

The background features a light gray gradient with several realistic water droplets of various sizes scattered across the surface. A faint, circular, textured pattern is visible in the upper center of the image.

SOLVING LINEAR EQUATIONS

EQUATIONS AND SOLUTIONS

- EQUATIONS ARE MATHEMATICAL STATEMENTS THAT SAY TWO EXPRESSIONS ARE EQUAL.
- SOLUTIONS ARE VALUES OF THE VARIABLES THAT MAKE THE EQUATION TRUE (ANSWERS).

SOLVING EQUATIONS

- TO SOLVE AN EQUATION IS TO FIND A SOLUTION. TO FIND A SOLUTION, YOU MUST FIRST *ISOLATE THE VARIABLE*.
- TO ISOLATE THE VARIABLE, YOU MUST USE THE INVERSE OF THE OPERATION TO “UNDO” THE CURRENT OPERATION. MAKE SURE YOU PERFORM THE SAME OPERATION ON BOTH SIDES OF THE EQUAL SIGN.

ADDITION PROPERTY OF EQUALITY

Properties of Equality

WORDS	NUMBERS	ALGEBRA
<p>Addition Property of Equality</p> <p>You can add the same number to both sides of an equation, and the statement will still be true.</p>	$3 = 3$ $3 + 2 = 3 + 2$ $5 = 5$	$a = b$ $a + c = b + c$

EXAMPLES

- SOLVE EACH EQUATION.
- $x - 10 = 4$

EXAMPLES

- SOLVE EACH EQUATION.
- $x - 10 = 4$ (EQUATION)
- $x - 10 + 10 = 4 + 10$
- $x = 14$ (SOLUTION)

EXAMPLES

- SOLVE EACH EQUATION.
- $M - 48 = 29$

EXAMPLES

- SOLVE EACH EQUATION.
- $M - 48 = 29$ (EQUATION)
- $M - 48 + 48 = 29 + 48$
- $M = 77$ (SOLUTION)

SUBTRACTION PROPERTY OF EQUALITY

Properties of Equality

WORDS	NUMBERS	ALGEBRA
<p>Subtraction Property of Equality</p> <p>You can subtract the same number from both sides of an equation, and the statement will still be true.</p>	$7 = 7$ $7 - 5 = 7 - 5$ $2 = 2$	$a = b$ $a - c = b - c$

EXAMPLES

- SOLVE EACH EQUATION.

- $x + 7 = 9$

EXAMPLES

- SOLVE EACH EQUATION.
- $x + 7 = 9$ (EQUATION)
- $x + 7 - 7 = 9 - 7$
- $x = 2$ (SOLUTION)

EXAMPLES

- SOLVE EACH EQUATION.
- $21 + Q = -18$

EXAMPLES

- SOLVE EACH EQUATION.
- $21 + Q = -18$ (EQUATION)
- $21 - 21 + Q = -18 - 21$
- $Q = -39$ (SOLUTION)

MULTIPLICATION PROPERTY OF EQUALITY

Properties of Equality

WORDS	NUMBERS	ALGEBRA
<p>Multiplication Property of Equality</p> <p>You can multiply both sides of an equation by the same number, and the statement will still be true.</p>	$6 = 6$ $6(3) = 6(3)$ $18 = 18$	$a = b$ $ac = bc$

EXAMPLES

- SOLVE EACH EQUATION.
- $(P/5) = 10$

EXAMPLES

- SOLVE EACH EQUATION.
- $(P/5) = 10$ (EQUATION)
- $(P/5) * 5 = 10 * 5$
- $P = 50$ (SOLUTION)

EXAMPLES

- SOLVE EACH EQUATION.
- $18 = (W/2)$

EXAMPLES

- SOLVE EACH EQUATION.
- $18 = (W/2)$ (EQUATION)
- $18 * 2 = (W/2) * 2$
- $W = 36$ (SOLUTION)

