T,θ,n − 3) (X,T,θ,n 2nd [TEST] [3] 5)

Adjust window and graph

WINDOW (-) 5 ENTER 15 ENTER 1 ENTER (-) 1 ENTER 20 ENTER 1 ENTER 1 ENTER GRAPH

Press TRACE and use the left and right arrow keys to move the trace cursor. See that $f(4) \approx 7$ and $f(10) \approx 17$.

SHARP EL-9600c

Select dot mode.

2ndF FORMAT [E] 2

Y= (3 X/θ/T/n − 1) (X/θ/T/n MATH [F] 5 2) ENTER (7) (2 MATH [F] 6 X/θ/T/n) MATH [G] 1 (7) (X/θ/T/n MATH [F] 6 5) ENTER (2 X/θ/T/n − 3) (X/θ/T/n MATH [F] 3 5) ENTER

WINDOW (-) 5 ENTER 15 ENTER 1 ENTER (-) 1 ENTER 20 ENTER 1 ENTER GRAPH

Press TRACE and use the left and right arrow keys to move the trace cursor. Use the up and down arrow keys to select a different branch of the function f. See that $f(4) \approx 7$ and that $f(10) \approx 17$.

2ndF [CALC] [1] 4 ENTER

2nd [CALC] [1] 10 ENTER

CASIO CFX-9850GA PLUS

From the main menu, select GRAPH.

Select dot mode.

SHIFT [SET UP] F2 EXIT

3 X,θ,T − 1 , SHIFT [(-) 5 , 2 SHIFT] EXE 7 , SHIFT [2 , 5 SHIFT] EXE 2 X,θ,T − 3 , SHIFT [5 , 15 SHIFT] EXE

SHIFT F3 (-) 5 EXE 15 EXE 1 EXE (-) 1 EXE 20 EXE 1 ENTER EXIT F6

Press F1 and use the left and right arrow keys to move the trace cursor. Use the up and down arrow keys to select a different branch of the function f. See that $f(4) \approx 7$ and that $f(10) \approx 17$.

LESSON 2.7

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Practice A

For use with pages 114–120

Evaluate the function for the given value of *x*.

$f(x) = \begin{cases} 3, & \text{if } x \le 0 \\ 2, & \text{if } x > 0 \end{cases}$ $\quad g(x) = \begin{cases} x + 5, & \text{if } x \le 3 \\ 2x - 1, & \text{if } x > 3 \end{cases}$ $\quad h(x) = \begin{cases} \frac{1}{2}x - 4, & \text{if } x \le -2 \\ 3 - 2x, & \text{if } x > -2 \end{cases}$

1. $f(2)$ **2.** $f(-4)$ **3.** $f(0)$ **4.** $f\left(\frac{1}{2}\right)$

5. $g(7)$ **6.** $g(0)$ **7.** $g(-1)$ **8.** $g(3)$

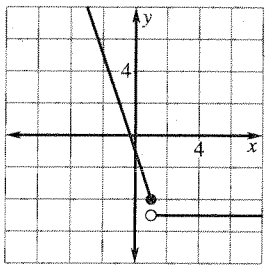
9. $h(-4)$ **10.** $h(-2)$ **11.** $h(-1)$ **12.** $h(6)$

Match the piecewise function with its graph.

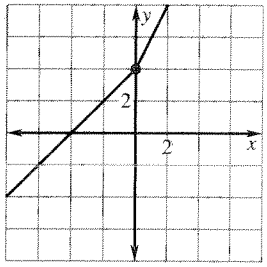
13. $f(x) = \begin{cases} x - 4, & \text{if } x \le 1 \\ 3x, & \text{if } x > 1 \end{cases}$ **14.** $f(x) = \begin{cases} x + 4, & \text{if } x \le 0 \\ 2x + 4, & \text{if } x > 0 \end{cases}$ **15.** $f(x) = \begin{cases} 3x - 2, & \text{if } x \le 1 \\ x + 2, & \text{if } x > 1 \end{cases}$

16. $f(x) = \begin{cases} 2x + 3, & \text{if } x \ge 0 \\ x + 4, & \text{if } x < 0 \end{cases}$ **17.** $f(x) = \begin{cases} 3x - 1, & \text{if } x \ge -1 \\ -5, & \text{if } x < -1 \end{cases}$ **18.** $f(x) = \begin{cases} -3x - 1, & \text{if } x \le 1 \\ -5, & \text{if } x > 1 \end{cases}$

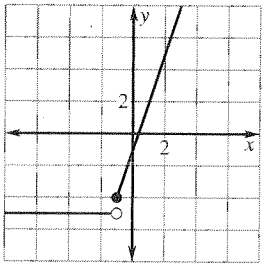
A.



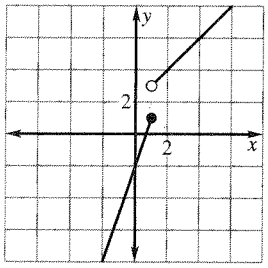
B.



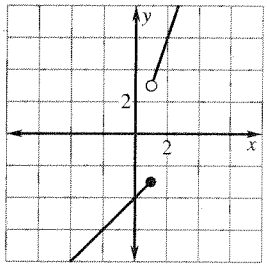
C.



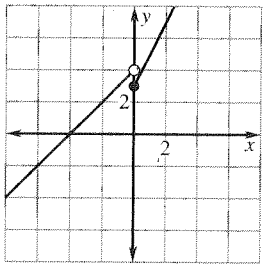
D.



E.



F.



19. ***Amusement Park Rates*** The admission rates at an amusement park are as follows.

Children 5 years old and under: free
Children over 5 years and up to (and including) 12 years: $5.00
Children over 12 years and up to (and including) 18 years: $12.00
Adults: $18.00

Write a piecewise function that gives the admission price for a given age. Graph the function.

LESSON 2.7

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Practice B

For use with pages 114–120

Evaluate the function for the given value of x.

$f(x) = \begin{cases} 3x - 7, & \text{if } x \le 2 \\ 6 - 2x, & \text{if } x > 2 \end{cases}$ $\quad g(x) = \begin{cases} 3x + 5, & \text{if } x < 5 \\ -x + 3, & \text{if } x \ge 5 \end{cases}$ $\quad h(x) = \begin{cases} \frac{2}{3}x + 1, & \text{if } x > -3 \\ 2x - 3, & \text{if } x \le -3 \end{cases}$

1. $f(0)$ **2.** $f(2)$ **3.** $f(4)$ **4.** $f(-3)$

5. $g(5)$ **6.** $g(-4)$ **7.** $g(3)$ **8.** $g(10)$

9. $h(-9)$ **10.** $h(-3)$ **11.** $h(6)$ **12.** $h(1)$

Graph the function.

