

## Solving Equations

- can use inspection (look and figure out in your head); systematic trial (guess and test) algebra tiles or rearranging equation to solve for the unknown.

### Solution by Addition & Subtraction

In an equation, the left side of the equation (on left of equal sign) must equal to the right side of the equation (right side of equal sign). Therefore, if you change one side of the equation you must change the other side of the equation also, to keep the entire equation balanced.

Like a balanced scale, if you remove weight from one side, you must remove the same amount of weight from the other side to keep equilibrium.

### Solving for the unknown examples:

eg. #1

$$p + 6 = 15$$

$$\underline{-6} \quad \underline{-6}$$

$$p = 9$$

--First step is to simplify by + or - like terms on each individual side of the equation

--Second step is to collect variables to same side of the equation by cancelling out (use opposite operation)

--Then continue to isolate the variable by using the opposite operation

verify:  $9 + 6 = 15$

$15=15$  therefore our answer is correct

- \* **“What you do to one side of the equation, do to the other side as well.”**

eg. #2

$$9c + 2 - 6c = 2c + 17$$

$$\begin{array}{r} 3c + 2 = 2c + 17 \\ -2c \quad \quad -2c \end{array}$$

$$\begin{array}{r} c + 2 = 17 \\ - 2 \quad - 2 \end{array}$$

$c = 15$
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Step #1 Simplify

Step #2 Collect variables

\* Move smallest number  
with variable to avoid  
negatives

Step #3 Isolate variable

eg. #3

$$9p - 12p + 6 - 12 = -2p + 6p + 2 - 6p$$

$$\begin{array}{r} -3p + -6 = -2p + 2 \\ +3p \quad \quad +3p \\ \hline \end{array}$$

$$\begin{array}{r} - 6 = p + 2 \\ - 2 \quad \quad - 2 \\ \hline \end{array}$$

$- 8 = p$
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## Solution by Multiplication and Division

Work backwards to isolate variable.

\* Like unwrapping a present to get to the gift.

eg. #1

$$\frac{p}{3} + 2 = 12 \quad \text{Step \#1 -- simplify (nothing to do)}$$

$$\frac{p}{3} + 2 = 12 \quad \text{Step \#2 -- collect like terms (all p's together already)}$$

$$\frac{p}{3} \underline{-2} \quad \underline{-2} \quad \text{Step \#3 -- isolate the variable}$$

$$\frac{p}{3} = 10$$

$$3 \times \frac{p}{3} = 10 \times 3$$

$$\boxed{p = 30}$$

eg. #2  $\frac{4}{n} - 2 = 6$

$$\frac{4}{n} \quad +2 \quad +2$$

$$\frac{4}{n} = 8$$

$$n \times \frac{4}{n} = 8 \times n$$

\*This is done to get the variable out of the denominator.

$$\frac{4}{8} = \frac{8n}{8}$$

$$\boxed{0.5 \text{ or } 1/2 = n}$$

$$\begin{array}{r} \text{eg. \#3} \quad 6 - x = -10 \\ \quad \underline{-6} \quad \quad \quad \underline{= -6} \\ \quad -1x = -16 \end{array}$$

$$\frac{-1x}{-1} = \frac{-16}{-1}$$

$x = 16$
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$$\text{eg. \#4} \quad 2z + 8z - 12z + 5 = 3z + 12$$

$$\begin{array}{r} -2z + 5 = 3z + 12 \\ \underline{+2z} \quad \quad \underline{= +2z} \\ 5 = 5z + 12 \\ \underline{-12} \quad \quad \quad \underline{-12} \end{array}$$

$$\frac{-7}{5} = \frac{5z}{5}$$

$z = -1 \frac{2}{5}$
or
$z = -1.4$

$$\text{eg. \#5} \quad 12n + 16 - 3n = 15n + 36$$

$$\frac{9n + 16}{-9n} = \frac{15n + 36}{-9n}$$

$$\frac{16}{-36} = \frac{6n + 36}{-36}$$

$$\frac{-20}{6} = \frac{6n}{6}$$

$$\boxed{n = -3.3}$$

$$\text{eg. \#6} \quad 3p - 7p + 12 - 15 = 2p + p - 5p + 10$$

$$\frac{-4p + -3}{+4p} = \frac{10 + -2p}{+4p}$$

$$\frac{-3}{+ -10} = \frac{10 + 2p}{-10}$$

$$\frac{-13}{2} = \frac{2p}{2}$$

$$\boxed{-6.5 = p}$$

## Distributive Property

Remember the formula for the perimeter of a rectangle:

