3-7 Negative Integers as Exponents

You know by the rule of exponents that you learned for multiplying powers of the same base that

$$10^1 \times 10^2 = 10^{1+2} = 10^3.$$

Since we want to apply the same rule to negative exponents, we must have

$$10^1 \times 10^{-1} = 10^{1+(-1)} = 10^0 = 1$$

$$10^2 \times 10^{-2} = 10^{2+(-2)} = 10^0 = 1$$

and so on. We know that

$$10^1 \times \frac{1}{10} = 10 \times 0.1 = 1 \text{ and } 10^2 \times \frac{1}{10^2} = 100 \times 0.01 = 1,$$

so 10^{-1} should equal $\frac{1}{10}$ and 10^{-2} should equal $\frac{1}{10^2}$. This example suggests the following general rule.

Rule

For all numbers $a (a \neq 0)$, m, and n,

$$a^{-m} = \frac{1}{a^m}$$

EXAMPLE Write the expression without exponents.

a. 5^{-2} **b.** $(-3)^{-2}$ **c.** $(-4)^{-1}(-4)^{-2}$

Solution

a. $5^{-2} = \frac{1}{5^2} = \frac{1}{5 \times 5} = \frac{1}{25}$

b. $(-3)^{-2} = \frac{1}{(-3)^2} = \frac{1}{(-3)(-3)} = \frac{1}{9}$

c. $(-4)^{-1} \times (-4)^{-2} = (-4)^{-1+(-2)} = (-4)^{-3}$

$$= \frac{1}{(-4)^3} = \frac{1}{(-4)(-4)(-4)} = \frac{1}{-64}$$

Class Exercises

Use the rules for exponents to state the expression without exponents.

1. 3^{-4} **2.** $(-6)^{-2}$ **3.** $10^4 \times 10^{-4}$ **4.** $3^5 \times 3^{-7}$ **5.** $(-2)^3(-2)^{-1}$

Self-Test B

Find the product.

1. $4.2(-11.3)$ **2.** $-6.7(20.4)$ **3.** $7.5(-4.2)(-12)$ [3-5]

Find the quotient.

4. $121 \div (-11)$ **5.** $-68.2 \div 2.2$ **6.** $-0.56 \div (-0.07)$ [3-6]

Write the expression without exponents.

7. 4^{-2} **8.** $(-6)^{-3}$ **9.** $7^5 \times 7^{-8}$ **10.** $(-9)^{-2} \times (-9)^0$ [3-7]

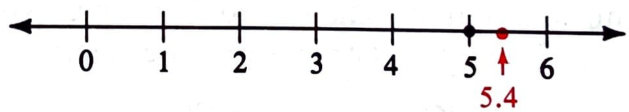
Self-Test answers and Extra Practice are at the back of the book.

NONROUTINE PROBLEM SOLVING: *Greatest Integer Function*

We use the symbol $[x]$ (read *the greatest integer in x*) to represent the greatest integer less than or equal to x.

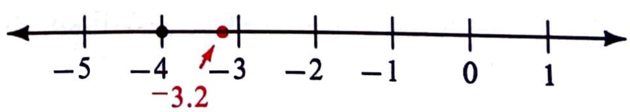
EXAMPLE **a.** $[5.4]$ **b.** $[-3.2]$

Solution **a.** There is no integer equal to 5.4, so we must find the greatest integer that is less than 5.4.



As shown on the number line, the greatest integer that is less than 5.4 is 5. Thus *the greatest integer in 5.4* is 5.

b. There is no integer equal to -3.2, so we must find the greatest integer that is less than -3.2.



As shown on the number line, the greatest integer that is less than $^-3.2$ is $^-4$. Thus the *greatest integer in* $^-3.2$ is $^-4$.

Find the value of each of the following.

1. $[6.2]$ **2.** $[1.23]$ **3.** $[3]$ **4.** $[45]$

5. $[-12]$ **6.** $[-1]$ **7.** $[-4.89]$ **8.** $[-0.36]$

4-3 Least Common Denominator

In calculations and comparisons, we work with more than one fraction. It is sometimes necessary to replace fractions with equivalent fractions so that all have the same denominator, called a *common denominator.* For example, in the addition $\frac{1}{6} + \frac{3}{4}$ we may write $\frac{1}{6}$ as $\frac{2}{12}$ and $\frac{3}{4}$ as $\frac{9}{12}$, using 12 as a common denominator. We may also use 24, 36, 48, or any other multiple of both denominators as a common denominator.

