Solving Multi-Step Equations

A previous lesson focused on basic two-step equations.

One type of two-step equations had two constant terms, one on each side of the equal sign.

Solve:

$2x - 3 = 11$	One constant term is on each side of the equal sign.
$+3 \quad +3$	Use the inverse operation $+3$ to collect the constant terms.
$2x = 14$	Rewrite.
$\div 2 \quad \div 2$	Split the variable term.
$x = 7$	

Another type of two-step equations had two variable terms, one on each side of the equal sign.

Solve:

$5x = 3x + 14$	One variable term is on each side of the equal sign.
$-3x \quad -3x$	Use the inverse operation $-3x$ to collect the variable terms.
$2x = 14$	Rewrite.
$\div 2 \quad \div 2$	Split the variable term.
$x = 7$	

Multi-Step Equations

Multi-step equations have a variety of structures. One class of multi-step equations is the three-step equation. A basic three-step equation has two variable terms, one on each side of the equal sign, and two constant terms, one on each side of the equal sign.

Solve:

$$5x - 3 = 3x + 11$$ One constant term is on each side of the equal sign.

$$+ 3 \qquad\qquad + 3$$ Use the inverse operation $+ 3$ to collect the constant terms.

$$5x = 3x + 14$$ Rewrite. One variable term is on each side of the equal sign

$$- 3x \qquad - 3x$$ Use the inverse operation $- 3x$ to collect the variable terms.

$$2x = 14$$ Rewrite.

$$\div 2 \qquad \div 2$$ Remove the coefficient by using the inverse operation $\div 2$.

$$x = 7$$

Note: The first step in solving this equation was to add 3 to both sides of the equation. The problem can be solved using three alternative first steps.

Activity:

Solve the equation $5x - 3 = 3x + 11$ three more times. Each solution must have a different first step. What can you say about the final answer in each case?

Exercises:

Solve the following equations. Remember to check your answer.

1. $7x - 3 = 4x + 3$
2. $5y + 9 = 2y - 3$

3. $-4m + 2 = 6m + 12$
4. $-8t - 5 = -9t - 7$

5. $3r - 2 = -5r + 14$
6. $6p - 7 = -6p - 7$

7. $5 - y = 3 - 2y$
8. $3 - 2t = 5 - 5t$

9. $7 - 5p = 6 + p$
10. $-11 + 6x = -6x + 13$

In this next group of questions you may be required to 'simplify' the equation 'before' you begin to use inverse operations. Remember to check your answer.

11. $4x + 12 - 9 = 3 + 2x - 6$
12. $1 + 4x - 4 = 3x - 6 + 6$

13. $-2x - 6 = 12 + 3x + 2$
14. $x + 4x - 8 = 6 + x - 3x$

15. $3n - 6 + 12 = 4n + 8 - 2n$
16. $11 - 8 - 6x = -4x + 7$