10.1 Lesson

The following numbers are **integers.**

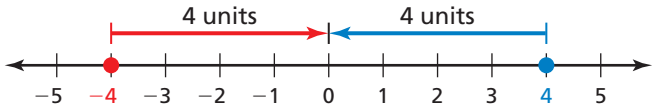
. . . , −3, −2, −1, 0, 1, 2, 3, . . .

Key Vocabulary
integer
absolute value

Key Idea

Absolute Value

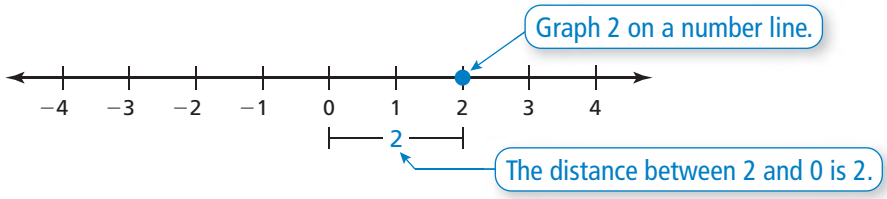
Words The **absolute value** of an integer is the distance between the number and 0 on a number line. The absolute value of a number a is written as $|a|$.



Numbers $|-4| = 4$ $|4| = 4$

EXAMPLE 1 Finding Absolute Value

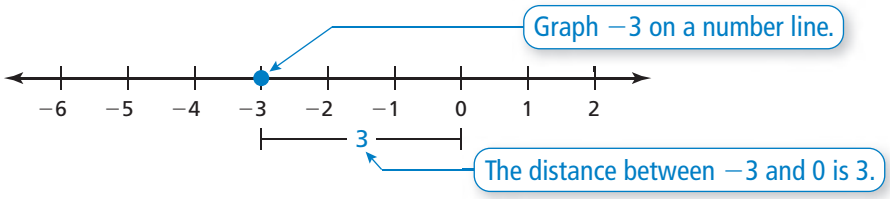
Find the absolute value of 2.



∴ So, $|2| = 2$.

EXAMPLE 2 Finding Absolute Value

Find the absolute value of −3.



∴ So, $|-3| = 3$.

On Your Own

Now You're Ready
Exercises 4–19

Find the absolute value of the integer.

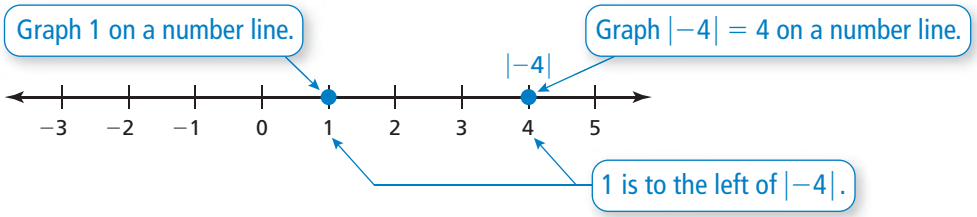
1. 7 **2.** −1 **3.** −5 **4.** 14

EXAMPLE 3 Comparing Values

Remember

A number line can be used to compare and order integers. Numbers to the left are less than numbers to the right. Numbers to the right are greater than numbers to the left.

Compare 1 and $|-4|$.



∴ So, $1 < |-4|$.

On Your Own

Now You're Ready
Exercises 20–25

Copy and complete the statement using <, >, or =.

5. $|-2|$ ☐ -1

6. -7 ☐ $|6|$

7. $|10|$ ☐ 11

8. 9 ☐ $|-9|$

EXAMPLE 4 Real-Life Application

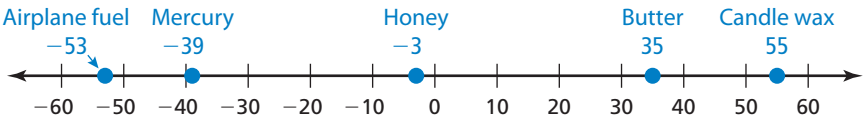
Substance	Freezing Point (°C)
Butter	35
Airplane fuel	−53
Honey	−3
Mercury	−39
Candle wax	55

The *freezing point* is the temperature at which a liquid becomes a solid.

a. Which substance in the table has the lowest freezing point?

b. Is the freezing point of mercury or butter closer to the freezing point of water, 0°C?

a. Graph each freezing point.



∴ Airplane fuel has the lowest freezing point, −53°C.

b. The freezing point of water is 0°C, so you can use absolute values.

Mercury: $|-39| = 39$ **Butter:** $|35| = 35$

∴ Because 35 is less than 39, the freezing point of butter is closer to the freezing point of water.

On Your Own

9. Is the freezing point of airplane fuel or candle wax closer to the freezing point of water? Explain your reasoning.

10.1 Exercises

Vocabulary and Concept Check

1. **VOCABULARY** Which of the following numbers are integers?

$$9,\ 3.2,\ -1,\ \frac{1}{2},\ -0.25,\ 15$$

2. **VOCABULARY** What is the absolute value of an integer?

3. **WHICH ONE DOESN'T BELONG?** Which expression does *not* belong with the other three? Explain your reasoning.

$|6|$ $\quad$ 6 $\quad$ -6 $\quad$ $|-6|$

Practice and Problem Solving

Find the absolute value of the integer.

1 2 **4.** 9 **5.** -6 **6.** -10 **7.** 10

8. -15 **9.** 13 **10.** -7 **11.** -12

12. 5 **13.** -8 **14.** 0 **15.** 18

16. -24 **17.** -45 **18.** 60 **19.** -125

Copy and complete the statement using <, >, or =.

3 **20.** $2 \square |-5|$ **21.** $|-4| \square 7$ **22.** $-5 \square |-9|$

23. $|-4| \square -6$ **24.** $|-1| \square |-8|$ **25.** $|5| \square |-5|$

ERROR ANALYSIS **Describe and correct the error.**

26. ✗ $|10| = -10$

27. ✗ $|-5| < 4$

28. **SAVINGS** You deposit \$50 in your savings account. One week later, you withdraw \$20. Write each amount as an integer.

29. **ELEVATOR** You go down 8 floors in an elevator. Your friend goes up 5 floors in an elevator. Write each amount as an integer.

Order the values from least to greatest.

30. $8, |3|, -5, |-2|, -2$

31. $|-6|, -7, 8, |5|, -6$

32. $-12, |-26|, -15, |-12|, |10|$

33. $|-34|, 21, -17, |20|, |-11|$

Simplify the expression.

34. $|-30|$

35. $-|4|$

36. $-|-15|$

37. PUZZLE Use a number line.

a. Graph and label the following points on a number line: $A = -3$, $E = 2$, $M = -6$, $T = 0$. What word do the letters spell?

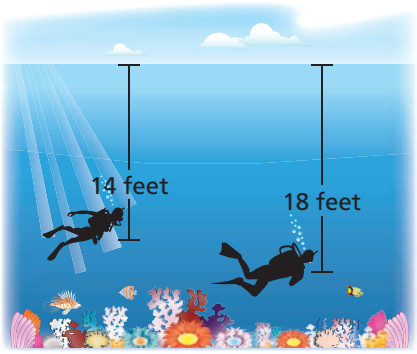
b. Graph and label the absolute value of each point in part (a). What word do the letters spell now?

