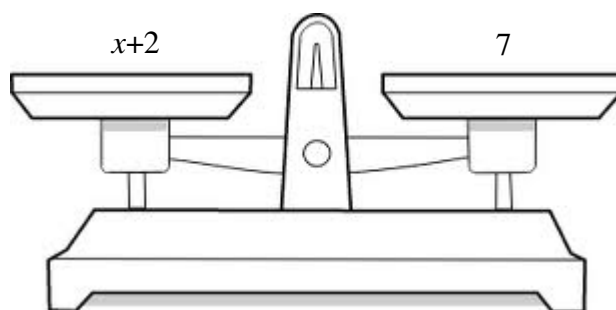Example 1: $x+2=7$

What are you trying to solve for? You are trying to solve for $x$.

How do you solve for $x$?
You need to get $x$ all by itself on one side of the equation.

Think of an equation as a balance or a scale.



Since an equation means both sides are equal, that means the scale is balanced. The left side equals the right side. You need to keep the scale balanced at all times.

That means whatever you do to one side of the scale (say subtract 2 on the left), I need to do the same on the right side. Subtracting 2 on both sides keeps the scale balanced.

## How To Show My Work

Showing your work in a particular way is very important in our equation unit.

Example 1:

Think:

What do I need to do to get *x* all alone?
This is called **isolating the variable**. Since someone added 3, you will need to subtract 3.

$$x+3=-4$$
$$-3 \mid -3$$
$$x=-7$$

Draw this vertical line to separate the left and right sides of the scale.

Since you subtracted 3 on the left, you need to subtract 3 on the right to stay balanced.

## How To Check My Work

Start with the original equation.

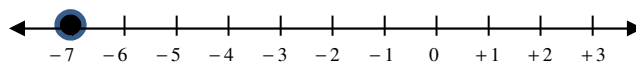Plug in what you believe the answer is.

Solve the left side.

$$x+3=-4$$
$$-7+3=-4$$
$$-4=-4$$

Since -4=-4 you have balanced your scale. Therefore your answer is correct and x=-7.

## How To Graph My Answer

Place a solid dot on the number line at the location of your answer.

$$-7 \quad -6 \quad -5 \quad -4 \quad -3 \quad -2 \quad -1 \quad 0 \quad +1 \quad +2 \quad +3$$

## Solving Equation Examples

Example 1:

How do you undo
subtracting 7?
You need to add 7 to
both sides.

$$x-7=-12$$
$$+7 \mid +7$$
$$x=-5$$

Have you noticed that
the equal signs fall
right on the line each
time?

Check

$$x-7=-12$$
$$-5-7=-12$$
$$-12=-12$$

Example 2:

How do you undo
add -10?
You can either
subtract -10 or add
10. Subtracting a
negative is the same
as adding a positive.

$$x+-10=6$$
$$--10 \mid --10$$
$$x=16$$

$$x+-10=6$$
$$+10 \mid +10$$
$$x=16$$

Check

$$x+-10=6$$
$$16+-10=6$$
$$6=6$$

## Solving Multiplication and Division Equations

Example 1: $-6x = -42$

How do you undo a multiply by -6? You need to divide both sides by -6.

$$\frac{-6x}{-6} = \frac{-42}{-6}$$

$$x = 7$$

Remember that we use this sign to show division. Please do not use the elementary school division signs.

Check

$$-6x = -42$$
$$-6(7) = -42$$
$$-42 = -42$$

Example 2: $\dfrac{x}{-5} = 12$

How do you undo a divide by -5? You need to multiply by -5. What do you multiply by -5? You are multiplying the $x$ by -5 so write it next to the $x$.

$$-5 \bullet \frac{x}{-5} = 12 \bullet -5$$

$$x = -60$$

Check

$$\frac{x}{-5} = 12$$

$$\frac{-60}{-5} = 12$$

$$12 = 12$$

## Solving One-Step Word Problems

Example:  Mrs. Fauatea has an IQ of 208.  This is 94 higher than the IQ of Lady Gaga.  What is Lady Gaga's IQ?

STEP 1:  Define a variable.  What is the unknown?  What are you trying to solve for in the problem?

$$g = \text{Lady Gaga's IQ}$$

STEP 2:  Write the equation to be solved.

We know Lady Gaga's IQ + 94 = Mrs. Fauatea's IQ

Therefore, the equation is $g + 94 = 208$

Note that the variable should not be all by itself (isolated) in the original equation.  If it is you have already started solving the equation.

STEP 3:  Solve.

$$
\begin{array}{r}
g + 94 = 208 \\
-94 \quad | \quad -94 \\
g = 114
\end{array}
$$

Lady Gaga's IQ is 114.

