12-2 Solving Multi-Step Equations

Warm Up

Problem of the Day

Lesson Presentation

Warm Up

Solve.

1. $-8p - 8 = 56$

2. $13d - 5 = 60$

3. $9x + 24 = 60$

4. $\dfrac{k}{7} + 4 = 11$

5. $19 + \dfrac{z}{4} = 24$

$p = -8$

$d = 5$

$x = 4$

$k = 49$

$z = 20$

Problem of the Day

Without a calculator, multiply 2.637455 by 6, add 12, divide the result by 3, subtract 4, and then multiply by 0.5. What number will you end with? (*Hint:* If you start with *x*, what do you end with?)

2.637455 (the number you started with)

Learn to solve multi-step equations.

Additional Example 1: Combining Like Terms to Solve Equations

Solve 12 – 7b + 10b = 18.

12 – 7b + 10b = 18

12 + 3b = 18   *Combine like terms.*

– 12   – 12   *Subtract 12 from both sides.*

3b = 6

$$\frac{3b}{3} = \frac{6}{3}$$ *Divide both sides by 3.*

b = 2

Check It Out: Example 1

Solve 14 – 8*b* + 12*b* = 62.

$$14 - 8b + 12b = 62$$

$$14 + 4b = 62$$ *Combine like terms.*

$$\underline{- 14 \qquad\quad - 14}$$ *Subtract 14 from both sides.*

$$4b = 48$$

$$\frac{4b}{4} = \frac{48}{4}$$ *Divide both sides by 4.*

$$b = 12$$

You may need to use the Distributive Property to solve an equation that has parentheses. Multiply each term inside the parentheses by the factor that is outside the parentheses. Then combine like terms.

Additional Example 2: Using the Distributive Property to Solve Equations

Solve 5(y – 2) + 6 = 21

$$5(y - 2) + 6 = 21$$

$$5(y) - 5(2) + 6 = 21$$ *Distribute 5 on the left side.*

$$5y - 4 = 21$$ *Simplify and combine like terms.*

$$\underline{+ 4 \quad + 4}$$ *Add 4 to both sides.*

$$\frac{5y}{5} = \frac{25}{5}$$ *Divide both sides by 5.*

$$y = 5$$

Check It Out: Example 2

Solve 3(x – 3) + 4 = 28

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

$$3(x) - 3(3) + 4 = 28$$ *Distribute 3 on the left side.*

$$3x - 5 = 28$$ *Simplify and combine like terms.*

$$\underline{+ 5 \quad + 5}$$ *Add 5 to both sides.*

$$\frac{3x}{3} = \frac{33}{3}$$ *Divide both sides by 3.*

$$x = 11$$

Additional Example 3: Problem Solving Application

Troy owns three times as many trading cards as Hillary. Subtracting 9 from the number of trading cards Troy owns and then dividing by 6 gives the number of cards owns. If Sean owns 24 trading cards, how many trading cards does Hillary own?

Additional Example 3 Continued

1 **Understand the Problem**

Rewrite the question as a statement.

- Find the number of trading cards that Hillary owns.

List the **important information:**

- Troy owns 3 times as many trading cards as Hillary has.

- Subtracting 9 from the number of trading cards that Troy owns and then dividing by 6 gives the number cards Sean owns.

- Sean owns 24 trading cards.

Additional Example 3 Continued

2 **Make a Plan**

Let c represent the number of trading cards Hillary owns. Then $3c$ represents the number Troy has, and $\dfrac{3c - 9}{6}$ represents the number Sean owns, which equals 24.

Solve the equation $\dfrac{3c - 9}{6} = 24$ for c to find the number of cards Hillary owns.

Additional Example 3 Continued

3 **Solve**

$$\frac{3c - 9}{6} = 24$$

$$(6)\frac{3c - 9}{6} = (6)24$$ *Multiply both sides by 6.*

$$3c - 9 = 144$$

$$3c - 9 + 9 = 144 + 9$$ *Add 9 to both sides.*

$$3c = 153$$

$$\frac{3c}{3} = \frac{153}{3}$$ *Divide both sides by 3.*

$$c = 51$$

Hillary owns 51 cards.

Additional Example 3 Continued

4 **Look Back**

If Hillary owns 51 cards, then Troy owns 153 cards. When you subtract 9 from 153, you get 144. And 144 divided by 6 is 24, which is the number of cards that Sean owns. So the answer is correct.

Check It Out: Example 3

John is twice as old as Helen. Subtracting 4 from John's age and then dividing by 2 gives William's age. If William is 24, how old is Helen?

Check It Out: Example 3 Continued

1 **Understand the Problem**

Rewrite the question as a statement.

• Find Helen's age.

List the **important information:**

• John is 2 times as old as Helen.

• Subtracting 4 from John's age and then dividing by 2 gives William's age.

• William is 24 years old.

Check It Out: Example 3 Continued

2 **Make a Plan**

Let h stand for Helen's age. Then $2h$ represents John's age, and $\dfrac{2h - 4}{2}$ represents William's age, which equals 24.

Solve the equation $\dfrac{2h - 4}{2} = 24$ for h to find Helen's age.

Check It Out: Example 3 Continued

3 **Solve**

$$\frac{2h-4}{2} = 24$$

$$(2)\,\frac{2h-4}{2} = (2)24 \qquad \textit{Multiply both sides by 2.}$$

$$2h - 4 = 48$$

$$2h - 4 + 4 = 48 + 4 \qquad \textit{Add 4 to both sides.}$$

$$2h = 52$$

$$\frac{2h}{2} = \frac{52}{2} \qquad \textit{Divide both sides by 2.}$$

$$h = 26$$

Helen is 26 years old.

Check It Out: Example 3 Continued

4 **Look Back**

If Helen is 26 years old, then John is 52 years old. When you subtract 4 from 52 you get 48. And 48 divided by 2 is 24, which is the age of William. So the answer is correct.

Lesson Quiz

Solve.

1. $c + 21 + 5c = 63$ $c = 7$

2. $-x - 11 + 17x = 53$ $x = 4$

3. $59 = w - 16 = 4w$ $15 = w$

4. $4(k - 3) + 1 = 33$ $k = 11$

5. Kelly swam 4 times as many laps as Kathy. Adding 5 to the number of laps Kelly swam gives you the number of laps Julie swam. If Julie swam 9 laps, how many laps did Kathy swim?   1 lap