38. OPEN-ENDED Write a negative integer whose absolute value is greater than 3.

REASONING Determine whether $n \geq 0$ or $n \leq 0$.

39. $n + |-n| = 2n$

40. $n + |-n| = 0$



41. CORAL REEF Two scuba divers explore the only living coral reef in North America, located just off the Florida Keys.

a. Write an integer for the position of each diver relative to sea level.

b. Which integer in part (a) is greater?

c. Which integer in part (a) has the greater absolute value? Compare this with the position of the diver farther from sea level.

42. VOLCANOES The *summit elevation* of a volcano is the elevation of the top of the volcano relative to sea level. The summit elevation of the volcano Kilauea in Hawaii is 1277 meters. The summit elevation of the underwater volcano Loihi in the Pacific Ocean is −969 meters. Which summit is closer to sea level?

43. MINIATURE GOLF The table shows golf scores, relative to *par*.

Player	Score
1	+5
2	0
3	−4
4	−1
5	+2

a. The player with the lowest score wins. Which player wins?

b. Which player is at par?

c. Which player is farthest from par?

True or False? Determine whether the statement is *true* or *false*. Explain your reasoning.

44. If $x < 0$, then $|x| = -x$.

45. The absolute value of every integer is positive.

Fair Game Review What you learned in previous grades & lessons

Add.

46. 19 + 32

47. 50 + 94

48. 181 + 217

49. 1149 + 2021

50. MULTIPLE CHOICE Which value is *not* a whole number?

Ⓐ −5 Ⓑ 0 Ⓒ 4 Ⓓ 113

10.2 Lesson

Key Vocabulary
opposites
additive inverse

Key Idea

Adding Integers with the Same Sign

Words Add the absolute values of the integers. Then use the common sign.

Numbers $2 + 5 = 7$ $-2 + (-5) = -7$

EXAMPLE 1 Adding Integers with the Same Sign

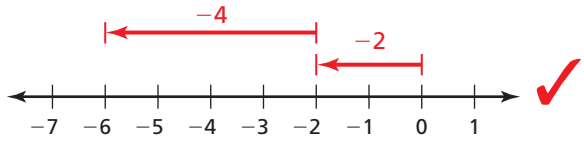
Find $-2 + (-4)$. Use a number line to check your answer.

$-2 + (-4) = -6$ Add $|-2|$ and $|-4|$.

Use the common sign.

∴ The sum is -6.

Check



On Your Own

Add.

1. $7 + 13$ **2.** $-8 + (-5)$ **3.** $-20 + (-15)$

The Meaning of a Word

Opposite

When you sit across from your friend at the lunch table, you sit **opposite** your friend.

Two numbers that are the same distance from 0, but on opposite sides of 0, are called **opposites.** For example, -3 and 3 are opposites.

Key Ideas

Adding Integers with Different Signs

Words Subtract the lesser absolute value from the greater absolute value. Then use the sign of the integer with the greater absolute value.

Numbers $8 + (-10) = -2$ $-13 + 17 = 4$

Additive Inverse Property

Words The sum of an integer and its **additive inverse,** or opposite, is 0.

Numbers $6 + (-6) = 0$ $-25 + 25 = 0$

EXAMPLE 2 Adding Integers with Different Signs

a. Find $5 + (-10)$.

$5 + (-10) = -5$ $|-10| > |5|$. So, subtract $|5|$ from $|-10|$.

Use the sign of -10.

∴ The sum is -5.

b. Find $-3 + 7$.

$-3 + 7 = 4$ $|7| > |-3|$. So, subtract $|-3|$ from $|7|$.

Use the sign of 7.

∴ The sum is 4.

c. Find $-12 + 12$.

$-12 + 12 = 0$ The sum is 0 by the Additive Inverse Property.

-12 and 12 are opposites.

∴ The sum is 0.

On Your Own

Now You're Ready
Exercises 8–23

Add.

4. $-2 + 11$ **5.** $13 + (-8)$ **6.** $9 + (-10)$

7. $-8 + 4$ **8.** $7 + (-7)$ **9.** $-31 + 31$

EXAMPLE 3 Adding More than Two Integers

The list shows four bank account transactions in July. Find the change C in the account balance.

JULY TRANSACTIONS	
Deposit	$50
Withdrawal	-$40
Deposit	$75
Withdrawal	-$50

Find the sum of the four transactions.

$C = 50 + (-40) + 75 + (-50)$ Write the sum.

$= 10 + 75 + (-50)$ Add 50 and -40.

$= 85 + (-50)$ Add 10 and 75.

$= 35$ Add 85 and -50.

∴ Because $C = 35$, the account balance increased $35 in July.

On Your Own

Now You're Ready
Exercises 28–33

10. WHAT IF? In Example 3, the deposit amounts are $30 and $55. Find the change C in the account balance.

10.2 Exercises

Vocabulary and Concept Check

1. **WRITING** How do you find the additive inverse of an integer?
2. **NUMBER SENSE** Is $3 + (-4)$ the same as $-4 + 3$? Explain.

Tell whether the sum is *positive*, *negative*, or *zero* without adding. Explain your reasoning.

3. $-8 + 20$
4. $50 + (-50)$
5. $-10 + (-18)$

Tell whether the statement is *true* or *false*. Explain your reasoning.

6. The sum of two negative integers is always negative.
7. An integer and its absolute value are always opposites.

Practice and Problem Solving

Add.

1 2 8. $6 + 4$
9. $-4 + (-6)$
10. $-2 + (-3)$
11. $-5 + 12$
12. $5 + (-7)$
13. $8 + (-8)$
14. $9 + (-11)$
15. $-3 + 13$
16. $-4 + (-16)$
17. $-3 + (-4)$
18. $14 + (-5)$
19. $0 + (-11)$
20. $-10 + (-15)$
21. $-13 + 9$
22. $18 + (-18)$
23. $-25 + (-9)$

ERROR ANALYSIS **Describe and correct the error in finding the sum.**

24. ✗ $9 + (-6) = -3$

25. ✗ $-10 + (-10) = 0$

26. **TEMPERATURE** The temperature is $-3°$F at 7 A.M. During the next four hours, the temperature increases $21°$F. What is the temperature at 11 A.M.?
27. **BANKING** Your bank account has a balance of $-\$12$. You deposit $\$60$. What is your new balance?

Add.

3 28. $13 + (-21) + 16$
29. $22 + (-14) + (-35)$
30. $-13 + 27 + (-18)$
31. $-19 + 26 + 14$
32. $-32 + (-17) + 42$
33. $-41 + (-15) + (-29)$

Tell how the Commutative and Associative Properties of Addition can help you find the sum mentally. Then find the sum.

34. $9 + 6 + (-6)$
35. $-8 + 13 + (-13)$
36. $9 + (-17) + (-9)$
37. $7 + (-12) + (-7)$
38. $-12 + 25 + (-15)$
39. $6 + (-9) + 14$

ALGEBRA **Evaluate the expression when $a = 4$, $b = -5$, and $c = -8$.**

40. $a + b$ **41.** $b + c$ **42.** $|a + b + c|$

43. **OPEN-ENDED** Write two integers with different signs that have a sum of -25. Write two integers with the same sign that have a sum of -25.