The **least common denominator** (LCD) of two or more fractions is the *least common multiple* (LCM) of their denominators. The LCD of $\frac{1}{6}$ and $\frac{3}{4}$ is 12, since 12 is the LCM of 6 and 4.

EXAMPLE 1 Write equivalent fractions with the LCD: $\frac{1}{24}$, $\frac{5}{48}$, $\frac{11}{120}$.

Solution The LCD is the least common multiple of 24, 48, and 120. Use prime factorization to find the LCM.

Prime factorization of 24: $2 \times 2 \times 2 \times 3$, or $2^3 \times 3$
Prime factorization of 48: $2 \times 2 \times 2 \times 2 \times 3$, or $2^4 \times 3$
Prime factorization of 120: $2 \times 2 \times 2 \times 3 \times 5$, or $2^3 \times 3 \times 5$

The LCM is the product of the highest powers of each factor. The LCM $= 2^4 \times 3 \times 5 = 240$, so the LCD $= 240$.

$$\frac{1}{24} = \frac{1 \times 10}{24 \times 10} = \frac{10}{240} \qquad \frac{5}{48} = \frac{5 \times 5}{48 \times 5} = \frac{25}{240} \qquad \frac{11}{120} = \frac{11 \times 2}{120 \times 2} = \frac{22}{240}$$

EXAMPLE 2 Replace __?__ with $<$, $>$, or $=$ to make a true statement.

a. $\frac{5}{6}$ __?__ $\frac{6}{7}$ **b.** $-\frac{5}{8}$ __?__ $-\frac{9}{14}$

Solution First rewrite each pair of fractions as equivalent fractions with the LCD. Then compare the fractions.

a. The LCD is the LCM of 6 and 7, or 42.

$$\frac{5}{6} = \frac{5 \times 7}{6 \times 7} = \frac{35}{42} \qquad \frac{6}{7} = \frac{6 \times 6}{7 \times 6} = \frac{36}{42}$$

$$\frac{35}{42} < \frac{36}{42}, \text{ so } \frac{5}{6} < \frac{6}{7}.$$

b. The LCD is the LCM of 8 and 14, or 56.

$$-\frac{5}{8} = -\frac{5 \times 7}{8 \times 7} = -\frac{35}{56} \qquad -\frac{9}{14} = -\frac{9 \times 4}{14 \times 4} = -\frac{36}{56}$$

$$-\frac{35}{56} > -\frac{36}{56}, \text{ so } -\frac{5}{8} > -\frac{9}{14}.$$

When fractions have variables in their denominators, we may obtain a common denominator by finding a common multiple of the denominators.

EXAMPLE 3 Write equivalent fractions with a common denominator: $\frac{2}{a}, \frac{3}{b}$.

Solution $\frac{2}{a} = \frac{2 \times b}{a \times b} = \frac{2b}{ab}$ $\frac{3}{b} = \frac{3 \times a}{b \times a} = \frac{3a}{ab}$

Class Exercises

State the LCM of the pair of numbers.

1. 6, 18
2. 11, 4
3. 10, 8
4. 15, 12
5. 32, 48

State the LCD of the pair of fractions.

6. $\frac{1}{2}, \frac{3}{4}$
7. $\frac{5}{6}, \frac{1}{2}$
8. $\frac{3}{4}, -\frac{1}{3}$
9. $-\frac{2}{9}, \frac{1}{6}$
10. $\frac{1}{16}, \frac{5}{12}$

Written Exercises

Write the fractions as equivalent fractions with the least common denominator (LCD).

A

1. $\frac{1}{3}, \frac{1}{12}$
2. $\frac{1}{4}, \frac{1}{12}$
3. $\frac{3}{4}, \frac{5}{8}$
4. $\frac{3}{8}, \frac{3}{16}$
5. $\frac{2}{9}, -\frac{1}{27}$
6. $-\frac{1}{7}, \frac{1}{49}$
7. $\frac{10}{21}, \frac{2}{49}$
8. $\frac{7}{18}, \frac{5}{36}$
9. $-\frac{2}{3}, \frac{7}{30}$
10. $\frac{5}{12}, -\frac{6}{11}$
11. $\frac{4}{75}, \frac{7}{100}$
12. $\frac{9}{56}, \frac{4}{63}$
13. $-\frac{3}{7}, -\frac{7}{112}$
14. $-\frac{4}{17}, -\frac{9}{16}$
15. $\frac{5}{42}, \frac{5}{49}$
16. $\frac{5}{84}, \frac{7}{12}$

