### Example 12 Application: Solving Linear Equations

The original price of a Blu-Ray player was reduced by $45.50. The sale price was $165.90. Solve the equation $y - 45.50 = 165.90$ to determine the original price of the Blu-Ray player.

**Solution**

$$y - 45.50 = 165.90$$

$$y - 45.50 + 45.50 = 165.90 + 45.50 \qquad \text{Use the addition principle of equality by adding 45.50 to both sides.}$$

$$y = 211.40 \qquad \text{Simplify.}$$

The original price of the Blu-Ray player was $211.40.

***Now work margin exercise 12.***

***Completion Example Answers***

**7.** $5x - 4x - 1.5 = 6.3 + 4.0$ Write the equation.

$x - 1.5 = 10.3$ Combine like terms on both sides of the equation.

$x - 1.5 + 1.5 = 10.3 + 1.5$ Add 1.5 (the opposite of –1.5) to both sides of the equation.

$x = 11.8$ Simplify.

**11.** $\frac{4x}{5} = \frac{3}{10}$ Write the equation.

$\frac{5}{4} \cdot \frac{4}{5} x = \frac{5}{4} \cdot \frac{3}{10}$ Multiply both sides by $\frac{5}{4}$.

$1 \cdot x = \frac{1 \cdot \cancel{5}}{4} \cdot \frac{3}{2 \cdot \cancel{5}}$ Simplify.

$x = \frac{3}{8}$

***Margin Exercise Answers***

**1. a.** $x = 4$ is not a solution **b.** $y = 0.5$ is a solution **c.** $z = 2.2$ is a solution **d.** $y = -7$ is a solution

**2.** $x = 17$ **3.** $x = -12$ **4.** $x = 3.7$ **5.** $x = \frac{9}{8}$ **6.** $z = -5$ **7.** $z = 4.2$ **8.** $x = 11$ **9.** $x = 4$ **10.** $x = 15$

**11.** $x = \frac{6}{5}$ **12.** The original price of the wool coat was $100.59.

**12.** The original price of a wool coat was reduced by $15.80. The reduced price was $84.79. Solve the equation $y - 15.80 = 84.79$ to determine the original price of the coat.

# 9.1 Exercises

## Concept Check

**Fill-in-the-Blank.** Complete each sentence using information found in this section.

1. A/An _____ is a statement that two algebraic expressions are equal.

2. If an equation contains a variable, any number that gives a true statement when substituted for the variable is a/an _____ of the equation.

3. The _____ principle of _____ involves adding the same algebraic expression to both sides of an equation.

4. The objective of solving linear equations is to get the variable (with a coefficient of +1) on one side of the equation and any _____ on the other side.

5. Multiplying by the reciprocal of the coefficient of the variable is the same as _____ by the coefficient.

6. If both sides of an equation are multiplied by the same nonzero constant, the _____ principle of equality can be used.

**True/False.** Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

7. When an algebraic expression is added to both sides of an equation, the new equation has the same solutions as the original equation.

8. The process of finding the solution set to an equation is called simplifying the equation.

9. A linear equation in $x$ is also called a first-degree equation in $x$.

10. Equations with the same solutions are said to be equivalent equations.

## Practice

Determine whether the given number is a solution to the given equation by substituting and then evaluating. See Example 1.

1. $x + 4 = 2$ given that $x = -2$
2. $z + (-12) = 6$ given that $z = 18$
3. $x - 3 = -7$ given that $x = 4$
4. $x - 2 = -3$ given that $x = 1$
5. $-10 + x = -14$ given that $x = -4$
6. $-9 - x = -14$ given that $x = 5$
7. $-26 + |x| = -8$ given that $x = -18$
8. $42 + |z| = -30$ given that $z = -72$
9. $|x| - |-3| = 25$ given that $x = -28$
10. $|-2| + |x| = 13$ given that $x = -11$

Solve each equation. See Examples 2 through 11.

11. $x - 6 = 1$
12. $x - 10 = 9$
13. $y + 7 = 3$
14. $y + 12 = 5$
15. $x + 15 = -4$
16. $x + 17 = -10$
17. $22 = n - 15$
18. $36 = n - 20$
19. $6 = z + 12$
20. $18 = z + 1$
21. $x - 20 = -15$
22. $x - 10 = -11$
23. $y + 3.4 = -2.5$
24. $y + 1.6 = -3.7$
25. $x + 3.6 = 2.4$
26. $x + 2.7 = 3.8$
27. $x + \frac{1}{20} = \frac{3}{5}$
28. $n - \frac{2}{7} = \frac{3}{14}$

**29.** $5x = 45$

**30.** $9x = 108$

**31.** $32 = 4y$

**32.** $51 = 17y$

**33.** $\frac{3x}{4} = 15$

**34.** $\frac{5x}{7} = 65$

**35.** $\frac{y}{5} = 2$

**36.** $\frac{x}{3} = -4$

**37.** $-1 = \frac{x}{8}$

**38.** $0 = \frac{x}{15}$

**39.** $7x - 8x = 13 - 25$

**40.** $10n - 11n = 20 - 14$

**41.** $3n - 2n + 6 = 14$

**42.** $7n - 6n + 13 = 22$

**43.** $1.7y + 1.3y = 6.3$

**44.** $2.5y + 7.5y = 4.2$

**45.** $\frac{3}{4}x = \frac{5}{3}$

**46.** $\frac{5}{6}x = \frac{5}{3}$

**47.** $7.5x = -99.75$

**48.** $-14 = 0.7x$

**49.** $1.5y - 0.5y + 6.7 = -5.3$

**50.** $2.6y - 1.6y - 5.1 = -2.9$

**51.** $10x - 9x - \frac{1}{2} = -\frac{9}{10}$

**52.** $6x - 5x + \frac{3}{4} = -\frac{1}{12}$

**53.** $1.4x - 0.4x + 2.7 = -1.3$

**54.** $3.5y - 2.5y - 6.3 = -1.0 - 2.5$

**55.** $\frac{7x}{4} - \frac{3x}{4} + \frac{7}{8} = \frac{3}{2}$

**56.** $\frac{5n}{2} - \frac{3n}{2} + \frac{4}{5} = \frac{7}{5} - \frac{1}{10}$

**57.** $6.2 = -3.5 + 7n - 6n$

**58.** $-7.2 = 1.3n - 0.3n - 1.0$

**59.** $1.7x = -5.1 - 1.7$

**60.** $3.2x = 2.8 - 9.2$

Use a calculator to help solve the following equations.

