

Algebra

2-4

Solving Equations With Variables on Both Sides

© CONTENT STANDARDS

8.EE.7, 8.EE.7.b

What You'll Learn

To write and solve equations with variables on both sides

Gather your clicker and notebook.

Why Learn This?

Equations can help you calculate your savings from part-time jobs. An equation shows that two expressions are equal. Because expressions can contain variables, some equations have variables on both sides of the equal sign.





Find the negative symbol on your clicker. You may need it for today's questions.



$$-13 - 18 = \underline{\quad}$$

Text in your
answer.



$$22 - (-5) = \underline{\quad}$$

TEXT IN YOUR ANSWER



$$-32/4 = \underline{\quad}$$

Text in your answer.



$$(-5) + (-6) = \underline{\hspace{2cm}}$$

Text in your answer.

To solve an equation with variables on both sides, bring all the variable terms to one side of the equation first.

EXAMPLE Variables on Both Sides

1 Solve $7 + 3h = -1 - 5h$.

$$7 + 3h = -1 - 5h$$

$$7 + 3h + 5h = -1 - 5h + 5h \quad \leftarrow \text{Add } 5h \text{ to each side.}$$

$$7 + 8h = -1 \quad \leftarrow \text{Combine like terms.}$$

$$7 - 7 + 8h = -1 - 7 \quad \leftarrow \text{Subtract } 7 \text{ from each side.}$$

$$8h = -8 \quad \leftarrow \text{Simplify.}$$

$$\frac{8h}{8} = \frac{-8}{8} \quad \leftarrow \text{Divide each side by } 8.$$

$$h = -1 \quad \leftarrow \text{Simplify.}$$

Check $7 + 3h = -1 - 5h$

$$7 + 3(-1) \stackrel{?}{=} -1 - 5(-1) \quad \leftarrow \text{Substitute } -1 \text{ for } h.$$

$$4 = 4 \quad \checkmark \quad \leftarrow \text{The solution checks.}$$

1 EXAMPLE Solve $9 + 2p = -3 - 4p$.

$$9 + 2p = -3 - 4p$$

$$9 + 2p + 4p = -3 - 4p + 4p \quad \leftarrow \text{Add } 4p \text{ to each side.}$$

$$9 + 6p = -3 \quad \leftarrow \text{Combine like terms.}$$

$$9 - 9 + 6p = -3 - 9 \quad \leftarrow \text{Subtract 9 from each side.}$$

$$6p = -12 \quad \leftarrow \text{Simplify.}$$

$$\frac{6p}{6} = \frac{-12}{6} \quad \leftarrow \text{Divide each side by 6.}$$

$$p = -2 \quad \leftarrow \text{Simplify.}$$

Consider copying this example in to your notes.

Check $9 + 2p = -3 - 4p$

$$9 + 2(-2) \stackrel{?}{=} -3 - 4(-2) \quad \leftarrow \text{Substitute } -2 \text{ for } p.$$

$$5 = 5 \quad \checkmark \quad \leftarrow \text{The solution checks.}$$

Work with your table partners to see if you can solve this one together.

 **Quick Check**

1. Solve $7b - 2 = b + 10$. Check the solution.

EXAMPLE Application: Science

- 2 Gridded Response** Your science class is doing an experiment. You start with 2 plants. Plant A is 5 cm tall and Plant B is 8 cm tall. Plant A is fertilized and grows 2 cm per day. Plant B is not fertilized and grows 1.5 cm per day. Predict in how many days the plants will be the same height.

Words $5 + 2 \text{ cm} \cdot \text{number of days} = 8 + 1.5 \text{ cm} \cdot \text{number of days}$

↓ Let d = the number of days.

Equation $5 + 2 \cdot d = 8 + 1.5 \cdot d$

$$5 + 2d = 8 + 1.5d$$

$$5 + 2d - 2d = 8 + 1.5d - 2d \leftarrow \text{Subtract } 2d \text{ from each side.}$$

$$5 = 8 - 0.5d \leftarrow \text{Simplify.}$$

$$5 - 8 = 8 - 8 - 0.5d \leftarrow \text{Subtract 8 from each side.}$$

$$-3 = -0.5d \leftarrow \text{Simplify.}$$

$$\frac{-3}{-0.5} = \frac{-0.5d}{-0.5} \leftarrow \text{Divide each side by } -0.5.$$

$$6 = d \leftarrow \text{Simplify.}$$

The plants will be the same height in 6 days.

