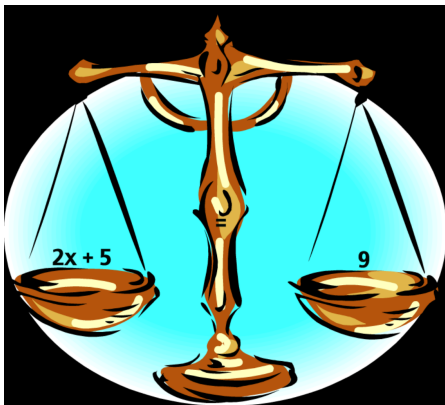


# How to Do Word Problems



## Solving Linear Equations

## Properties of Equality

Property Name	Mathematics Operation
Addition Property	If $A = B$ , then $A + C = B + C$
Subtraction Property	If $A = B$ , then $A - C = B - C$
Multiplication Property	If $A = B$ , then $A \cdot C = B \cdot C$
Division Property	If $A = B$ , then $\frac{A}{C} = \frac{B}{C}, C \neq 0$

## More Useful Properties of Equality

Property Name	Mathematics Operation
Distributive Property	$A(B + C) = A \cdot B + A \cdot C$
Identity Property	$A + 0 = A$ & $A \cdot 1 = A$
Inverse Property	$A + (-A) = 0$ & $A \cdot \frac{1}{A} = 1, A \neq 0$

## Steps for Solving Linear Equations

When you have	Use	To
Parenthesis	Distribution	Remove Parenthesis
Fractions	LCD	Clear Fractions
Addition	Subtraction	Undo Addition
Subtraction	Addition	Undo Subtraction
Multiplication	Division	Undo Multiplication

