Lesson 8-3
Writing Equations

Interactive Study Guide

See pages 173–174 for:
- Getting Started
- Real-World Link
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Essential Question

How are equations and inequalities used to describe and solve multi-step problems?

Common Core State Standards

Content Standards
7.EE.4, 7.EE.4a, 8.EE.7, 8.EE.7b

Mathematical Practices
1, 3, 4, 7

What You'll Learn
- Write two-step equations.
- Solve verbal problems by writing and solving two-step equations.

Real-World Link

Tablet Computers Touch-screen computers have been around for twenty years. Their ease of use and speed are two reasons that more and more consumers are purchasing them. Accessories, such as docking stations, power adapters, and connection kits, help users get the most out of their tablets.

Write Two-Step Equations

A power adapter costs $5 more than a docking station. The total cost of the accessories is $63. You can summarize this information by writing an equation.

Words	Docking station plus power adapter costs $63
Variable	Let d = the cost of the docking station. So, $d + 5$ = the cost of the power adapter.
Equation	$d + d + 5 = \$63$

Example 1

Translate each sentence into an equation.

a. Zack has 6 shirts. This is 4 less than twice the number of shirts n that Xavier has.

$6 = 2n - 4$

b. Eight more than the quotient of a number y and -3 is -24.

$8 + \frac{y}{-3} = -24$

c. Jeremy has 13 baseball cards, which is 7 more than one-fifth the number m Michael has.

$13 = 7 + \frac{1}{5}m$

Got It? Do these problems to find out.

1a. Four more than 0.3 times a number x is -26.

1b. Hannah has 24 stickers. This is 6 less than twice the number of stickers n Molly has.

1c. The quotient of a number n and 7, increased by 6, is equal to 12.

$\frac{n}{7} + 6 = 12$

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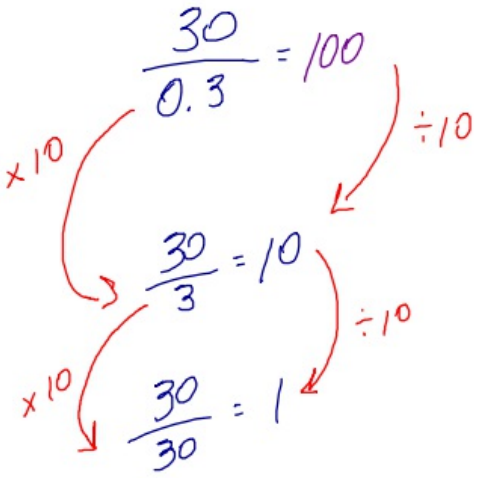

$$\frac{30}{0.3} \times \frac{10}{10} = \frac{300}{3} = 100$$

Example 2

Juan's father was 29 years old when Juan was born. This year, the sum of their ages is 53. Find their ages.

Let x = Juan's age. Then, $x + 29$ = Juan's father's age.

$x + x + 29 = 53$	Write the equation.
$2x + 29 = 53$	Distributive Property
$2x + 29 - 29 = 53 - 29$	Subtraction Property of Equality
$2x = 24$	Simplify.
$x = 12$	Mentally divide each side by 2.

Juan is 12 years old. His father is 12 + 29 or 41 years old.

Equations
Look for the words *is, total, equals,* or *is equal to* when you translate sentences into equations.

Got It? Do this problem to find out.

2. Deisha saved d dollars last month. This month she saved $8 more than 3 times the amount she saved last month. She saved a total of $141. Write and solve an equation to find how much she saved last month.

Two-Step Verbal Problems

In some real-world situations, you start with a given amount and then increase the amount at a constant rate.

Example 3

Logan collected pledges for the charity walk-a-thon. He will receive total contributions of $65.50 plus $21.75 for every mile that he walks. How many miles will he need to walk to raise $370?

First, write an equation to model the situation.

