

Essential Question How can you use inverse operations to solve an equation?

Key: = Variable = 1 = -1 = Zero Pair

1 EXAMPLE: Using Addition to Solve an Equation

Use algebra tiles to model and solve $x - 3 = -4$.

Model the equation $x - 3 = -4$.

To get the green tile by itself, remove the red tiles on the left side by adding three yellow tiles to each side.

Remove the three "zero pairs" from each side.

The remaining tile shows the value of x .

So, $x = -1$.

2 EXAMPLE: Using Addition to Solve an Equation

Use algebra tiles to model and solve $-5 = n + 2$.

Model the equation $-5 = n + 2$.

Remove the yellow tiles on the right side by adding two red tiles to each side.

Remove the two "zero pairs" from the right side.

The remaining tiles show the value of n .

So, $-7 = n$ or $n = -7$.

3 ACTIVITY: Solving Equations Using Algebra Tiles

Work with a partner. Use algebra tiles to model and solve the equation.

a. $y + 10 = -5$

b. $p - 7 = -3$

c. $-15 = t - 5$

d. $8 = 12 + z$

4 ACTIVITY: Writing and Solving Equations

Work with a partner. Write an equation shown by the algebra tiles. Then solve.

a. 

b. 

c. 

d. 

What Is Your Answer?

5. Decide whether the statement is *true* or *false*. Explain your reasoning.
 - a. In an equation, any letter can be used as a variable.
 - b. The goal in solving an equation is to get the variable by itself.
 - c. In the solution, the variable always has to be on the left side of the equal sign.
 - d. If you add a number to one side, you should add it to the other side.
6. **IN YOUR OWN WORDS** How can you use inverse operations to solve an equation without algebra tiles? Give two examples.
7. What makes the cartoon funny?
8. The word *variable* comes from the word *vary*. For example, the temperature in Maine varies a lot from winter to summer.

Write two other English sentences that use the word *vary*.



“Dear Sir: Yesterday you said $x = 2$. Today you are saying $x = 3$. Please make up your mind.”

Practice

Use what you learned about solving equations using inverse operations to complete Exercises 5–8 on page 74.

Key Vocabulary

 equivalent equations,
p. 72

 Key Ideas
Addition Property of Equality

Words Two equations are **equivalent equations** if they have the same solutions. Adding the same number to each side of an equation produces an equivalent equation.

Algebra If $a = b$, then $a + c = b + c$.

Subtraction Property of Equality

Words Subtracting the same number from each side of an equation produces an equivalent equation.

Algebra If $a = b$, then $a - c = b - c$.

EXAMPLE 1 Solving Equations
Remember

To solve equations, use *inverse operations* that “undo” each other. For example, use addition to solve an equation with subtraction.

a. Solve $x - 5 = -1$.

$$x - 5 = -1$$

Write the equation.

$$\underline{+5} \quad \underline{+5}$$

Add 5 to each side.

$$x = 4$$

Simplify.

∴ So, the solution is $x = 4$.

Check

$$x - 5 = -1$$

$$4 - 5 \stackrel{?}{=} -1$$

$$-1 = -1 \quad \checkmark$$

b. Solve $z + \frac{3}{2} = \frac{1}{2}$.

$$z + \frac{3}{2} = \frac{1}{2}$$

Write the equation.

$$\underline{-\frac{3}{2}} \quad \underline{-\frac{3}{2}}$$

Subtract $\frac{3}{2}$ from each side.

$$z = -1$$

Simplify.

∴ So, the solution is $z = -1$.

On Your Own

Solve the equation. Check your solution.

1. $p - 5 = -2$

2. $w + 13.2 = 10.4$

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

Now You're Ready
Exercises 5–20

EXAMPLE 2 Standardized Test Practice

A company has a profit of \$750 this week. This profit is \$900 more than the profit P last week. Which equation can be used to find P ?

- (A) $750 = 900 - P$ (B) $750 = P + 900$
 (C) $900 = P - 750$ (D) $900 = P + 750$

Words The profit this week is \$900 more than the profit last week.

Equation $750 = P + 900$

∴ The equation is $750 = P + 900$. The correct answer is (B).

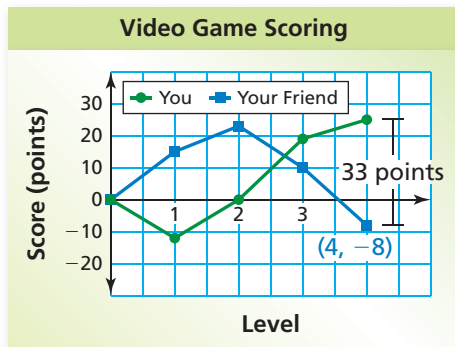
On Your Own

Now You're Ready
Exercises 22–25

4. A company has a profit of \$120.50 today. This profit is \$145.25 less than the profit P yesterday. Write an equation that can be used to find P .

EXAMPLE 3 Real-Life Application

The line graph shows the scoring while you and your friend played a video game. Write and solve an equation to find your score after Level 4.



You can determine the following from the graph.

Words Your friend's score is 33 points less than your score.

Variable Let s be your score after Level 4.

Equation $-8 = s - 33$

$$-8 = s - 33 \quad \text{Write equation.}$$

$$+ 33 \quad + 33 \quad \text{Add 33 to each side.}$$

$$25 = s \quad \text{Simplify.}$$

∴ Your score after Level 4 is 25 points.

