Algebra: Addition Property of Equality

Vocabulary

Equivalent Equations	Equations that have the same solution. $5x+3=27-x$ and $14-2x=6$ are equivalent equations because 4 is the solution to both equations.

Think of the equation: $x+5=8$

   To solve the equation, our goal is to ISOLATE the variable.

   That is, we need to eliminate the $+5$ so the x can be all alone on the left side of the equation.

   Since both sides of an equation are equal or "balanced", whatever we do to eliminate the $+5$ from the left side, we must do the same to the right side.

   Let's add -5 (the opposite of $+5$) to both sides.

$$x+5-5=8-5$$
$$x+0=3$$
$$x=3 \qquad \text{The solution is 3.}$$

Special properties are used to move and/or eliminate terms within equations.

Addition property of Equality Adding the same number to both sides of an equation does not change the solution of the equation.	If $a=b$, then $a+c=b+c$	If $x-5=4$, then $x-5+5=4+5$
Subtraction property of Equality Subtracting the same number from both sides of an equation does not change the solution of the equation.	If $a=b$, then $a-c=b-c$	If $x+6=4$, then $x+6-6=4-6$

As long as the same term is added to both sides or subtracted to both sides, the equation will remain balanced and the solution will remain unchanged.

Example: Solve $x+7=-5$ for the value of x.

$x+7=-5$	Use the subtraction property of equality to subtract 7 from both sides.
$x+7-7=-5-7$	Simplify. $x+7-7=-5-7$; $x+0=-12$; $x=-12$
$x=-12$	Check the solution. $-12+7=-5$; $-5=-5$ is true.

Example: Solve $8 = g - 3$ for the value of g.

$8 = g - 3$	Use the addition property of equality to add 3 to both sides.
$8 + 3 = g - 3 + 3$	Simplify. $8 + 3 = g - 3 + 3$; $11 = g + 0$; $11 = g$
$11 = g$	Check the solution. $8 = 11 - 3$; $8 = 8$ is true.

Example: Solve $4x - 8 = 3x + 7$ for the value of x.

$4x - 8 = 3x + 7$	Use the addition or subtraction property to combine like variables on one side and the constants on the other.
$4x - 8 + 8 = 3x + 7 + 8$ $4x = 3x + 15$ $4x - 3x = 3x - 3x + 15$	Use the addition property to add 8 to both sides. Combine like terms. Use the subtraction property to subtract $3x$ from both sides. Combine like terms.
$x = 15$	Check the solution. $4(15) - 8 = 3(15) + 7$; $60 - 8 = 45 + 7$; $52 = 52$ is true.

Example: Solve $3(2x - 6) = -4 + 5x$ for the value of x.

$3(2x - 6) = -4 + 5x$ $6x - 18 = -4 + 5x$	Use the distributive property first to remove the ( ).
$6x - 18 + 18 = -4 + 18 + 5x$ $6x = 14 + 5x$ $6x - 5x = 14 + 5x - 5x$	Use the addition property to add 18 to both sides. Combine like terms. Use the subtraction property to subtract $5x$ from both sides. Combine like terms.
$x = 14$	Check the solution in the ORIGINAL equation. $3(2(14) - 6) = -4 + 5(14)$; $3(28 - 6) = -4 + 70$; $3(22) = -4 + 70$; $66 = 66$ is true.

TRY: Solve for the value of x.

$$x + 27 = -9 \qquad\qquad\qquad -8 = x - 39$$

$$4x - 8 = 3x$$

$$3(5x - 6) = 14x - 3$$

$$4x - 6 = 3x + 9$$

$$3(5x - 6) = 2(7x - 6)$$

$$8 - 7(2 - 3x) - 5x = 4(5x - 1) - 3x - 2$$ (careful – just follow the rules and trust your work)