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SOLVING MULTI-STEP EQUATIONS

LESSON SUMMARY

In this lesson you will use addition, subtraction, multiplication, and division to solve equations that have more than one step. You will also solve equations where the coefficient of the variable is a fraction.

SOLVING EQUATIONS REQUIRING MORE THAN ONE STEP

You learned the basic steps needed to solve algebraic equations in the previous lesson, so now you're ready to solve more complicated equations. These equations may require that you do two or more steps. Remember that the basic rules for solving equations are:

1. What you do to one side of the equation, you must do to the other side.
2. You can add, subtract, multiply, or divide both sides of an equation by the same number.

Can you guess what steps you would use to solve $3x + 1 = 10$? Ask yourself which numbers you need to get rid of so that the variable will be on a side by itself. In other words, you need to isolate the variable. To get the x on a side by itself, or to isolate the variable, you will need to eliminate the 3 and the 1. Does it matter which number you get rid of first? Yes! You

generally get rid of the number with the variable—that is, the coefficient of x—last. Therefore, you would eliminate the 1 first and the 3 last.

Example: $3x + 1 = 10$

Subtract 1 from both sides of the equation.	$3x + 1 - 1 = 10 - 1$
Simplify both sides of the equation.	$3x = 9$
Divide both sides of the equation by 3.	$\frac{3x}{3} = \frac{9}{3}$
Simplify both sides of the equation.	$x = 3$

Example: $5x - 2 = 13$

Add 2 to both sides of the equation.	$5x - 2 + 2 = 13 + 2$
Simplify both sides of the equation.	$5x = 15$
Divide both sides of the equation by 5.	$\frac{5x}{5} = \frac{15}{5}$
Simplify both sides of the equation.	$x = 3$

Example: $\frac{x}{9} + 4 = 13$

Subtract 4 from both sides of the equation.	$\frac{x}{9} + 4 - 4 = 13 - 4$
Simplify both sides of the equation.	$\frac{x}{9} = 9$
Multiply both sides of the equation by 9.	$\frac{x}{9} \cdot 9 = 9 \cdot 9$
Simplify both sides of the equation.	$x = 81$

Example: $18 = 9 - 3x$

Subtract 9 from both sides of the equation.	$18 - 9 = 9 - 9 - 3x$
Simplify both sides of the equation.	$9 = -3x$
Divide both sides of the equation by –3.	$\frac{9}{-3} = \frac{-3x}{-3}$
Simplify both sides of the equation.	$-3 = x$

You know that you have solved an equation when you get x on a side by itself. The variable can be on the left side of the equation or on the right side of the equation. The equations $x = 3$ and $3 = x$ are the same, and both are acceptable answers.

PRACTICE

Solve the equations. Show each step you use to solve the equation.

_____ **1.** $24x + 1 = 25$

_____ **2.** $14x + 2 = 16$

_____ **3.** $13x - 11 = 15$

_____ **4.** $2x - 3 = -13$

_____ **5.** $\frac{x}{3} + 2 = 3$

_____ **6.** $\frac{x}{7} - 7 = 2$

_____ **7.** $-2x + 3 = 17$

_____ **8.** $-2x - 3 = 2$

_____ **9.** $16 = 2x - 4$

_____ **10.** $-10 = 3x + 5$

_____ **11.** $-13 = -3x + 2$

_____ **12.** $-\frac{x}{3} + 2 = 4$

_____ **13.** $3x + 1 = 6$

_____ **14.** $\frac{x}{4} - 4 = -14$

_____ **15.** $2.2x + 1 = 3.2$

_____ **16.** $\frac{x}{.3} - 1 = 5$

_____ **17.** $-2x + 1 = 27$

_____ **18.** $\frac{x}{5} - 3 = -3$

_____ **19.** $6x - 3 = 3$

_____ **20.** $5x + 2 = 2$

SETTING UP EQUATIONS FOR WORD PROBLEMS

You can use the same rules discussed at the beginning of this lesson to figure out the correct answer to word problems. Take a look at the following examples.

Example: You received a raise in your hourly rate of pay. Your new rate of pay is $10 an hour. You are now earning $4 more than $\frac{2}{3}$ your original wage. How much did you make before you got your raise? What was your raise?

Let x = the original rate of pay.

Then $4 + \frac{2}{3}x = \$10$.

Solution:	$4 + \frac{2}{3}x = 10$
Subtract 4 from both sides of the equation.	$4 - 4 + \frac{2}{3}x = 10 - 4$
Simplify both sides of the equation.	$\frac{2}{3}x = 6$
Multiply both sides of the equation by $\frac{3}{2}$.	$\frac{2}{3}x \cdot \frac{3}{2} = 6 \cdot \frac{3}{2}$
Simplify both sides of the equation.	$x = \$9$

Your raise was $10 – $9 = $1.