

More Two-Step Equations



Interactive Study Guide

See pages 175–176 for:

- Getting Started
- Real-World Link
- Notes



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, 5

What You'll Learn

- Solve equations of the form $p(x + q) = r$.
- Solve verbal problems by writing and solving equations of the form $p(x + q) = r$.



Real-World Link

Bowling Did you know that bowling has increased in popularity in the last decade? Forty-eight states now recognize bowling as a high school or club sport, compared to twenty states just 10 years ago. Bowling alleys typically charge for the number of games played, as well as for shoe rental.



Solve Two-Step Equations

A bowling alley charges \$3 to rent shoes. Four friends each pay for one game and for renting shoes. The total cost is \$28. You can solve the two-step equation $4(x + 3) = 28$ to find the cost of a game.

Example 1

Solve each equation.

a. $4(x + 3) = 28$

$$4(x + 3) = 28$$

Write the equation.

$$\frac{4(x + 3)}{4} = \frac{28}{4}$$

Division Property of Equality

$$x + 3 = 7$$

Simplify.

$$x + 3 - 3 = 7 - 3$$

Subtraction Property of Equality.

$$x = 4$$

Simplify.

b. $\frac{3}{5}(m - 6) = -9$

$$\frac{3}{5}(m - 6) = -9$$

Write the equation.

$$\frac{5}{3} \cdot \frac{3}{5}(m - 6) = \frac{5}{3} \cdot (-9)$$

Multiplication Property of Equality

$$m - 6 = -15$$

Simplify.

$$m - 6 + 6 = -15 + 6$$

Addition Property of Equality.

$$m = -9$$

Simplify.

Got It? Do these problems to find out.

1a. $22 = -2(y - 3)$ **-8**

1b. $3.2(x + 3.7) = 4.8$ **-2.2**



Example 2



DeAndre is ordering tickets to a concert. He buys 3 tickets that all have the same price. There is a service charge of \$4.75 per ticket. The total cost of his order is \$111.75. What is the price of each ticket?

First, write an equation to model the situation.

Words

3 times the total cost of each ticket equals \$111.75.



Variable

Let t = the price of a ticket.



So, $t + 4.75$ is the total cost of a ticket including the service charge.

Equation

$$3(t + 4.75) = \$111.75$$

$$3(t + 4.75) = \$111.75$$

Write the equation.

$$\frac{3(t + 4.75)}{3} = \frac{\$111.75}{3}$$

Division Property of Equality

$$t + 4.75 = 37.25$$

Simplify.

$$t + 4.75 - 4.75 = 37.25 - 4.75$$

Subtraction Property of Equality

$$t = 32.50$$

Simplify.

Each ticket costs \$32.50.

Got It? Do this problem to find out.

2. Natasha buys 5 bottles of orange juice. She has coupons for \$0.65 off the regular price of each bottle of the juice. After using the coupons, the total cost of the orange juice is \$6.20. What is the regular price of a bottle of orange juice? **\$1.89**

Use the Distributive Property

You can also solve a two-step equation of the form $p(x + q) = r$ by using the Distributive Property. This is useful when the number outside the parentheses is not a factor of the constant term on the other side of the equation.

Example 3



Solve $6(y + 4) = -15$.

$$6(y + 4) = -15$$

Write the equation.

$$6y + 24 = -15$$

Distributive Property

$$6y + 24 - 24 = -15 - 24$$

Subtraction Property of Equality

$$6y = -39$$

Simplify.

$$\frac{6y}{6} = \frac{-39}{6}$$

Division Property of Equality

$$y = -6\frac{1}{2}$$

Simplify.



Watch Out!

When you use the Distributive Property, make sure you multiply each term inside the parentheses by the number outside the parentheses.

Got It? Do these problems to find out.

3a. $11 = 5(g - 3)$ **$5\frac{1}{5}$**

3b. $9(-3 + x) = -2$ **$2\frac{7}{9}$**



Guided Practice

Solve each equation. (Examples 1 and 3)

- $2(n - 4) = 16$ **12**
- $6(y + 9) = 24$ **-5**
- $35 = 7(m + 7)$ **-2**
- $32 = 8(x - 1)$ **5**
- $\frac{1}{3}(c - 4) = 12$ **40**
- $\frac{2}{5}(b + 4) = 6$ **11**
- $15 = \frac{3}{8}(z - 5)$ **45**
- $18 = \frac{9}{10}(x - 1)$ **21**
- $0.2(v - 5) = -1$ **0**
- $4.5(x + 3) = 9.9$ **-0.8**
- $3(p - 1.5) = 13.5$ **6**
- $4(p + 9) = 24.8$ **-2.8**