2 EXAMPLE Each week you set aside \$18 for a stereo and put the remainder in a savings account. After 7 weeks, the amount you place in the savings account is 4.2 times your total weekly pay. How much do you make each week?

Words



Equation

$$7 \cdot (\text{weekly amount} - 18) = 4.2 \cdot \text{Weekly amount}$$

Let x = the amount earned weekly.

$$7(x - 18) = 4.2x$$

$$7x - 126 = 4.2x \quad \leftarrow \text{Distributive Property}$$

$$7x - 7x - 126 = 4.2x - 7x \quad \leftarrow \text{Subtract } 7x \text{ from each side.}$$

$$-126 = -2.8x \quad \leftarrow \text{Combine like terms.}$$

$$\frac{-126}{-2.8} = \frac{-2.8x}{-2.8} \quad \leftarrow \text{Divide each side by } -2.8.$$

$$45 = x \quad \leftarrow \text{Simplify.}$$



Solve: $4(3u - 1) = 20$

A 4

D -4

B 3

E -3

C 2

F -2



Solve: $0.5t - 4 = t - 0.8$

A 1.6

D -3.2

B -1.6

E 6.4

C 3.2

F -6.4



Solve $3(k - 8) = -1k$

A 6

D 24

B 8

E -8

C -6

F -24



Solve: $2 + 14z = -8 + 9z$

A -1

D 7

B -2

E 12

C -3

F 28



Solve: $7m = 9(m + 4)$

A 29

D 20

B -43

E -9

C -18

F 41

Power down your clickers and put them away.

You have time to begin on your homework now.

Reteaching 2-4

Solving Equations With Variables on Both Sides

When an equation has a variable on both sides, add or subtract to get the variable on one side.

$$\begin{aligned}\text{Solve: } -6m + 45 &= 3m \\ -6m + 6m + 45 &= 3m + 6m \quad \leftarrow \text{Add } 6m \text{ to each side.} \\ 45 &= 9m \\ \frac{45}{9} &= \frac{9m}{9} \\ 5 &= m\end{aligned}$$

$$\begin{aligned}\text{Check: } -6m + 45 &= 3m \\ -6(5) + 45 &\stackrel{?}{=} 3(5) \\ 15 &= 15 \quad \checkmark\end{aligned}$$

Sometimes you need to distribute a term in order to simplify.

$$\begin{aligned}\text{Solve: } 5(x - 3) &= 32 - 2 \\ 5x - 15 &= 32 - 2 \quad \leftarrow \text{Distributive Property} \\ 5x - 15 &= 30 \\ 5x &= 45 \\ \frac{5x}{5} &= \frac{45}{5} \\ x &= 9\end{aligned}$$

$$\begin{aligned}\text{Check: } 5(x - 3) &= 32 - 2 \\ 5(9 - 3) &= 32 - 2 \\ 30 &= 30 \quad \checkmark\end{aligned}$$

Solve each equation. Check the solution.

1. $9j + 35 = 4j$

$j =$ _____

2. $13s = 2s - 66$

$s =$ _____

3. $2(5t - 4) = 12t$

$t =$ _____

4. $6q = 6(4q + 1)$

$q =$ _____

5. $7(t - 2) - t = 4$

$t =$ _____

6. $6w + 4 = 4w + 1$

$w =$ _____

7. $2(2q + 1) = 3(q - 2)$

$q =$ _____

8. $5z - 3 = 2(z - 3)$

$z =$ _____

9. $4(x + 0) = 2x + 6$

$x =$ _____

10. $5(k - 4) = 4 - 3k$

$k =$ _____

11. $8 - m - 3m = 16$

$m =$ _____

12. $6n + n + 14 = 0$

$n =$ _____

13. $7(p + 1) = 9 - p$

$p =$ _____

14. $41 - q = 3(q - 5)$

$q =$ _____

15. $25 + 2t = 5(t + 2)$

$t =$ _____