Words	$65.50 plus $21.75 per mile equals $370.
Variable	Let m = the number of miles Logan walks. So, $21.75m$ = contributions for walking m miles.
Equation	$65.50 + 21.75m = 370$

$65.50 + 21.75m = 370$	Write the equation.
$65.50 - 65.50 + 21.75m = 370 - 65.50$	Subtraction Property of Equality
$21.75m = 304.5$	Simplify.
$\frac{21.75m}{21.75} = \frac{304.5}{21.75}$	Division Property of Equality
$m = 14$	Simplify.

Logan needs to walk 14 miles to raise $370.

Got It? Do this problem to find out.

3. Jasmine bought 6 DVDs, all at the same price. The tax on her purchase was $5.04, and the total was $85.74. What was the price of each DVD?

Guided Practice

Translate each sentence into an equation. (Example 1)

1. The quotient of a number and 3, less 8, is 16.
2. Tiffani spent $95 for clothes. This is $15.80 more than 4 times the amount her sister spent for school supplies.
3. Morgan has 98 baseball cards in his collection, which is twelve less than the product of $\frac{2}{3}$ and the number of cards Tyler has.

Solve each problem by writing and solving an equation. (Examples 2 and 3)

4. Kendra pays $132 for shoes and clothes. The clothes cost $54 more than the shoes. How much do the shoes cost?
5. During the spring car wash, the Activities Club washed 14 fewer cars than during the summer car wash. They washed a total of 96 cars during both car washes. How many cars did they wash during the spring car wash?
6. **Financial Literacy** A gym charges a $49.95 activation fee and $17.50 per month for a membership. If you spend $364.95, for how many months do you have a gym membership?

Independent Practice

Go online for Step-by-Step Solutions

Translate each sentence into an equation. (Example 1)

7. Eighteen more than half a number is 8.
8. The product of a number and 9, less 20, is 7.
9. There are 48 soccer teams in the Springtown Association. This is three less than three times the number of teams in the Lyon Association.
10. Eileen drove for 85 minutes. This is 21 more minutes than one-third the number of minutes Ethan drove.

Solve each problem by writing and solving an equation. (Examples 2 and 3)

11. In 2007, Candace Parker, from the University of Tennessee, made 37 more field goals than she did in 2006. She had a total of 497 field goals for those years. How many field goals did she make in 2006?
12. The Marsh family took a vacation that covered a total distance of 1356 miles. The return trip was 284 miles shorter than the first part of the trip. How long was the return trip?
13. Three friends share the cost of renting a game system. Each person also rents one game for $8.50. If each person pays $13.25, what is the cost of renting the system?
14. Suppose you purchase 3 identical T-shirts and a hat. The hat costs $19.75 and you spend $56.50 in all. How much does each T-shirt cost?

15. You return a book that was 6 days overdue. Including a previous unpaid balance of $0.90, your new balance is $2.40. How much is the daily fine for an overdue book?

16. STEM The main span of a suspension bridge is the roadway between the bridge's towers. The main span of the Walt Whitman Bridge in Philadelphia is 2000 feet long. This is 600 feet longer than two-fifths of the length of the main span of the George Washington Bridge in New York City. Write and solve an equation to find the length of the George Washington Bridge.

17. In his DVD collection, Domingo has eight more than twice as many animated movies as action movies. If he has 24 animated movies, write and solve an equation to find how many action movies are in his collection.

18. At the start of the school trip to Washington D.C., the tour bus has 40 gallons of gasoline in the fuel tank. Each hour, the bus uses 7 gallons of gasoline. The bus will stop for gas when there are 10 gallons left.

   a. Make a table to show how many gallons of gasoline are remaining in the tank after each hour.

   b. Write and solve an equation to find how many hours will pass before the bus will have to stop for gasoline.

19. CCSS **Multiple Representations** In this problem, you will use tables, graphs, and equations to solve a problem. Misty is saving money to buy an MP3 player that costs $212. She has already saved $47 and plans to save an additional $15 per week.