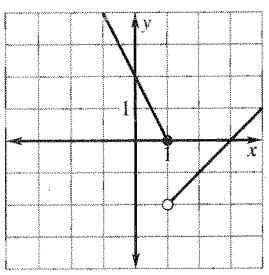
13. $f(x) = \begin{cases} 3, & \text{if } x \le 4 \\ -1, & \text{if } x > 4 \end{cases}$ **14.** $f(x) = \begin{cases} x + 3, & \text{if } x \le 0 \\ 2x, & \text{if } x > 0 \end{cases}$ **15.** $f(x) = \begin{cases} x - 4, & \text{if } x < 2 \\ 3 - x, & \text{if } x \ge 2 \end{cases}$

16. $f(x) = \begin{cases} 2x + 3, & \text{if } x \ge -1 \\ -3x + 1, & \text{if } x < -1 \end{cases}$ **17.** $f(x) = \begin{cases} -x, & \text{if } x > 5 \\ \frac{2}{5}x, & \text{if } x \le 5 \end{cases}$ **18.** $f(x) = \begin{cases} \frac{1}{2} - x, & \text{if } x > 0 \\ 2x + 3, & \text{if } x \le 0 \end{cases}$

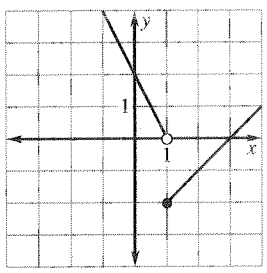
19. $f(x) = \begin{cases} x + 1, & \text{if } x < 0 \\ -x + 1, & \text{if } 0 \le x \le 2 \\ x - 1, & \text{if } x > 2 \end{cases}$ **20.** $f(x) = \begin{cases} 2x, & \text{if } x \ge -1 \\ 3x, & \text{if } -2 < x < -1 \\ -x, & \text{if } x \le -2 \end{cases}$ **21.** $f(x) = \begin{cases} 2, & \text{if } x \le -3 \\ -1, & \text{if } -3 < x < 3 \\ 3, & \text{if } x \ge 3 \end{cases}$

Write equations for the piecewise function whose graph is shown.

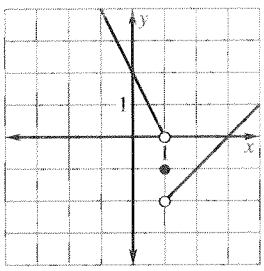
22.



23.



24.



Tour Bus **In Exercises 25 and 26, use the following information.**
A company provides bus tours of historical cities. The given function describes the rate for small groups and the discounted rate for larger groups, where x is the number of people in your group.

$$C = \begin{cases} 8.95x, & \text{if } 0 < x \le 10 \\ 7.50x, & \text{if } x > 10 \end{cases}$$

25. Graph the function.

26. Identify the domain and range of the function.

27. ***Commission Rate*** You are employed by a company in which commission rates are based on how much you sell. If you sell up to \$100,000 of merchandise in a month, you earn 5% of sales as a commission. If you sell over \$100,000, you earn 8% commission on your sales. Write a piecewise function that gives the amount you earn in commission in a given month for x dollars in sales.

Lesson 2.7

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NAME _____ DATE _____

Practice C

For use with pages 114–120

Evaluate the function for the given value of x.

$f(x) = \begin{cases} 3x + 5, & \text{if } x < \frac{1}{2} \\ 2x + 1, & \text{if } x \geq \frac{1}{2} \end{cases}$ $\quad g(x) = [\![x]\!]$ $\quad h(x) = 3[\![x + 2]\!] - 1$

1. $f(3)$ **2.** $f(\frac{1}{2})$ **3.** $f(\frac{1}{3})$ **4.** $f(\frac{5}{2})$

5. $g(3.2)$ **6.** $g(1.8)$ **7.** $g(-2.4)$ **8.** $g(-6.9)$

9. $h(1.8)$ **10.** $h(3.1)$ **11.** $h(-0.4)$ **12.** $h(-3.1)$

Graph the function.

13. $f(x) = \begin{cases} x + 3, & \text{if } x < \frac{1}{2} \\ 2x - 1, & \text{if } x \geq \frac{1}{2} \end{cases}$

14. $f(x) = \begin{cases} 2x, & \text{if } x < -2 \\ x - 2, & \text{if } -2 \leq x \leq 2 \\ -2x, & \text{if } x > 2 \end{cases}$

15. $f(x) = \begin{cases} x + 1, & \text{if } x < 1 \\ 3x - 1, & \text{if } x > 1 \end{cases}$

16. $f(x) = [\![x + 1]\!]$ **17.** $f(x) = 3[\![x - 2]\!]$ **18.** $f(x) = [\![4x]\!]$

19. $f(x) = [\![2x + 3]\!]$ **20.** $f(x) = 2[\![3x - 1]\!] + 4$ **21.** $f(x) = -[\![2x + 1]\!] - 3$

Engraving **In Exercises 22–24, use the following information.**
A gift shop sells pewter mugs for \$35. They are currently running an engraving promotion. The first six letters are engraved free. Each additional letter costs \$0.20.

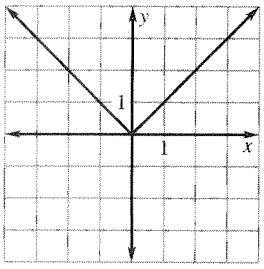
22. Write a piecewise model that gives the price of the mug with x engraved letters.

23. Graph the function.

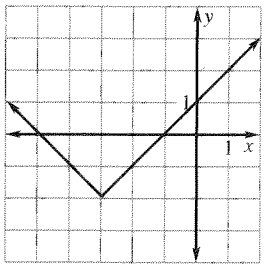
24. What is the price of a mug with the name Jamie Lynn Krane engraved?

25. ***Commission Sales*** A company pays its employees a combination of salary and commission. An employee with sales less than \$100,000 earns a \$15,000 salary plus 3% commission. An employee with sales of \$100,000 to \$200,000 earns an \$18,000 salary plus 4% commission. An employee who earns more than \$200,000 in sales earns a \$20,000 salary plus 5% commission. Write a piecewise model that gives the pay of an employee with x in annual sales.

26. ***Absolute value*** Write the function $f(x) = |x|$ as a piecewise function.



27. ***Absolute value*** Write the function $f(x) = |x + 3| - 2$ as a piecewise function.



