

Solve Addition and Subtraction Equations

Objective Solve addition and subtraction equations.

Learn About It

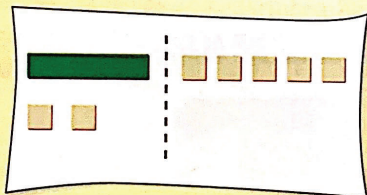
Inverse operations are operations that undo each other. Addition and subtraction are examples of inverse operations. To solve some equations, you can use inverse operations to isolate the variable on one side of the equals sign.

Try this activity to solve an addition equation by using inverse operations.

Materials: algebra tiles (Learning Tool 38), workmat

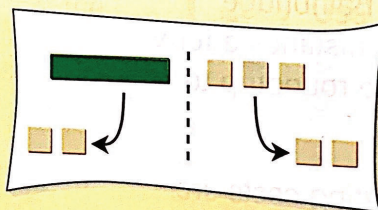
Solve the equation $x + 2 = 5$ for x .

STEP 1 Model the equation with algebra tiles.



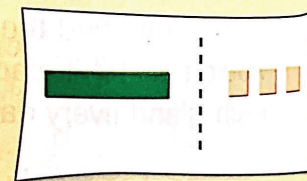
$$x + 2 = 5$$

STEP 2 Subtract two 1-tiles from each side.



$$x + 2 - 2 = 5 - 2$$

STEP 3 The solution to the equation is 3.



$$x = 3$$

► When you add or subtract the same number to each side of an equation, you are using a property of equality.

The Addition and Subtraction Properties of Equality

Adding or subtracting the same number from both sides of an equation results in a new equation, having the same solutions as the original.

Use properties to solve the equation $t - 5 + 2 = 11$.

STEP 1 Simplify each side of the equation.

$$\begin{aligned} t - 5 + 2 &= 11 \\ t - 3 &= 11 \end{aligned}$$

STEP 2 Use the Addition Property of Equality. Add 3 to both sides.

$$t - 3 + 3 = 11 + 3$$

STEP 3 Isolate the variable. Solve for t .

$$\begin{aligned} t &= 11 + 3 \\ t &= 14 \end{aligned}$$

Solution: 14 is a solution to the equation.

Guided Practice

Solve. State the inverse operation you used.

1. $4.56 + n = 184.72$

2. $p + 5 - 4 = 23$

3. $s - 8 = 18$

4. $y + 6 - 12 = 38$

Explain Your Thinking

How can you check the solution to an equation?

Ask Yourself

- Did I use inverse operations to isolate the variable?
- Did I perform the same operation on both sides of the equals sign?

Practice and Problem Solving

Solve. State the inverse operation you used. Check your work.

5. $y + 5 = 14$

6. $a - 8 = 12$

7. $s + 98 - 27 = 138$

8. $c + 45.6 - 38.25 = 112.76$

9. $12 + d = 45$

10. $3 + f - 17 = 43$

11. $t + 23 - 36 + 23 = 59$

12. $j + 38 = 4 + 5 \times 3$

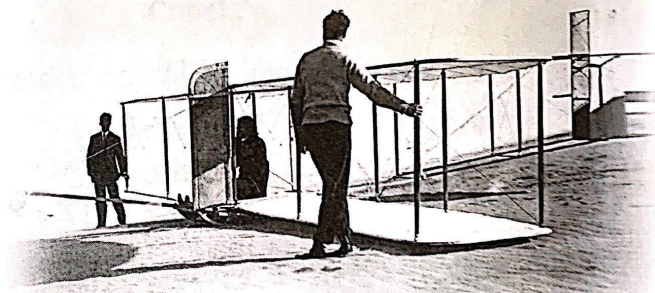
13. $35 - 56 = h - 47$

Solve.

14. In his first flight, Orville Wright flew 120 feet. His brother Wilbur Wright went on to fly a distance that was 732 feet farther. How far did Wilbur fly?

15. Wilbur's flight lasted 59 seconds. Orville's flight took 47 seconds less time. How long was Orville's flight?

16. **Reasoning** Ann has decided to make a 55-mile bike trip to Kitty Hawk in 2 days. If Ann can ride 18 miles per day now, how many more miles will she need to be able to ride in one day in order to cover half the trip each day?



The Wright brothers tried several models before their first flight took place at Kitty Hawk, North Carolina, on Thursday, December 17, 1903.

17. **Analyze** Over six trial flights, a model airplane stayed airborne for an average of 26 seconds. For the first five trials, the flight times were 28 seconds, 10 seconds, 52 seconds, 20 seconds, and 26 seconds. What was the sixth time?