DIVISION PROPERTY OF EQUALITY

Properties of Equality

WORDS	NUMBERS	ALGEBRA
<p>Division Property of Equality</p> <p>You can divide both sides of an equation by the same nonzero number, and the statement will still be true.</p>	$8 = 8$ $\frac{8}{4} = \frac{8}{4}$ $2 = 2$	$a = b$ $(c \neq 0)$ $\frac{a}{c} = \frac{b}{c}$

EXAMPLES

- SOLVE EACH EQUATION.
- $7x = 56$

EXAMPLES

- SOLVE EACH EQUATION.
- $7X = 56$ (EQUATION)
- $7X / 7 = 56 / 7$
- $X = 8$ (SOLUTION)

EXAMPLES

- SOLVE EACH EQUATION.
- $84 = 3B$

EXAMPLES

- SOLVE EACH EQUATION.
- $84 = 3B$ (EQUATION)
- $84 / 3 = 3B / 3$
- $X = 28$ (SOLUTION)

MORE PROPERTIES OF EQUALITY

KEY CONCEPT		Properties of Equality
Property	Symbols	Examples
Reflexive	For any real number a , $a = a$.	$-7 + n = -7 + n$
Symmetric	For all real numbers a and b , if $a = b$, then $b = a$.	If $3 = 5x - 6$, then $5x - 6 = 3$.
Transitive	For all real numbers a , b , and c , if $a = b$ and $b = c$, then $a = c$.	If $2x + 1 = 7$ and $7 = 5x - 8$, then $2x + 1 = 5x - 8$.
Substitution	If $a = b$, then a may be replaced by b and b may be replaced by a .	If $(4 + 5)m = 18$, then $9m = 18$.

MULTI-STEP EQUATIONS

- MULTI-STEP EQUATIONS ARE EQUATIONS WITH MORE THAN ONE OPERATION AND THEREFORE REQUIRE MORE THAN ONE STEP TO SOLVE. IDENTIFY THE OPERATIONS IN THE EQUATION AND THE ORDER IN WHICH THEY ARE APPLIED TO THE VARIABLE. THEN USE INVERSE OPERATIONS AND WORK BACKWARD TO UNDO THEM ONE AT A TIME.

$$3.95c + 19.95 = 63.40$$

Operations in the Equation

- 1 First c is **multiplied** by 3.95.
- 2 Then 19.95 is **added**.

Work Backward 

To Solve

- 1 **Subtract** 19.95 from both sides of the equation.
- 2 Then **divide** both sides by 3.95.

EXAMPLES

- SOLVE $10 = 6 - 2X$.

EXAMPLES

- SOLVE $10 = 6 - 2X$.
- $10 = 6 - 2X$
- $10 - 6 = 6 - 6 - 2X$
- $4 = -2X$
- $4 / -2 = -2X / -2$
- $-2 = X$

FIRST X IS MULTIPLIED BY -2. THEN 6 IS ADDED.

WORK BACKWARD: SUBTRACT 6 FROM BOTH SIDES.

*SINCE X IS MULTIPLIED BY -2, DIVIDE BOTH SIDES
BY -2 TO UNDO THE MULTIPLICATION.*

EXAMPLES

- SOLVE $1.5 = 1.2Y - 5.7$.

EXAMPLES

- SOLVE $1.5 = 1.2Y - 5.7$.
- $1.5 = 1.2Y - 5.7$
- $1.5 + 5.7 = 1.2Y - 5.7 + 5.7$
- $7.2 = 1.2Y$
- $7.2 / 1.2 = 1.2Y / 1.2$
- $6 = Y$

FIRST Y IS MULTIPLIED BY 1.2. THEN 5.7 IS SUBTRACTED.

WORK BACKWARD: ADD 5.7 TO BOTH SIDES.

