

# Chapter Summary

## WHAT did you learn?

Graph and compare real numbers. (2.1)

Find the opposite and the absolute value of a real number. (2.1)

Add real numbers. (2.2)

Subtract real numbers. (2.3)

Organize data in a matrix. (2.4)

Add and subtract two matrices. (2.4)

Multiply real numbers. (2.5)

Use the distributive property. (2.6)

Combine like terms. (2.6)

Divide real numbers. (2.7)

Express the likelihood of an event as a probability or as odds. (2.8)

## WHY did you learn it?

Find the coldest temperature recorded. (p. 64)

Find the speed and velocity of an elevator. (p. 66)

Decide whether an atom is an ion. (p. 74)

Find the price change of an ounce of gold. (p. 83)

Organize music store price data. (p. 90)

Find employee wage rates after a raise. (p. 90)

Find the vertical distance a hawk travels. (p. 96)

Find the total weight a train is hauling. (p. 104)

Simplify algebraic expressions. (p. 102)

Find the price change of a share of stock. (p. 111)

Find how likely it is that a test is given on a Friday. (p. 117)

## How does Chapter 2 fit into the BIGGER PICTURE of algebra?

The numbers you worked with in Chapter 1 were zero or positive. In this chapter you studied rules for adding, subtracting, multiplying, and dividing with both positive and negative numbers. You are building a sense for the type of problems associated with negative numbers, such as losses, deficits, and low temperatures.

This chapter introduces some of the rules of algebra. By learning to create, simplify, and evaluate algebraic expressions and matrices, you will be able to solve many real-life problems. These skills will also prepare you for the algebra that you will study later in this course.

### STUDY STRATEGY

## How did you use the lessons in this chapter?

The notes you made as you studied Chapter 2, using the **Study Strategy** on page 62, may include these properties.

**Lesson 2.2**

**Commutative Property**  
 $a + b = b + a$        $-4 + 6 = 6 + (-4)$

**Associative Property**  
 $(a + b) + c = a + (b + c)$   
 $(-8 + 5) + 3 = -8 + (5 + 3)$

**Identity Property**  
 $a + 0 = a$        $-9 + 0 = -9$

**Property of Zero**  
 $a + -a = 0$        $-7.5 + 7.5 = 0$

## VOCABULARY

- real number line, p. 63
- real numbers, p. 63
- origin, p. 63
- negative numbers, p. 63
- positive numbers, p. 63
- integers, p. 63
- graph of a number, p. 63
- plotting a point, p. 63
- opposites, p. 65
- absolute value, p. 65
- velocity, p. 66
- counterexample, p. 66
- terms of an expression, p. 80
- matrix, p. 86
- entry, or element, of a matrix, p. 86
- distributive property, p. 100
- coefficient, p. 102
- like terms, p. 102
- constant terms, p. 102
- simplified expression, p. 102
- reciprocal, p. 108
- probability of an event, p. 114
- outcomes, p. 114
- theoretical probability, p. 114
- favorable outcomes, p. 114
- experimental probability, p. 115
- odds, p. 116

## 2.1

### THE REAL NUMBER LINE

Examples on pp. 63–66

**EXAMPLES** You can use a number line to graph the real numbers  $2$ ,  $-\frac{1}{2}$ ,  $0.8$ ,  $-1\frac{1}{4}$ ,  $-2$ , and  $-0.8$ , and then put them in order from least to greatest.



In order from least to greatest, the numbers are  $-2$ ,  $-1\frac{1}{4}$ ,  $-0.8$ ,  $-\frac{1}{2}$ ,  $0.8$ , and  $2$ .  
The *opposite* of  $0.8$  is  $-0.8$ . Both  $2$  and  $-2$  have an *absolute value* of  $2$ .