LESSON 2.7

NAME _____ DATE _____

Reteaching with Practice

For use with pages 114–120

GOAL Represent piecewise functions

VOCABULARY

Piecewise functions are represented by a combination of equations, each corresponding to a part of the domain.

A **step function** has a graph which resembles a set of stair steps. An example of a step function is the *greatest integer function.* This function is denoted by $g(x) = [\![x]\!]$, where for every real number x, $g(x)$ is the greatest integer less than or equal to x.

EXAMPLE 1 *Evaluating a Piecewise Function*

Evaluate $f(x)$ when (a) $x = -1$, (b) $x = 1$, and (c) $x = 3$.

$$f(x) = \begin{cases} 2x + 3, & \text{if } x < 0 \\ 2, & \text{if } 0 \le x < 2 \\ -x + 1, & \text{if } x \ge 2 \end{cases}$$

SOLUTION

a. $f(x) = 2x + 3$	Because $-1 < 0$, use first equation.
$f(-1) = 2(-1) + 3 = 1$	Substitute -1 for x.
b. $f(x) = 2$	Because $0 \le 1 < 2$, use second equation.
$f(1) = 2$	Substitute 1 for x.
c. $f(x) = -x + 1$	Because $3 \ge 2$, use third equation.
$f(3) = -3 + 1 = -2$	Substitute 3 for x.

Exercises for Example 1

Evaluate the function for the given value of *x*.

$$f(x) = \begin{cases} x + 1, & \text{if } x > 1 \\ -x - 2, & \text{if } x \le 1 \end{cases} \qquad g(x) = \begin{cases} 3x + 2, & \text{if } x < 5 \\ -2x, & \text{if } x \ge 5 \end{cases}$$

1. $g(5)$ **2.** $f(0)$ **3.** $f(3)$ **4.** $g(-2)$

Lesson 2.7

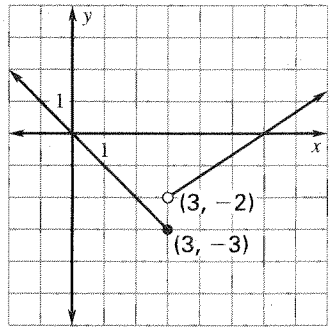
NAME _____ DATE _____

Reteaching with Practice

For use with pages 114–120

EXAMPLE 2 Graphing a Piecewise Function

Graph the function: $f(x) = \begin{cases} -x, & \text{if } x \le 3 \\ \frac{2}{3}x - 4, & \text{if } x > 3 \end{cases}$



SOLUTION

To the right of $x = 3$, the graph is given by $y = \frac{2}{3}x - 4$. To the left of and including $x = 3$, the graph is given by $y = -x$.

The graph consists of two rays.

Exercises for Example 2

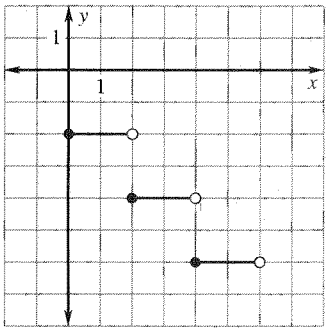
Graph the function.

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

6. $f(x) = \begin{cases} \frac{1}{2}x + 4, & \text{if } x < 2 \\ -2x + 9, & \text{if } x \ge 2 \end{cases}$

EXAMPLE 3 Graphing a Step Function

Graph the function. $f(x) = \begin{cases} -2, & \text{if } 0 \le x < 2 \\ -4, & \text{if } 2 \le x < 4 \\ -6, & \text{if } 4 \le x < 6 \end{cases}$



SOLUTION

The graph is composed of three line segments, because the function has three parts. The intervals of x tell you that each line segment is 2 units in length and begins with a solid dot and ends with an open dot.

Exercises for Example 3

Graph the step function.

7. $f(x) = \begin{cases} 1, & \text{if } 0 < x \le 1 \\ 3, & \text{if } 1 < x \le 2 \\ 4, & \text{if } 2 < x \le 3 \\ 6, & \text{if } 3 < x \le 4 \end{cases}$

8. $f(x) = \begin{cases} -1, & \text{if } -2 \le x < 1 \\ -2, & \text{if } 1 \le x < 3 \\ -3, & \text{if } 3 \le x < 6 \\ -4, & \text{if } 6 \le x < 8 \end{cases}$

LESSON 2.7

NAME _____ DATE _____

Quick Catch-Up for Absent Students

For use with pages 114–121

The items checked below were covered in class on (date missed) _____

Lesson 2.7: Piecewise Functions

____ **Goal 1:** Represent piecewise functions. (pp. 114–115)

Material Covered:

____ Example 1: Evaluating a Piecewise Function

____ Example 2: Graphing a Piecewise Function

____ Example 3: Graphing a Step Function

____ Example 4: Writing a Piecewise Function

Vocabulary:

piecewise function, p. 114 step function, p. 115

____ **Goal 2:** Use piecewise functions to model real-life quantities. (p. 116)

Material Covered:

____ Example 5: Using a Step Function

____ Example 6: Using a Piecewise Function

Activity 2.7: Graphing Piecewise Functions (p. 121)

____ **Goal:** Graph a piecewise function using a graphing calculator.

____ Student Help: Keystroke Help

____ Student Help: Look Back

____ Other (specify) _____

_____

Homework and Additional Learning Support

____ Textbook (specify) pp. 117–120

_____

____ *Reteaching with Practice* worksheet (specify exercises) _____

____ *Personal Student Tutor* for Lesson 2.7

Lesson 2.7

NAME _____ DATE _____

Interdisciplinary Application

For use with pages 114–120

Antiques

ECONOMICS Antique dealers make their living through buying, selling, and shipping antiques to collectors all over the world.

Suppose you start an antique dealership that deals with African art. Collectors pay you to research, find pieces, and have the pieces shipped to them. In preparation for your business, you have gathered the following information from several shipping companies to determine their prices. Notice that some companies charge based on the weight of the package while others charge a flat rate.

Name of Shipper	*Up to 10 lb*	*10–25 lb*	*Over 25 lb*
Express Move	$1.25 per pound	$1.00 per pound	$0.75 per pound
Ship Rite	$11.25 flat rate	$18.00 flat rate	$25.00 flat rate
Packages Inc.	$2.00 per pound	An additional $1.50 for each pound over 10 pounds	An additional $1.10 for each pound over 25 pounds

1. Write a piecewise-defined function representing the cost of shipping x pounds with Express Move.
2. Write a piecewise-defined function representing the cost of shipping x pounds with Ship Rite.
3. Write a piecewise-defined function representing the cost of shipping x pounds with Packages Inc.
4. On the same set of axes, graph the functions that represent the costs for the three different companies.
5. Suppose you were shipping a 17-pound statue from Ghana and had the choice of the three companies here. Which would you pick? How much would the shipping cost be?
6. Suppose you knew that all of your packages are between 10 and 25 pounds. Which company (or companies) provide the least expensive shipping in this range?
7. When is Packages Inc. the cheapest carrier?

