Al-Mustaqbal-College University

Chemical Engineering and Petroleum Industry Department

Analytical chemistry

First class / first term

Lecture one part 1

By

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Lecture one

Solutions : Homogenous mixture for two or more substances , one of them called solute and the other one is the solvent .

The solute is an active substance in reaction and the solvent is active.

There are many solutions formed by dissolving gasses in liquids like CO_2 in water .

 # Homogenous solution : A partial homogenous mixing for two or more substances that will not react chemically with each other.

 # Heterogeneous solution : Represent with suspended and colloidal solution.

Aqueous solution : is the solution in which water is the solvent .
Non-aqueous solution : when the solvent is any substance except water.

Classification of solutions are depends upon :

a) nature of molecules (or the volume of atoms or molecules of solute) ,these solutions are :

1) True solution.
2) Suspended solution.
3) Colloidal solution.

b) solute concentration in solution , it can be classified into :

1) saturated solution.
2) unsaturated solution.
3) super saturated solution.

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Units of weight and concentration:

Concentration of solution : is the weight of solute dissolved in a given amount (volume or weight) of solvent.

Weight of solute can be expressed by :

1) physical units , e.g. gram(g) , milligram(mg) , kilogram(kg).
2) chemical units : - includes ,
    a) g- atomic weight.
    b) g- molecular weight.
    c) g- formula weight.
    d) g- ionic weight.
    e) g- equivalent weight.

Mole : is the summation of the atomic weight in grams for all of the atoms in the chemical formula for the species,.
No. of moles =Mw(g)/M.wt(g/m)

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Methods for the expression of concentration of solutions :

There are several methods for express the concentration of solutions :

1) Molarity (M) : moles of solute contained in one liter of solution or mol/L or ml.mol/ml

2) Normality (N) : number of g-equivalent weight of solute that are contained in a liter of solution.

Example \ Calculate the molecular weight of the compound :**$Fe(OH)_3.12H_2O$**

Atomic mass of iron = 55.85

Atomic mass of oxygen = 16

Hydrogen atomic mass = 1

These atomic masses can be obtained from the periodic table

Molecular weight = the sum of the atomic mass of each element in the molecular formula X the number of its presence in the formula

Molecular weight of ($Fe(OH)_3.12H_2O$) = **55.58 + (16+1)*3 +12(1*2+16)**

= **373.58** amu

Lecture one

For example, the molecular formula for hexane (C_6H_{14}). There are 6 carbon atoms and 14 hydrogen atoms in each hexane molecule. The atomic weight of Carbon and Hydrogen can be found in the periodic table.

Carbon atomic weight: 12.01
Hydrogen atomic weight: 1.01

Molecular weight = (number of C carbon atoms) (atomic weight) +
(number of H atoms) (H atomic weight)

Molecular weight of hexane = **(6 x 12.01) + (14 x 1.01)**
= 72.06 + 14.14
= 86.20 amu

Example: Find the molecular weight, Mw, of the following molecules:

N_2, NO, C_2H_6, N_2O_4, $C_8H_{18}O_4N_2S$, CO_2, H_2O_2, $Ca(NO_3)_2$, $Al_2(CO_3)_3$, $MgSO_4.7H_2O$, $C_8H_{10}N_4O_2$, $C_6H_{12}O_6$, H_2SO_4, C_2H_5 OH, $Zn(NO_3)_2$.

Atomic weight: (H = 1, C = 12, N = 14, O = 16, Mg = 24.3, Al = 27, S = 32.1, Ca =40.1, Zn = 65.4)

Lecture one

$$Mw_{N_2} = (2 \times 14) = 28 \text{ amu}$$

$$Mw_{NO} = (14) + (16) = 30 \text{ amu}$$

$$Mw_{C_2H_6} = (2 \times 12) + (6 \times 1) = 30 \text{ amu}$$

$$Mw_{N_2O_4} = (2 \times 14) + (4 \times 16) = 92 \text{ amu}$$

$$Mw_{C_8H_{18}O_4N_2S} = (8 \times 12) + (18 \times 1) + (4 \times 16) + (2 \times 14) + (32) = 238 \text{ amu}$$

$$Mw_{CO_2} = (12) + (2 \times 16) = 44 \text{ amu}$$

$$Mw_{H_2O_2} = (2 \times 1) + (2 \times 16) = 34 \text{ amu}$$

$$Mw_{Ca(NO_3)_2} = (40.1) + 2((14) + (3 \times 16)) = 164.1 \text{ amu}$$

$$Mw_{Al_2(CO_3)_3} = (2 \times 27) + 3((12) + (3 \times 16)) = 234 \text{ amu}$$

$$Mw_{MgSO_4.7H_2O} = (24.3) + (32.1) + (4 \times 16) + 7((2 \times 1) + (16)) = 246.4 \text{ amu}$$

$$Mw_{C_8H_{10}N_4O_2} = (8 \times 12) + (10 \times 1) + (4 \times 14) + (2 \times 16) = 194 \text{ amu}$$

$$Mw_{C_6H_{12}O_6} = (6 \times 12) + (12 \times 1) + (6 \times 16) = 180 \text{ amu}$$

$$Mw_{H_2SO_4} = (2 \times 1) + (32.1) + (4 \times 16) = 98.1 \text{ amu}$$

$$Mw_{C_2H_5OH} = (2 \times 12) + (5 \times 1) + (16) + (1) = 46 \text{ amu}$$

$$Mw_{Zn(NO_3)_2} = (65.4) + 2((14 + 3 \times 16)) = 189.4 \text{ amu}$$