B

17. $\frac{7}{8}, \frac{5}{16}, \frac{21}{40}$
18. $\frac{1}{4}, \frac{1}{9}, \frac{1}{5}$
19. $\frac{3}{7}, \frac{7}{4}, \frac{4}{9}$
20. $\frac{11}{18}, \frac{1}{54}, \frac{2}{27}$
21. $\frac{1}{65}, \frac{3}{5}, \frac{9}{26}$
22. $-\frac{7}{8}, \frac{9}{28}, \frac{2}{49}$
23. $-\frac{5}{6}, \frac{2}{9}, -\frac{7}{8}$
24. $\frac{11}{12}, \frac{1}{72}, -\frac{7}{8}$
25. $\frac{a}{3}, \frac{b}{6}$
26. $\frac{m}{25}, \frac{n}{15}$
27. $\frac{h}{25}, \frac{h}{100}, \frac{h}{125}$
28. $\frac{a}{2}, \frac{b}{3}, \frac{c}{4}$

Write the fractions as equivalent fractions with a common denominator.

29. $\frac{1}{c}, \frac{2}{3c}$
30. $\frac{1}{x}, \frac{1}{y}$
31. $\frac{3}{x}, \frac{1}{y}, \frac{5}{z}$
32. $\frac{-1}{r}, \frac{2}{rs}, \frac{r}{s}$

4. Carl is 4 ft tall. If he grew $1\frac{1}{8}$ in. during the past year, and $\frac{3}{4}$ in. the year before, how tall was he one year ago?

5. On Monday, Kim jogged $1\frac{1}{2}$ mi in $\frac{1}{4}$ h. On Wednesday she jogged $2\frac{1}{3}$ mi in $\frac{1}{3}$ h. How much farther did Kim jog on Wednesday than on Monday?

B 6. Last year, total rainfall for April and May was $7\frac{1}{4}$ in. This year 3 in. of rain fell in April and $2\frac{5}{8}$ in. fell in May. How much less rain fell this year than last year during April and May?

C 7. A 512-page book has pages 7 in. wide by 9 in. high. The printed area measures $5\frac{3}{8}$ in. by $7\frac{3}{4}$ in. The left margin is $\frac{5}{16}$ in. and the top margin is $\frac{9}{16}$ in. How wide are the margins at the right and the bottom of each page?

Self-Test A

Complete.

1. $5 \times \underline{\ ?\ } = \frac{5}{8}$ 2. $3 \times \underline{\ ?\ } = -1$ [4-1]

3. $7 \div 9 = \underline{\ ?\ }$ 4. $-\frac{2}{3} = \frac{-2}{3} = \underline{\ ?\ }$

Write as a proper fraction in lowest terms or as a mixed number in simple form.

5. $\frac{16}{64}$ 6. $-\frac{72}{30}$ 7. $\frac{32}{42}$ 8. $\frac{-71}{48}$ 9. $\frac{68}{16}$ [4-2]

Write as an improper fraction.

10. $2\frac{1}{5}$ 11. $-3\frac{2}{3}$ 12. $6\frac{4}{15}$ 13. $1\frac{7}{12}$ 14. $-8\frac{5}{8}$

Write as equivalent fractions with the least common denominator.

15. $\frac{7}{9}, \frac{7}{8}$ 16. $-\frac{10}{49}, \frac{2}{21}$ 17. $\frac{3}{50}, \frac{6}{225}$ 18. $-\frac{8}{15}, -\frac{1}{30}$ [4-3]

Add or subtract. Write the answer as a proper fraction in lowest terms or as a mixed number in simple form.

19. $\frac{1}{3} + \frac{1}{4}$ 20. $\frac{1}{5} - \frac{1}{3}$ 21. $\frac{2}{15} + \left(-\frac{5}{6}\right)$ [4-4]

22. $16\frac{5}{8} - \frac{3}{4}$ 23. $17\frac{1}{3} + 5\frac{1}{9}$ 24. $-6\frac{3}{8} + 2\frac{1}{6}$

Self-Test answers and Extra Practice are at the back of the book.

▲ See Pages E5–E6

4-7 Fractions and Decimals

Any fraction can be represented as a decimal. You may recall that a fraction such as $\frac{3}{4}$ can be easily written as an equivalent fraction whose denominator is a power of 10, and then as a decimal. To represent $\frac{3}{4}$ as a decimal, we first write it as an equivalent fraction with denominator 100.

$$\frac{3}{4} = \frac{3 \times 25}{4 \times 25} = \frac{75}{100} = 0.75$$

For most fractions, however, we use the fact that $\frac{a}{b} = a \div b$ and divide numerator by denominator.