LESSON 2.7

NAME _____ DATE _____

Challenge: Skills and Applications

For use with pages 114–120

1. Let $f(x)$ be defined as follows:

$$f(x) = \begin{cases} 2 \text{ if } x \text{ is an integer} \\ 1 \text{ if } x \text{ is not an integer} \end{cases}$$

   a. Find each of the following: $f(0), f\left(\frac{1}{3}\right), f\left(\frac{1}{2}\right), f\left(\sqrt{2}\right), f(2), f(\pi)$

   b. Sketch the graph of $y = f(x)$.

2. What is perhaps the ultimate piecewise-defined function was proposed by the German mathematician Gustav Peter Lejeune Dirichlet (1805–1859). It is defined as follows:

$$f(x) = \begin{cases} 1 \text{ if } x \text{ is a rational number} \\ 0 \text{ if } x \text{ is an irrational number} \end{cases}$$

   a. Find each of the following values: $f(2), f\left(\frac{1}{2}\right), f\left(\sqrt{2}\right), f\left(\frac{5}{4}\right), f(\pi)$.

   b. Explain how you know that Dirichlet's function is actually a function, and not just a relation. Could a computer draw an accurate graph of this function?

3. Suppose m and k are numbers and let $g(x)$ be defined piecewise as follows:

$$g(x) = \begin{cases} \frac{1}{2}x + k \text{ if } x < 3 \\ mx + 2 \text{ if } x \geq 3 \end{cases}$$

   a. Suppose $m = \frac{3}{2}$. What must the value of k be in order for the graph of $y = g(x)$ to be connected?

   b. Suppose $k = 4$. What must the value of m be in order for the graph to be connected?

4. Let $f(x)$ be defined for all nonnegative real numbers as follows:

$$f(x) = \begin{cases} 1 \text{ if } x = 0 \\ f(0)x + f(0) \text{ if } 0 < x \leq 1 \\ f(1)(x - 1) + f(1) \text{ if } 1 < x \leq 2 \\ f(2)(x - 2) + f(2) \text{ if } 2 < x \leq 3 \\ \ldots \end{cases}$$

   a. Find $f(1), f(2), f(3)$, and $f(4)$.

   b. Sketch the graph of $f(x)$ for $0 \leq x \leq 4$.

Lesson 2.7

LESSON 2.8

TEACHER'S NAME _____ CLASS _____ ROOM _____ DATE _____

Lesson Plan

1-day lesson (See *Pacing the Chapter*, TE pages 64C–64D) For use with pages 122–128

GOALS
1. **Represent absolute value functions.**
2. **Use absolute value functions to model real-life situations.**

State/Local Objectives _____

_____

✓ Check the items you wish to use for this lesson.

STARTING OPTIONS

____ Homework Check: TE page 117; Answer Transparencies
____ Warm-Up or Daily Homework Quiz: TE pages 122 and 120, CRB page 106, or Transparencies

TEACHING OPTIONS

____ Motivating the Lesson: TE page 123
____ Lesson Opener (Graphing Calculator): CRB page 107 or Transparencies
____ Graphing Calculator Activity with Keystrokes: CRB pages 108–109
____ Examples 1–4: SE pages 123–124
____ Extra Examples: TE pages 123–124 or Transparencies
____ Closure Question: TE page 124
____ Guided Practice Exercises: SE page 125

APPLY/HOMEWORK

Homework Assignment

____ Basic 12–17, 18–38 even, 40, 41, 49, 50, 57–65 odd; Quiz 3: 1–14
____ Average 12–17, 18–38 even, 40–45, 49, 50, 57–65 odd; Quiz 3: 1–14
____ Advanced 12–17, 18–38 even, 40–45, 49–55, 57–65 odd; Quiz 3: 1–14

Reteaching the Lesson

____ Practice Masters: CRB pages 110–112 (Level A, Level B, Level C)
____ Reteaching with Practice: CRB pages 113–114 or Practice Workbook with Examples
____ Personal Student Tutor

Extending the Lesson

____ Applications (Real-Life): CRB page 116
____ Challenge: SE page 127; CRB page 117 or Internet

ASSESSMENT OPTIONS

____ Checkpoint Exercises: TE pages 123–124 or Transparencies
____ Daily Homework Quiz (2.8): TE page 128 or Transparencies
____ Standardized Test Practice: SE page 127; TE page 128; STP Workbook; Transparencies
____ Quiz (2.6–2.8): SE page 128

Notes _____

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LESSON 2.8

TEACHER'S NAME _____ CLASS _____ ROOM _____ DATE _____

Lesson Plan for Block Scheduling

Half-day lesson (See *Pacing the Chapter,* TE pages 64C–64D) **For use with pages 122–128**

GOALS
1. **Represent absolute value functions.**
2. **Use absolute value functions to model real-life situations.**

State/Local Objectives _____

_____

_____

CHAPTER PACING GUIDE	
Day	**Lesson**
1	2.1 (all); 2.2 (all)
2	2.3 (all)
3	2.4 (all)
4	2.5 (all); 2.6 (all)
5	2.7 (all); **2.8 (all)**
6	Review/Assess Ch. 2

✓ Check the items you wish to use for this lesson.

STARTING OPTIONS

____ Homework Check: TE page 117; Answer Transparencies
____ Warm-Up or Daily Homework Quiz: TE pages 122 and 120, CRB page 106, or Transparencies

TEACHING OPTIONS

____ Motivating the Lesson: TE page 123
____ Lesson Opener (Graphing Calculator): CRB page 107 or Transparencies
____ Graphing Calculator Activity with Keystrokes: CRB pages 108–109
____ Examples 1–4: SE pages 123–124
____ Extra Examples: TE pages 123–124 or Transparencies
____ Closure Question: TE page 124
____ Guided Practice Exercises: SE page 125

APPLY/HOMEWORK

Homework Assignment (See also the assignment for Lesson 2.7.)