STEP 4:  Check.

$$
\begin{aligned}
g + 94 &= 208 \\
114 + 94 &= 208 \\
208 &= 208
\end{aligned}
$$

## Solving Two-Step Equations

What if the equation has more than one operation?  For example, $5x + 2 = -18$

How do you know which operation to undo first?  Since you will be UNDOING the operations to solve for *x*, you need to work BACKWARDS through the order of operations.

$$\begin{array}{c} G \\ E \\ MD \\ AS \end{array} \uparrow$$

Remember G stands for any grouping symbols, including parentheses.

You want to undo any addition and subtraction first.  Then undo any multiplying and dividing.

Example 1:

$$5x + 2 = -18$$
$$\underline{-2 \quad | \quad -2}$$
$$\frac{5x}{5} = \frac{-20}{5}$$
$$x = -4$$

$$5x + 2 = -18$$
$$5 \bullet -4 + 2 = -18$$
$$-20 + 2 = -18$$
$$-18 = -18 \checkmark$$

Notice in the checks you now work forward through PEMDAS because you know all the numbers.

Example 2:

$$\frac{x}{-4} - 7 = -13$$
$$\underline{+7 \quad | \quad +7}$$
$$-4 \bullet \frac{x}{-4} = -6 \bullet -4$$
$$x = 24$$

$$\frac{x}{-4} - 7 = -13$$
$$\frac{24}{-4} - 7 = -13$$
$$-6 - 7 = -13$$
$$-13 = -13 \checkmark$$

## Like & Unlike Terms

You can combine LIKE terms.
You cannot combine UNLIKE terms.

In the real world if you have 6 grapes, 5 apples, and 12 grapes, you could combine all your grapes together.

6 grapes + 12 grapes = 18 grapes

Grapes and apples are unlike so you can't combine them (unless you are making fruit salad ☺.)

How do you know if there are like terms in an equation or expression?

LIKE TERMS have the **same variables** with exactly the **same exponents**.

$$5x + 3x = 8x \qquad \longleftarrow \qquad \text{Like terms}$$
$$6x^2 + 4x^2 = 10x^2 \qquad \longleftarrow \qquad \text{Like terms}$$
$$2xy + 6xy = 8xy \qquad \longleftarrow \qquad \text{Like terms}$$

$$5x + 2y \qquad \longleftarrow \qquad \text{Unlike terms}$$
$$6x + 3xy \qquad \longleftarrow \qquad \text{Unlike terms}$$
$$3x + 2x^2 \qquad \longleftarrow \qquad \text{Unlike terms}$$

## Like & Unlike Terms

How To Solve Difficult Problems with Like & Unlike Terms

Method 1:  Identify all like terms (including the operation)

$$-7e + 6f + 2e - 8f$$

$$\boxed{-7e} + \boxed{6f} + \boxed{2e} - \boxed{8f}$$

$$-7e + 2e = -5e$$
$$+6f - 8f = -2f$$

Therefore the answer is

$$-5e + -2f$$

Method 2:  If the negatives give you difficulty, you may want to make everything addition before starting.

$$-3 - 4g - 17 - 8g$$
$$-3 + -4g + -17 + -8g$$
$$-20 + -12g$$

## Distributive Property

The day after a test I **distribute** the tests back to the class. They all start together with me and I pass them back so each student receives their test.

TESTS

Tests start together and end up spread out everywhere.

Numbers can be distributed as well.

Example: $5 \bullet (7+8)$ is equal to $5 \bullet (7+8) = 5 \bullet 7 + 5 \bullet 8$

Notice that the answer is 75 whether you solve the original expression or the expression after you have distributed.

This is called distributing the 5. You multiply the 5 times the 7 AND the 5 times the 8.

If you only worked with numbers it probably would not make sense to distribute very often. Using the order of operations would usually be faster. However, what about variables?

THE DISTRIBUTIVE PROPERTY

$( \quad + \quad )$

$+$

USING THE DISTRIBUTIVE PROPERTY...

$5 (m \times 12)$

$5(m) + 5(12) = 5 \times m + 5 \times 12$

$5m + 60$

one combo meal

$3 \left( 2 \quad + \quad \right) = 6 \quad + 3$

$3(2t + d) = 6t + 3d$

## Distributive Property

Example 1:

$$7(2x+3)$$

$$7 \bullet 2x + 7 \bullet 3$$

$$14x + 21$$

What is being distributed?
The 7. I draw rainbows
to show it being
distributed to every term
in the parentheses.

Example 2:

$$-6(3x-7)$$

$$-6 \bullet 3x + -6 \bullet -7$$

$$-18x + 42$$

Here we are distributing -6.
Be careful and notice that
the answer is plus 42.

Example 3:

$$-4(5x-6) - 3(2x+2)$$

$$-4(5x-6) + -3(2x+2)$$

$$-20x + 24 + -6x + -6$$

$$-26x + 18$$

Notice that we are
distributing a negative 3 to
the second parentheses.
After distributing you
combine all like terms.