*SINCE Y IS MULTIPLIED BY 1.2, DIVIDE BOTH SIDES
BY 1.2 TO UNDO THE MULTIPLICATION.*

MULTI-STEP EQUATIONS THAT HAVE FRACTIONS

- WHEN SOLVING EQUATIONS THAT CONTAIN FRACTIONS, MULTIPLY EVERY TERM BY THE LEAST COMMON DENOMINATOR TO CLEAR THE FRACTIONS.

$$\frac{q}{15} - \frac{1}{5} = \frac{3}{5}$$
$$15\left(\frac{q}{15} - \frac{1}{5}\right) = 15\left(\frac{3}{5}\right) \quad \text{Multiply both sides by 15, the LCD of the fractions.}$$
$$15\left(\frac{q}{15}\right) - 15\left(\frac{1}{5}\right) = 15\left(\frac{3}{5}\right) \quad \text{Distribute 15 on the left side.}$$
$$q - 3 = 9 \quad \text{Simplify.}$$
$$\begin{array}{r} \underline{+3} \quad \underline{+3} \\ q \quad = 12 \end{array} \quad \text{Since 3 is subtracted from } q, \text{ add 3 to both sides to undo the subtraction.}$$

EXAMPLES

- SOLVE EACH EQUATION.

- $\frac{3}{4}U + \frac{1}{2} = \frac{7}{8}$

EXAMPLES

- SOLVE EACH EQUATION.

- $\frac{3}{4}U + \frac{1}{2} = \frac{7}{8}$

- $8\left(\frac{3}{4}U + \frac{1}{2}\right) = 8 * \frac{7}{8}$

- $6U + 4 = 7$

- $6U + 4 - 4 = 7 - 4$

- $6U = 3$

- $6U / 6 = 3 / 6$

- $U = \frac{1}{2}$

MULTIPLY BY THE LCD TO CLEAR THE FRACTION

*USE MULTI-STEP EQUATION PROCEDURES TO SOLVE
THE EQUATION.*

EXAMPLES

- SOLVE EACH EQUATION.

- $\frac{p-15}{9} = -6$

- $9 * \frac{p-15}{9} = 9 * -6$

- $p - 15 = -54$

- $p = -39$

MULTIPLY BY THE LCD TO CLEAR THE FRACTION

*USE MULTI-STEP EQUATION PROCEDURES TO SOLVE
THE EQUATION.*

SOLVING EQUATIONS WITH VARIABLES ON EACH SIDE

- TO SOLVE AN EQUATION WITH VARIABLES ON EACH SIDE OF THE EQUAL SIGN, SIMPLIFY EACH SIDE, THEN USE INVERSE OPERATIONS TO GROUP VARIABLES ON ONE SIDE AND NUMBERS ON THE OPPOSITE SIDE. LAST, ISOLATE THE VARIABLE.

EXAMPLES

- SOLVE $6Y + 21 + 7 = 4Y - 20 + 5Y$

EXAMPLES

- SOLVE $6Y + 21 + 7 = 4Y - 20 + 5Y$

- $6Y + 21 + 7 = 4Y - 20 + 5Y$

- $6Y + 28 = 9Y - 20$

- $6Y - 6Y + 28 = 9Y - 6Y - 20$

- $28 = 3Y - 20$

- $28 + 20 = 3Y - 20 + 20$

- $48 = 3Y$

- $48 / 3 = 3Y / 3$

- $16 = Y$

ORIGINAL EQUATION

SIMPLIFY

SUBTRACTION PROPERTY

SIMPLIFY

ADDITION PROPERTY

SIMPLIFY

DIVISION PROPERTY

SOLUTION

EXAMPLES

- SOLVE $3(W + 7) - 5W = W + 12$

EXAMPLES

- SOLVE $3(W + 7) - 5W = W + 12$
- $3(W + 7) - 5W = W + 12$
- $3W + 21 - 5W = W + 12$
- $-2W + 21 = W + 12$
- $-2W + 2W + 21 = W + 2W + 12$
- $21 = 3W + 12$
- $21 - 12 = 3W + 12 - 12$
- $9 = 3W$
- $9 / 3 = 3W / 3$
- $3 = W$

ORIGINAL EQUATION

DISTRIBUTIVE PROPERTY

SIMPLIFY

ADDITION PROPERTY

SIMPLIFY

SUBTRACTION PROPERTY

SIMPLIFY

DIVISION PROPERTY

SOLUTION