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

- Mr. Vargas takes his class of 24 students ice skating. Each student pays an entrance fee to enter the rink and a \$4 fee to rent skates. The total cost for the students to enter the rink and rent skates is \$216. What is the ice-skating rink's entrance fee? **$24(f + 4) = 216$; \$5**
- Vanessa makes 7 identical flower arrangements for the tables at a banquet. Each arrangement contains some roses and 9 tulips. Vanessa uses a total of 147 flowers to make the arrangements. How many roses are in each arrangement? **$7(r + 9) = 147$; 12**

Independent Practice

Go online for Step-by-Step Solutions



Solve each equation. (Examples 1 and 3)

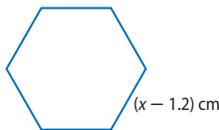
- $15(x - 6) = -45$ **3**
- $7(n - 14) = -42$ **8**
- $-2(b + 5) = 12$ **-11**
- $18 = -3(m - 6)$ **0**
- $\frac{2}{7}(4 + c) = 6$ **17**
- $\frac{4}{5}(2 + m) = 24$ **28**
- $-0.5(x - 2.4) = 6$ **-9.6**
- $34 = -0.4(p + 22)$ **-107**
- $\frac{2}{3}(n - 9) = \frac{8}{9}$ **$10\frac{1}{3}$**
- $-\frac{1}{3}(p + 1) = \frac{1}{6}$ **$-\frac{3}{2}$**
- $1.5(d + 3.5) = -2.4$ **-5.1**
- $2.6 = -5.2(3.4 + m)$ **-3.9**

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

- Brody drives the same distance to and from work each day. He also drives an additional 1.5 miles each day to go to the gym. During a 5-day workweek, Brody drives a total of 71.25 miles. What is the distance to and from work? **$5(d + 1.5) = 71.25$; 12.75 mi**
- Denisha and 4 of her friends all have discount passes to a movie theater. The passes are good for \$2.95 off the regular price of admission. The 5 friends go to the theater together and spend a total of \$47.75 on admission. What is the regular price of admission? **$5(a - 2.95) = 47.75$; \$12.50**
- Financial Literacy** Aiden has saved \$85 per month for the past 7 months. He plans to save the same amount each month in the future until he has saved a total of \$1955 for a new computer. For how many additional months will Aiden need to save? **$85(7 + m) = 1955$; 16 months**
- An airplane has two sections, business class and economy class. In each section, there are 6 seats in a row. There are 24 rows in economy class, and there are 174 seats on the plane. How many rows of seats are there in business class? **$6(b + 24) = 174$; 5 rows**

31. The hexagon shown here is a regular hexagon, so each side has the same length. The perimeter of the hexagon is 20.4 centimeters. What is the value of x ?

$$20.4 = 6(x - 1.2); 4.6$$



32. **STEM** Each minute, Carly's computer uploads 1.8 megabytes of data and downloads d megabytes of data. Over a period of 15 minutes, the computer uploads and downloads a total of 136.5 megabytes of data. How many megabytes of data does Carly's computer download each minute? $15(1.8 + d) = 136.5$; 7.3 MB

33. **CCSS Use Math Tools** A student solved the equation $7.9(x + 3.2) = 32.39$ and found the solution $x = 21.19$. Explain how you can use estimation to show that the student's solution is incorrect.

Sample answer: You can estimate the solution of the equation by solving $8(x + 3) = 32$, which has the solution $x = 1$. So, the solution of the given equation should be close to 1. Therefore, the student's solution must be incorrect.

B Solve each equation.

34. $4(x - 5) + 3 = 31$ 12
 35. $19 = -2(4 + z) - 3$ -15
 36. $3.5(c - 8) + c = 12.5$ 9
 37. $4.1(m + 4) - 2.1m = 6$ -5.2
 38. $5(2x - 1) = 25$ 3
 39. $23 = 9(4x - 1)$ $\frac{8}{9}$
 40. $18 = \frac{3}{4}(2w - 1)$ $12\frac{1}{2}$
 41. $\frac{4}{5}(10y - 15) = 20$ 4
 42. $\frac{2}{3}(3p - 5) = \frac{4}{9}$ $\frac{17}{9}$

43. Use the table to write and solve an equation for each problem.

- a. A group of 6 friends each bought a sandwich and a cup of soup. The total cost was \$50.70. Find the price of a cup of soup. $6(4.95 + s) = 50.70$; \$3.50
 b. Kevin bought a ticket to the museum and lunch for himself and 3 friends. He bought a sandwich, a side salad, and a drinks for lunch for each person. He spent a total of \$76. Find how much money Kevin spent on each ticket. $4(10.15 + x) = 76$; \$8.85

