OXYACID EXAMPLES

acetic acid

$H^+ \quad C_2H_3O_2^-$

$HC_2H_3O_2$

nitrous acid

$H^+ \quad NO_2^-$

HNO_2

carbonic acid

$H^+ \quad CO_3^{2-}$

H^+

H_2CO_3

Basically, the acid forms of the polyatomic ions will have the same number of acidic hydrogens as the charge on the polyatomic.

SUMMING UP CHEMICAL NOMENCLATURE

- You need to be able to tell, by looking at a name OR a formula, what kind of compound you are working with!

DON'T GET THE NAMING SYSTEMS MIXED UP! EACH KIND OF COMPOUND IS NAMED WITH ITS OWN SYSTEM!

FROM A CHEMICAL NAME

- If the name has a Roman numeral, the name of a metal, or "ammonium", the compound is likely IONIC
- If the name has a Greek prefix AND the prefix is NOT in front of the word "hydrate", the compound is BINARY MOLECULAR
- If the name contains the word "acid":

... and starts with "hydro-", then the compound is a BINARY ACID

... and does not start with "hydro-", the compound is an OXYACID

FROM A CHEMICAL FORMULA

- if the formula contains a metal or the NH_4^+ ion, it is likely IONIC

H_2O H_2O_2

- If the formula starts with H and is not either water or hydrogen peroxide, the compound is likely an ACID. Which kind?

  - BINARY ACIDS contain only two elements

  - OXYACIDS contains oxygen

- If the formula contains only nonmetals or metalloids (and is not an ammonium compound or an acid), the compound is likely MOLECULAR

Examples:

PCl_3: BINARY MOLECULAR
Name: phosphorus trichloride

NH_4Cl: IONIC (ammonium ion)
Name: ammonium chloride

H_3PO_4: OXYACID (hydrogen, phosphate)
Name: phosphoric acid

CHEMICAL EQUATIONS

- are the "recipes" in chemistry
- show the substances going into a reaction, substances coming out of the reaction, and give other information about the process

$$MgCl_2(aq) + 2AgNO_3(aq) \xrightarrow{\text{"yields"}} 2AgCl(s) + Mg(NO_3)_2(aq)$$

REACTANTS - materials that are needed fot a reaction

PRODUCTS - materials that are formed in a reaction

COEFFICIENTS - give the ratio of molecules/atoms of one substance to the others

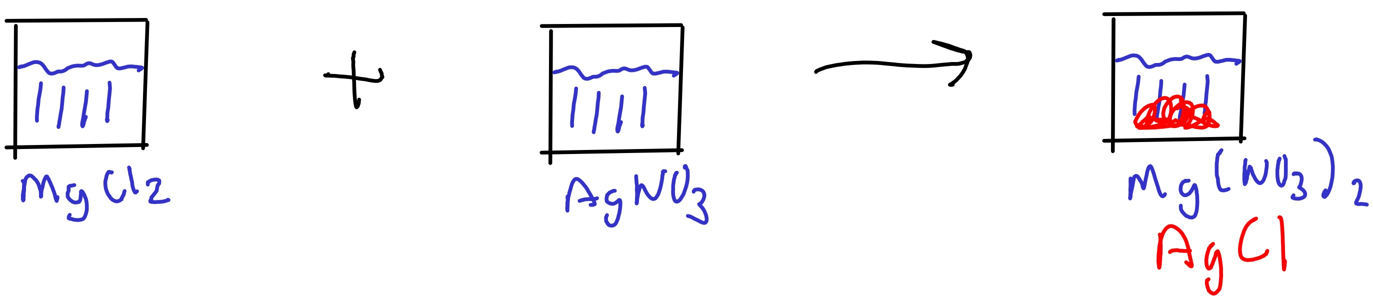
PHASE LABELS - give the physical state of a substance:

(s) -solid

(l) - liquid

(g) - gas

(aq) - aqueous. In other words, dissolved in water



CHEMICAL EQUATIONS

$$2Mg(s) + O_2(g) \xrightarrow{\Delta} 2MgO(s)$$

REACTION CONDITIONS - give conditions necessary for chemical reaction to occur. May be:

- Δ apply heat
- catalysts - substances that will help reaction proceed faster
- other conditions, such as required temperatures

- Reaction conditions are usually written above the arrow, but may also be written below if the reaction requires several steps or several different conditions

COEFFICIENTS

- Experimentally, we can usually determine the reactants and products of a reaction

- We can determine the proper ratios of reactants and products WITHOUT further experiments, using a process called BALANCING

  - BALANCING a chemical equation is making sure the same number of atoms of each element go into a reaction as come out of it.

