12-1 Solving Two-Step Equations

Warm Up

Problem of the Day

Lesson Presentation

Warm Up

Solve.

1. $n + 9 = 17$ $n = 8$

2. $6x = 42$ $x = 7$

3. $71 - z = 55$ $z = 16$

4. $\frac{y}{8} = 9$ $y = 72$

Problem of the Day

Rhombus *ABCD* has a perimeter of 19 cm. If you subtract 1.88 from the length of side *BC* and then divide the result by 7, you get 0.41. What is the length of side *BC*?

19 ÷ 4 = 4.75 cm. (All sides of a rhombus are the same length.)

12-1 Solving Two-Step Equations

Learn to solve two-step equations.

12-1 Solving Two-Step Equations

When you solve equations that have one operation, you use an inverse operation to isolate the variable. You can also use inverse operations to solve equations that have more than one operation.

$$\begin{array}{rcl} n + 7 & = & 15 \\ \underline{-\ 7} & & \underline{-7} \\ n & = & 8 \end{array}$$

$$\begin{array}{rcl} 2x + 3 & = & 23 \\ \underline{\quad -\ 3} & & \underline{-\ 3} \\ 2x & = & 20 \end{array}$$

You need to use another operation to isolate x.

It is often a good plan to follow the order of operations in reverse when solving equations that have more than one operation.

Additional Example 1A: Solving Two-Step Equations Using Division

Solve. Check each answer.

$9c + 3 = 39$

$9c + 3 = 39$

$-3 \quad -3$

$9c = 36$

Subtract 3 from both sides.

$\frac{9c}{9} = \frac{36}{9}$

Divide both sides by 9.

$c = 4$

Additional Example 1A Continued

Check.

$9c + 3 = 39$

$9(4) + 3 \stackrel{?}{=} 39$ *Substitute 4 for c.*

$36 + 3 \stackrel{?}{=} 39$

$39 \stackrel{?}{=} 39$ ✓ *4 is a solution.*

Helpful Hint

Reverse the order of operations when solving equations that have more than one operation.

Additional Example 1B: Solving Two-Step Equations Using Division

Solve. Check the answer.

$-34 = -4m - 6$

$$-34 = -4m - 6$$
$$+6 \qquad +6$$
$$-28 = -4m$$

Add 6 to both sides.

$$\frac{-28}{-4} = \frac{-4m}{-4}$$

Divide both sides by –4.

$$7 = m$$

Additional Example 1B Continued

Check.

$-4m - 6 = -34$

$-4(7) - 6 \stackrel{?}{=} -34$ *Substitute 7 for m.*

$-28 - 6 \stackrel{?}{=} -34$

$-34 \stackrel{?}{=} -34$ ✓ *7 is a solution.*

Check It Out: Example 1A

Solve. Check the answer.

$7c + 6 = 48$

$$7c + 6 = 48$$

$$\underline{\quad - 6 \quad} \qquad \underline{-6}$$

$$7c \qquad = 42$$

Subtract 6 from both sides.

$$\frac{7c}{7} = \frac{42}{7}$$

Divide both sides by 7.

$$c = 6$$

Check It Out: Example 1A Continued

Check.

$7c + 6 = 48$

$7(6) + 6 \stackrel{?}{=} 48$ *Substitute 6 for c.*

$42 + 6 \stackrel{?}{=} 48$

$48 \stackrel{?}{=} 48$ ✓ *6 is a solution.*

Check It Out: Example 1B

Solve. Check the answer.

$-6m - 8 = -50$

$$-6m - 8 = -50$$
$$+8 \qquad +8$$
$$-6m = -42$$

Add 8 to both sides.

$$\frac{-6m}{-6} = \frac{-42}{-6}$$

Divide both sides by –6.

$$m = 7$$

Check It Out: Example 1B Continued

Check.

$$-6m - 8 = -50$$

$$-6(7) - 8 \stackrel{?}{=} -50 \qquad \textit{Substitute 7 for m.}$$

$$-42 - 8 \stackrel{?}{=} -50$$

$$-50 \stackrel{?}{=} -50 \checkmark \qquad \textit{7 is a solution.}$$

Additional Example 2A: Solving Two-Step Equations Using Multiplication

Solve.

$$6 + \frac{y}{5} = 21$$

$$6 + \frac{y}{5} = 21$$

$$-6 \qquad -6$$

Subtract 6 from both sides.

$$\frac{y}{5} = 15$$

$$(5)\frac{y}{5} = (5)15$$

Multiply both sides by 5.

$$y = 75$$

Additional Example 2B: Solving Two-Step Equations Using Multiplication

Solve.

$$\frac{x}{7} - 11 = 9$$

$$\frac{x}{7} - 11 = 9$$

$$+11 \qquad +11$$

$$\frac{x}{7} = 20$$

Add 11 to both sides.

$$(7)\frac{x}{7} = (7)20$$

Multiply both sides by 7.

$$x = 140$$

Check It Out: Example 2A

Solve.

$$8 + \frac{y}{2} = 48$$

$$8 + \frac{y}{2} = 48$$

-8 $\qquad$ -8 $\qquad$ *Subtract 8 from both sides.*

$$\frac{y}{2} = 40$$

$(2)\frac{y}{2} = (2)40$ $\qquad$ *Multiply both sides by 2.*

$$y = 80$$

Check It Out: Example 2B

Solve.

$$\frac{x}{5} - 31 = 19$$

$$\frac{x}{5} - 31 = 19$$

$$+31 \quad +31$$

$$\frac{x}{5} = 50$$

Add 31 to both sides.

$$(5)\frac{x}{5} = (5)50$$

Multiply both sides by 5.

$$x = 250$$

Additional Example 3: *Consumer Math Application*

Jamie rented a canoe while she was on vacation. She paid a flat rental fee of $85.00, plus $7.50 each day. Her total cost was $130.00. For how many days did she rent the canoe?

Let d represent the number of days she rented the canoe.

$$7.5d + 85 = 130$$

$$-85 \quad -85$$

Subtract 85 from both sides.

$$7.5d = 45$$

$$\frac{7.5d}{7.5} = \frac{45}{7.5}$$

Divide both sides by 7.5.

$$d = 6$$

Jamie rented the canoe for 6 days.

Check It Out: Example 3

Jack's father rented a car while they were on vacation. He paid a rental fee of $20.00 per day, plus 20¢ a mile. He paid $25.00 for mileage and his total bill for renting the car was $165.00. For how many days did he rent the car?

Let d represent the number of days he rented the car.

$$20d + 25 = 165$$

$$-25 \quad -25$$

Subtract 25 from both sides.

$$20d = 140$$

$$\frac{20d}{20} = \frac{140}{20}$$

Divide both sides by 20.

$$d = 7$$

Jack's father rented the car for 7 days.

Lesson Quiz

Solve. Check your answers.

1. $6x + 8 = 44$ $x = 6$

2. $14y - 14 = 28$ $y = 3$

3. $12 = \frac{m}{7} + 3$ $63 = m$

4. $\frac{v}{-8} - 6 = 8$ $v = -112$

5. Last Sunday, the Humane Society had a 3-hour adoption clinic. During the week the clinic is open for 2 hours on days when volunteers are available. If the Humane Society was open for a total of 9 hours last week, how many weekdays was the clinic open? 3 days