____ Block Schedule: 12–17, 18–38 even, 40–45, 49, 50, 57–65 odd; Quiz 3: 1–14

Reteaching the Lesson

____ Practice Masters: CRB pages 110–112 (Level A, Level B, Level C)
____ Reteaching with Practice: CRB pages 113–114 or Practice Workbook with Examples
____ Personal Student Tutor

Extending the Lesson

____ Applications (Real Life): CRB page 116
____ Challenge: SE page 127; CRB page 117 or Internet

ASSESSMENT OPTIONS

____ Checkpoint Exercises: TE pages 123–124 or Transparencies
____ Daily Homework Quiz (2.8): TE page 128 or Transparencies
____ Standardized Test Practice: SE page 127; TE page 128; STP Workbook; Transparencies
____ Quiz (2.6–2.8): SE page 128

Notes _____

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LESSON 2.8

NAME _____ DATE _____

Available as a transparency

WARM-UP EXERCISES

For use before Lesson 2.8, pages 122–128

Evaluate the expression for $x = -6$.

1. $|x|$
2. $-|x - 3|$
3. $|1 - x| + 4$
4. $2|x - 1.5| + 0.5$
5. $-3|x + 4| - 1$

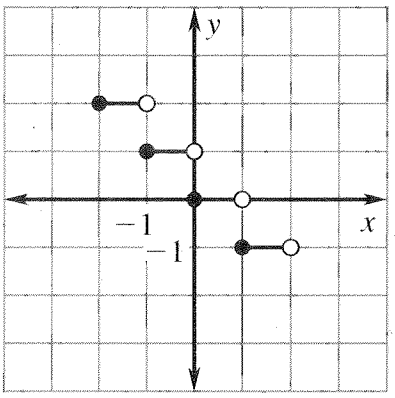
DAILY HOMEWORK QUIZ

For use after Lesson 2.7, pages 114–121

1. Evaluate $f(x) = \begin{cases} x, & \text{if } x > 3 \\ 2x - 1, & \text{if } x \le 3 \end{cases}$ for $f(4)$ and $f(0)$.

2. Graph $f(x) = \begin{cases} -x, & \text{if } x \le 1 \\ \frac{3}{2}x - \frac{3}{2}, & \text{if } x > 1 \end{cases}$.

3. Write equations for the step function whose graph is shown.



Lesson 2.8

LESSON 2.8

NAME _____ DATE _____

Available as a transparency

Graphing Calculator Activity Opener

For use with pages 122–128

SET UP: Work with a partner.
YOU WILL NEED: • Graphing calculator

Choose one student to be the Grapher and the other to be the Guesser.

1. Grapher: Choose a function of the form $y = a|x|$ and graph it on the graphing calculator as y_1. Do not let the Guesser see the function, only the graph.

Guesser: Look at the graph and guess the function.

Grapher: Graph the guess as y_2.

Guesser: If your guess is not correct, guess again.

Grapher: Change y_2 to the new guess and graph again.

Continue until the graphs of the two functions match.

2. Change roles and repeat the activity. Make a equal to a negative number or to a number between 0 and 1. Adjust the viewing window as needed.

3. Repeat the activity two more times using functions of the form $y = |x| + k$, alternating roles.

4. Repeat the activity two more times using functions of the form $y = |x - h|$, alternating roles.

Lesson 2.8

LESSON 2.8

NAME _____ DATE _____

Graphing Calculator Activity

For use with pages 122–128

GOAL **To graph equations of absolute value functions**

Recall that $|x| = \begin{cases} x, \text{ if } x \geq 0 \\ 0, \text{ if } x = 0 \\ -x, \text{ if } x < 0 \end{cases}$

Activity

1. Use the above definition to graph $y = |x|$.
2. Use a graphing calculator to check your work in Step 1.
3. Use a graphing calculator to graph each of these functions in the same viewing window.

   $y = |x| + 3$ $\quad y = |x| + 5$ $\quad y = |x| + 7$

3. Repeat Step 3 for these functions.

   $y = |x| - 2$ $\quad y = |x| - 4$ $\quad y = |x| - 6$

3. Describe the effect of c on the graph of $y = |x| + c$.

Exercises

1. Use the following phrases to describe how the graph of each function in parts (a)-(d) is related to the graph of $y = |x|$.

   - shifted up 1 unit
   - shifted up 2 units
   - shifted down 1 unit
   - shifted down 3 units

   (a) $y = |x| + 1$ (b) $y = |x| + 2$ (c) $y = |x| - 3$ (d) $y = |x| - 1$

2. Use a graphing calculator to graph each of these functions in the same viewing window.

   $y = |x|$ $\quad y = |x - 5|$ $\quad y = |x + 4|$

3. Described the effect of h on the graph of $y = |x - h|$.

Lesson 2.8

NAME _____ DATE _____

Graphing Calculator Activity

For use with pages 122–128

TI-82

Step 2:

Y= 2nd [ABS] X,T,θ ZOOM 6

Step 3

Y= 2nd [ABS] X,T,θ + 3 ENTER 2nd [ABS] X,T,θ + 5 ENTER 2nd [ABS] X,T,θ + 7 ENTER GRAPH

Step 4:

Y= 2nd [ABS] X,T,θ − 2 ENTER 2nd [ABS] X,T,θ − 4 ENTER 2nd [ABS] X,T,θ − 6 ENTER GRAPH

TI-83

Step 2:

Y= MATH ► 1 X,T,θ,n) ZOOM 6

Step 3

Y= MATH ► 1 X,T,θ,n) 3 ENTER MATH ► 1 X,T,θ,n) + 5 ENTER MATH ► 1 X,T,θ,n) + 7 ENTER GRAPH

Step 4:

Y= MATH ► 1 X,T,θ,n) − 2 ENTER MATH ► 1 X,T,θ,n) − 4 ENTER MATH ► 1 X,T,θ,n) − 6 ENTER GRAPH

SHARP EL-9600c

Step 2:

Y= MATH [B] 1 X/θ/T/n ZOOM 6

Step 3:

Y= MATH [B] 1 X/θ/T/n ► + 3 ENTER MATH [B] 1 X/θ/T/n ► + 5 ENTER MATH [B] 1 X/θ/T/n ► + 7 ENTER GRAPH

Step 4:

Y= MATH [B] 1 X/θ/T/n ► − 2 ENTER MATH [B] 1 X/θ/T/n ► − 4 ENTER MATH [B] 1 X/θ/T/n ► − 6 ENTER GRAPH

CASIO CFX-9850GA PLUS

Step 2:

From the main menu, choose GRAPH.

OPTN F5 F1 X,θ,T EXE SHIFT F3 F3 EXIT F6

Step 3:

From the main menu, choose GRAPH.

OPTN F5 F1 X,θ,T + 3 EXE OPTN F5 F1 X,θ,T + 5 EXE OPTN F5 F1 X,θ,T + 7 EXE F6

Step 4:

From the main menu, choose GRAPH.

