TOPIC: SOLVING LINEAR EQUATIONS

Introduction to Linear Equations

- Recall: An **equation** is a statement that two algebraic **expressions** are equal.

New | **Linear Equations in One Variable**

expression   *expression*

$$2x + 6 \qquad 0$$

____

$$\boxed{ax + b = c}$$

a, b, c are ________ numbers

a ________ 0

- The **solution** to an equation is the value of the variable that makes the statement ______ when plugged in.

EXAMPLE Determine whether the given value is a solution to the equation.

(A) $2x + 6 = 0\ ;\ x = -3$

(B) $5 = 8w - 3\ ;\ w = -1$

- For a linear equation, write the **solution set** by putting the solution in set brackets { }.

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EXAMPLE Determine whether each of the following is a linear equation in one variable.

$(\boldsymbol{A})$

$$4x - 7 + 3$$

$(\boldsymbol{B})$

$$5y - y = 2$$

$(\boldsymbol{C})$

$$6x + 1 = 2t^2$$

PRACTICE Identify the following as either an expression or equation.

$(\boldsymbol{A})$

$$\frac{2m}{3} + 8$$

[EXPRESSION | EQUATION]

$(\boldsymbol{B})$

$$4(a - 2) = 21$$

[EXPRESSION | EQUATION]

PRACTICE Which of the following is a linear equation in one variable?

A. $x + 5 = 12$

B. $x^2 = 25$

C. $y + z = 10$

D. $x - 3 < 7$

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PRACTICE Which of the following is a linear equation in one variable?

A. $2(x + 5) - 3x = x^2 + 1$

B. $x(x + 4) = 0$

C. $4(x + 3) = 2x + 18$

D. $x^2 + 5x = 10$

PRACTICE Verify that the given value is a solution to the equation.

$(\boldsymbol{A})$

$y = -2; 5y + 4 = 14$

[SOLUTION | NOT A SOLUTION]

$(\boldsymbol{B})$

$a = 2; 4a + 3 = 2a + 9$

[SOLUTION | NOT A SOLUTION]

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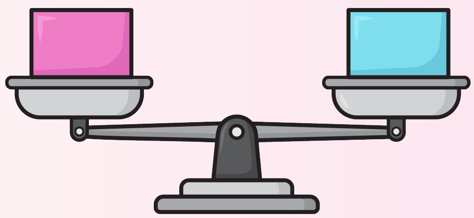
Addition and Subtraction Properties of Equality

- To **solve** an equation, ____________ the variable using operations like **addition** and **subtraction**.
  - Operations must ***ALWAYS*** be done to ______ sides of an equation to create *equivalent equations*.

Addition **Property of Equality**	***Subtraction*** **Property of Equality**
If $a = b$, then a ____ $= b$ _____	If $a = b$, then a ____ $= b$ _____
Use when eqn has **[ADDITION | SUBTRACTION]**	*Use when eqn has* **[ADDITION | SUBTRACTION]**
$x - 6 = 0$	$0 = x + 2$
$x - 6$ _____ $= 0$ _____	0 _____ $= x + 2$ _____
____ $=$ _____	____ $=$ _____



- Check your solution by replacing variable in original equation & verifying that it makes the statement **true**.

EXAMPLE Solve the linear equation, then check your solution.

$y - 1.2 = 5.8$

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PRACTICE Solve the given linear equation using addition and subtraction properties of equality.

$(\boldsymbol{A})$

$$x + \frac{2}{8} = -\frac{3}{8}$$

$(\boldsymbol{B})$

$$-5.4 + c = 1.6$$

PRACTICE Solve the given linear equation using addition and subtraction properties of equality.

$(\boldsymbol{A})$

$$6h - (-12) = 5 + 5h$$

$(\boldsymbol{B})$

$$2(x + 5) = 3(x - 1)$$

$(\boldsymbol{C})$

$$3(y + 3) + (1 - y) = 3y + 14$$

EXAMPLE Translate the following statement into a linear equation and solve.

A number decreased by 7 is equal to 15. What is the number?

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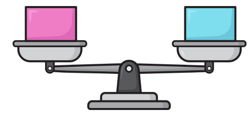
Multiplication and Division Properties of Equality

- Recall: Solve a linear equation by using operations done to ***both*** sides to isolate the variable.



  - **Multiplication** and **division** can also be used to create *equivalent equations*.