Number of Weeks	Amount of Savings ($)
1	62
2	■
3	■
4	■

   a. Symbols Write a variable expression to represent the amount of money saved after w weeks. Then use the expression to complete the table at the right.

   b. Graph Make a line graph of the data in the table. How can you use the graph to find the number of weeks it will take her to save enough money for the MP3 player?

   c. Symbols Write and solve an equation to find the number of weeks it will take her to save the money.

   d. Words Compare the methods for finding the solution that you used in parts **b** and **c**.

H.O.T. Problems Higher Order Thinking

20. CCSS **Identify Structure** Write a two-step equation with a solution of 6. Write the equation using both words and symbols.

21. CCSS **Reason Inductively** An example of two consecutive even numbers is 4 and 6. They can be represented by n and $n + 2$. Find 3 consecutive even numbers whose sum is 30.

22. CCSS **Identify Structure** The equations $\frac{x+4}{5} = 20$ and $\frac{x}{5} + 4 = 20$ are both two-step equations. Compare and contrast how to solve them.

23. CCSS **Persevere with Problems** Emelia discovered that if she takes three-fourths of her age and adds 9, it produces the same result as when she takes one-fourth of her age and adds 21. How old is Emelia?

24. **Building on the Essential Question** Explain how two-step equations are used to represent real-world problems.

Standardized Test Practice

25. An electrician charges $35 for a house call and $80 per hour for each hour worked. If the total charge was $915, which equation would you use to find the number of hours n that the electrician worked?

A $35n + 2n(80) = 915$
B $80 + 35n = 915$
C $35 + (80 - n) = 915$
D $35 + 80n = 915$

26. Belinda scored 16 goals this season. This is 4 more than three times the number she scored last season. Which equation could you use to find how many goals she scored last season?

F $4n + 3 = 16$
G $3n + 4 = 16$
H $4n - 3 = 16$
J $3n - 4 = 16$

27. A hot air balloon is at an altitude of 113.2 meters. The balloon's altitude decreases by 10.8 meters every minute. Which equation can you use to find the number of minutes m until the balloon's altitude is 70 meters?

A $113.2m - 10.8 = 70$
B $113.2m + 10.8 = 70$
C $113.2 - 10.8m = 70$
D $113.2 + 10.8m = 70$

28. You and your friend spent a total of $15 for lunch. Your friend's lunch cost $3 more than yours did. How much did you spend for lunch?

F $6
G $7
H $8
J $9

Common Core Review

Solve each equation. Check your solution. 8.EE.7

29. $x + 12 = -10$
30. $-\frac{y}{6} = -2$
31. $2p + 13 = -7$
32. $7y + 3 = -11$
33. $-8t - 9 = -41$
34. $8z = 14$
35. $\frac{1}{5}g - 5 = -3$
36. $7 = \frac{1}{3}m + 20$
37. $18.3 = 2.5c - 1.3$
38. $2.9y + 6 = -2.7$
39. $\frac{1}{8}t + 3 = 0$
40. $\frac{2}{5} + \frac{1}{2}d = \frac{3}{5}$

41. A concert ticket costs t dollars, a hamburger costs h dollars, and soda costs s dollars. Write an expression that represents the total cost of a ticket, hamburger, and soda for n people. 6.EE.2a

42. STEM The air pressure decreases as the distance from Earth increases. The table shows the air pressure for certain distances. 7.RP.2a

a. Write a set of ordered pairs for the data.
b. Graph the data.
c. Is the relationship a proportional relationship? Why or why not?

Air Pressure	
Height (mi)	Pressure (lb/in^2)
0 (sea level)	14.7
1	10.2
2	6.4
3	4.3
4	2.7
5	1.6

43. In 2011, the state of Illinois produced about 2×10^9 bushels of corn. This was about 4 times the amount of corn produced in Wisconsin. About how many bushels of corn were produced in Wisconsin? Write in scientific notation. 8.EE.4

Use the Distributive Property to write each expression as an equivalent algebraic expression. 6.EE.3

44. $4(x + 3)$
45. $8(y - 2)$
46. $-6(z - 7)$
47. $-2(-9 - p)$