ANALYTICAL CHEMISTRY

Read the details of the information given below from Skoog and West's "Fundamentals of Analytical Chemistry" book, which is recommended as a reference.

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Calculations Used in Analytical Chemistry

Some Important Units of Measurement

Solutions and Their Concentrations

Chemical Stoichiometry

4A Some important units of measurement

SI units
The distinction between mass and weight
Mole
Millimole
Calculating the amount of a substance in moles or millimoles

- Mass measurements: kg, g, mg, or µg

- Volumes of liquids: L, mL, µL, and nL

$$1\ L = 10^{-3}\ m^3$$

$$1\ mL = 1\ cm^3$$

The **ångstrom unit Å** is a non-SI unit of length that is widely used to express the wavelength of very short radiation.

$$1\ Å = 0.1\ nm = 10^{-10}\ m$$

The process of comparing masses is usually called *weighing*.

The objects of known mass as well as the results of weighing are frequently called *weights*.

4A-3 Mole

Abbreviation: mol

It is the amount of the specified substance that contains the same number of particles as the number of carbon atoms in exactly 12 grams of ^{12}C.

Avogadro's number $N_A = 6.022 \times 10^{23}$

Molar mass (*M*): The mass in grams of 1 mole of that substance.

4A-4 Millimole

Millimole is 1/1000 of a mole.

The mass in grams of a millimole, the millimolar mass (m*M*), is likewise 1/1000 of the molar mass.

$$1 \text{ mmol} = 10^{-3} \text{ mol}$$

$$10^{3} \text{ mmol} = 1 \text{ mol}$$

What is the mass in grams of Na^+ (22.99 g/mol) in 25.0 g of Na_2SO_4 (142.0 g/mol)?

4B Solutions and their concentrations

Concentration of solutions

- Molar concentration,
- Percent concentration,
- Solution-diluent volume ratio,
- p-functions

Molar concentration

The **molar concentration** c_x of a solution of a solute species X is the number of moles of that species that is contained in 1 liter of the solution (*not 1 L of the solvent*).

The unit is **molar**, symbolized by **M**, which has the dimensions of mol/L, or mol L^{-1}

Percent Concentration

Concentrations in terms of percent (parts per hundred)

Common methods are:

$$\text{weight percent (w/w)} = \frac{\text{weight solute}}{\text{weight solution}} \times 100\%$$

$$\text{volume percent (v/v)} = \frac{\text{volume solute}}{\text{volume solution}} \times 100\%$$

$$\text{weight/volume percent (w/v)} = \frac{\text{weight solute, g}}{\text{volume solution, mL}} \times 100\%$$

4B-2 Density and specific gravity of solutions

The **density** of a substance is its mass per unit volume, and its **specific gravity** is the ratio of its mass to the mass of an equal volume of water at 4°C.

- Density has units of kilograms per liter or grams per milliliter.
- Specific gravity is dimensionless.

4C Chemical stoichiometry

Stoichiometry is the quantitative relationship among the amounts of reacting chemical species.

Empirical formulas and molecular formulas

Empirical formula: The simplest whole number ratio of atoms in a chemical compound.

Molecular formula: The number of atoms in a molecule.

4C-2 Stoichiometric calculations

A balanced chemical equation gives the combining ratios, or stoichiometry—in units of moles—of reacting substances and their products.