MENTAL MATH **Use mental math to solve the equation.**

44. $d + 12 = 2$ **45.** $b + (-2) = 0$ **46.** $-8 + m = -15$

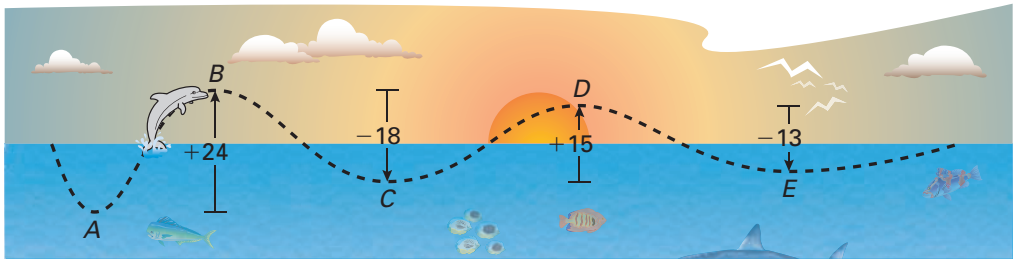
47. **FIRST DOWN** In football, a team must gain 10 yards to get a first down. The team gains 6 yards on the first play, loses 3 yards on the second play, and gains 8 yards on the third play. Which expression can be used to decide whether the team gets a first down?

$10 + 6 - 3 + 8$ $6 + (-3) + 8$ $6 + (-3) + (-8)$

48. **DOLPHIN** Starting at point A, the path of a dolphin jumping out of the water is shown.

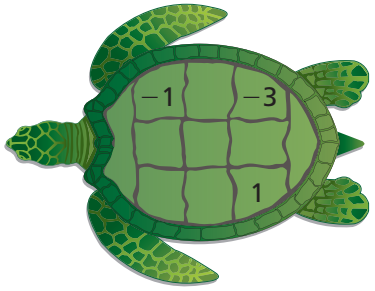
a. Is the dolphin deeper at point C or point E? Explain your reasoning.

b. Is the dolphin higher at point B or point D? Explain your reasoning.



49. **Puzzle** According to a legend, the Chinese Emperor Yu-Huang saw a magic square on the back of a turtle. In a *magic square*, the numbers in each row and in each column have the same sum. This sum is called the magic sum.

Copy and complete the magic square so that each row and each column has a magic sum of 0. Use each integer from -4 to 4 exactly once.



Fair Game Review What you learned in previous grades & lessons

Subtract.

50. $69 - 38$ **51.** $82 - 74$ **52.** $177 - 63$ **53.** $451 - 268$

54. **MULTIPLE CHOICE** What is the range of the numbers below?

12, 8, 17, 12, 15, 18, 30

(A) 12 (B) 15 (C) 18 (D) 22

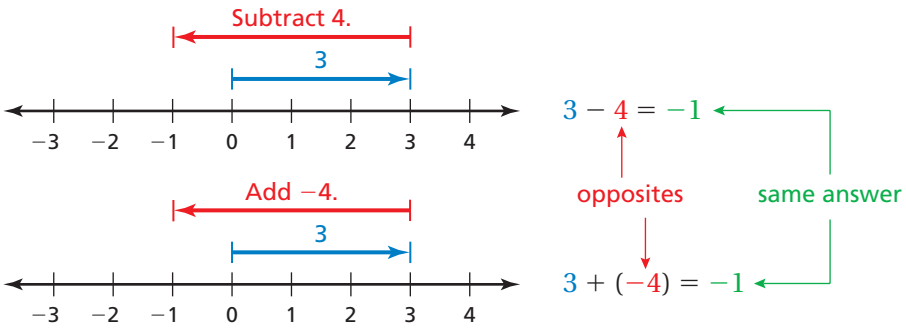
10.3 Lesson

Key Idea

Subtracting Integers

Words To subtract an integer, add its opposite.

Numbers $3 - 4 = 3 + (-4) = -1$



EXAMPLE 1 Subtracting Integers

a. Find 3 − 12.

$3 - 12 = 3 + (-12)$ Add the opposite of 12.

$= -9$ Add.

∴ The difference is −9.

b. Find −8 − (−13).

$-8 - (-13) = -8 + 13$ Add the opposite of −13.

$= 5$ Add.

∴ The difference is 5.

c. Find 5 − (−4).

$5 - (-4) = 5 + 4$ Add the opposite of −4.

$= 9$ Add.

∴ The difference is 9.

On Your Own

Now You're Ready
Exercises 8–23

Subtract.

1. $8 - 3$
2. $9 - 17$
3. $-3 - 3$
4. $-14 - 9$
5. $9 - (-8)$
6. $-12 - (-12)$

EXAMPLE 2 Subtracting Integers

Evaluate $-7 - (-12) - 14$.

$$\begin{aligned} -7 - (-12) - 14 &= -7 + 12 - 14 && \text{Add the opposite of } -12. \\ &= 5 - 14 && \text{Add } -7 \text{ and } 12. \\ &= 5 + (-14) && \text{Add the opposite of } 14. \\ &= -9 && \text{Add.} \end{aligned}$$

∴ So, $-7 - (-12) - 14 = -9$.

On Your Own

Now You're Ready
Exercises 27–32

Evaluate the expression.

7. $-9 - 16 - 8$

8. $-4 - 20 - 9$

9. $0 - 9 - (-5)$

10. $0 - (-6) - 8$

11. $15 - (-20) - 20$

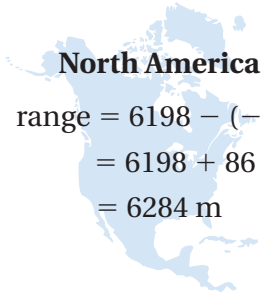
12. $13 - 18 - (-18)$

EXAMPLE 3 Real-Life Application

Which continent has the greater range of elevations?

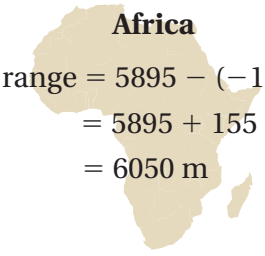
	North America	Africa
Highest Elevation	6198 m	5895 m
Lowest Elevation	−86 m	−155 m

To find the range of elevations for each continent, subtract the lowest elevation from the highest elevation.



North America

$\text{range} = 6198 - (-86)$
$= 6198 + 86$
$= 6284 \text{ m}$



Africa

$\text{range} = 5895 - (-155)$
$= 5895 + 155$
$= 6050 \text{ m}$

∴ Because 6284 is greater than 6050, North America has the greater range of elevations.

On Your Own

13. The highest elevation in Mexico is 5700 meters, on Pico de Orizaba. The lowest elevation in Mexico is −10 meters, in Laguna Salada. Find the range of elevations in Mexico.

10.3 Exercises

Vocabulary and Concept Check

1. **WRITING** How do you subtract one integer from another?
2. **OPEN-ENDED** Write two integers that are opposites.
3. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.

Find the difference of 3 and −2.

What is 3 less than −2?

How much less is −2 than 3?

Subtract −2 from 3.

MATCHING **Match the subtraction expression with the corresponding addition expression.**

4. $9 - (-5)$
5. $-9 - 5$
6. $-9 - (-5)$
7. $9 - 5$

A. $-9 + 5$ B. $9 + (-5)$ C. $-9 + (-5)$ D. $9 + 5$

Practice and Problem Solving

Subtract.