OPTN F5 F1 X,θ,T − 2 EXE OPTN F5 F1 X,θ,T − 4 EXE OPTN F5 F1 X,θ,T − 6 EXE F6

LESSON 2.8

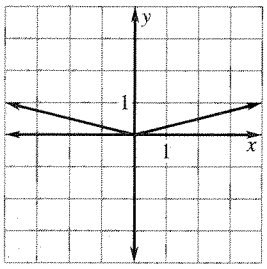
NAME _____ DATE _____

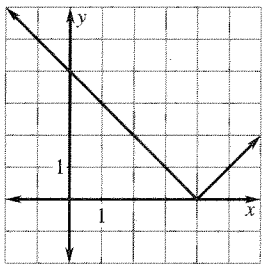
Practice A

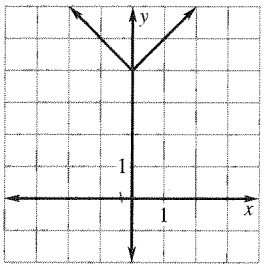
For use with pages 122–128

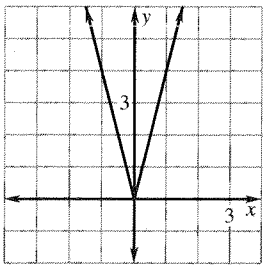
Match the function with its graph.

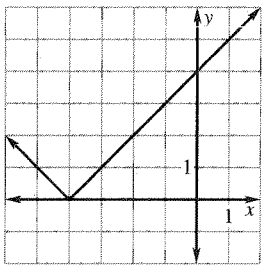
1. $f(x) = |x + 4|$
2. $f(x) = |x - 4|$
3. $f(x) = |x| + 4$
4. $f(x) = |x| - 4$
5. $f(x) = 4|x|$
6. $f(x) = \frac{1}{4}|x|$

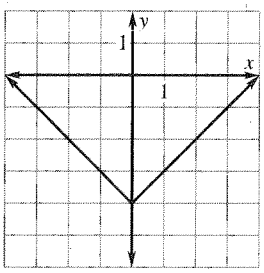
A.


B.


C.


D.


E.


F.


Tell whether the graph of the function opens up or down.

7. $y = -3|x|$
8. $y = 3|x + 1|$
9. $y = |x + 1| - 10$
10. $y = 4|x - 1| + 3$
11. $y = -2|x + 1| + 7$
12. $y = -|x - 2| + 4$

Identify the vertex of the graph of the given function.

13. $y = 2|x| - 3$
14. $y = |x - 1| + 2$
15. $y = |x + 3| - 5$
16. $y = |x - 7| - 2$
17. $y = 2|x + 1| + 9$
18. $y = -5|x + 3|$

Tell whether the graph of the function is *wider, narrower,* or the *same width* as the graph of $y = |x|$.

19. $y = |x - 8|$
20. $y = 2|x - 1|$
21. $y = \frac{1}{2}|x + 3| - 2$
22. $y = -3|x + 1| + 7$
23. $y = -\frac{2}{3}|x - 6| + 3$
24. $y = \frac{9}{10}|x| + 13$

Swimwear **In Exercises 25 and 26, use the following information.**
A sporting goods store sells swimming suits year round. The number of suits sold can be modeled by the function $S = -90|t - 6| + 540$, where t is the time in months and S is the sales in dollars.

25. Graph the function for $0 \le t \le 12$.
26. What is the maximum sales in one month? In what month is the maximum reached?

LESSON 2.8

NAME _____ DATE _____

Practice B

For use with pages 122–128

Tell whether the graph of the function opens up or down.

1. $y = |x + 3| - 5$ **2.** $y = -4|x - 1| + 6$ **3.** $y = \frac{2}{3}|x - 2| + 9$

Identify the vertex of the graph of the given function.

4. $y = 2|x + 13| - 6$ **5.** $y = -3|x - 4| - 7$ **6.** $y = \frac{1}{5}|x + 2| + 11$

Tell whether the graph is *wider, narrower,* or the *same width* as the graph of $y = |x|$.

7. $y = \frac{3}{5}|x - 3| + 7$ **8.** $y = -8|x + 9| - 12$ **9.** $y = -\frac{5}{2}|x - 1| - 3$

Graph the function.

10. $y = |x| - 4$ **11.** $y = |x - 4|$ **12.** $y = |x + 2| - 3$

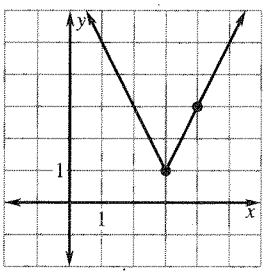
13. $y = |x + 1| + 3$ **14.** $y = 2|x - 3|$ **15.** $y = -|x + 5|$

16. $y = |x - 4| + 5$ **17.** $y = 3|x - 1| - 2$ **18.** $y = -2|x + 7| - 4$

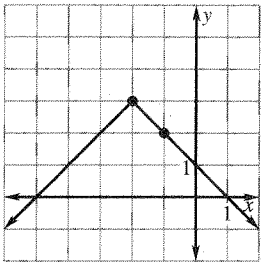
19. $y = \frac{1}{2}|x| - 2$ **20.** $y = \frac{2}{3}|x + 2| + 1$ **21.** $y = -\frac{1}{2}|x - 1| + 2$

Write an equation of the graph shown.

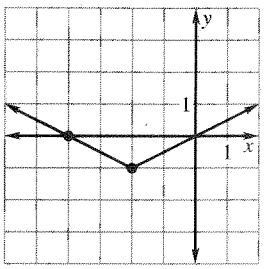
22.



23.

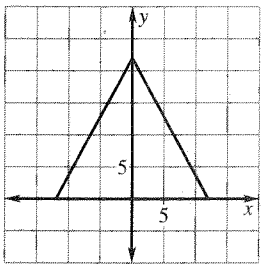


24.



A-Frame Home **In Exercises 25 and 26, use the following information.**

The roof line of an A-frame home follows the path given by $y = -\frac{11}{6}|x| + 22$. Each unit on the coordinate plane represents one foot.



25. Find the vertex of the graph.

26. What does the y-value of the vertex tell us about the home?

Fine Dining **In Exercises 27 and 28, use the following information.**

An exclusive restaurant is open from 3:00 P.M. to 10:00 P.M. Each evening, the number of people served S increases steadily and then decreases according to the model $S = -30|t - 6.5| + 105$ where $t = 0$ represents 12:00 P.M.

27. Graph the function.

28. Find the vertex of the graph. Explain what each coordinate of the vertex represents.

Lesson 2.8

LESSON 2.8

NAME _____ DATE _____

Practice C

For use with pages 122–128

Tell whether the graph of the function opens up or down.

