Chapter 37

SOLVING MULTISTEP EQUATIONS

Isolating the variable is the goal of solving equations, because on the other side of the equal sign will be the answer!

Here are the ways to isolate a variable:

1. Use inverse operations (as many times as necessary):

EXAMPLE: Solve for x: $3x + 7 = 28$.

$3x + 7 = 28$

$3x + 7 - 7 = 28 - 7$ (What is the inverse of addition? Subtraction.)

$3x = 21$

$\frac{3x}{3} = \frac{21}{3}$ (What is the inverse of multiplication? Division.)

$x = 7$

2. Use the distributive property, then use inverse operations.

LOOK FOR PARENTHESES WITH A NUMBER ATTACHED TO THE OUTSIDE.

EXAMPLE: Solve for m: $3(m-6)=-12$.

$3(m-6)=-12$ (We can distribute the 3 across the terms in the parentheses like so: $3(m-6)=3m-3\cdot6$.)

$3m-18=-12$ (Add 18 to both sides.)

$3m=6$ (Divide both sides by 3.)

$m=2$

3. Combine **LIKE TERMS**, then use inverse operations.

"LIKE TERMS" ARE TERMS THAT HAVE THE SAME VARIABLES AND POWERS.

EXAMPLE: Solve for y: $4y+5y=90$.

$4y+5y=90$ ($4y$ and $5y$ are like terms. So, we can combine them: $4y+5y=9y$)

$9y=90$ (Divide both sides by 9.)

$y=10$

EXAMPLE: Solve for y: $6y + 5 = 2y - 3$.

$6y + 5 = 2y - 3$

$6y - 2y + 5 = 2y - 2y - 3$

(6y and 2y are like terms but they are on different sides of the equal sign. We can combine them only by doing the inverse operation on both sides of the equation—the opposite of $2y$ is $-2y$.)

$4y + 5 = -3$

IT'S USUALLY EASIER TO DO THE INVERSE OPERATION OF THE SMALLER TERM—IN THIS CASE $2y$ IS SMALLER THAN $6y$.

$4y + 5 - 5 = -3 - 5$

(Next, subtract 5 from both sides.)

$\frac{4y}{4} = \frac{-8}{4}$

(Last, divide both sides by 4 to get y alone.)

$y = -2$

Sometimes, several steps are necessary in order to isolate a variable on one side of the equal sign. This example uses all three of the previous tools!

EXAMPLE:

Solve for w: $-3(w-3)-9w-9=4(w+2)-12$.

$-3(w-3)-9w-9=4(w+2)-12$ (First, use the distributive property to simplify.)

$-3w+9-9w-9=4w+8-12$ (Now, combine like terms on each side of the equal sign.)

$-12w=4w-4$ (Last, use inverse operations to get the variable alone on one side of the equation like so: $-12w-4w=4w-4-4w$.)

$-16w=-4$ (Use inverse operations again.)

$w=\frac{1}{4}$ (Don't forget to always simplify fractions!)

Plug your answer into the original equation to check your work.

CHECK YOUR KNOWLEDGE

Solve for the unknown variable.

1. $6x + 10 = 28$
2. $-2m - 4 = 8$
3. $x + x + 2x = 48$
4. $3y + 4 + 3y - 6 = 34$
5. $9(w - 6) = -36$
6. $-5(t + 3) = -30$
7. $5z + 2 = 3z - 10$
8. $11 + 3x + x = 2x - 11$
9. $-5(n - 1) = 7(n + 3)$
10. $-3(c - 4) - 2c - 8 = 9(c + 2) + 1$

ANSWERS

CHECK YOUR ANSWERS

1. $x = 3$
2. $m = -6$
3. $x = 12$
4. $y = 6$
5. $w = 2$
6. $t = 3$
7. $z = -6$
8. $x = -11$
9. $n = -\frac{4}{3}$ or $-1\frac{1}{3}$
10. $c = -\frac{15}{14}$ or $-1\frac{1}{14}$