Mixed Review and Test Prep

Open Response

If the number is an integer, write its opposite. If it is not, write *no*. (Ch. 11, Lesson 1)

18. $43\frac{1}{2}$

19. -34

20. -90.7

21. 146

Multiple Choice

22. Solve $s + 18 - 11 = 123$ for s .
(Ch. 12, Lesson 3)

A 94

C 130

B 152

D 116

Solve Addition and Subtraction Equations

Practice
12.3

Solve. State the inverse operation you used. Check your work.

1. $b - 18 = 24$

2. $m + 29.6 = 50.4$

3. $t + 20 = 56$

4. $q - 8 = 3$

5. $28 = a - 32$

6. $16 = v + 9$

7. $m + 6 = 12 + 15$

8. $k + 9 - 2 = 17$

9. $s + 9 - 12 = 19$

10. $p + 6 + 4 = 47$

11. $f + 19 - 23 = 93 - 15$

12. $k + 15 + 47 = 102 - 22$

Test Prep

13. What is the solution of $x + 29 = 42$?

- A $x = 3$
- B $x = 13$
- C $x = 23$
- D $x = 71$

14. Find the solution for $x + 25 = 28 + 42$. Explain how you found your answer.

Solve Addition and Subtraction Equations

Ask Yourself

- Did I use inverse operations to isolate the variable?
- Did I perform the same operation on both sides of the equals sign?

Solve. State the inverse operation you used. Check your work.

1. $75.9 = n - 12.5$

2. $x + 48 - 37 = 100$

3. $92 + 27 = p - 190$

4. $6 + r = 7.3 + 18.6$

5. $236 = 44 + w$

6. $5 + z = 3 \times 4 \times 8$

7. $250 \div 50 = n - 75$

8. $t - 3.5 = 1.4 + 1.3$

9. $69 + 32 = q + 37 + 5$

Problem Solving

Show Your Work

10. Ben makes \$9.50 per hour at the bookstore. Last week he worked 25 hours, paid \$9.00 in taxes, and then spent \$35 from his paycheck on groceries. How much money did he have left?
- _____

Use with text pages 306–307.

Solve Multiplication and Division Equations

Objective Solve multiplication and division equations.

Learn About It

Winona rides a bus 12 miles a month to and from her guitar lessons. If she has 4 lessons each month, how can Winona write and solve an equation to find the number of miles she rides to and from each lesson?

Winona wrote the equation $4 \times x = 12$ to express *4 trips times a number of miles is 12 miles*.

You can solve a multiplication equation by using division, the inverse of multiplication.

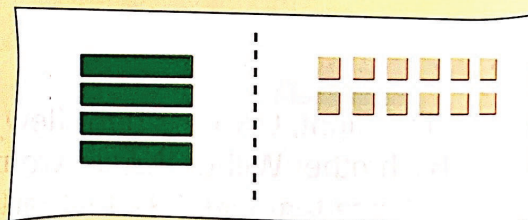
Use algebra tiles to solve the equation $4 \times x = 12$ for x .

Materials • algebra tiles (Learning Tool 38), workmat



STEP 1 Model the equation with algebra tiles.

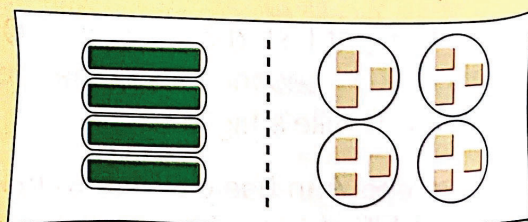
1



$$4 \times x = 12$$

STEP 2 Isolate the x -tile. Use the *inverse* of multiplication. Divide the tiles into 4 equal groups.

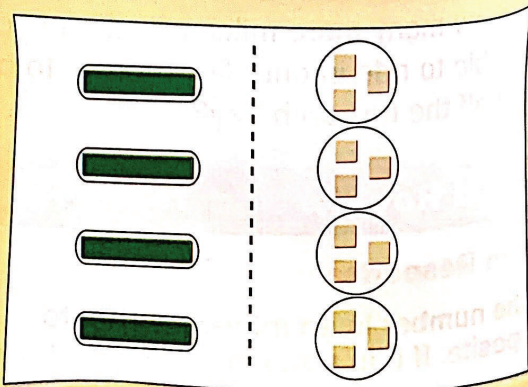
2



$$(4 \times x) \div 4 = 12 \div 4$$

STEP 3 Match each x -tile to a group of 1-tiles. Each x -tile is equivalent to 3 1-tiles.

3



$$x = 3$$

► When you multiply or divide each side of an equation by the same nonzero number, you are using a property of equality.

