Solving Linear Equations I

Connections

Solving equations is something you'll probably do the most in algebra. In this lesson, you'll learn how to solve basic linear equations.

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Why Should You Learn It?

Maria says:

Some people think equations won't ever be useful in their daily lives, but I don't agree. Sometimes you're solving an equation without even knowing it!

For example, there's a nice jacket I want to buy. It costs $120. I've been putting aside some cash so I don't use my credit card. I already saved $85.

$$\$85 + ? = \$120$$

I can use algebra to determine how much more money I need. Look at the equation above. $85 plus an unknown amount equals $120. The unknown amount is the solution to the equation and how much more I need to save. You subtract to get the answer.

$$? = \$120 - \$85$$

The unknown amount, how much more I need to save, is $120 minus $85, which is $35.

CONNECTIONS

Learn It

Addition and Subtraction Equations

Addition equations have a variable and a plus sign, and subtraction equations have a variable and a minus sign.

Subtraction Property of Equality

When you want to solve an addition equation, use the subtraction property of equality. It says that you can subtract the same number from each side of an equation and the equation will still be true.

Look at this equation:

$$w + 73 = 98$$

It's an addition equation because there's a variable w and a plus sign. To solve it, subtract 73 from both sides using the subtraction property of equality.

$$w + 73 - 73 = 98 - 73$$

Subtract because subtraction is the opposite of addition. It gets the variable w alone so you can figure out the solution.

$$w + 0 = 98 - 73$$

$$w = 25$$

73 minus 73 is 0, so that leaves w alone. On the other side of the equals sign, 98 minus 73 is 25. The solution to the equation is 25.

Addition Property of Equality

To solve a subtraction equation, use the **addition property of equality**, which says you can add the same number to each side of an equation and the equation will still be true.

Look at the equation:

$$-4 = x - 10$$

It's a subtraction equation because there's the variable x and a minus sign after it.

You can use the addition property of equality and add 10 to each side of the equation.

$$-4 + 10 = x - 10 + 10$$

$$-4 + 10 = x + 0$$

$$6 = x \text{ or } x = 6$$

So, x is just equal to −4 plus 10, which is 6.

Try It 1: Addition and Subtraction Equations

What is the solution to the equation?

$$m + 47 = 31$$

A	B	C	D
$m = 16$	$m = 78$	$m = -78$	$m = -16$

Go to page 1 of the answers and explanations to see the answer.

Try It 2: Addition and Subtraction Equations

What is the solution to the equation?

$$x - 11 = -4$$

A	B	C	D
$x = -7$	$x = -14$	$x = 14$	$x = 7$

Go to page 1 of the answers and explanations to see the answer.

Try It 3: Addition and Subtraction Equations

What is the solution to the equation?

$$5.92 = x + 3.02$$

A	B	C	D
$x = -2.9$	$x = 2.9$	$x = -8.94$	$x = 8.94$

Go to page 1 of the answers and explanations to see the answer.

Try It 4: Addition and Subtraction Equations

What is the solution to the equation?

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

A	B	C	D
$x = -\frac{1}{15}$	$x = \frac{3}{8}$	$x = \frac{11}{15}$	$x = \frac{1}{15}$

Go to page 1 of the answers and explanations to see the answer.

Multiplication and Division Equations

Division Property of Equality

Multiplication equations have a variable multiplied by a number. When you want to solve a multiplication equation, use the **division property of equality**. It says that you can divide by the same number on each side of an equation and the equation will still be true.

Here's a multiplication equation:

$$5x = -45$$

The opposite of multiplication is division, so divide both sides by 5, then the 5s will cancel out and the x will be alone.

$$\frac{5x}{\mathbf{5}} = \frac{-45}{\mathbf{5}}$$

$$\frac{\cancel{5}\,x}{\cancel{\mathbf{5}}} = \frac{-45}{\mathbf{5}}$$

$$x = \frac{-45}{\mathbf{5}}$$

$$x = -9$$

You can now see x is equal to -45 divided by 5. A negative divided by a positive is a negative, and 45 divided by 5 is 9, so the solution to the equation is x equals -9.

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Multiplication Property of Equality

To solve a division equation, use the **multiplication property of equality**, which says you can multiply the same number on each side of an equation and the equation will still be true.

Look at this division equation:

$$\frac{m}{3} = \frac{1}{6}$$

You can multiply both sides by 3, using the multiplication property of equality. Doing this gets *m* alone because dividing by 3 and multiplying by 3 makes the 3s cancel out.

$$\frac{m}{3} \cdot \mathbf{3} = \frac{1}{6} \cdot \mathbf{3}$$

$$\frac{m}{\cancel{3}} \cdot \cancel{\mathbf{3}} = \frac{1}{6} \cdot \mathbf{3}$$

$$m = \frac{3}{6}$$

$$m = \frac{1}{2}$$

So, *m* is equal to one-sixth times 3, which is three-sixths. Note that three-sixths isn't simplified. Three-sixths simplifies to one-half. The solution to the equation is *m* equals one-half.

Try It 1: Multiplication and Division Equations

What is the solution to the equation?

$$\mathbf{9}w = -18$$

A	B	C	D
$w = -9$	$w = -2$	$w = -162$	$w = -\frac{1}{2}$

Go to page 1 of the answers and explanations to see the answer.

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Try It 2: Multiplication and Division Equations

What is the solution to the equation?

$$\frac{y}{2 \cdot 5} = 18$$

A	B	C	D
$y = 45.5$	$y = 7.2$	$y = 20.5$	$y = 45$

Go to page 2 of the answers and explanations to see the answer.

Try It 3: Multiplication and Division Equations

What is the solution to the equation?

$$-0.5x = -11.5$$

A	B	C	D
$x = -23$	$x = 5.75$	$x = 23$	$x = -5.75$

Go to page 2 of the answers and explanations to see the answer.

Try It 4: Multiplication and Division Equations

What is the solution to the equation?

$$\frac{y}{-6} = -30$$

A	B	C	D
$y = -180$	$y = 180$	$y = -5$	$y = 5$

Go to page 2 of the answers and explanations to see the answer.

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1. What is the solution to the equation?

$$x - 17 = -2$$

A	B	C	D
$x = 19$	$x = -15$	$x = -19$	$x = 15$

2. What is the solution to the equation?

$$-16c = 8$$

A	B	C	D
$c = -2$	$c = 24$	$c = -128$	$c = -\frac{1}{2}$

3. What is the solution to the equation?

$$\frac{d}{9} = \frac{2}{3}$$

A	B	C	D
$d = \frac{2}{27}$	$d = 6$	$d = \frac{1}{6}$	$d = 18$

4. What is the solution to the equation?

$$-5x = -75$$

A	B	C	D
$x = -15$	$x = -25$	$x = 15$	$x = 25$

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5. What is the solution to the equation?

$$y + 14.9 = 10.7$$

A	B	C	D
$y = 4.2$	$y = 25.6$	$y = -4.2$	$y = -25.6$

6. What is the solution to the equation?

$$56 = -0.7y$$

A	B	C	D
$y = 39.2$	$y = -39.2$	$y = -8$	$y = -80$

7. What is the solution to the equation?

$$\frac{p}{7} = \frac{1}{2}$$

A	B	C	D
$p = \frac{2}{7}$	$p = 14$	$p = \frac{1}{14}$	$p = \frac{7}{2}$

8. What is the solution to the equation?

$$x + \frac{1}{3} = \frac{3}{5}$$

A	B	C	D
$x = 1$	$x = \frac{1}{2}$	$x = \frac{14}{15}$	$x = \frac{4}{15}$

Go to page 2 of the answers and explanations to see the answers.