SOLVING TWO-STEP EQUATIONS

In this unit, you will extend your knowledge of equations. You will solve two-step equations using algebra and inverse properties. You will solve equations that include whole numbers and integers.

Using Inverses to Solve Equations

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Addition and subtraction are inverses. Multiplication and division are inverses. This idea is valuable for solving algebraic equations.

If we have an equation $15m = 45$, then we can use the inverse operation, division, to solve it.

We "operate" on both sides by using division, and then simplify to find a solution.

$15m = 45$	15 times $m = 45$
$\frac{15m}{15} = \frac{45}{15}$	Divide both sides by 15. (Divide is the inverse of multiply.)
$\frac{15}{15}(m) = \frac{45}{15}$	$\frac{15m}{15}$ is the same as $\frac{15}{15}(m)$.
$1m = 3$	Simplify both sides.
$m = 3$	$1m$ is the same as m.

The solution is $m = 3$.

Example 1: Solve $5n + 15 = 30$ using inverse operations.

$5n+15=30$	Given
$5n+15-15=30-15$	Use the same inverse operation (subtraction) on both sides of the equation.
$5n=15$	Simplify
$\frac{5n}{5}=\frac{15}{5}$	Use the same inverse operation (division) on both sides of the equation.
$n=3$	Simplify

The solution is $n=3$.

Example 2: Solve $5z - 12 = -2$ using inverse operations.

$5z-12=-2$	Given
$5z-12+12=-2+12$	Use the same inverse operation (addition) on both sides of the equation.
$5z=10$	Simplify
$\frac{5z}{5}=\frac{10}{5}$	Use the same inverse operation (division) on both sides of the equation.
$z=2$	Simplify

The solution is $z=2$.

Example 3: Solve $4n + 3 = -5$ using inverse operations.

$4n+3=-5$	Given
$4n+3-3=-5-3$	Use the same inverse operation (subtraction) on both sides of the equation.
$4n=-8$	Simplify
$\frac{4n}{4}=\frac{-8}{4}$	Use the same inverse operation (division) on both sides of the equation.
$n=-2$	Simplify

The solution is $n=-2$.

Example 4: Write an equation for the following, and then solve: "Twenty-three is five more than three times a number".

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$$23 = 5 + 3x$$

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$23 - 5 = 5 + 3x - 5$ Subtract 5 from both sides of the equation (inverse of addition).

$23 - 5 = 5 - 5 + 3x$ Use the commutative property on the right side of the equation by switching $3x$ and -5 around.

$18 = 3x$ Simplify

$6 = x$ $(or \quad x = 6)$

The solution is $x = 6$.

Example 5: Write an equation for the following, and then solve: For the tournament game, Andrew bought an adult ticket for $7.50 and 5 student tickets. If the total cost of the tickets were $30, what was the price of a student ticket?

Think algebraically.

Let t = the price of a student ticket.

$5t$	price of 5 student tickets
$5t+7.50$	price of the adult ticket added to the price of student tickets (total cost)
30	Total cost is given.
$5t+7.50 \;=\; 30$	total cost $=$ total cost

Now solve.

$5t+7.50=30$	
$5t+7.50-7.50=30-7.50$	Use the inverse operation of addition and subtract 7.50 from both sides of the equation.
$5t=22.50$	Simplify.
$t=4.50$	Divide.

Each student ticket costs $4.50.