Reasonable? From the graph, your score after Level 4 is between 20 points and 30 points. So, 25 points is a reasonable answer.

On Your Own

5. **WHAT IF?** In Example 3, you have -12 points after Level 1. Your score is 27 points less than your friend's score. What is your friend's score?

2.4 Exercises



Vocabulary and Concept Check

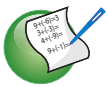
- VOCABULARY** What property would you use to solve $m + 6 = -4$?
- VOCABULARY** Name two inverse operations.
- WRITING** Are the equations $m + 3 = -5$ and $m = -2$ equivalent? Explain.
- WHICH ONE DOESN'T BELONG?** Which equation does *not* belong with the other three? Explain your reasoning.

$$x + 3 = -1$$

$$x + 1 = -5$$

$$x - 2 = -6$$

$$x - 9 = -13$$



Practice and Problem Solving

Solve the equation. Check your solution.

- $a - 6 = 13$
- $-3 = z - 8$
- $-14 = k + 6$
- $x + 4 = -14$
- $c - 7.6 = -4$
- $-10.1 = w + 5.3$
- $\frac{1}{2} = q + \frac{2}{3}$
- $p - 3\frac{1}{6} = -2\frac{1}{2}$
- $g - 9 = -19$
- $-9.3 = d - 3.4$
- $4.58 + y = 2.5$
- $x - 5.2 = -18.73$
- $q + \frac{5}{9} = \frac{1}{6}$
- $-2\frac{1}{4} = r - \frac{4}{5}$
- $w + 3\frac{3}{8} = 1\frac{5}{6}$
- $4\frac{2}{5} + k = -3\frac{2}{11}$

21. **ERROR ANALYSIS** Describe and correct the error in finding the solution.

$$\begin{array}{r} x + 8 = 10 \\ + 8 \quad + 8 \\ \hline x = 18 \end{array}$$

Write the verbal sentence as an equation. Then solve.

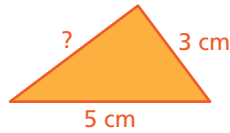
22. 4 less than a number n is -15 .
23. 10 more than a number c is 3.
24. The sum of a number y and -3 is -8 .
25. The difference between a number p and 6 is -14 .

In Exercises 26–28, write an equation. Then solve.

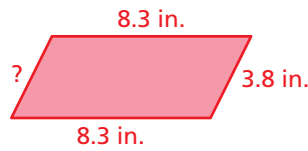
26. **DRY ICE** The temperature of dry ice is -109.3°F . This is 184.9°F less than the outside temperature. What is the outside temperature?
27. **PROFIT** A company makes a profit of $\$1.38$ million. This is $\$2.54$ million more than last year. What was the profit last year?
28. **PIER** The difference between the lengths of a paddle boat and a pier is $-7\frac{3}{4}$ feet. The pier is $18\frac{1}{2}$ feet long. How long is the paddle boat?

GEOMETRY Write and solve an equation to find the unknown side length.

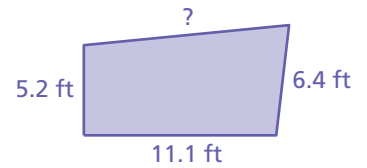
29. Perimeter = 12 cm



30. Perimeter = 24.2 in.



31. Perimeter = 34.6 ft



In Exercises 32–36, write an equation. Then solve.

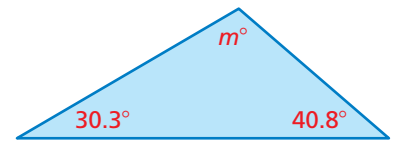


32. **STATUE OF LIBERTY** The total height of the Statue of Liberty and its pedestal is 153 feet more than the height of the statue. What is the height of the statue?

33. **BUNGEE JUMPING** Your first jump is $50\frac{1}{6}$ feet higher than your second jump. Your first jump reaches $-200\frac{2}{5}$ feet. What is the height of your second jump?

34. **TRAVEL** Boatesville is $65\frac{3}{5}$ kilometers from Stanton. A bus traveling from Stanton is $24\frac{1}{3}$ kilometers from Boatesville. How far has the bus traveled?

35. **GEOMETRY** The sum of the measures of the angles of a triangle equals 180° . What is the measure of the missing angle?



36. **SKATEBOARDING** The table shows your scores in a skateboarding competition. The leader has 311.62 points. What score do you need in the fourth round to win?

Round	1	2	3	4
Points	63.43	87.15	81.96	?

37. **CRITICAL THINKING** Find the value of $2x - 1$ when $x + 6 = 2$.



Find the values of x .

38. $|x| = 2$

39. $|x| - 2 = 4$

40. $|x| + 5 = 18$



Fair Game Review What you learned in previous grades & lessons

Multiply or divide. (Section 1.4 and Section 1.5)

41. -7×8

42. $6 \times (-12)$

43. $18 \div (-2)$

44. $-26 \div 4$

45. **MULTIPLE CHOICE** A class of 144 students voted for a class president. Three-fourths of the students voted for you. Of the students who voted for you, $\frac{5}{9}$ are female. How many female students voted for you? (Section 2.3)

(A) 50

(B) 60

(C) 80

(D) 108