Things to know about equivalent equations in algebra

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Here are **examples of equivalent equations, how to solve them for one or more variables, and how you can use this skill outside of the classroom** .

Things to remember

1. Equivalent equations are algebraic equations that have the same or identical solutions.
2. Adding or subtracting the same number or expression to both sides of an equation produces an equivalent equation.
3. Multiplying or dividing both sides of an equation by the same nonzero number produces an equivalent equation.

Equivalent equations with 1 variable

The simplest examples of **equivalent equations** do not have any variables. For example, these three equations are equivalent:

1. 3 + 2 = 5

2. 4 + 1 = 5
3. 5 + 0 = 5

Typically, equivalent equation problems require you to solve for one variable to see if it is the same (same square root) as the variable in another equation.

For example, the following equations are equivalent:

1. x = 5
2. -2x = -10

In both cases, x = 5. How do we know this? How do you solve the equation "-2x = -10"? The first step is to know the rules of equivalent equations:

1. Adding or subtracting the same number or expression to both sides of an equation produces an equivalent equation.
2. Multiplying or dividing both sides of an equation by the same nonzero number produces an equivalent equation.
3. Raising both sides of the equation to the same odd power or taking the same odd root will produce an equivalent equation.
4. If both sides of an equation are nonnegative, raising both sides of an equation to the same even power or taking the same even root will produce an equivalent equation.

For example

Applying these rules to real life, determine whether these two equations are equivalent:

1. x + 2 = 7
2. 2x + 1 = 11

To solve this equation, you need to find " **x** " for each equation. If " **x** " is the same for both equations, then they are equivalent. If " **x** " is different (i.e. the equations have different solutions), then they are not equivalent. For the first equation:

1. x + 2 = 7
2. x + 2 - 2 = 7 - 2 (subtract both sides to the same number)
3. x = 5

For the second equation:

1. 2x + 1 = 11
2. 2x + 1 - 1 = 11 - 1 (subtract both sides to the same number)
3. 2x = 10
4. 2x/2 = 10/2 (divide both sides of the equation by the same number)
5. x = 5

So the two equations are equivalent because x = 5 in each case.

Practical equivalent equations

You can use equivalent equations in everyday life. They are especially useful when shopping. For example, let's say you like a certain shirt. One company sells the shirt for $6 with $12 shipping, while another company sells the shirt for $7.50 with $9 shipping. Which shirt has the best price? How many shirts would you have to buy to get the prices from both companies to be the same?

To solve this problem, let "x" be the number of shirts. To start, let x = 1 for the purchase of one shirt. For company #1:

1. Price = 6x + 12 = (6)(1) + 12 = 6 + 12 = $18

For company number 2:

1. Price = 7.5x + 9 = (1)(7.5) + 9 = 7.5 + 9 = $16.50

So if you buy a shirt, the second company will have a better price.

To find the point where the prices are equal, let " **x** " be the number of shirts, but set the two equations equal. Solve for " **x** " to find the number of shirts you have to buy:

1. 6x + 12 = 7.5x + 9
2. 6x - 7.5x = 9 - 12 (except for numbers or expressions that are the same on each side)
3. -1.5x = -3
4. 1.5x = 3 (divide both sides by the same number, -1)
5. x = 3/1.5 (divide both sides by 1.5)
6. x = 2

If you buy two shirts, the price will be the same no matter where you buy them. You can use the same math to determine which company offers better prices on larger orders, and also to calculate how much you will save by comparing prices between the two companies.

Equivalent equation with two variables

If you have two equations and two unknowns (x and y), you can determine whether two sets of linear equations are equivalent.

For example, if you are given the equations:

1. -3x + 12y = 15
2. 7x - 10y = -2

You can determine whether the following systems are equivalent:

1. -x + 4y = 5
2. 7x -10y = -2

To solve this problem, find "x" and "y" for each system of equations. If the values ??are the same, then the systems of equations are equivalent.

Start with the first set. To solve two equations with two variables, isolate one variable and plug its solution into the other equation. To isolate the variable "y":

1. -3x + 12y = 15
2. -3x = 15 - 12y
3. x = -(15 - 12y)/3 = -5 + 4y (substitute "x" into the second equation)
4. 7x - 10y = -2
5. 7(-5 + 4y) - 10y = -2
6. -35 + 28y - 10y = -2
7. 18y = 33
8. y = 33/18 = 11/6

Now, substitute "y" back into any equation to solve for "x":

1. 7x - 10y = -2
2. 7x = -2 + 10(11/6)

Doing this, you will end up with x = 7/3.

To answer the question, you can apply the same principles to the second set of equations to solve for "x" and "y" to see that they are indeed equivalent.

However, a smart student will notice that the two sets of equations are equivalent without doing any difficult calculations. The only difference between the first equation in each set is that the first equation is three times the second (equivalent) equation. The second equation is exactly the same.