1. $y = -\frac{1}{3}|x + 2| + 4$
2. $y = 3 + \frac{1}{2}|x + 1|$
3. $y = 4 - 2|x + 3|$

Identify the vertex of the graph of the given function.

4. $y = 3|x - 2| + 5$
5. $y = \frac{1}{3}\left|x - \frac{3}{8}\right| - 1$
6. $y = 6 + \frac{4}{5}\left|x - \frac{2}{3}\right|$

Tell whether the graph is *wider, narrower,* or the *same width* as the graph of $y = |x|$.

7. $y = -\frac{2}{3}|x + 1| - 4$
8. $y = \frac{5}{6}|x - 3| + 1$
9. $y = 4 - \frac{7}{6}|x + 3|$

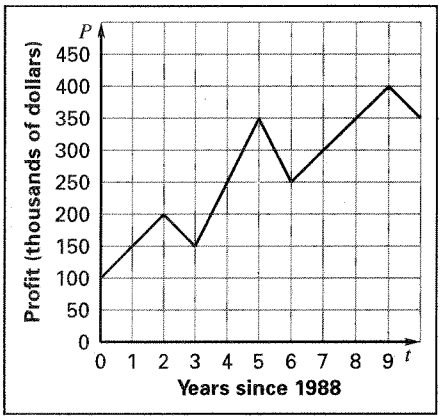
Graph the function.

10. $y = 2|x + 1| - 4$
11. $y = -3|x - 3| + 2$
12. $y = -4 + 5|x + 2|$
13. $y = \frac{1}{2}|x - 3| + 1$
14. $y = -\frac{1}{3}|x + 2| + 3$
15. $y = 2\left|x - \frac{1}{2}\right| + 3$
16. $y = -\left|x + \frac{2}{3}\right| - 1$
17. $y = 2.5|x - 1.3| - 2.4$
18. $y = -1.8|x + 2.2| + 1.6$

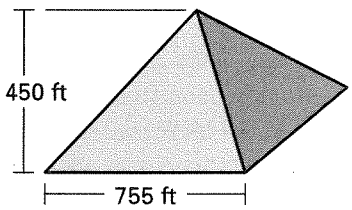
Graph the function by making a table and plotting points. Then write a function of the form $y = a|x - h| + k$ that has the same graph.

19. $y = |2x|$
20. $y = |-3x|$
21. $y = |2x + 6|$
22. $y = |-5x + 20|$
23. $y = |4x| + 2$
24. $y = |-2x| - 3$
25. $y = |-2x - 8| + 1$
26. $y = |3x - 9| + 2$
27. $y = 2|2x + 10| + 1$

28. ***Company's Profit*** The profit for a company from 1988 to 1998 is modeled by the graph. The profit is measured in thousands of dollars and $t = 0$ corresponds to 1988. Write a piecewise function that represents the profit.



29. ***Pyramids of Egypt*** The largest pyramid included in the first wonder of the world is Khufu. It stands 450 feet tall and its base is 755 feet long. Imagine that a coordinate plane is placed over a side of the pyramid. In the coordinate plane, each unit represents one foot and the origin is at the center of the pyramid's base. Write an absolute value function for the outline of the pyramid.



Lesson 2.8

LESSON 2.8

NAME _____ DATE _____

Reteaching with Practice

For use with pages 122–128

GOAL **Represent absolute value functions and use absolute value functions to model real-life situations**

VOCABULARY

The absolute value function has the standard form of $y = a|x - h| + k$, and its graph has the following characteristics.

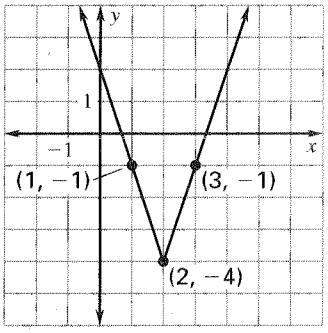
- The **vertex** occurs at the point (h, k), and the graph is symmetric in the line $x = h$.
- The graph is V-shaped and opens up if $a > 0$ and down if $a < 0$.
- The graph is wider than the graph of $y = |x|$ if $|a| < 1$ and narrower if $|a| > 1$.

EXAMPLE 1 *Graphing an Absolute Value Function*

Graph $y = 3|x - 2| - 4$.

SOLUTION

First plot the vertex at $(2, -4)$. Then plot another point, such as $(1, -1)$.Use symmetry to plot a third point, $(3, -1)$. Connect these three points with a V-shaped graph. Notice that $a = 3 > 0$ and $|a| > 1$, so the graph opens up and is narrower than $y = |x|$.



Exercises for Example 1

Graph the function.

1. $y = -2|x + 1| + 3$ **2.** $y = |x - 3| + 4$ **3.** $y = |x| + 5$

4. $y = 5|x - 2|$ **5.** $y = -|x - 1| - 3$ **6.** $y = -|x| - 2$

Lesson 2.8

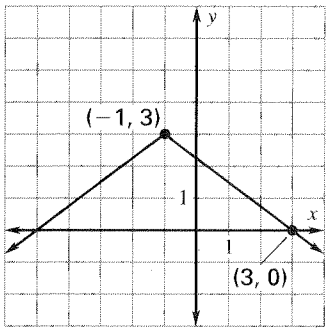
NAME _____ DATE _____

Reteaching with Practice

For use with pages 122–128

EXAMPLE 2 Writing an Absolute Value Function

Write an equation of the graph shown.



SOLUTION

The vertex is $(-1, 3)$, so the equation has the form $y = a|x + 1| + 3$.

To find a, substitute the coordinates of the point $(3, 0)$ into the equation and solve.

$y = a\|x + 1\| + 3$	Write equation.
$0 = a\|3 + 1\| + 3$	Substitute 0 for y and 3 for x.
$0 = 4a + 3$	Simplify.
$-3 = 4a$	Subtract 3 from each side.
$-\frac{3}{4} = a$	Solve for a.

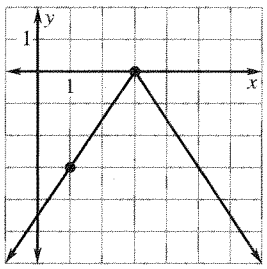
An equation of the graph is $y = -\frac{3}{4}|x + 1| + 3$.

✓ CHECK Notice the graph opens down since $a = -\frac{3}{4} < 0$, and it is wider than the graph of $y = |x|$ since $|a| = \left|-\frac{3}{4}\right| = \frac{3}{4} < 1$.