EXAMPLE 1 Write as a decimal: **a.** $-\frac{5}{16}$ **b.** $\frac{24}{55}$

Solution **a.** First find $5 \div 16$.

$$\begin{array}{r}
0.3125 \\
16\overline{)5.0000} \\
\underline{4\,8} \\
20 \\
\underline{16} \\
40 \\
\underline{32} \\
80 \\
\underline{80} \\
0
\end{array}$$

Therefore, $-\frac{5}{16} = -0.3125$.

The decimal -0.3125 is called a **terminating decimal** because the final remainder is 0 and the division ends.

b. Find $24 \div 55$.

$$\begin{array}{r}
0.43636 \\
55\overline{)24.00000} \\
\underline{22\,0} \\
2\,00 \\
\underline{1\,65} \\
350 \\
\underline{330} \\
200 \\
\underline{165} \\
350 \\
\underline{330} \\
20
\end{array}$$

Therefore, $\frac{24}{55} = 0.43636\ldots$.

The digits 36 continue to repeat without end. The decimal $0.43636\ldots$ is called a **repeating decimal.** We often write $0.43636\ldots$ as $0.4\overline{36}$, with a bar over the block of digits that repeats.

To say that $\frac{24}{55} = 0.43636\ldots$ means that the successive decimals 0.436, 0.4363, 0.43636, and so on, will come closer and closer to the value $\frac{24}{55}$.

We can predict when a fraction will result in a terminating decimal because the fraction in lowest terms has a denominator with no prime factors other than 2 and 5. Thus, the fraction $\frac{24}{55}$ does not result in a terminating decimal because its denominator has 11 as a prime factor.

When working with a mixed number, such as $-1\frac{5}{16}$ or $1\frac{24}{25}$, we may consider the mixed number as a sum of a whole number and a fraction, or we may rewrite the mixed number as an improper fraction and then divide.

If a and b are integers and $b \neq 0$, the quotient $a \div b$ is either a terminating decimal or a repeating decimal. The reason for this is that, for any divisor, the number of possible remainders at each step of the division is limited to the whole numbers less than the divisor. Sooner or later, either the remainder is 0 and the division ends, as in part (a) of Example 1, or one of the remainders reappears in the division as in part (b) of Example 1. Then the same block of digits will reappear in the quotient.

Property

Every rational number can be represented by either a terminating decimal or a repeating decimal.

You already know how to write a terminating decimal as a fraction. Rewrite the decimal as a fraction whose denominator is a power of 10.

EXAMPLE 2 Write -0.625 as a fraction in lowest terms.

Solution

$$-0.625 = -\frac{625}{1000} = -\frac{625 \div 125}{1000 \div 125} = -\frac{5}{8}$$

The next example shows a method for writing a repeating decimal as a fraction.

EXAMPLE 3 Write $-1.\overline{21}$ as a fraction in lowest terms.

Solution Let $n = 1.\overline{21}$.

Multiply both sides of the equation by a power of 10 determined by the number of digits in the block of repeating digits. Since there are

2 digits that repeat in the number $1.\overline{21}$, we multiply by 10^2, or 100.

$$\begin{aligned} 100n &= 121.\overline{21} \\ \text{Subtract:} \quad n &= 1.\overline{21} \\ \hline 99n &= 120 \\ n &= \frac{120}{99} = \frac{40}{33} \end{aligned}$$

Thus, $-1.\overline{21} = -\frac{40}{33}$, or $-1\frac{7}{33}$.

> ***Property***
>
> Every terminating or repeating decimal represents a rational number.

Some decimals, such as those below, neither terminate nor repeat.

$0.01001000100001\ldots$ $\qquad$ $1.234567891011121314\ldots$

The two decimals shown follow patterns, but they are not repeating patterns. The decimal on the right is made up of consecutive whole numbers beginning with 1.

Decimals that neither terminate nor repeat represent **irrational numbers.** Together, the rational numbers and the irrational numbers make up the set of **real numbers.** The number line that you have studied is sometimes called the **real number line.** For every point on the line, there is exactly one real number and for every real number there is exactly one point on the number line.

Class Exercises

Tell whether the decimal for the fraction is terminating or repeating. If the decimal is terminating, state the decimal.