Multiplication **Property of Equality**	***Division*** **Property of Equality**
If $a = b$, then a ____ $= b$ ____	If $a = b$, then $a = b$
Use when eqn has **[MULTIPLICATION | DIVISION]**	*Use when eqn has* **[MULTIPLICATION | DIVISION]**
$\frac{x}{2} = 9$	$20 = 5x$
$\frac{x}{2}$ _____ $= 9$ _____	$20 = 5x$
_____ = _____	_____ = _____

- Isolate the variable *term* using _________ BEFORE using ×/÷ to fully isolate *variable*.

EXAMPLE Solve the linear equation, then check your solution.

$3a - 4 = 11$

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EXAMPLE Solve the linear equation, then check your solution.

$1.2a + 2.3 = 5.9$

PRACTICE Solve the given linear equation using multiplication and division properties of equality.

$(\boldsymbol{A})$ $-8x = 64$

$(\boldsymbol{B})$ $\frac{y}{4} = -\frac{21}{6}$

$(\boldsymbol{C})$ $\frac{126}{14} = 3y$

PRACTICE Solve the given linear equation, then check your answer.

$(\boldsymbol{A})$ $-(h + 3) = 11$

$(\boldsymbol{B})$ $0.5t + 1.5t = 7 + 3 - 4$

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EXAMPLE Translate the following statement into a linear equation and solve.

Three times L equals 54. What is the value of L?

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Multiplication Property for Fraction Coefficients

- If the variable in a linear equation has a fraction **coefficient**, cancel by multiplying both sides by its ______________.
  - Recall: The product of a **number** and its **reciprocal** is 1. For example, $\frac{2}{3} \cdot \frac{3}{2} = 1$

EXAMPLE Solve the following equations.

Recall
If $a = b$,
then $ac = bc$

(A) $\frac{3}{4}x = 9$

(B) $10 = \frac{5}{3}y$

PRACTICE Solve the given linear equation, then check your answer.

$\frac{1}{2} = \frac{3}{4}x$

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TOPIC RESOURCE: PROPERTIES OF EQUALITY

Name	Use when equation has…	Property of Equality If $a = b$, then…	Example	
Addition	–	$a + c = b + c$	$x - 6 = 0$ $x - 6 + 6 = 0 + 6$ $x = 6$	
Subtraction	+	$a - c = b - c$	$0 = x + 2$ $0 - 2 = x + 2 - 2$ $-2 = x$	
Multiplication	÷	$ac = bc$	$\frac{x}{2} = 24$ $2 \cdot \frac{x}{2} = 24 \cdot 2$ $x = 48$	$\frac{3}{4}x = 9$ $\frac{4}{3} \cdot \frac{3}{4}x = 9 \cdot \frac{4}{3}$ $x = 12$
Division	×	$\frac{a}{c} = \frac{b}{c}$	$20 = 5x$ $\frac{20}{5} = \frac{5x}{5}$ $4 = x$	

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Strategy for Solving Linear Equations

◆ To solve ***ANY*** linear equation, *simplify* & then use *multiple* properties of equality. You can follow these steps:

EXAMPLE Solve the linear equation.

$3(x-2)+2=x+8$

Recall

If $a=b$, then…

$a+c=b+c$	$ac=bc$
$a-c=b-c$	$\frac{a}{c}=\frac{b}{c}$

(Properties of Equality)

HOW TO: Solve Linear Equations

1) Simplify both sides of the equation
- *Distribute* into ( )
- *Combine* like terms

2) Use ______ props. to **collect**:
- All *variable* terms on one side
- All *constant* terms on other side

3) Use ______ props. to **isolate** variable

4) Check solution by plugging in *orig. eqn*

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PRACTICE Solve the given linear equation. Check your solution.

$(\boldsymbol{A})$

$$2(x+3)=14$$

HOW TO: Solve Linear Equations

1) Simplify both sides of the equation
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2) Use $+/-$ props. to **collect**:
- All *variable* terms on one side
- All *constant* terms on other side

3) Use $\times/\div$ props. to **isolate** variable

4) Check solution by plugging in *orig. eqn*

$(\boldsymbol{B})$

$$-5-y=3(y+9)$$

PRACTICE Solve the given linear equation. Check your solution.

$$4(x+1)-3(x-2)=2x+5$$