Exercises for Example 2

Write an equation of the graph shown.

7.



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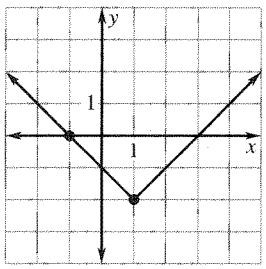

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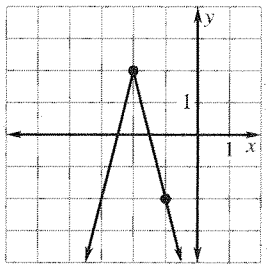

LESSON 2.8

NAME _____ DATE _____

Quick Catch-Up for Absent Students

For use with pages 122–128

The items checked below were covered in class on (date missed) _____

Lesson 2.8: Absolute Value Functions

____ **Goal 1:** Represent absolute value functions. (pp. 122–123)

Material Covered:

____ Activity: Graphs of Absolute Value Functions

____ Student Help: Skills Review

____ Example 1: Graphing an Absolute Value Function

____ Example 2: Writing an Absolute Value Function

Vocabulary:

vertex of an absolute value graph, p. 122

____ **Goal 2:** Use absolute value functions to model real-life situations. (p. 124)

Material Covered:

____ Example 3: Interpreting an Absolute Value Function

____ Example 4: Interpreting an Absolute Value Graph

____ Other (specify) _____

_____

Homework and Additional Learning Support

____ Textbook (specify) pp. 125–128

_____

____ *Reteaching with Practice* worksheet (specify exercises) _____

____ *Personal Student Tutor* for Lesson 2.8

Lesson 2.8

LESSON 2.8

NAME _____ DATE _____

Real-Life Application: When Will I Ever Use This?

For use with pages 122–128

City Planning

Many small towns in the United States do not have a large enough population to support a rescue squad or paramedic unit by themselves. Frequently they must depend on larger nearby towns to serve their emergency medical needs. However, these small towns often have a small group of people to serve as *first responders,* trained medical personnel that will report to an emergency call to stabilize the patient while waiting for the paramedics from the larger town.

Plainview, North Carolina, is such a town. It is situated 15 miles outside of Dunn, North Carolina, and has most of its residences along a single, long highway. The Plainview city council has approved money to build a small rescue station along the highway to serve as a headquarters for the Plainview first responders. Your job is to determine where along the highway the rescue station should be built.

Assume that the highway is a straight line. The point on the highway where the town limits start is marked as zero. The town has residences at points 0.5, 1, 1.2, 1.3, 1.8, 2, and 2.5 miles from point zero. Answer the following questions to determine the location where the rescue station should be built.

1. Let x represent the unknown position of the rescue station. Write an absolute value expression for the distance between the station and the house located at the 1-mile marker.
2. Write absolute value expressions for the distance between the station and the rest of the houses in Plainview.
3. Let y represent the total distance between the station and all of the houses. Write an algebraic equation for y.
4. Use a graphing calculator to graph the equation in Exercise 3.
5. Suppose a Plainview town council member would only approve the funding if the station could be located within 0.5 mile of each house. Is this possible?
6. Use your graph to find the position along the highway that minimizes the total distance between the station and all of the houses.

LESSON 2.8

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Challenge: Skills and Applications

For use with pages 122–128

Graph each inequality.

1. $2|x - 1| < y + 3$

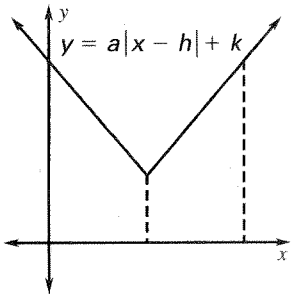
2. $y \leq -\frac{1}{2}|x + 1| + 4$

Graph each absolute value equation.

3. $|x + y| = 5$

4. $|x| + |y| = 6$

5. The graph shown at the right is that of a typical absolute value function $y = a|x - h| + k$, with $h > 0$ and $k > 0$. Find, in terms of a, k, and h, the area of the region between the graph and the x-axis, and between the y-axis and the line $x = 2h$.

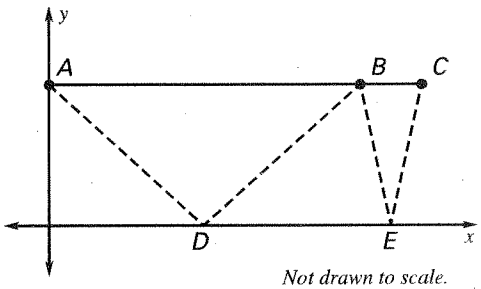


6. Two friends, Jin Chang and Juanita Alvarez, decide to meet for dinner at a restaurant. Each will try to arrive some time after 5:00 P.M., and each will wait 10 minutes for the other, if she is not already there.

   a. Let x = Linda's arrival time and let y = Juanita's arrival time, in minutes after 5:00 P.M. Write an absolute value inequality that expresses that they will arrive at times that differ by no more than 10 minutes.

   b. Graph the absolute value inequality you wrote in part (a).

7. Imagine that you are "standing on" the y-axis, with your feet at point A and your head at point C. Your eyes are at point B. You would like to put a mirror along the x-axis that would allow you to see the reflection of your whole body.



Not drawn to scale.

   a. Suppose points A, B, and C have coordinates (0, 40), (64, 40), and (68, 40). Find an absolute value function that models the path of light from your feet to your eyes: ADB, and another absolute value function that models the path of light from the top of your head to you eyes: CEB.

   b. What is the minimum length the mirror can have? How does this relate to your height?

Lesson 2.8

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Chapter Review Games and Activities

For use after Chapter 2

1. Each member of the class should measure their height and the length of their foot in inches.

   Let x = height and y = length of foot.

2. Complete a table such as the one below for each member of the class.

Inches	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	. . .	*# in class*
x = height											
y = foot length											

3. Make a plot of the coordinates of the data.
4. Determine the slope of a line passing through any two given points.
5. Choose a partner and find the slope of a line passing through your coordinates and your partner's coordinates.
6. Determine the equation of the line passing through your coordinates and the coordinates of your partner.
   a. Give the slope and y-intercept of both of your lines.
   b. Write your equations in slope-intercept form.
   c. Write your equations in point-slope form.
7. Graph both lines in the Cartesian plane.
8. Approximate a line of best fit for your data.
9. Compare your line to that of the rest of the class.
10. Plot all class data on the same graph.
11. Sketch a line of best fit.
12. Choose two points to find a line of best fit.
13. Ask your teacher or a student from another class their height.
14. See how closely you can predict the length of their foot with the class's line of best fit.