1. $\frac{1}{4}$ **2.** $\frac{5}{6}$ **3.** $2\frac{2}{5}$ **4.** $-\frac{9}{10}$ **5.** $-1\frac{1}{2}$ **6.** $\frac{13}{30}$

State as a fraction in which the numerator is an integer and the denominator is a power of 10.

7. 0.13 **8.** -0.9 **9.** 1.4 **10.** -0.007 **11.** 3.03 **12.** -5.001

Self-Test B

Multiply or divide. Write the answer as a proper fraction in lowest terms or as a mixed number in simple form.

1. $\frac{3}{4} \times 5$	2. $\frac{1}{8} \times \left(-\frac{1}{3}\right)$	3. $\frac{28}{35} \times \frac{21}{14}$	[4-5]
4. $8\frac{3}{4} \times \frac{3}{16}$	5. $-3\frac{1}{8} \times \left(-4\frac{4}{5}\right)$	6. $-2\frac{4}{7} \times 3\frac{1}{6}$	
7. $\frac{5}{8} \div \frac{10}{24}$	8. $-\frac{11}{16} \div \frac{44}{8}$	9. $-\frac{18}{5} \div \left(-\frac{9}{35}\right)$	[4-6]
10. $1\frac{1}{4} \div 25$	11. $4\frac{1}{3} \div \left(-\frac{26}{27}\right)$	12. $-4\frac{2}{7} \div \left(-2\frac{1}{14}\right)$	

Write as a decimal. Use a bar to show repeating digits.

13. $\frac{5}{8}$ 14. $\frac{2}{11}$ 15. $-\frac{1}{80}$ 16. $\frac{7}{6}$ [4-7]

Write as a proper fraction in lowest terms or as a mixed number in simple form.

17. 0.875 18. $1.\overline{6}$ 19. -2.213 20. $0.2\overline{3}$

Self-Test answers and Extra Practice are at the back of the book.

COMPUTER INVESTIGATION: *Decimal Approximation*

The following program will print a decimal approximation for any positive proper fraction. The first approximation is rounded to the number of digits that the computer usually displays. The computer will then print an approximation to any desired number of digits.

```
10  PRINT "INPUT NUMERATOR, THEN DENOMINATOR"
20  INPUT N,D
30  IF N > D THEN 10
40  PRINT N;"/";D;" = ";N / D
50  PRINT "HOW MANY DIGITS DO YOU WANT ?";
60  INPUT K
70  PRINT "OR .";
80  FOR I = 1 TO K
90  LET P = 10 * N / D
100  PRINT  INT (P);
110  LET N = 10 * N - D *  INT (P)
120  NEXT I
130  END
```

Use the program to discover the repeating pattern for these fractions.

1. $\frac{1}{7}$ 2. $\frac{2}{7}$ 3. $\frac{10}{11}$ 4. $\frac{5}{13}$ 5. $\frac{76}{99}$ 6. $\frac{12}{37}$ 7. $\frac{17}{33}$ 8. $\frac{134}{333}$

5-2 Equivalent Equations

On page 9, you learned that a *solution* of an equation involving a variable is a value of the variable that makes the equation true. Because the equation

$$x + 5 = 18$$

is true when $x = 13$, 13 is a solution of the equation. An equation may have no solution, one solution, or more than one solution.

The set of numbers that a variable may represent is called the *replacement set*. When the replacement set is small, we may substitute the values for the variable to solve the equation. When the replacement set is larger, for example the rational numbers, substitution may not be practical. In such cases, we use the properties that we have learned to change, or **transform,** the equation into a simpler equation that has the same solution. Two equations that have the same solution are called **equivalent equations.**

One transformation that we may use to obtain an equivalent equation is the following.

Simplify numerical expressions and variable expressions.

The example that follows shows how to use this transformation to obtain equivalent equations. You will learn how to solve equations in the lessons that follow.

EXAMPLE Simplify the expressions on both sides of the equation to obtain an equivalent equation.

a. $y - 8 + 3 = 24 \div 6$ **b.** $38 = 2n + 6 + 3n$ **c.** $2(a + 3) = 18$

Solution

a. Perform the operations on each side of the equation to simplify the numerical expressions.

$$y - 8 + 3 = 24 \div 6$$
$$y - 5 = 4$$

b. Combine like terms to simplify the variable expressions.

$$38 = 2n + 6 + 3n$$
$$38 = 2n + 3n + 6$$
$$38 = 5n + 6$$

c. Use the distributive property to simplify the left side.

$$2(a + 3) = 18$$
$$2a + 2(3) = 18$$
$$2a + 6 = 18$$

Throughout the rest of the chapter, if no replacement set is given for an equation, assume that the solution can be any number.