*Example:*

Solve:  $x - 7 = 3$

**Solution:**

Using properties of equality, we get

$$x - 7 = 3 \quad \text{(Original Equation)}$$

$$x - 7 + 7 = 3 + 7 \quad \text{(Addition Property)}$$

$$x + 0 = 10 \quad \text{(Inverse \& Simplify)}$$

$$x = 10 \quad \text{(Identity Property)}$$

{10}

*Example:*

Solve:  $x + 8 = -8$

**Solution:**

Using properties of equality, we get

$$x + 8 = -8 \quad \text{(Original Equation)}$$

$$x + 8 - 8 = -8 - 8 \quad \text{(Subtraction Property)}$$

$$x + 0 = -16 \quad \text{(Inverse & Simplify)}$$

$$x = -16 \quad \text{(Identity Property)}$$

**{-16}**

*Example:*

Solve:  $\frac{1}{4}x = -5$

**Solution:**

Using properties of equality, we get

$$\frac{1}{4}x = -5 \quad \text{(Original Equation)}$$

$$4 \cdot \frac{1}{4}x = 4 \cdot (-5) \quad \text{(Multiplication Property)}$$

$$1 \cdot x = -20 \quad \text{(Inverse & Simplify)}$$

$$x = -20 \quad \text{(Identity Property)}$$

$$\{-20\}$$

*Example:*

Solve:  $-5x = 45$

**Solution:**

Using properties of equality, we get

$$-5x = 45 \quad (\text{Original Equation})$$

$$\frac{-5x}{-5} = \frac{45}{-5} \quad (\text{Division Property})$$

$$1 \cdot x = -9 \quad (\text{Inverse \& Simplify})$$

$$x = -9 \quad (\text{Identity Property})$$

**{-9}**



*Example:*

Solve:  $2x - 3 = -25$

**Solution:**

Using properties of equality, we get

$$2x - 3 = -25 \quad \text{(Original Equation)}$$

$$2x - 3 + 3 = -25 + 3 \quad \text{(Addition Property)}$$

$$2x + 0 = -22 \quad \text{(Inverse & Simplify)}$$

$$2x = -22 \quad \text{(Identity Property)}$$

$$\frac{2x}{2} = \frac{-22}{2} \quad \text{(Division Property)}$$

$$1 \cdot x = -11 \quad \text{(Inverse & Simplify)}$$

$$x = -11 \quad \text{(Identity)}$$

**{-11}**

*Example:*

Solve:  $-3x + 2 = -28$

**Solution:**

Using properties of equality, we get

$$-3x + 2 = -28 \quad \text{(Original Equation)}$$

$$-3x + 2 - 2 = -28 - 2 \quad \text{(Subtraction Property)}$$

$$-3x + 0 = -30 \quad \text{(Inverse \& Simplify)}$$

$$-3x = -30 \quad \text{(Identity Property)}$$

$$\frac{-3x}{-3} = \frac{-30}{-3} \quad \text{(Division Property)}$$

$$1 \cdot x = -10 \quad \text{(Inverse \& Simplify)}$$

$$x = -10 \quad \text{(Identity)}$$

**{-10}**

*Example:*

Solve:  $4x - 13 = x + 26$

**Solution:**

Using properties of equality, we get

$$4x - 13 = x + 26 \quad \text{(Original Equation)}$$

$$4x - 13 + 13 = x + 26 + 13 \quad \text{(Addition Property)}$$

$$4x + 0 = x + 39 \quad \text{(Inverse & Simplify)}$$

$$4x = x + 39 \quad \text{(Identity Property)}$$

$$4x - x = x + 39 - x \quad \text{(Subtraction Property)}$$

$$3x = 39 + 0 \quad \text{(Simplify & Inverse)}$$

Solution(continued):

$$3x = 39 \quad (\text{Identity Property})$$

$$\frac{3x}{3} = \frac{39}{3} \quad (\text{Division Property})$$

$$1 \cdot x = 13 \quad (\text{Inverse \& Simplify})$$

$$x = 13 \quad (\text{Identity})$$

{13}

*Example:*

Solve:  $4(x + 2) - 8 = -20$

Solution:

Using properties of equality, we get

$$\begin{aligned}4(x + 2) - 8 &= -20 && \text{(Original Equation)} \\4x + 8 - 8 &= -20 && \text{(Distributive Property)} \\4x + 0 &= -20 && \text{(Inverse \& Simplify)} \\4x &= -20 && \text{(Identity Property)} \\\frac{4x}{4} &= \frac{-20}{4} && \text{(Division Property)} \\1 \cdot x &= -5 && \text{(Inverse \& Simplify)} \\x &= -5 && \text{(Identity)}\end{aligned}$$

**{-5}**

*Example:*

Solve:  $-3(x - 5) + 8 = 2(x + 3) - 32$

**Solution:**

Using properties of equality, we get

$$-3(x - 5) + 8 = 2(x + 3) - 32 \quad \text{(Original Equation)}$$

$$-3x + 15 + 8 = 2x + 6 - 32 \quad \text{(Distributive Property)}$$

$$-3x + 23 = 2x - 26 \quad \text{(Simplify)}$$

$$-3x + 23 - 23 = 2x - 26 - 23 \quad \text{(Inverse Property)}$$

$$-3x + 0 = 2x - 49 \quad \text{(Simplify)}$$

$$-3x = 2x - 49 \quad \text{(Identity Property)}$$

$$-3x - 2x = 2x - 49 - 2x \quad \text{(Inverse Property)}$$

Solution(continued):

$$-5x = -49 + 0 \quad (\text{Simplify \& Inverse})$$

$$-5x = -49 \quad (\text{Identity Property})$$

$$\frac{-5x}{-5} = \frac{-49}{-5} \quad (\text{Division Property})$$

$$1 \cdot x = 9.8 \quad (\text{Inverse \& Simplify})$$

$$x = 9.8 \quad (\text{Identity})$$

{9.8}

*Example:*

Solve:  $\frac{1}{5}x = \frac{3}{4}(x + 3) - 5$

## Solution:

Using properties of equality, we get

$$\frac{1}{5}x = \frac{3}{4}(x + 3) - 5 \quad \text{(Original Equation)}$$

$$20 \cdot \frac{1}{5}x = 20 \cdot \frac{3}{4}(x + 3) - 20 \cdot 5 \quad \text{(Multiply By LCD=20)}$$

$$4 \cdot x = 15 \cdot (x + 3) - 100 \quad \text{(Simplify)}$$

$$4x = 15x + 45 - 100 \quad \text{(Distributive Property)}$$

$$4x = 15x - 55 \quad \text{(Simplify)}$$

$$4x - 15x = 15x - 55 - 15x \quad \text{(Inverse Property)}$$

$$-11x = -55 + 0 \quad \text{(Simplify)}$$

$$-11x = -55 \quad \text{(Identity Property)}$$

$$\frac{-11x}{-11} = \frac{-55}{-11} \quad \text{(Division Property)}$$



Solution(continued):

$$1 \cdot x = 5 \quad (\text{Inverse \& Simplify})$$

$$x = 5 \quad (\text{Identity Property})$$

{5}

*Example:*

Solve:  $0.1x + 0.05(2x + 1) = 2.45$

**Solution:**

We can solve this equation by working with decimal numbers or use the multiplication property to remove the decimals.

