

# 1.2 Solving Multi-Step Equations

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Notes

Solving Multi-Step Equations

Start at the bottom of PEMDAS and undo each step by working upwards (aka. Undo in the order SADMEP)

Solving Two-Step Equations

Ex.  $3x + 4 = 19$

$$\begin{array}{r} -4 \quad -4 \\ \hline 3x = 15 \\ \hline 3 \quad 3 \\ \hline x = 5 \end{array}$$

PEMDAS to x?  
1st multiplied by 3 2nd  
2nd added by 4 1st

Check:  $3x + 4 = 19$

$$\begin{array}{l} 3(5) + 4 = 19 \\ 15 + 4 = 19 \\ 19 = 19 \checkmark \end{array}$$

Ex.  $-2 - 7x = 33$

$$\begin{array}{r} +2 \quad +2 \\ \hline -7x = 35 \\ \hline -7 \quad -7 \\ \hline x = -5 \end{array}$$

PEMDAS to x?  
1st multiplied by -7 2nd  
2nd subtracted by 2 1st

Check:  $-2 - 7x = 33$

$$\begin{array}{l} -2 - 7(-5) = 33 \\ -2 + 35 = 33 \\ 33 = 33 \checkmark \end{array}$$

Solving Equations with a Division Bar

Ex.  $3\left(\frac{-2x-4}{3}\right) = (60)3$

$$\begin{array}{r} -2x - 4 = 180 \\ +4 \quad +4 \\ \hline -2x = 184 \\ \hline -2 \quad -2 \\ \hline x = -92 \end{array}$$

PEMDAS to x?  
1st multiplied by -2 3rd  
2nd subtracted by 4 2nd  
3rd divided by 3 1st

Check:

Solving Equations with (Parentheses)

Method 1 (most transferable)  
1<sup>st</sup> Distribute, 2<sup>nd</sup> Solve

Ex.  $3(8x + 5) = 63$

$$\begin{array}{l} 3(8x) + 3(5) = 63 \\ 24x + 15 = 63 \\ -15 \quad -15 \\ \hline 24x = 48 \\ \hline 24 \quad 24 \\ \hline x = 2 \end{array}$$

The Check:  
 $3(8x + 5) = 63$   
Never Distribute in a check  
 $3(8(2) + 5) = 63$   
 $3(16 + 5) = 63$   
 $3(21) = 63$   
 $63 = 63 \checkmark$   
**Match!**

Method 2 (actually undo PEMDAS)  
Treat the expression in () as a unit

Ex.  $3(8x + 5) = 63$

$$\begin{array}{r} 8x + 5 = 21 \\ -5 \quad -5 \\ \hline 8x = 16 \\ \hline 8 \quad 8 \\ \hline x = 2 \end{array}$$

Solving Combining Like Terms Equations

When like terms are on the same side, Combine and simplify the expression first. Then start solving for the variable with inverse operations.

Ex.  $2w - 3w + 5 = 27$

$$\begin{array}{r} -1w + 5 = 27 \\ -5 \quad -5 \\ \hline -1w = 22 \\ \hline -1 \quad -1 \\ \hline w = -22 \end{array}$$

Substitute value each time you see the variable!

Check:  $2w - 3w + 5 = 27$

Never combine like terms in a check!

$$\begin{array}{l} 2(-22) - 3(-22) + 5 = 27 \\ -44 + 66 + 5 = 27 \\ 22 + 5 = 27 \\ 27 = 27 \checkmark \end{array}$$

# 1.2 Solving Multi-Step Equations

Ex.  $-18 = 8x - 9 - 5x$

$$-18 = 3x - 9$$

$$+9 \quad +9$$


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$$-9 = 3x$$

$$\frac{-9}{3} = \frac{3x}{3}$$

$$-3 = x \text{ or } x = -3$$

Check:  $-18 = 8x - 9 - 5x$

$$-18 = 8(-3) - 9 - 5(-3)$$

$$-18 = -24 - 9 + 15$$

$$-18 = -33 + 15$$

$$-18 = -18 \checkmark$$

**Solving Complex Equations**

- 1<sup>st</sup> Distribute and get rid of Parentheses
- 2<sup>nd</sup> Combine any like terms
- 3<sup>rd</sup> Isolate x with inverse operations

Ex.  $4y - 3(y + 5) = 21$

$$4y - 3y - 15 = 21$$

$$y - 15 = 21$$

$$+15 \quad +15$$


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$$y = 36$$

Check:

fix!

Ex.  $\frac{2x + k - 8(5 + k)}{4} = 10$

$$\frac{2x + k - 40 - 8k}{4} = 10$$

Check:

$$4 \left( \frac{-5k - 40}{4} \right) = (10) \cdot 4$$

$$-5k - 40 = 40$$

$$+40 \quad +40$$

$$-5k = 80$$

$$\frac{-5k}{-5} = \frac{80}{-5} \rightarrow k = -16$$

$0 \div \text{anything} = 0$

**Writing and Solving Multi-Step Application Equations**

Ex. Jenny wants to buy a shirt that costs \$24.98. There was a discount and now the shirt is \$19.50. How much was the discount?

$$24.98 - x = 19.50$$

or

$$24.98 - 24.98x = 19.50$$

Ex. A garden has a length 2 inches longer than three times the width. The Perimeter is 36 inches. What is the width and length of the garden?

$l = 3w + 2$        $P = 36$  inches

$P = 5 + 5 + 5 + 5$

Garden is 4 inches wide + 14 inches long

$$36 = 2w + 2(3w + 2)$$

$$36 = 2w + 6w + 4$$

$$36 = 8w + 4$$

$$32 = 8w$$

$$w = 4$$

$l = 3w + 2$   
 $l = 3(4) + 2$   
 $l = 12 + 2$   
 $l = 14$