1

8. $4 - 7$
9. $8 - (-5)$
10. $-6 - (-7)$
11. $-2 - 3$
12. $5 - 8$
13. $-4 - 6$
14. $-8 - (-3)$
15. $10 - 7$
16. $-8 - 13$
17. $15 - (-2)$
18. $-9 - (-13)$
19. $-7 - (-8)$
20. $-6 - (-6)$
21. $-10 - 12$
22. $32 - (-6)$
23. $0 - (20)$

24. **ERROR ANALYSIS** Describe and correct the error in finding the difference $7 - (-12)$.

✗ $7 - (-12) = 7 + (-12) = -5$

25. **SWIMMING POOL** The floor of the shallow end of a swimming pool is at −3 feet. The floor of the deep end is 9 feet deeper. Which expression can be used to find the depth of the deep end?

$-3 + 9$ $-3 - 9$ $9 - 3$

26. **SHARKS** A shark is at −80 feet. It swims up and jumps out of the water to a height of 15 feet. Write a subtraction expression for the vertical distance the shark travels.

Evaluate the expression.

2

27. $-2 - 7 + 15$
28. $-9 + 6 - (-2)$
29. $12 - (-5) - 8$
30. $8 + 14 - (-4)$
31. $-6 - (-8) + 5$
32. $-15 - 7 - (-11)$

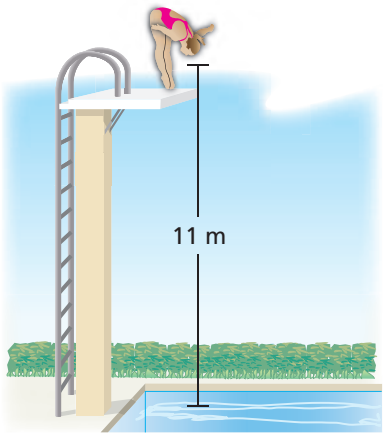
MENTAL MATH **Use mental math to solve the equation.**

33. $m - 5 = 9$ **34.** $w - (-3) = 7$ **35.** $6 - c = -9$

ALGEBRA **Evaluate the expression when $k = -3$, $m = -6$, and $n = 9$.**

36. $4 - n$ **37.** $m - (-8)$

38. $-5 + k - n$ **39.** $|m - k|$



40. **PLATFORM DIVING** The figure shows a diver diving from a platform. The diver reaches a depth of 4 meters. What is the change in elevation of the dive?

41. **OPEN-ENDED** Write two different pairs of negative integers, x and y, that make the statement $x - y = -1$ true.

42. **TEMPERATURE** The table shows the record monthly high and low temperatures in Anchorage, AK.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High (°F)	56	57	56	72	82	92	84	85	73	64	62	53
Low (°F)	−35	−38	−24	−15	1	29	34	31	19	−6	−21	−36

a. Find the range of temperatures for each month.

b. What are the all-time high and all-time low temperatures?

c. What is the range of the temperatures in part (b)?

REASONING **Tell whether the difference between the two integers is *always*, *sometimes*, or *never* positive. Explain your reasoning.**

43. Two positive integers **44.** Two negative integers

45. A positive integer and a negative integer **46.** A negative integer and a positive integer

Number Sense **For what values of a and b is the statement true?**

47. $|a - b| = |b - a|$ **48.** $|a + b| = |a| + |b|$ **49.** $|a - b| = |a| - |b|$

Fair Game Review What you learned in previous grades & lessons

Add.

50. $-5 + (-5) + (-5) + (-5)$ **51.** $-9 + (-9) + (-9) + (-9) + (-9)$

Multiply.

52. 8×5 **53.** 6×78 **54.** 36×41 **55.** 82×29

56. **MULTIPLE CHOICE** Which value of n makes the value of the expression $4n + 3$ a composite number?

Ⓐ 1 Ⓑ 2 Ⓒ 3 Ⓓ 4

10 Study Help

You can use an **idea and examples chart** to organize information about a concept. Here is an example of an idea and examples chart for absolute value.

Absolute Value: the distance between a number and 0 on the number line

Example

$|3| = 3$

Example

$|-5| = 5$

Example

$|0| = 0$

On Your Own

Make an idea and examples chart to help you study these topics.

1. integers
2. adding integers
   - **a.** with the same sign
   - **b.** with different signs
3. Additive Inverse Property
4. subtracting integers

"I made an idea and examples chart to give my owner ideas for my birthday next week."

After you complete this chapter, make idea and examples charts for the following topics.

5. multiplying integers
   - **a.** with the same sign
   - **b.** with different signs
6. dividing integers
   - **a.** with the same sign
   - **b.** with different signs
7. quadrants
8. plotting ordered pairs

10.1–10.3 Quiz

Copy and complete the statement using <, >, or =.

1. $|-8|$ ☐ 3

2. 7 ☐ $|-7|$

Order the values from least to greatest.

3. $-4, |-5|, |-4|, 3, -6$

4. $12, -8, |-15|, -10, |-9|$

Simplify the expression.

5. $-3 + (-8)$

6. $-4 + 16$

7. $3 - 9$

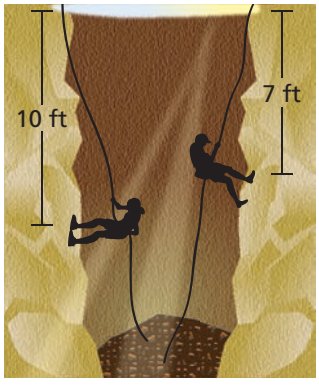
8. $-5 - (-5)$

Evaluate the expression when $a = -2$, $b = -8$, and $c = 5$.

9. $4 - a - c$

10. $|b - c|$

11. **EXPLORING** Two climbers explore a cave.



a. Write an integer for the depth of each climber relative to the surface.

b. Which integer in part (a) is greater?

c. Which integer in part (a) has the greater absolute value?

12. **SCHOOL CARNIVAL** The table shows the income and expenses for a school carnival. The school's goal was to raise $1100. Did the school reach its goal? Explain.

Games	Concessions	Donations	Flyers	Decorations
$650	$530	$52	−$28	−$75

13. **TEMPERATURE** Temperatures in the Gobi Desert reach −40°F in the winter and 90°F in the summer. Find the range of the temperatures.

10.4 Lesson

Key Ideas

Multiplying Integers with the Same Sign

Words The product of two integers with the same sign is positive.

Numbers $2 \cdot 3 = 6$ $\quad -2 \cdot (-3) = 6$

Multiplying Integers with Different Signs

Words The product of two integers with different signs is negative.

Numbers $2 \cdot (-3) = -6$ $\quad -2 \cdot 3 = -6$

EXAMPLE 1 Multiplying Integers with the Same Sign

Find $-5 \cdot (-6)$.

The integers have the same sign.

$-5 \cdot (-6) = 30$

The product is positive.

∴ The product is 30.

EXAMPLE 2 Multiplying Integers with Different Signs

Multiply.

a. $3(-4)$ **b.** $-7 \cdot 4$

The integers have different signs.

$3(-4) = -12$ $\quad -7 \cdot 4 = -28$

The product is negative.

∴ The product is -12. ∴ The product is -28.

On Your Own

Now You're Ready
Exercises 8–23

Multiply.

