

Sec 1.3 Solve Linear Equations

Before

You simplified algebraic expressions.

Now

You will solve linear equations.

Why?

So you can solve problems about earnings

Goals

- **Goal 1: To solve linear equations**
- **Goal 2: To use linear equations to solve real-life problems**

Definition

- An **equation** is a statement in which two expressions are equal.
- A **linear equation** in one variable is an equation that can be written in the form $ax = b$ where a and b are constants and $a \neq 0$.
- A number is a **solution** of an equation if the statement is true when the number is substituted for the variable.

Definition

- Two equations are **equivalent equations** if they have the same solutions.
- We solve equations by changing them to simpler equivalent equations.

Transformations That Produce Equivalent Equations

- Addition Property of Equality - Add the same number to both sides
 - If $a=b$, then $a+c = b+c$.
- Subtraction Property of Equality - Subtract the same number from both sides
 - If $a=b$, then $a - c = b - c$.

Transformations That Produce Equivalent Equations

- Multiplication Property of Equality - Multiply both sides by the same nonzero number
 - If $a=b$ and $c \neq 0$, then $ac = bc$.
- Division Property of Equality - Divide both sides by the same nonzero number
 - If $a=b$ and $c \neq 0$, then $a \div c = b \div c$.

Example 1 Solve (Variable on One Side)

$$\frac{2}{7}x + 4 = 10$$

$$\frac{2}{7}x = 6$$

$$\frac{2}{7}x = \frac{6 \cdot 3}{1 \cdot 3}$$

$$x = 21$$

Example 2 Solve (Variable on Both Sides)

$$6n + 3 = 4n + 11$$

$$6n = 4n + 8$$

$$2n = 8$$

$$n = 4$$

GUIDED PRACTICE for Examples 1 and 2

Solve the equation. Check your solution.

- $4x + 9 = 21$
- $7x - 41 = -13$
- $-\frac{3}{5}x + 1 = 4$

★ **REAL ESTATE** A real estate agent's base salary is \$22,000 per year. The agent earns a 4% commission on total sales. How much must the agent sell to earn \$60,000 in one year?

Example 3 Solve (Distributive Property)

$$-4(3 + x) + 5 = 4(x + 3)$$

$$-12 - 4x + 5 = 4x + 12$$

$$-7 = 8x + 12$$

$$-19 = 8x$$

$$-\frac{19}{8} = x$$

$$-2.375 = x$$

Example 4 (Solving an Equation with Fractions)

$$\frac{1}{2}x - \frac{5}{3} = -\frac{1}{2}x + \frac{19}{4}$$

$$x - \frac{5}{3} = \frac{19}{4}$$

$$x = \frac{77}{12}$$

Example 5 Real-Life Model

- REAL ESTATE: A real estate broker's base salary is \$18,000. She earns a 4% commission on total sales. How much must she sell to earn \$55,000 total?
- First, create a verbal model:

Total Income	=	Base Salary	+	Commission Rate	•	Total Sales
55,000	=	18,000	+	.04	•	x

Example 5 Real-Life Model

- REAL ESTATE: A real estate broker's base salary is \$18,000. She earns a 4% commission on total sales. How much must she sell to earn \$55,000 total?
- Next, give labels to these items:
 - Total Income = 55,000 (dollars)
 - Base Salary = 18,000 (dollars)
 - Commission rate = 0.04 (percent in decimal form)
 - Total sales = x (dollars)

Example 5 Real-Life Model

- REAL ESTATE: A real estate broker's base salary is \$18,000. She earns a 4% commission on total sales. How much must she sell to earn \$55,000 total?
- Next, create an algebraic model by replacing the verbal model with the labels:
- $55000 = 18000 + 0.04x$

Example 5 Real-Life Model

- How much must she sell to earn \$55,000 total?
- Solve the equation and answer the question.
- $$55000 = 18000 + 0.04x$$

$$\begin{array}{r} 55000 \\ -18000 \\ \hline 37000 = 0.04x \\ \frac{37000}{.04} = \frac{0.04x}{.04} \\ 925000 = x \end{array}$$

Example 6 Real-Life Model

- CAR WASH: It takes you eight minutes to wash a car and it takes a friend six minutes to wash a car. How long does it take the two of you to wash seven cars if you work together?
- First, create a verbal model:

Your rate (cars/minute)	•	Time (minutes)	+	Friend's rate (cars/minute)	•	Time (minutes)	=	Cars washed (cars)
$\frac{1}{8}$ car / 8 min	•	x min	+	$\frac{1}{6}$ car / 6 min	•	x min	=	7 cars

Example 6 Real-Life Model

- CAR WASH: It takes you eight minutes to wash a car and it takes a friend six minutes to wash a car. How long does it take the two of you to wash seven cars if you work together?

$$\frac{1 \text{ car}}{8 \text{ min}} \cdot x \text{ min} + \frac{1 \text{ car}}{6 \text{ min}} \cdot x \text{ min} = 7 \text{ cars}$$

$$\frac{1}{8}x + \frac{1}{6}x = 7$$

$$\frac{24}{8} \cdot \frac{1}{24}x + \frac{24}{6} \cdot \frac{1}{24}x = 7 \cdot \frac{24}{24}$$

$$3x + 4x = 168$$

$$7x = 168$$

$$x = 24 \text{ min}$$



GUIDED PRACTICE

Solve the equation. Check your solution.

5. $-2x + 9 = 2x - 7$

6. $10 - x = -6x + 15$

7. $3(x + 2) = 5(x + 4)$

8. $-4(2x + 5) = 2(-x - 9) - 4x$

9. $\frac{1}{4}x + \frac{2}{5}x = 39$

10. $\frac{2}{3}x + \frac{5}{6} = x - \frac{1}{2}$

11. **WHAT IF?** In Example 5, suppose it takes you 9 minutes to wash a car and it takes your friend 12 minutes to wash a car. How long does it take the two of you to wash 7 cars if you work together?



Assignment


- Sec 1.3:

- 1, 2, 3-32 LC, 40, 41-49 LC, 54, 55, 60, 3-70, 7, 80, 82

- Quiz next time Sec 1.1 & 1.2



Additional Examples



Additional Examples