Stoichiometric Relationships Summary

1 mole ≡ number of carbon atoms in exactly 12g of C-12. This quantity is equal to 6.022×10^{23} and is known as Avogadro's number.

The **molecular mass** of a substance is the sum of the atomic masses of the individual atoms it contains and is expressed in amu's (u). The term **formula mass** is used for the empirical formula of an ionic compound.

The **molar mass** of any element or compound is equal to the sum of the molar masses of the individual atoms it contains. That sum will always equal 1 mole of that substance (i.e. 40.01g of NaOH = 1 mole of NaOH formula units or 6.022×10^{23} units.)

1 mole of ANY gas at STP (standard temperature and pressure = 0^{o}C and 1atm) occupies a volume of 22.4 L.

The concentration of a solution is commonly measured in a unit called Molarity (M). The units are moles of solute per liter of solution. A 1M solution has 1 mole of solute particles per liter of the total solution. Molarity can be affected by temperature since volume in involved in the unit.

Molarity (M) = moles solute / liters of solution

Another common unit of concentration is molality (m). The units are moles of solute per kilogram of solvent. Molality if not affected by temperature.

Molality (m) = moles solute / kilograms of solvent

Dilutions: When diluting solutions the relationship $M_1V_1 = M_2V_2$ is used, where M_1 and is the beginning molarity, M_2 is the desired final molarity, V_2 is the volume of final solution desired and V_1 (which is what you would normally be solving for is the amount of original solution to use which you would then dilute with water to V_2.

A limiting reagent is the reactant chemical that is in shortest supply (based on the mole ratios in the balanced equation, NOT by mass) that will limit the amount of product(s) that can be formed. The chemical in excess is known as the excess reagent.

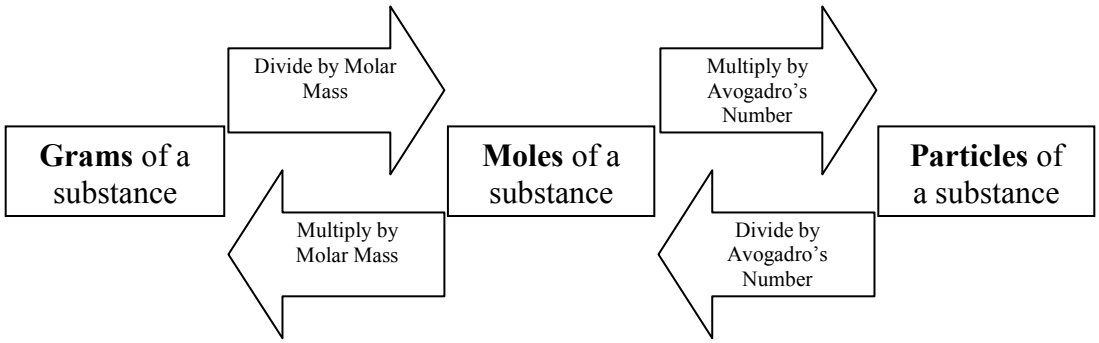
Other Concentration Expressions:

Weight (mass) percent in solution = grams solute / (grams solute + grams solvent)

Mass percent composition of a compound = mass of part / mass of whole compound

For extremely dilute solutions: Parts per million, billion or trillion may be used
For gases this is usually expressed in terms of molecules or volumes
For liquid solutions it is usually based on mass, which leads to the following:
1ppm = 1mg/L 1ppb = 1μg/L 1ppt = 1ng/L

Helpful Stoichiometry Relationships



Avogadro's Number = 6.022×10^{23}

Avogadro's number represents the number of carbon atoms in exactly 12.0g of the Carbon-12 isotope.

If the "particle" listed in the above table is a compound, to find the number of atoms of a particular element you must multiply the subscript of that element by the total number of particles.

A "**mole**" of something is 6.022×10^{23} units of that something (atoms, molecules, baseballs, etc.)

The **atomic mass** of an atom is the mass of the atom expressed in amu's (atomic mass units) where 1 amu is the mass of a proton or neutron.

The **molar mass** of a substance is the mass (usually expressed in grams) required to obtain 6.022×10^{23} (Avogadro's number) units of that substance.

The atomic mass and molar mass are numerically the same; however the units are *very different*.

Never use coefficients of a balanced equation to determine the molar mass of a substance. **Only** use coefficients to compare mole ratios or reactants and products.

When **balancing equations**, **never** change the subscripts of a compound and never place coefficients in the middle of a compound. **Only** use coefficients placed in front of the entire compound.

A **limiting reagent** is the substance that you run out of first in a reaction. It should always be used to calculate the amount of product produced since it will determine the extent of the reaction (i.e. the other reactant(s) will have some leftovers).

Percent composition = (mass represented by a particular element)/(mass of the whole compound)

Percent yield = (actual grams of product formed)/(theoretical grams of product that could be formed)

Molecules refer to covalently bonded compounds only.

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