1. $5 \cdot 5$

2. $4(11)$

3. $-1(-9)$

4. $-7 \cdot (-8)$

5. $12 \cdot (-2)$

6. $4(-6)$

7. $-10(6)$

8. $-5 \cdot 7$

EXAMPLE 3 Using Exponents

Study Tip

Place parentheses around a negative number to raise it to a power.

a. Evaluate $(-2)^2$.

$(-2)^2 = (-2) \cdot (-2)$ Write $(-2)^2$ as repeated multiplication.

$= 4$ Multiply.

b. Evaluate -5^2.

$-5^2 = -(5 \cdot 5)$ Write 5^2 as repeated multiplication.

$= -25$ Multiply.

c. Evaluate $(-4)^3$.

$(-4)^3 = (-4) \cdot (-4) \cdot (-4)$ Write $(-4)^3$ as repeated multiplication.

$= 16 \cdot (-4)$ Multiply.

$= -64$ Multiply.

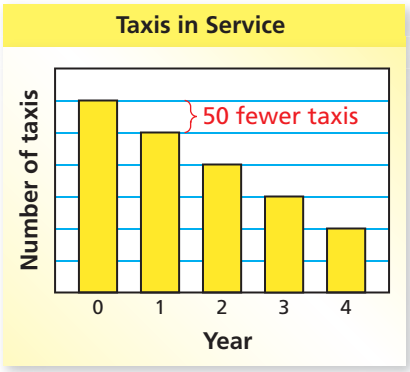
On Your Own

Now You're Ready
Exercises 32–37

Evaluate the expression.

9. $(-3)^2$ **10.** $(-2)^3$ **11.** -7^2 **12.** -6^3

EXAMPLE 4 Real-Life Application



The bar graph shows the number of taxis a company has in service. The number of taxis decreases by the same amount each year for four years. Find the total change in the number of taxis.

The bar graph shows that the number of taxis in service decreases by 50 each year. Use a model to solve the problem.

Total change = Change per year • Number of years

$= -50 \cdot 4$

$= -200$

Use -50 for the change per year because the number *decreases* each year.

∴ The total change in the number of taxis is -200.

On Your Own

13. A manatee population decreases by 15 manatees each year for 3 years. Find the total change in the manatee population.

10.4 Exercises

Vocabulary and Concept Check

1. **WRITING** What do you know about the signs of two integers whose product is (a) positive and (b) negative?
2. **WRITING** How is $(-2)^2$ different from -2^2?

Tell whether the product is *positive* or *negative* without multiplying. Explain your reasoning.

3. $4(-8)$
4. $-5(-7)$
5. $-3 \cdot (12)$

Tell whether the statement is *true* or *false*. Explain your reasoning.

6. The product of three positive integers is positive.
7. The product of three negative integers is positive.

Practice and Problem Solving

Multiply.

8. $6 \cdot 4$
9. $7(-3)$
10. $-2(8)$
11. $-3(-4)$
12. $-6 \cdot 7$
13. $3 \cdot 9$
14. $8 \cdot (-5)$
15. $-1 \cdot (-12)$
16. $-5(10)$
17. $-13(0)$
18. $-9 \cdot 9$
19. $15(-2)$
20. $-10 \cdot 11$
21. $-6 \cdot (-13)$
22. $7(-14)$
23. $-11 \cdot (-11)$

24. **JOGGING** You burn 10 calories each minute you jog. What integer represents the change in your calories after you jog for 20 minutes?
25. **EROSION** A shoreline in Volusia County recedes 9 feet each year. What integer represents the change in the shoreline after 4 years?

Multiply.

26. $3 \cdot (-8) \cdot (-2)$
27. $6(-9)(-1)$
28. $-3(-5)(-4)$
29. $-7(-3)(-5)$
30. $-6 \cdot 3 \cdot (-6)$
31. $3 \cdot (-12) \cdot 0$

Evaluate the expression.

32. $(-4)^2$
33. $(-1)^3$
34. -8^2
35. -6^2
36. $-5^2 \cdot 4$
37. $-2 \cdot (-3)^3$

ERROR ANALYSIS **Describe and correct the error in evaluating the expression.**

38. ✗ $-2(-7) = -14$

39. ✗ $-10^2 = 100$

ALGEBRA **Evaluate the expression when $a = -2$, $b = 3$, and $c = -8$.**

40. ab **41.** $|a^2c|$ **42.** $ab^3 - ac$

NUMBER SENSE **Find the next two numbers in the pattern.**

43. $-12, 60, -300, 1500, \ldots$ **44.** $7, -28, 112, -448, \ldots$

45. **GYM CLASS** You lose four points each time you attend gym class without sneakers. You forget your sneakers three times. What integer represents the change in your points?

46. **AIRPLANE** The height of an airplane during a landing is given by $22{,}000 + (-480t)$, where t is the time in minutes.

a. Copy and complete the table.

b. Estimate how many minutes it takes the plane to land. Explain your reasoning.

Time	5 min	10 min	15 min	20 min
Height				

47. **INLINE SKATES** In June, the price of a pair of inline skates is \$165. The price changes each of the next three months.

a. Copy and complete the table.

Month	Price of Skates
June	165 = \$165
July	165 + (−12) = \$____
August	165 + 2(−12) = \$____
September	165 + 3(−12) = \$____

b. Describe the change in the price of the inline skates for each month.

c. The table at the right shows the amount of money you save each month to buy the inline skates. Do you have enough money saved to buy the inline skates in August? September? Explain your reasoning.

Amount Saved	
June	\$35
July	\$55
August	\$45
September	\$18

48. Reasoning Two integers, a and b, have a product of 24. What is the least possible sum of a and b?

Fair Game Review What you learned in previous grades & lessons

Divide.

49. $27 \div 9$ **50.** $48 \div 6$ **51.** $56 \div 4$ **52.** $153 \div 9$

53. **MULTIPLE CHOICE** What is the prime factorization of 84?

Ⓐ $2^2 \times 3^2$ Ⓑ $2^3 \times 7$ Ⓒ $3^3 \times 7$ Ⓓ $2^2 \times 3 \times 7$

10.5 Lesson

Key Ideas

Dividing Integers with the Same Sign

Words The quotient of two integers with the same sign is positive.

Numbers $8 \div 2 = 4$ $\quad -8 \div (-2) = 4$

Dividing Integers with Different Signs

Words The quotient of two integers with different signs is negative.

Numbers $8 \div (-2) = -4$ $\quad -8 \div 2 = -4$

EXAMPLE 1 Dividing Integers with the Same Sign

Find $-18 \div (-6)$.

The integers have the same sign.

$-18 \div (-6) = 3$

The quotient is positive.

∴ The quotient is 3.

EXAMPLE 2 Dividing Integers with Different Signs

Divide.

a. $75 \div (-25)$ **b.** $\frac{-54}{6}$

The integers have different signs.

$75 \div (-25) = -3$ $\quad \frac{-54}{6} = -9$

The quotient is negative.

∴ The quotient is -3. ∴ The quotient is -9.

On Your Own

Now You're Ready
Exercises 8–23

Divide.

