

2-4

Solving Multi-Step Equations

Main Ideas

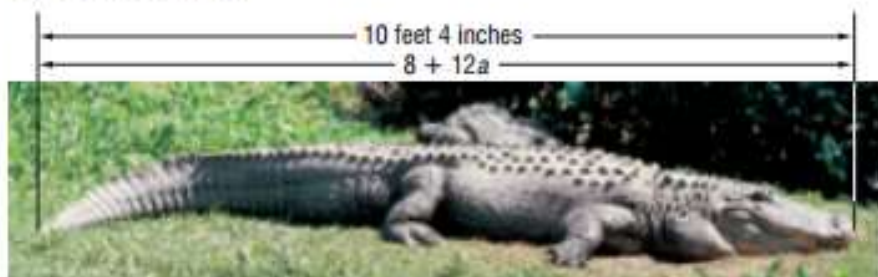
- Solve equations involving more than one operation.
- Solve consecutive integer problems.

New Vocabulary

multi-step equations
consecutive integers
number theory

GET READY for the Lesson

An alligator hatchling 8 inches long grows about 12 inches per year. The expression $8 + 12a$ represents the length in inches of an alligator that is a years old.



Since 10 feet 4 inches equals $10(12) + 4$ or 124 inches, the equation $8 + 12a = 124$ can be used to estimate the age of the alligator in the photograph. Notice that this equation involves more than one operation.

Solve Multi-Step Equations To solve equations with more than one operation, often called **multi-step equations**, undo operations by working backward.

EXAMPLE Solve Using Addition and Division

- 1 Solve $7m - 17 = 60$. Check your solution.

$$7m - 17 = 60 \quad \text{Original equation}$$

$$7m - 17 + 17 = 60 + 17 \quad \text{Add 17 to each side.}$$

$$7m = 77 \quad \text{Simplify.}$$

$$\frac{7m}{7} = \frac{77}{7} \quad \text{Divide each side by 7.}$$

$$m = 11 \quad \text{Simplify.}$$

CHECK $7m - 17 = 60$ Original equation

$$7(11) - 17 \stackrel{?}{=} 60 \quad \text{Substitute 11 for } m.$$

$$77 - 17 \stackrel{?}{=} 60 \quad \text{Multiply.}$$

$$60 = 60 \quad \checkmark$$

CHECK Your Progress

Solve each equation. Check your solution.

1A. $2a - 6 = 4$ 5

1B. $8 = 3r + 7$ $\frac{1}{3}$

1C. $\frac{t}{8} + 21 = 14$ -56

EXAMPLE Solve Using Multiplication and Addition

2 Solve $\frac{p-15}{9} = -6$.

$$\frac{p-15}{9} = -6$$
 Original equation

$$9\left(\frac{p-15}{9}\right) = 9(-6)$$
 Multiply each side by 9.

$$p-15 = -54$$
 Simplify.

$$p-15+15 = -54+15$$
 Add 15 to each side.

$$p = -39$$
 Simplify.

CHECK Your Progress

Solve each equation. Check your solution.

2A. $\frac{k-12}{5} = 4$ 32

2B. $\frac{n+1}{-2} = 15$ -31

Real-World EXAMPLE Write and Solve a Multi-Step Equation

- 3
- SKIING**
- Hugo is buying a pair of water skis that are on sale for
- $\frac{2}{3}$
- of the original price. After he uses a \$25 gift certificate, the total cost before taxes is \$115. What was the original price of the skis? Write an equation for the problem. Then solve the equation.

Words	Two-thirds	of	the price	minus	25	is	115.
Variable	Let p = original price of the skis.						
Equation	$\frac{2}{3}$	\cdot	p	$-$	25	$=$	115

$$\frac{2}{3}p - 25 = 115$$
 Original equation

$$\frac{2}{3}p - 25 + 25 = 115 + 25$$
 Add 25 to each side.

$$\frac{2}{3}p = 140$$
 Simplify.

$$\frac{3}{2}\left(\frac{2}{3}p\right) = \frac{3}{2}(140)$$
 Multiply each side by $\frac{3}{2}$.

$$p = 210$$
 Simplify.

The original price of the skis was \$210.

CHECK Your Progress

3. Write an equation for the following problem. Then solve the equation.
- Sixteen is equal to 7 increased by the product of 3 and a number.*
- $16 = 7 + 3n$
- ; 3

Study Tip**Leading coefficients**

Use the same steps to solve a multi-step equation if the leading coefficient is a fraction or an integer.



Solve Consecutive Integer Problems **Consecutive integers** are integers in counting order, such as 7, 8, and 9. Beginning with an even integer and counting by two will result in *consecutive even integers*. Beginning with an odd integer and counting by two will result in *consecutive odd integers*.

Consecutive Even Integers

$$-4, -2, 0, 2, 4$$

Consecutive Odd Integers

$$-3, -1, 1, 3, 5$$

The study of numbers and the relationships between them is called **number theory**.

EXAMPLE Solve a Consecutive Integer Problem

NUMBER THEORY Write an equation for the problem below. Then solve the equation and answer the problem.

Find three consecutive even integers whose sum is -42 .

Let n = the least even integer.

Then $n + 2$ = the next greater even integer, and $n + 4$ = the greatest of the three even integers.

Words	The sum of three consecutive even integers	is	-42 .
Equation	$n + (n + 2) + (n + 4)$	=	-42

$$n + (n + 2) + (n + 4) = -42 \quad \text{Original equation}$$

$$3n + 6 = -42 \quad \text{Simplify.}$$

$$3n + 6 - 6 = -42 - 6 \quad \text{Subtract 6 from each side.}$$

$$3n = -48 \quad \text{Simplify.}$$

$$\frac{3n}{3} = \frac{-48}{3} \quad \text{Divide each side by 3.}$$

$$n = -16 \quad \text{Simplify.}$$

$$n + 2 = -16 + 2 \text{ or } -14 \quad n + 4 = -16 + 4 \text{ or } -12$$

The consecutive even integers are -16 , -14 , and -12 .

CHECK -16 , -14 , and -12 are consecutive even integers.

$$-16 + (-14) + (-12) = -42 \quad \checkmark$$

Study Tip

Representing Consecutive Integers

You can use the same expressions to represent either consecutive even integers or consecutive odd integers. It is the value of n (odd or even) that differs between the two expressions.

CHECK Your Progress

4. Write an equation for the following problem. Then solve the equation and answer the problem. $n + (n + 1) + (n + 2) = 21$; 6, 7, 8
Find three consecutive integers whose sum is 21.

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