Graph the numbers on a number line. Then write two inequalities that compare the two numbers. **1–6. See margin for graphs.**

- |   |   |   |
|---|---|---|
| 1. $7$ and $-6$<br>$7 > -6, -6 < 7$                   | 2. $-3.9$ and $-4.3$<br>$-3.9 > -4.3, -4.3 < -3.9$    | 3. $-9$ and $8$ $-9 < 8, 8 > -9$  |
| 4. $-0.2$ and $-0.25$<br>$-0.2 > -0.25, -0.25 < -0.2$ | 5. $13.9$ and $-14.9$<br>$13.9 > -14.9, -14.9 < 13.9$ | 6. $\left -\frac{4}{7}\right $ and $-\left \frac{5}{11}\right $<br>$\left -\frac{4}{7}\right  > -\left \frac{5}{11}\right $<br>$-\left \frac{5}{11}\right  < \left -\frac{4}{7}\right $ |

Examples on pp. 72–74

## 2.2

### ADDITION OF REAL NUMBERS

**EXAMPLES** Find  $-8 + (-6)$ .

$$\begin{aligned} |-8| + |-6| &= 14 && \text{Same sign rule} \\ -8 + (-6) &= -14 && \text{Attach common sign.} \end{aligned}$$

Find  $4 + (-7)$ .

$$\begin{aligned} |-7| - |4| &= 3 && \text{Opposite sign rule} \\ 4 + (-7) &= -3 && \text{Attach sign of } -7. \end{aligned}$$

Find the sum.

- |                                  |                                   |   |
|----------------------------------|-----------------------------------|---|
| 7. $12 + (-7)$ <b>5</b>          | 8. $-24 + (-16)$ <b>-40</b>       | 9. $2.4 + (-3.1)$ <b>-0.7</b>   |
| 10. $9 + (-10) + (-3)$ <b>-4</b> | 11. $-35 + 41 + (-18)$ <b>-12</b> | 12. $-2\frac{3}{4} + 5\frac{3}{8} + \left(-4\frac{1}{2}\right)$ <b><math>-1\frac{7}{8}</math></b> |

## 2.3

## SUBTRACTION OF REAL NUMBERS

Examples on  
pp. 79–81**EXAMPLES** To subtract a real number, add its opposite.

$$3 - (-5) = 3 + 5 \quad \text{Add the opposite.} \quad -8 - 7 = -8 + (-7) \quad \text{Add the opposite.}$$

$$= 8 \quad \text{Find the sum.} \quad = -15 \quad \text{Find the sum.}$$

Evaluate the expression.

13.  $-2 - 7 - (-8)$  **-1**      14.  $5 - 11 - (-6)$  **0**      15.  $-18 - 14 - (-15)$  **-17**

16.  $-5.7 + 3.1 - 8.6$  **-11.2**      17.  $-\frac{7}{16} + \left(-\frac{3}{8}\right) - \frac{13}{4}$   **$-4\frac{1}{16}$**       18.  $-\frac{23}{36} - \left|-\frac{4}{9}\right| + \left(-\frac{7}{12}\right)$   **$-1\frac{2}{3}$**

## 2.4

## ADDING AND SUBTRACTING MATRICES

Examples on  
pp. 86–88**EXAMPLES** To add or subtract matrices, add or subtract corresponding entries.

$$\begin{bmatrix} -1 & 3 \\ 2 & -2 \end{bmatrix} + \begin{bmatrix} 2 & 0 \\ -5 & 1 \end{bmatrix} = \begin{bmatrix} -1+2 & 3+0 \\ 2+(-5) & -2+1 \end{bmatrix} = \begin{bmatrix} 1 & 3 \\ -3 & -1 \end{bmatrix}$$

$$\begin{bmatrix} 6 & -6 \\ -2 & 4 \\ -2 & 1 \end{bmatrix} - \begin{bmatrix} -3 & 3 \\ -2 & 5 \\ 7 & -4 \end{bmatrix} = \begin{bmatrix} 6-(-3) & -6-3 \\ -2-(-2) & 4-5 \\ -2-7 & 1-(-4) \end{bmatrix} = \begin{bmatrix} 9 & -9 \\ 0 & -1 \\ -9 & 5 \end{bmatrix}$$

Find the sum and the difference of the matrices.

19.  $\begin{bmatrix} -3 & -2 \\ 8 & 4 \end{bmatrix}, \begin{bmatrix} 4 & -2 \\ -7 & 5 \end{bmatrix}$       20.  $\begin{bmatrix} -2 & 5 & 9 \\ -3 & 10 & 0 \end{bmatrix}, \begin{bmatrix} -1 & -6 & 11 \\ -2 & -7 & 1 \end{bmatrix}$

19.  $\begin{bmatrix} 1 & -4 \\ 1 & 9 \end{bmatrix}; \begin{bmatrix} -7 & 0 \\ 15 & -1 \end{bmatrix}$

20.  $\begin{bmatrix} -3 & -1 & 20 \\ -5 & 3 & 1 \end{bmatrix}; \begin{bmatrix} -1 & 11 & -2 \\ -1 & 17 & -1 \end{bmatrix}$

## 2.5

## MULTIPLICATION OF REAL NUMBERS

Examples on  
pp. 93–95**EXAMPLES** A product is negative if it has an odd number of negative factors.