The Multiplication and Division Properties of Equality

Multiplying or dividing both sides of an equation by the same nonzero number results in a new equation, having the same solutions as the original.

Use properties to solve the equation $4 \times x = 12$.

Since the variable x is multiplied by a number, use the Division Property of Equality to isolate the variable.

$$\begin{aligned}4 \times x &= 12 \\4 \times x \div 4 &= 12 \div 4 \quad \leftarrow \text{Divide both sides by 4.} \\x &= 12 \div 4 \quad \leftarrow \text{Isolate the variable.} \\x &= 3 \quad \leftarrow \text{Solve for } x.\end{aligned}$$

Check: Check your work by substituting the solution into the original equation.

$$\begin{aligned}4 \times x &= 12 \\4 \times 3 &= 12 \\12 &= 12\end{aligned}$$

So the solution, 3, is correct.

Solution: Winona rides 3 miles to and from each lesson.

Another Example

Use Multiplication to Solve

$$\begin{aligned}\frac{a}{1.5} &= 22 \\ \frac{a}{1.5} \times 1.5 &= 22 \times 1.5 \quad \leftarrow \text{Multiply both sides by 1.5.} \\ &\quad \text{(Multiplication Property of Equality)} \\ a &= 22 \times 1.5 \quad \leftarrow \text{Isolate the variable.} \\ a &= 33\end{aligned}$$


Check:

$$\begin{aligned}\frac{a}{1.5} &= 22 \\ \frac{33}{1.5} &= 22 \\ 22 &= 22 \quad \text{It checks.}\end{aligned}$$

Guided Practice

Solve. State the inverse operation you used.

- $4.5 \times c = 18$
- $a \times 4 = 24$
- $n \div 7 = 8$
- $m \div 7 = 30$

Explain Your Thinking  Why is it helpful to isolate the variable when solving an equation?

Ask Yourself

- Did I perform the same operation on both sides of the equals sign?
- Did I check my work?

Practice and Problem Solving

Solve. State the inverse operation you used.

- $d \div 9 = 2$
- $c \div 3 = 9$
- $y \times 8 = 64$
- $j \div 7 = 49$
- $120 \times u = 240$
- $m \div 12 = 36$

7. $2 \times e = 14$

8. $f \div 5 = 3$

11. $k \times 4 = 36$

12. $m \div 45 = 3$

15. $p \times 18 = 18$

16. $t \div 15 = 10$

Go On 

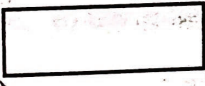
Solve Multiplication and Division Equations

Solve. State the inverse operation you used.

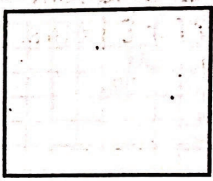
1. $m \times 8 = 56$ _____
2. $t \div 4 = 15$ _____
3. $c \div 18 = 14$ _____
4. $k \times 9 = 108$ _____
5. $15 \times j = 225$ _____
6. $m \div 6 = 8$ _____
7. $y \div 18 = 26$ _____
8. $b \times 8 = 104$ _____
9. $z \times 14 = 126$ _____
10. $s \div 19 = 17$ _____
11. $n \div 9 = 9$ _____
12. $x \times 8 = 72$ _____

Remember that the area, A , of a rectangle is $l \times w$.
Write and solve an equation to find each missing length or width.

13. $A = 12 \text{ cm}^2$
 $l = 6 \text{ cm}$



14. $A = 30 \text{ cm}^2$
 $w = 5 \text{ cm}$



Algebra • Functions Write a function rule to show how the input (m) is changed to the output (n).

15.

Input (m)	Output (n)
10	30
5	15
m	?

16.

Input (m)	Output (n)
30	10
27	9
m	?

Test Prep

17. What is the solution for $4 \times c = 64$?
 A 256 C 60
 B 68 D 16
18. Pedro bought 4 boxes of cereal for \$12. What is the cost per box? Explain how you found your answer.

Inverse Multiplication and Division Equations

Ask Yourself

- Did I perform the same operation on both sides of the equals sign?
- Did I check my work?

10. State the inverse operation you used.

$n \times 7 = 126$

2. $p \times 8 = 32$

3. $42 \times p = 252$

$90 \times a = 360$

5. $n \div 22 = 7$

6. $32 \times t = 192$

7. $w \div 234 = 6$

8. $t \times 5 = 85$

9. $q \times 10 = 20$

$p \times 15 = 195$

11. $m \div 25 = 168$

12. $j \div 17 = 3$

Problem Solving

1. Donya spent \$240 on tickets to a play. If she bought tickets for 16 people, how much did each ticket cost?
- _____

Show Your Work