1. $14 \div 2$
2. $-32 \div (-4)$
3. $-40 \div (-8)$
4. $0 \div (-6)$
5. $\frac{-49}{7}$
6. $\frac{21}{-3}$

EXAMPLE 3 Evaluating Expressions

Evaluate $10 - x^2 \div y$ when $x = 8$ and $y = -4$.

$$\begin{aligned} 10 - x^2 \div y &= 10 - 8^2 \div (-4) && \text{Substitute 8 for } x \text{ and } -4 \text{ for } y. \\ &= 10 - 8 \cdot 8 \div (-4) && \text{Write } 8^2 \text{ as repeated multiplication.} \\ &= 10 - 64 \div (-4) && \text{Multiply 8 and 8.} \\ &= 10 - (-16) && \text{Divide 64 and } -4. \\ &= 26 && \text{Subtract.} \end{aligned}$$

Remember

Use order of operations when evaluating an expression.

On Your Own

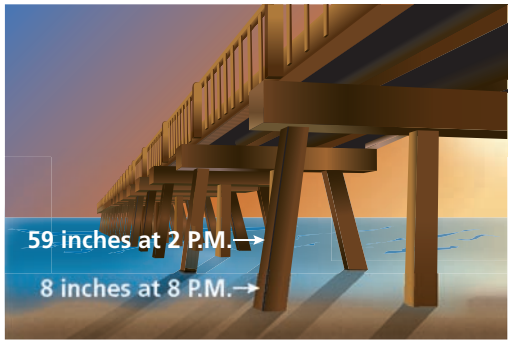
Now You're Ready
Exercises 28–31

Evaluate the expression when $a = -18$ and $b = -6$.

7. $a \div b$ **8.** $\dfrac{a + 6}{3}$ **9.** $\dfrac{b^2}{a} + 4$

EXAMPLE 4 Real-Life Application

You measure the height of the tide using support beams of the Jacksonville Beach Pier. Your measurements are shown in the picture. What is the mean hourly change in the height?



Use a model to solve the problem.

$$\text{Mean hourly change} = \frac{\text{Final height} - \text{Initial height}}{\text{Elapsed Time}}$$

$$\begin{aligned} &= \frac{8 - 59}{6} && \text{Substitute. The elapsed time from 2 P.M. to 8 P.M. is 6 hours.} \\ &= \frac{-51}{6} && \text{Subtract.} \\ &= -8.5 && \text{Divide.} \end{aligned}$$

∴ The mean change in the height of the tide is -8.5 inches per hour.

On Your Own

10. The height of the tide at the Bay of Fundy in New Brunswick decreases 36 feet in 6 hours. What is the mean hourly change in the height?

10.5 Exercises

Vocabulary and Concept Check

1. **WRITING** What can you tell about two integers when their quotient is positive? negative? zero?
2. **VOCABULARY** A quotient is undefined. What does this mean?
3. **OPEN-ENDED** Write two integers whose quotient is negative.
4. **WHICH ONE DOESN'T BELONG?** Which expression does *not* belong with the other three? Explain your reasoning.

$\frac{10}{-5}$ $\frac{-10}{5}$ $\frac{-10}{-5}$ $-\left(\frac{10}{5}\right)$

Tell whether the quotient is *positive* or *negative* without dividing.

5. $-12 \div 4$
6. $\frac{-6}{-2}$
7. $15 \div (-3)$

Practice and Problem Solving

Divide, if possible.

8. $4 \div (-2)$
9. $21 \div (-7)$
10. $-20 \div 4$
11. $-18 \div (-6)$
12. $\frac{-14}{7}$
13. $\frac{0}{6}$
14. $\frac{-15}{-5}$
15. $\frac{54}{-9}$
16. $-33 \div 11$
17. $-49 \div (-7)$
18. $0 \div (-2)$
19. $60 \div (-6)$
20. $\frac{-56}{14}$
21. $\frac{18}{0}$
22. $\frac{65}{-5}$
23. $\frac{-84}{-7}$

ERROR ANALYSIS **Describe and correct the error in finding the quotient.**

24. ✗ $\frac{-63}{-9} = -7$

25. ✗ $0 \div (-5) = -5$

26. **ALLIGATORS** An alligator population in a nature preserve in the Everglades decreases by 60 alligators over 5 years. What is the mean yearly change in the alligator population?
27. **READING** You read 105 pages of a novel over 7 days. What is the mean number of pages you read each day?

ALGEBRA **Evaluate the expression when $x = 10$, $y = -2$, and $z = -5$.**

28. $x \div y$
29. $\frac{10y^2}{z}$
30. $\left|\frac{xz}{-y}\right|$
31. $\frac{-x^2 + 6z}{y}$

Find the mean of the integers.

32. $3, -10, -2, 13, 11$

33. $-26, 39, -10, -16, 12, 31$

Evaluate the expression.

34. $-8 - 14 \div 2 + 5$

35. $24 \div (-4) + (-2) \cdot (-5)$

36. **PATTERN** Find the next two numbers in the pattern $-128, 64, -32, 16, \ldots$. Explain your reasoning.

37. **HIKING** While hiking along the Croom Tract Loop section of the Florida Trail, a hiker climbs down an 84-foot hill in 4 minutes. What is the mean change in elevation per minute?

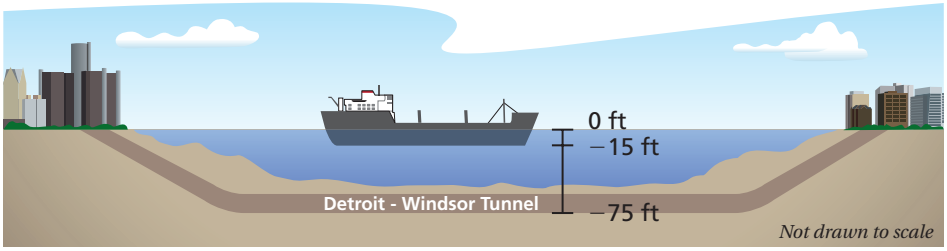
38. **THE MASTERS** In 1997, at the age of 21, Tiger Woods became the youngest golfer to win the Masters Tournament. The table shows his score for each round.

Scorecard	
Round 1	-2
Round 2	-6
Round 3	-7
Round 4	-3

a. Tiger set the tournament record with the lowest total score. What was his total score?

b. What was his mean score per round?

39. **TUNNEL** The Detroit-Windsor Tunnel is an underwater highway that connects the cities of Detroit, Michigan, and Windsor, Ontario. How many times deeper is the roadway than the bottom of the ship?



40. **AMUSEMENT PARK** The regular admission price for an amusement park is \$72. For a group of 15 or more, the admission price is reduced by \$25. How many people need to be in a group to save \$500?

41. Number Sense Write five different integers that have a mean of -10. Explain how you found your answer.

Fair Game Review What you learned in previous grades & lessons

Graph the values on a number line. Then order the values from least to greatest.

42. $-6, 4, |2|, -1, |-10|$

43. $3, |0|, |-4|, -3, -8$

44. $|5|, -2, -5, |-2|, -7$

45. **MULTIPLE CHOICE** What is the value of $4 \cdot 3 + (12 \div 2)^2$?