*Example:*

Solve by working with decimal numbers:

$$0.1x + 0.05(2x + 1) = 2.45$$

*Solution:*

$0.1x + 0.05(2x + 1) = 2.45$	(Original Equation)
$0.1x + 0.1x + 0.05 = 2.45$	(Distributive Property)
$0.2x + 0.05 = 2.45$	(Simplify)
$0.2x + 0.05 - 0.05 = 2.45 - 0.05$	(Subtraction Property)
$0.2x + 0 = 2.4$	(Inverse & Simplify)
$0.2x = 2.4$	(Identity Property)
$\frac{0.2x}{0.2} = \frac{2.4}{0.2}$	(Division Property)

Solution(continued):

$$1 \cdot x = 12 \quad (\text{Inverse Property})$$

$$x = 12 \quad (\text{Identity Property})$$

$$\{12\}$$

*Example:*

Solve by removing decimal numbers:  $0.1x + 0.05(2x + 1) = 2.45$

**Solution:**

We can remove the decimal by using the multiplication property and multiply by  $10^2$  since we have two decimal places.

Solution(continued):

$$0.1x + 0.05(2x + 1) = 2.45 \quad \text{(Original Equation)}$$

$$100 \cdot 0.1x + 100 \cdot 0.05(2x + 1) = 100 \cdot 2.45 \quad \text{(Multiply By 100)}$$

$$10x + 5(2x + 1) = 245 \quad \text{(Simplify)}$$

$$10x + 10x + 5 = 245 \quad \text{(Distributive Prop.)}$$

$$20x + 5 = 245 \quad \text{(Simplify)}$$

$$20x + 5 - 5 = 245 - 5 \quad \text{(Subtraction Prop.)}$$

$$20x + 0 = 240 \quad \text{(Inverse & Simplify)}$$

$$20x = 240 \quad \text{(Identity Prop.)}$$

$$\frac{20x}{20} = \frac{240}{20} \quad \text{(Division Prop.)}$$

Solution(continued):

$$1 \cdot x = 12 \quad (\text{Inverse \& Simplify})$$

$$x = 12 \quad (\text{Identity Prop.})$$

{12}

## Special Situations When No Variable Is Left

And You Have A	Then
True Statement	There are Infinitely Many Solutions
False Statement	There is no solution

*Example:*

Solve:  $2(x - 5) + 8 = 2x - 2$

**Solution:**

Using properties of equality, we get

$2(x - 5) + 8 = 2x - 2$	(Original Equation)
$2x - 10 + 8 = 2x - 2$	(Distributive Property)
$2x - 2 = 2x - 2$	(Simplify)
$2x - 2 + 2 = 2x - 2 + 2$	(Inverse Property)
$2x = 2x$	(Simplify)
$2x - 2x = 2x - 2x$	(Inverse Property)
$0 = 0$	(Simplify)

Solution(continued):

In this example, there is no variable left and we have a true statement in  $0 = 0$ , therefore there are

infinitely many solutions.

*Example:*

Solve:  $2(2x - 5) - 4x = 10$

Solution:

Using properties of equality, we get

$$2(2x - 5) - 4x = 10 \quad (\text{Original Equation})$$

$$4x - 10 - 4x = 10 \quad (\text{Distributive Property})$$

Solution(continued):

$$-10 + 0 = 10 \quad (\text{Inverse Property})$$

$$-10 = 10 \quad (\text{Identity Property})$$

In this example, there is no variable left and we have a false statement in  $-10 = 10$ , therefore there is

no solution.

When a linear equation has	it is called
exactly one solution,	a conditional equation.
infinitely many solutions,	an identity.
no solutions,	a contradiction.