A product is positive if it has an even number of negative factors.

a.  $(-4)(5) = -20$       **One negative factor**

b.  $\left(-\frac{1}{3}\right)(-3)(2) = 2$       **Two negative factors**

c.  $(-2)(-1)(-3) = -6$       **Three negative factors**

Find the product.

21.  $(-3)(12)$  **-36**      22.  $(5)(-8)$  **-40**      23.  $(-40)(-15)$  **600**      24.  $(-1)(9)$  **-9**

25.  $(-17)\left(\frac{2}{9}\right)$   **$-3\frac{7}{9}$**       26.  $(-14)(-0.3)$  **4.2**      27.  $|(9)(-5.5)|$  **49.5**      28.  $(-3.2)(-10)(2)$  **64**

29.  $(-7)(-6)(-2)$  **-84**      30.  $(-12)(2)(-0.5)$  **12**      31.  $(-24)\left(-\frac{7}{12}\right)$  **14**      32.  $(11)(-1)(-7)(-3)$  **-231**

## THE DISTRIBUTIVE PROPERTY

Examples on  
pp. 100–102

**EXAMPLES** You can use the distributive property to rewrite expressions without parentheses.

$$8(x + 3) = 8x + 24$$

$$a(b + c) = ab + ac \text{ or } (b + c)a = ba + ca$$

$$3(x - 6) = 3x - 18$$

$$a(b - c) = ab - ac \text{ or } (b - c)a = ba - ca$$

Use the distributive property to rewrite the expression without parentheses.

33.  $5(x + 12)$

$5x + 60$

34.  $(y + 6)9$

$9y + 54$

35.  $5.5(b - 10)$

$5.5b - 55$

36.  $(3.2 - w)2$

$6.4 - 2w$

37.  $(t + 11)(-3)$

$-3t - 33$

38.  $-2(s + 13)$

$-2s - 26$

39.  $-2.5(z - 5)$

$-2.5z + 12.5$

40.  $-x\left(\frac{3}{7} + y\right)$

$-\frac{3x}{7} - xy$

## DIVISION OF REAL NUMBERS

Examples on  
pp. 108–110

**EXAMPLE** To divide 7 by  $-6$ , multiply 7 by the reciprocal of  $-6$ .

$$7 \div (-6) = 7 \cdot \left(-\frac{1}{6}\right) = -\frac{7}{6}$$

$$b \div a = b \cdot \frac{1}{a}$$

Find the quotient.

41.  $48 \div (-12)$   $-4$  42.  $-34 \div 2$   $-17$  43.  $39 \div (-13)$   $-3$  44.  $-57 \div (-19)$   $3$

45.  $55 \div (-1.1)$   $-50$  46.  $-63 \div 4\frac{1}{5}$   $-15$  47.  $\frac{48}{-3}$   $-16$  48.  $-\frac{-84}{7}$   $12$

## PROBABILITY AND ODDS

Examples on  
pp. 114–116

**EXAMPLES** Find how likely it is that you will randomly choose a green marble from a bag with 11 green, 2 blue, and 7 red marbles.

**Probability**

$$P = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}}$$

$$P = \frac{11}{20} = 0.55$$

The probability is 0.55.

**Odds**

$$\text{Odds} = \frac{\text{Number of favorable outcomes}}{\text{Number of unfavorable outcomes}}$$

$$= \frac{11}{9}$$

The odds are 11 to 9.

Find the probability and the odds of randomly choosing a red marble from a bag of red and white marbles.

49. Number of red marbles: 12  
Total number of marbles: 48  $0.25$ ,  $1$  to  $3$  50. Number of red marbles: 9  
Total number of marbles: 81  $\frac{1}{9} \approx 0.11$ ;  $1$  to  $8$

51. Number of white marbles: 36  
Total number of marbles: 40  $0.1$ ,  $1$  to  $9$  52. Number of white marbles: 17  
Total number of marbles: 68  $0.75$ ,  $3$  to  $1$

Find the value of the expression.