COMMUNICATION IN MATHEMATICS: *Study Skills*

When you find a reference in the text to material that you studied earlier, reread the material in the earlier section to help you understand the new lesson. For example, page 146 includes a reference to the definition of *solution* that you learned earlier. Turn back to page 9 to review the definition.

Class Exercises

Simplify the expressions on both sides of the equation to obtain an equivalent equation.

1. $m - 9 + 5 = 32 \div 8$

2. $4 \times 12 = 3 + h - 10$

3. $13 + 8 + k = 11 \times 5$

4. $45 \div 9 = t - 7 - 8$

5. $42 = 3n + 2 + 5n$

6. $8v - 10 + 2v = 30$

7. $7q + 15 - 2q = 25$

8. $35 = y - 7 + 5y$

9. $3(x + 2) = 18$

10. $20 = 5(a - 3)$

Written Exercises

Simplify the expressions on both sides of the equation to obtain an equivalent equation.

A

1. $b + 10 - 3 = 44 \div 2$

2. $5 \times 23 = 8 + k + 7$

3. $24 \times 3 = 8 + 12 + u$

4. $c - 11 + 4 = 54 \div 9$

5. $26 \div 13 = -7 - 5 + v$

6. $8 \times 12 = e + 14 - 2$

7. $4 + 9 + f - 3 = 24 \div 2 \times 3$

8. $6 \times 8 \div 3 = t + 12 - 9 + 6$

9. $33 = 4n - 7 + 6n$

10. $12a + 8 - 3a = 35$

11. $13q - 2q - 2 = 20$

12. $14 = 7d - 2 + d$

13. $15 = 3z + 5 + 2z$

14. $-8v + 2v + 3 = 21$

15. $4x + 8x - 2x + 7 = -13$

16. $18 = 2f - 5f + 9 + 6f$

17. $4(j + 2) = 36$

18. $42 = (g + 3)7$

19. $20 = (e - 5)2$

20. $-8(m - 1) = 24$

Solve.

34. $15 - 6(x + 2) = 1$

35. $50 = 2(5r + 2) - 1$

36. $26 = -5(4 + 8y) - 6$

37. $3a = 2.5(8 + a)$

38. $0.3(p + 4) = 2.7p$

39. $x(4.8 - 2) = 4.8x - 2$

40. $4q + 19 = \frac{5}{6}q$

41. $\frac{3}{5}c = 2c - 7$

42. $\frac{2}{3}a = -15 - a$

C **43.** $\frac{1}{2}b + \frac{3}{5} = 2b - \frac{9}{10}$

44. $\frac{3}{4}f - \frac{1}{2} = 2f + \frac{1}{2}$

45. $-\frac{1}{6}\left(t - \frac{1}{3}t\right) = -t + 36$

46. $-z - 9 = \frac{3}{4}\left(2z + \frac{4}{3}\right)$

47. $\frac{2}{3}\left(m - \frac{1}{2}\right) + 3 = \frac{m}{3} - 7$

48. $\frac{1}{2}(-4x - 5) = 7x - \frac{1}{2}$

Write an equation for the word sentence and solve for *y*.

49. Nine divided by six is four times the difference of a number *y* subtracted from four.

50. Five times the sum of a number *y* and 11 is seventeen minus three.

51. Five eighteenths subtracted from one third of a number *y* is twice the number *y*.

52. One half the sum of five and a number *y* is one quarter *y*.

Self-Test A

Use one of the properties of equality to form a true sentence.

1. If $35 + p = 47$, then $p = \underline{\ ?\ }$.

2. If $-6a = 48$, then $a = \underline{\ ?\ }$. [5-1]

Simplify the expressions on both sides of the equation to obtain an equivalent equation.

3. $17 = 3x - 9 + 5x - 8$

4. $24 \div 3 = 5(m - 9)$ [5-2]

Use transformations to solve the equation.

5. $x + 19 = 24$

6. $36 = y - 11$

7. $a + 14 = -9 - 3$ [5-3]

8. $-8q = 56$

9. $\frac{m}{18} = 9$

10. $\frac{1}{4}d = 8$ [5-4]

11. $27 = 2y - 13$

12. $-2(7 + 2b) = 52$

13. $6n - 9 - 3n = n - 17$ [5-5]

Self-Test answers and Extra Practice are at the back of the book.