

Writing Equivalent Equations

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WHAT'S COVERED

In this lesson, you will learn how to determine if equations are equivalent by solving each equation and comparing their solution. Specifically, this lesson will cover:

1. Equivalent Equations

In mathematics, we work with equivalent equations all the time. Think about the process for solving a multi-step equation. We might start with something such as $5x + 3 = 23$. Using inverse operations, we create a series of equivalent equations in order to find a value for x .

$$5x + 3 = 23 \quad \text{Subtract 3 from both sides}$$

$$5x = 20 \quad \text{This is considered an equivalent equation. Divide both sides by 4 to get another equivalent equation.}$$

$$x = 4 \quad \text{A second equivalent equation}$$

The equations above are all considered equivalent equations, because they have the same solution. In each equation, the solution is $x = 4$.

2. Determining if Two Equations are Equivalent

In order to determine if two equations are equivalent, we will solve each equation, and then compare their solutions. If their solutions are the same, we can say the equations are equivalent. If the solutions are not the same, we know that the equations are not equivalent.

➞ **EXAMPLE** Determine if the equations below are equivalent:

$$-5x + 2 = -13$$

$$14 - 4x = 2$$

Solve each equation separately:

$$-5x + 2 = -13 \quad \text{Subtract 2 from both sides}$$

$$-5x = -15 \quad \text{Divide both sides by -5}$$

$$x = 3 \quad \text{Our Solution}$$

$$14 - 4x = 2 \quad \text{Subtract 14 from both sides}$$

$$-4x = -12 \quad \text{Divide both sides by -4}$$

$$x = 3 \quad \text{Our Solution}$$

The solutions to our equations are both $x = 3$ and $x = 3$. Since the solutions are the same, the two equations are equivalent.

➞ **EXAMPLE** Determine if the equations below are equivalent:

$$-3x + 2 = 5$$

$$\frac{1}{2}x + 9 = 8$$

Solve each equation separately:

$$-3x + 2 = 5 \quad \text{Subtract 2 from both sides}$$

$$-3x = 3 \quad \text{Divide both sides by -3}$$

$$x = -1 \quad \text{Our Solution}$$

$$\frac{1}{2}x + 9 = 8 \quad \text{Subtract 9 from both sides}$$

$$\frac{1}{2}x = -1 \quad \text{Multiply both sides by 2}$$

$$x = -2 \quad \text{Our Solution}$$

The solutions to our equations are $x = -1$ and $x = -2$. Since the solutions are not the same, the two equations are not equivalent.



SUMMARY

We can define **equivalent equations** as equations that have the same solution or solution set. To **determine if two equations are equivalent** to each other, you just need to solve each equation and then determine if their solutions are the same.

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