Ⓐ 15 Ⓑ 48 Ⓒ 156 Ⓓ 324

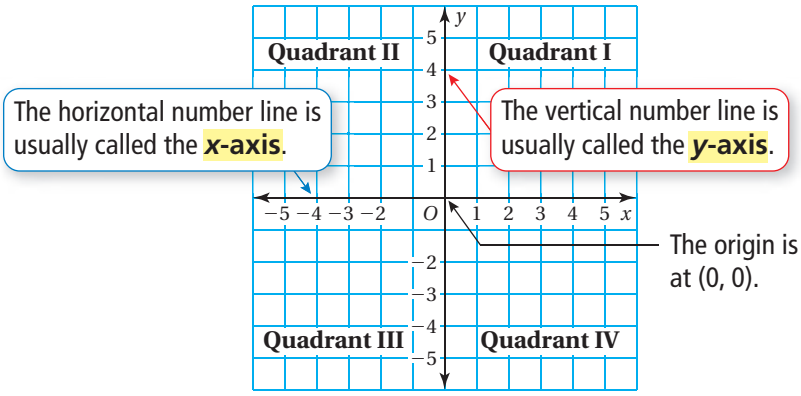
10.6 Lesson

Key Vocabulary
coordinate plane
origin
quadrant
x-axis
y-axis

Key Idea

The Coordinate Plane

A **coordinate plane** is formed by the intersection of a horizontal number line and a vertical number line. The number lines intersect at the **origin** and separate the coordinate plane into four regions called **quadrants.**



An *ordered pair* is a pair of numbers that is used to locate a point in a coordinate plane.

ordered pair

$(4, -2)$

The *x-coordinate* corresponds to a number on the *x*-axis.

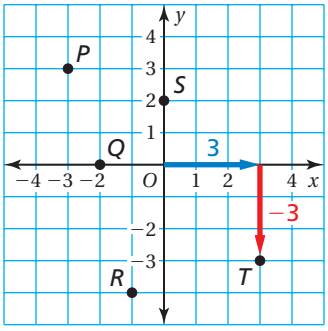
The *y-coordinate* corresponds to a number on the *y*-axis.

EXAMPLE 1 Standardized Test Practice

Which ordered pair corresponds to point *T*?

Ⓐ $(-3, -3)$ Ⓑ $(-3, 3)$

Ⓒ $(3, -3)$ Ⓓ $(3, 3)$



Point *T* is 3 units to the right of the origin and 3 units down. So, the *x*-coordinate is 3 and the *y*-coordinate is −3.

∴ The ordered pair $(3, -3)$ corresponds to point *T*. The correct answer is Ⓒ.

On Your Own

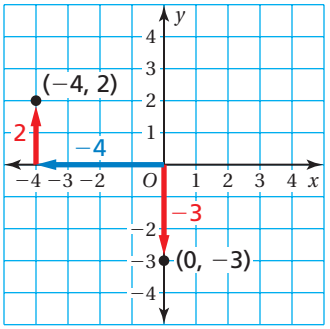
Now You're Ready
Exercises 5–14

Use the graph in Example 1 to write an ordered pair corresponding to the point.

1. Point *P* **2.** Point *Q* **3.** Point *R* **4.** Point *S*

EXAMPLE 2 Plotting Ordered Pairs

Plot (a) (−4, 2) and (b) (0, −3) in a coordinate plane. Describe the location of each point.



a. Start at the origin. Move 4 units left and 2 units up. Then plot the point.

∴ The point is in Quadrant II.

b. Start at the origin. Move 3 units down. Then plot the point.

∴ The point is on the y-axis.

On Your Own

Now You're Ready
Exercises 15–26

Plot the ordered pair in a coordinate plane. Describe the location of the point.

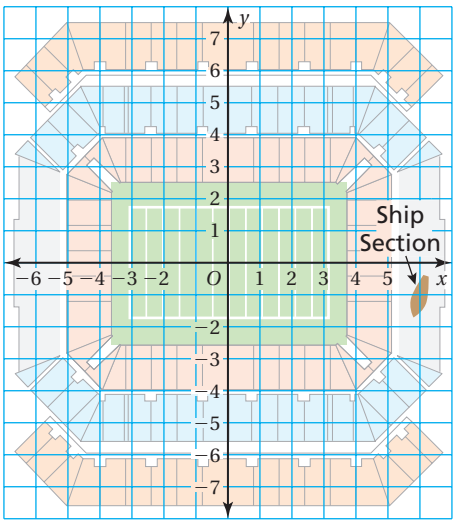
5. $A(2, 3)$

6. $B(-1, 0)$

7. $C(-5, -1)$

8. $D(3, -6)$

EXAMPLE 3 Real-Life Application



You and a friend have tickets to see a game in Tampa, Florida. You sit in the Ship Section and your friend sits at (−4, −2).

a. Write an ordered pair for your location. In which quadrant are you seated?

b. In which quadrant is your friend seated?

c. A fan in Quadrant II is chosen to win a prize. Do you or your friend have a chance to win the prize?

a. The Ship Section is 6 units to the right of the origin and 1 unit down. So, your seat is located at (6, −1). You are seated in Quadrant IV.

b. Move 4 units to the left of the origin and 2 units down. Your friend is seated in Quadrant III.

c. You are seated in Quadrant IV and your friend is seated in Quadrant III. So, you and your friend do not have a chance to win the prize.

On Your Own

9. WHAT IF? In Example 3, a fan sitting in the level closest to the playing field is chosen to win a prize. Do you or your friend have a chance to win the prize?

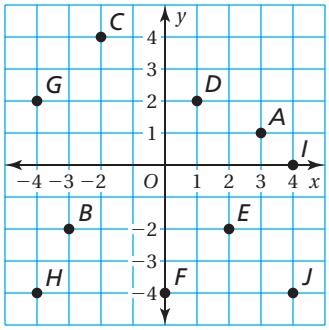
10.6 Exercises

Vocabulary and Concept Check

1. **VOCABULARY** How many quadrants are in a coordinate plane?
2. **VOCABULARY** Is the point $(0, -7)$ on the x-axis or the y-axis?
3. **WRITING** How are the locations of the points $(2, -2)$ and $(-2, 2)$ different?
4. **WRITING** Describe the characteristics of ordered pairs in each of the four quadrants.

Practice and Problem Solving

Write an ordered pair corresponding to the point.



5. Point A
6. Point B
7. Point C
8. Point D
9. Point E
10. Point F
11. Point G
12. Point H
13. Point I
14. Point J

Plot the ordered pair in a coordinate plane. Describe the location of the point.

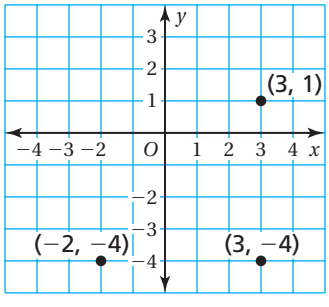
15. $K(4, 3)$
16. $L(-1, 2)$
17. $M(0, -6)$
18. $N(3, -2)$
19. $P(2, -4)$
20. $Q(-2, 4)$
21. $R(-4, 1)$
22. $S(7, 0)$
23. $T(-4, -5)$
24. $U(-2, 5)$
25. $V(-3, 8)$
26. $W(-5, -1)$

ERROR ANALYSIS **Describe and correct the error in the solution.**

27. To plot (4, 5), start at (0, 0) and move 5 units right and 4 units up.

28. To plot (−6, 3), start at (0, 0) and move 6 units right and 3 units down.

29. **REASONING** The coordinates of three vertices of a square are shown in the figure. What are the coordinates of the fourth vertex?



30. **GEOMETRY** The points $D(1, 1)$, $E(1, -2)$, $F(-2, -2)$, and $G(-2, 1)$ are vertices of a figure.
    - **a.** Draw the figure in a coordinate plane.
    - **b.** Find the perimeter of the figure.
    - **c.** Find the area of the figure.