1.  $|8|$  **8**      2.  $|-2.7|$  **2.7**      3.  $|-6.4| - 3.1$  **3.3**      4.  $-(-4.5)$  **4.5**  
 5.  $4 + (-9)$  **-5**      6.  $-4.5 + (-9.1)$  **-13.6**      7.  $-2\frac{5}{6} + 3\frac{1}{4}$   **$\frac{5}{12}$**       8.  $9 + (-10) + 2$  **1**

Add or subtract the matrices. 9–11. See margin.

9.  $\begin{bmatrix} 3 & -7 \\ \frac{1}{2} & 6 \\ 0 & 2 \end{bmatrix} + \begin{bmatrix} 4 & 2 \\ \frac{1}{2} & 4 \\ 5 & \frac{1}{2} \end{bmatrix}$       10.  $\begin{bmatrix} -5 & -1 \\ 5 & 8 \\ \frac{7}{8} & 2\frac{1}{2} \end{bmatrix} - \begin{bmatrix} 6 & 3 \\ \frac{1}{2} & -2 \\ 0 & 2 \end{bmatrix}$       11.  $\begin{bmatrix} 2 & \frac{1}{2} & 4 \\ 5 & 16 & -7 \end{bmatrix} + \begin{bmatrix} 5 & \frac{1}{2} & -1 \\ -2 & 8 & 4 \end{bmatrix}$

Find the product or quotient.

12.  $(-6)(4)$  **-24**      13.  $72 \div (-12)$  **-6**      14.  $-36 \div (-4)$  **9**      15.  $(-8.4)(-100)$  **840**  
 16.  $-56 \div \left(-\frac{7}{8}\right)$  **64**      17.  $(-9)(8)\left(-\frac{5}{6}\right)$  **60**      18.  $-3740 \div (-10)$  **374**      19.  $-(-18)(-5)\left(\frac{7}{15}\right)$  **-42**  
 20.  $-\frac{3}{8} \div \frac{1}{2}$   **$-\frac{3}{4}$**       21.  $\left(1\frac{2}{7}\right)\left(1\frac{5}{9}\right)$  **2**      22.  $\left(-\frac{1}{2}\right)\left(\frac{3}{5}\right)\left(-\frac{2}{3}\right)\left(\frac{5}{8}\right)$   **$\frac{1}{8}$**       23.  $-7\frac{4}{5} \div \left(-1\frac{3}{10}\right)$  **6**

Simplify the expression.

24.  $(-5)(-w)(w)(w)$   **$5w^3$**       25.  $(-8)^2(-x)^3$   **$-64x^3$**       26.  $8(4 - q)$   **$32 - 8q$**       27.  $(6 + y)(-12)$   **$-72 - 12y$**   
 28.  $(35 - 10q)\left(-\frac{2}{5}\right)$   **$-14 + 4q$**       29.  $-9(y + 11)$   **$-9y - 99$**       30.  $5(3 - z) - z$   **$15 - 6z$**       31.  $14p + 2(5 - p)$   **$12p + 10$**

In Exercises 32–37, evaluate the expression for the given value of  $x$ .

32.  $5 - (-8) + x$  when  $x = -5$  **8**      33.  $|-9| - 2x + 5$  when  $x = 6$  **2**      34.  $-9x + 12$  when  $x = -2$  **30**  
 35.  $1 - 2x^2$  when  $x = -2$  **-7**      36.  $\frac{4-x}{-3}$  when  $x = -1$   **$-\frac{5}{3}$**       37.  $-4x^2 - 8x + 9$  when  $x = -5$  **-51**

38.  **PROFIT** A company had a first-quarter profit of \$2189.70, a second-quarter profit of \$1527.11, a third-quarter loss of \$2502.18, and a fourth-quarter loss of \$266.54. What was the company's profit or loss for the year? **\$948.09 profit**

39.  **EAGLES** An eagle dives from its nest with a velocity of  $-8\frac{1}{3}$  feet per second. Find the vertical displacement in  $4\frac{1}{2}$  seconds.  **$-37\frac{1}{2}$  ft**

 **BEVERAGE SURVEY** You do a survey asking students to identify their favorite beverage from the following categories: *soda, juice, water, and other*. You get the following results: 132 students choose *soda*, 59 choose *juice*, 43 choose *water*, and 26 choose *other*.

40. What is the probability that a randomly chosen student's favorite drink is juice?  **$\frac{59}{260} \approx 0.23$**   
 41. What are the odds that a randomly chosen student's favorite drink is water? **43 to 217**