- A properly balanced chemical equation has the smallest whole number ratio of reactants and products.

- There are several ways to do this, but we will use a modified trial-and-error procedure.

BALANCING

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

10 6 4 10

1. Pick an element. Avoid (if possible) elements that appear in more than one substance on each side of the equation.

2. Change the coefficients on substances containing this element so that the same number of atoms of the element are present on each side. CHANGE AS LITTLE AS POSSIBLE!

3. Repeat 1-2 until all elements are done.

4. Go back and quickly VERIFY that you have the same number of atoms of each element on each side, If you used any fractional coefficients, multiply each coefficient by the DENOMIMATOR of your fraction.

Use SMALLEST WHOLE NUMBER RATIOS!

BALANCING

$3MgCl_2 + 2Na_3PO_4 \longrightarrow Mg_3(PO_4)_2 + 6NaCl$

$C_2H_2 + \frac{5}{2}O_2 \longrightarrow 2CO_2 + H_2O$

4 1

5

To get rid of the fraction "5/2", we can multiply EVERY coefficient by the denominator of the fraction (2).

$$\boxed{2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O}$$

$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$

CHEMICAL CALCULATIONS - RELATING MASS AND ATOMS

$$\underline{\quad} Na_2CO_3 + \underline{2}HCl \rightarrow \underline{\quad} H_2O + \underline{\quad} CO_2 + \underline{2} NaCl$$

Chemical equations are written and balanced in terms of ATOMS and MOLECULES

- While chemical equations are written in terms of ATOMS and MOLECULES, that's NOT how we often measure substances in lab!

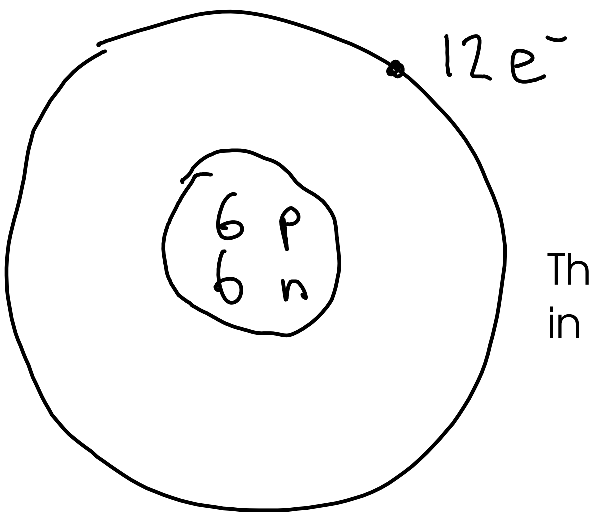
- measurements are usually MASS (and sometimes VOLUME), NOT number of atoms or molecules!

THE MOLE CONCEPT

- A "mole" of atoms is 6.022×10^{23} atoms

Why so big? Because atoms are so small!

- Why - in the metric dominated world of science - do we use such a strange number for quantity of atoms?



carbon-12

The mole is also defined as the number of carbon-12 atoms in exactly 12 g of carbon-12

THE MOLE CONCEPT

- Why define the mole based on an experimentally-measured number?

- The atomic weight of an element (if you put the number in front of the unit GRAMS) is equal to the mass of ONE MOLE of atoms of that element!

Carbon (C): Atomic mass 12.01 a~~m~~u → $\boxed{12.01\ g}$

↓

the mass of ONE MOLE of naturally-occurring carbon atoms

Magnesium (Mg): 24.31 g = the mass of ONE MOLE OF MAGNESIUM ATOMS

- So, using the MOLE, we can directly relate a mass and a certain number of atoms!

RELATING MASS AND MOLES

- Use DIMENSIONAL ANALYSIS (a.k.a "drag and drop")

- Need CONVERSION FACTORS - where do they come from?

- We use ATOMIC WEIGHT as a conversion factor.

$$\underbrace{Mg = 24.31}_{\text{Atomic mass}} \quad \Big| \quad 24.31\ g\ Mg = 1\ \underline{mol}\ Mg$$

"mol" is the abbreviation for "mole"

Example: How many moles of atoms are there in 250. g of magnesium metal?

$$24.31\ g\ Mg = mol\ Mg$$

$$250.\ \cancel{g\ Mg} \times \frac{mol\ Mg}{24.31\ \cancel{g\ Mg}} = \boxed{10.3\ mol\ Mg}$$

Example: You need 1.75 moles of iron. What mass of iron do you need to weigh out on the balance?

Fe: $55.85\ g\ Fe = mol\ Fe$

$$1.75\ mol\ Fe \times \frac{55.85\ g\ Fe}{mol\ Fe} = \boxed{97.7\ g\ Fe}$$