Museum Cafeteria	
Item	Price
sandwich	\$4.95
side salad	\$3.95
drink	\$1.25

45. She did not apply the Distributive Property correctly. The correct solution is $p = -\frac{2}{3}$.



H.O.T. Problems Higher Order Thinking

44. **CCSS Model with Mathematics** Write and solve a real-world problem that can be represented by the equation $4(x - 2.5) = 24$. **See margin.**

45. **CCSS Find the Error** Ella is solving the equation $-3(p - 4) = 14$. Find her mistake and correct it.

$$\begin{aligned} -3(p - 4) &= 14 \\ -3p - 4 &= 14 \\ -3p - 4 + 4 &= 14 + 4 \\ -3p &= 18 \\ p &= -16 \end{aligned}$$

46. **CCSS Justify Conclusions** Suppose for some value of k the solution of the equation $3.1(x - k) = 0$ is $x = 7$. What must be true about k ? Justify your conclusion.

46. $k = 7$; The value of the expression in parentheses must be 0, so $x - k = 0$ and $x = k$.

47. **CCSS Persevere with Problems** Joaquin is 4 years older than Becky. Three times the sum of their ages is 114. Write and solve an equation to find Joaquin's age. $3(2j - 4) = 114$; 21

48. **Sample answer:** If p is a factor of r or if p is a fraction, use the Division Property of Equality. Otherwise, use the Distributive Property.

48. **Building on the Essential Question** Explain how to decide whether to use the Distributive Property or the Division Property of Equality as your first step when you solve an equation of the form $p(x + q) = r$.



Standardized Test Practice

49. Gavin bought 6 boxes of cereal during a special sale. During the sale, the regular price of each box of cereal was reduced by \$1.25. Gavin paid a total of \$14.64 for the cereal. Which equation can you use to find the regular price p of the cereal? **B**
- A** $6(p + 1.25) = 14.64$
B $6(p - 1.25) = 14.64$
C $6p + 1.25 = 14.64$
D $6p - 1.25 = 14.64$
50. **Short Response** The formula $C = \frac{5}{9}(F - 32)$ describes the relationship between degrees Fahrenheit, F , and degrees Celsius, C . Suppose the current temperature is 35°C . What is the temperature in degrees Fahrenheit? **95°F**
51. For which of the following is -2.5 a solution? **H**
- F** $32 = 4(x + 5.5)$
G $32 = 4(x - 5.5)$
H $32 = 8(x + 6.5)$
J $32 = 8(x - 6.5)$
52. Jamila is solving the equation $\frac{3}{8}(x - 4) = 24$. If she solves the equation correctly, which of the following could be one step of her solution? **B**
- A** $x - 4 = 9$ **C** $\frac{3}{8}x - 4 = 24$
B $x - 4 = 64$ **D** $\frac{3}{8}x - \frac{3}{2} = 9$



Common Core Review

Find the percent of change. Round to the nearest tenth, if necessary. Then state whether the percent of change is an increase or decrease. **7.RP.3**

53. From 8 gallons to 12 gallons **50%; increase**
54. From 82 meters to 75 meters **-8.5%; decrease**
55. From \$216 to \$200 **-7.4%; decrease**
56. From 60 minutes to 62 minutes **3.3%; increase**
57. From 95 kilograms to 150 kilograms
57.9%; increase
58. From \$1300 to \$1150 **-11.5%; decrease**
59. A ticket to the movie costs \$8.50. A small bucket of popcorn costs p dollars, and a large drink costs twice as much as the popcorn. Write an expression that represents the total cost of a movie ticket, a small popcorn, and a large drink. **6.EE.2a $8.50 + 3p$**
60. The table shows the time it took three friends to walk different distances. Which of the three friends walked at the fastest rate? **7.RP.1 Sumitra**
- | Name | Distance (mi) | Time (h) |
|----------|---------------|---------------|
| Jonathan | $\frac{1}{4}$ | $\frac{1}{8}$ |
| Sumitra | $\frac{2}{3}$ | $\frac{1}{6}$ |
| Leah | $\frac{1}{2}$ | $\frac{1}{6}$ |
61. A contestant's score on a game show is -7 . The contestant then answers two questions correctly, each worth 4 points, and three questions incorrectly, with each error causing a loss of 5 points. What is the contestant's final score? **7.NS.3 -14**

Find each product or quotient. **7.NS.2**

62. $-4(-9)$ **36** 63. $-3(-2)(-6)$ **-36** 64. $-42 \div (-21)$ **2**
65. $-140 \div 5$ **-28** 66. $6 \cdot (-7)$ **-42** 67. $5(-3)(-4)$ **60**
68. $\frac{-400}{-25}$ **16** 69. $\frac{320}{-80}$ **-4** 70. $\frac{-169}{13}$ **-13**



Interactive Study Guide

See page 177 for:
• Mid-Chapter Check