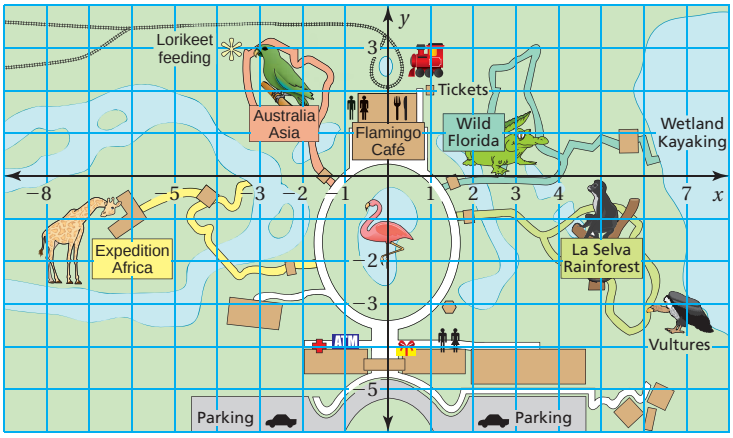
Tell whether the statement is *sometimes*, *always*, or *never* true. Explain your reasoning.

31. The x-coordinate of a point on the x-axis is zero.

32. The y-coordinate of points in Quadrant III are positive.

33. The x-coordinate of a point in Quadrant II has the same sign as the y-coordinate of a point in Quadrant IV.

BREVARD ZOO **In Exercises 34–38, use the map of the Brevard Zoo in Melbourne, Florida.**



34. Which exhibit is located at (2, 1)?

35. Name an attraction on the positive y-axis.

36. Is parking available in Quadrant II? If not, name a quadrant in which you can park.

37. Write two different ordered pairs that represent the location of La Selva Rainforest.

38. Which exhibit is closest to $(-8, -3)$?

39. **NUMBER SENSE** Name the ordered pair that is 5 units right and 2 units down from $(-3, 4)$.

Plot the ordered pair in a coordinate plane. Describe the location of the point.

40. $A\left(3, -\frac{3}{2}\right)$ **41.** $B\left(-\frac{5}{2}, \frac{10}{3}\right)$ **42.** $C(-5.25, -3.5)$ **43.** $D(-4.75, 0)$

44. Reasoning Your school is located at $(2, -1)$, which is 2 blocks east and 1 block south of the center of town. To get from your house to the school, you walk 5 blocks west and 2 blocks north.

a. What ordered pair corresponds to the location of your house?

b. Is your house or your school closer to the center of town? Explain.

Fair Game Review What you learned in previous grades & lessons

Copy and complete the statement using <, >, or =.

45. $\frac{-16}{2}$ ☐ $\frac{-12}{3}$ **46.** $2\frac{2}{5}$ ☐ $\frac{24}{10}$ **47.** 3.45 ☐ $3\frac{3}{8}$

48. **MULTIPLE CHOICE** What is $\frac{1}{3}$ of $3\frac{1}{2}$?

Ⓐ $\frac{1}{2}$ Ⓑ $1\frac{1}{6}$ Ⓒ $1\frac{1}{2}$ Ⓓ $10\frac{1}{2}$

10.4–10.6 Quiz

Simplify the expression.

1. $-7(6)$

2. $-1(-9)$

3. $\dfrac{-72}{-9}$

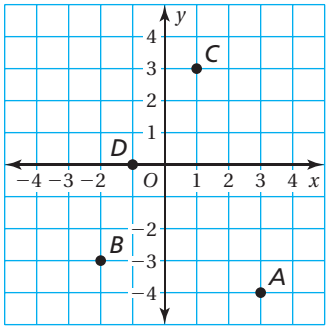
4. $-24 \div 3$

Evaluate the expression when $a = 4$, $b = -6$, and $c = -12$.

5. c^2

6. $\dfrac{|c - b|}{a}$

Write an ordered pair corresponding to the point.



7. Point A

8. Point B

9. Point C

10. Point D

11. **SPEECH** In speech class, you lose 3 points for every 30 seconds you go over the time limit. Your speech is 90 seconds over the time limit. What integer represents the change in your points?

12. **MOUNTAIN CLIMBING** On a mountain, the temperature decreases by 18°F every 5000 feet. What integer represents the change in temperature at 20,000 feet?

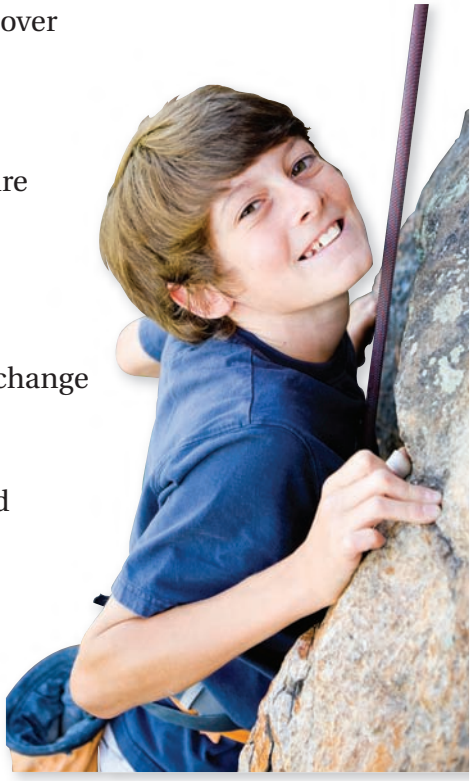
13. **GAMING** You play a video game for 15 minutes. You lose 165 points. What integer represents the average change in points per minute?

14. **GEOMETRY** The points $A(-4, 2)$, $B(1, -1)$, $C(1, 2)$, and $D(-4, -1)$ are the vertices of a figure.

a. Draw the figure in a coordinate plane.

b. Find the perimeter of the figure.

c. Find the area of the figure.



10 Chapter Test

Find the absolute value of the integer.

1. -9 **2.** 64 **3.** -22

Copy and complete the statement using <, >, or =.

4. $4 \square |-8|$ **5.** $-12 \square |-7|$ **6.** $-7 \square |3|$

Simplify the expression.

7. $-6 + (-11)$ **8.** $2 - (-9)$

9. $-9 \cdot 2$ **10.** $-72 \div (-3)$

11. $-5 + 17$ **12.** $-14(21)$

Plot the ordered pair in a coordinate plane. Describe the location of the point.

13. $K(1, 3)$ **14.** $L(-3, 0)$

15. $M(-4, 5)$ **16.** $N(2, -1)$

17. **BANKING** The balance of your checking account is \$86. You withdraw \$98. What is your new balance?

18. **NASCAR** A driver receives -25 points for each rule violation. What integer represents the change in points after four rule violations?

19. **GOLF** The table shows your scores, relative to *par*, for nine holes of golf. What is your total score for the nine holes?

Hole	1	2	3	4	5	6	7	8	9	Total
Score	+1	−2	−1	0	−1	+3	−1	−3	+1	?

20. **VISITORS** In a five-year period, the change in the number of visitors to Florida was $-1{,}145{,}000$ visitors.

a. What was the mean yearly change in the number of visitors?

b. During the third year, the change in the number of visitors was 200,000. Explain how the change for the 5 years can be negative.