**61.** $y + 32.861 = -17.892$

**62.** $x - 41.625 = 59.354$

**63.** $17.61x - 16.61x + 27.059 = 9.845$

**64.** $14.83y - 8.65 - 13.83y = 17.437 + 1.0$

**65.** $2.637x = 648.702$

**66.** $-0.3057y = 316.7052$

**67.** $-x = 145.6 + 17.89 - 10.32$

**68.** $-y = 143.5 + 178.462 - 200$

## Applications

Solve.

**69.** The Japanese writing system consists of three sets of characters, two with 81 characters (which all Japanese students must know), and a third, *kanji*, with over 50,000 characters (of which only some are used in everyday writing). If a Japanese student knows 2107 total characters, solve the equation $x + 2(81) = 2107$ to determine the number of *kanji* characters the student knows.

**70.** A nurse must give a patient 800 milliliters of intravenous solution over 4 hours. This can be represented by the equation $4x = 800$, where $x$ represents the amount of solution the patient receives per hour in milliliters.

**a.** Why was multiplication chosen in the equation?

**b.** Solve the equation to determine the value of $x$.

**c.** What does the answer to part b. mean? Write a complete sentence.

**71.** John is making a garden in his backyard. He buys enough topsoil to cover 300 square feet. John wants the garden to go along the side of his garage, which is 24 feet in length. To determine how wide the garden needs to be, John uses the equation $24x = 300$, where $x$ is the width of the garden in feet.

**a.** Why was multiplication chosen in this equation?

**b.** Solve the equation to determine the value of $x$.

**c.** What does the answer to part b. mean? Write a complete sentence.

**72.** A university enrolls both undergraduate and graduate students in all programs of study. There are a total of 28,000 students enrolled. Of this total, 17,500 students are undergraduates. Solve the equation $17{,}500 + x = 28{,}000$ to determine how many graduate students are enrolled in the university.

**73.** The diameter of the Milky Way is approximately 23,585 times the distance from the sun to the nearest star, Proxima Centauri. Considering that the Milky Way is roughly 100,000 light years across, solve the equation, $23{,}585x = 100{,}000$ to find the number of light years from the sun to this star. (Round your answer to the nearest hundredth.)

**74.** A group of students at Homestate University decide to start a math club. They create a Facebook page for their club, and their goal is get 5000 "likes" for their page. Three months after they launch their club and Facebook page, they have received a total of 3500 likes. Solve the equation $3500 + x = 5000$ to determine how many more likes they need to get to reach their goal.

**75.** An author is determined to have his first novel published by the publisher of George Orwell's *1984*, his favorite book. However, his contract with the publisher requires his novel to be at least 75,000 words, and he has only written 63,500 words. Solve the equation, $63{,}500 + x = 75{,}000$ to determine how many more words he must write.

**76.** The best pizza parlor in town slices their large pizzas so that each pizza contains 8 slices. Joe's fraternity hosts a pizza party for its members and guests, and the fraternity orders large pizzas from the best pizza parlor in town. By the end of the party, 400 slices of pizza had been eaten and all of the pizza boxes were empty. Solve the equation $8x = 400$ to determine how many pizzas were ordered for the party.

**77.** During rush week at Homestate University, the fraternities and sororities pledge a combined total of 450 freshmen. These 450 freshmen represent $\frac{1}{5}$ of the school's total enrollment. Solve the equation $\frac{1}{5}x = 450$ to determine the total number of students enrolled at Homestate University.

**78.** The inventory manager's computer crashed and he did not have a backup of his data. The company manager is requesting an inventory report for the week for a specific item. The inventory manager knows that there are currently 1472 of that item in stock. During the week, a shipment arrived with 1500 of the item. The company also shipped out 975 of the item during the week. This situation can be represented by $x + 1500 - 975 = 1472$, where $x$ is the number of items in the inventory at the beginning of the week.

**a.** Why were the operations of addition and subtraction chosen in this equation?

**b.** Solve the equation to determine the value of $x$.

**c.** What does the answer to part b. mean? Write a complete sentence.

**79.** Clara has $4200 saved to use as a down payment on the new car she is buying that costs $15,750. She will have to get a loan to pay for the rest of the cost. This situation can be modeled by $4200 + x = 15{,}750$, where $x$ is the amount of the loan in dollars.

**a.** Why was the operation of addition chosen in this equation?

**b.** Solve the equation to determine the value of $x$.

**c.** What does the answer to part b. mean? Write a complete sentence.

**80.** A sculptor has decided to begin a project to make scale models of famous landmarks out of stone. His first model will be of one of the moai, giant human figures carved from stone on Easter Island. If his model is to be $\frac{1}{12}$ scale, and the original moai weighs 75 tons, solve the equation $12x = 75$ to determine how many tons his completed sculpture will weigh.

## Writing & Thinking

**81.** **a.** Is the expression $6 + 3 = 9$ an equation? Explain.

**b.** Is 4 a solution to the equation $5 + x = 10$? Explain.