It can be stated as  $P = 2L + 2w$  or  $P = 2(L+w)$

Why are these two formulas the same? The second one can be turned into the first one by using the distributive property.

$$P = 2(L+w)$$

Take the number outside of the brackets and multiply it with all of the terms inside of the brackets.

$$P = 2L + 2w$$

When solving equations we often need to use the distributive property to simplify equations or expressions.

eg.  $-3(x+4) = 6x + 2$

$$-3x - 12 = 6x + 2$$

or  $-3x + -12 = 6x + 2$

Now gather your like terms.

$$-3x - 12 = 6x + 2$$

$$\begin{array}{r} +3x \quad +3x \\ -3x - 12 = 6x + 2 \\ \hline -12 = 9x + 2 \end{array}$$

Now isolate the variable.

$$-12 = 9x + 2$$

$$\begin{array}{r} -2 \quad -2 \\ -12 = 9x + 2 \\ \hline -14 = 9x \end{array}$$

$$\frac{-14}{9} = \frac{9x}{9} \quad (\text{dividing by 9 on each side})$$

$$x = -1.5$$

eg.

$$\begin{array}{l} \text{This means } -(2x-1) \\ \quad \quad \quad -1(2x-1) \\ \quad \quad \quad = -2x+1 \end{array}$$

(notice that all you need to do is change the signs of all terms inside the brackets when there is a negative sign in front of the bracket with no number behind it)

## Multiple Denominators: How to Eliminate Them

Sometimes questions are difficult if there are many denominators. To simplify matters get rid of these denominators by finding the common denominator and multiplying by it.

eg.  $\frac{2p}{7} = \frac{6}{7}$  \*7 is the common denominator so multiply every term by 7 on each side of the equation.

$$\frac{\cancel{7} (2p)}{1 \cancel{7}} = \frac{\cancel{6} \cancel{7}}{\cancel{7} 1}$$

$\frac{2p}{2} = \frac{6}{2}$  Now divide each side of the equation by 2.

$p=3$  This is the final answer (to solve for the variable).

Now verify.

$\frac{2(3)}{7} = \frac{6}{7}$  yes one side of the equation equals the other so the solution must be correct.

eg.  $\frac{3z-2}{5} = \frac{3}{2}$  The common denominator is 10 so multiply every term by 10.

$$\frac{\cancel{10} (3z-2)}{1 \cancel{5}} = \frac{\cancel{10} (3)}{1 \cancel{2}}$$

$(2)(3z-2) = (5)(3)$  To solve the left side of the equation you need to do the distributive property.

$$\begin{array}{r} \cancel{6z} - 4 = 15 \\ +4 \quad +4 \end{array}$$

$$\frac{6z}{6} = \frac{19}{6}$$

$z = 19/6$  or  $3 \frac{1}{6}$  or  $3.1\bar{6}$   
Now you can verify!!

eg.  $\frac{3y}{2} + \frac{4}{3} = \frac{1}{3}$  Common denominator is 6 so multiply each term by 6.

$$\frac{\cancel{6} (3y)}{1 \cancel{2}} + \frac{\cancel{6} (4)}{1 \cancel{3}} = \frac{\cancel{6} (1)}{1 \cancel{3}}$$

$$(3)(3y) + (2)(4) = (2)(1)$$

$$9y + \cancel{8} = 2$$

$\quad \quad \quad -8 \quad -8$

$$\frac{9y}{9} = \frac{-6}{9}$$

$y = -6/9$  which reduces to  $-2/3$  or divide it out to the decimal form and the answer would be  $-0.\overline{6}$