

This specially designed column will help you to brush up your concepts by practicing questions. You can mail us your queries and doubts related to this topic at editor@mtg.com. The queries will be entertained by the author.*

SOME BASIC CONCEPTS OF CHEMISTRY

In continuation with previous article :

- In 1961, ^{12}C was taken to decide masses of other atoms. $\left(\frac{1}{12}\right)^{\text{th}}$ the mass of ^{12}C -atom was taken as 1 unified mass (u), 1 atomic mass unit (amu), 1 carbon unit, 1 dalton, 1 aston and also 1 avogram. One amu corresponds to the production of 931.48 MeV energy.
- Average mass of all the naturally occurring isotopes of an element was taken its average atomic mass.
- The sum of atomic masses of all atoms of elements present in one molecule or formula unit was considered molecular mass.
- The mass of a compound per pre-decided atom is called its minimum molecular mass (Cannizzaro's view).
- The methodology for calculating number of particles, masses, moles and volumes of substance using chemical equations of reactions is called stoichiometry.
- In a chemical reaction, where two reactants are involved, the one which is completely consumed is called limiting reagent. Calculations of other substances are based on this limiting reagent.
- Most commonly used methods of expressing concentrations of solutions are :

(I) Concentration terms which are not affected by temperature.

- (a) Mass fraction = $\frac{\text{Mass of component}}{\text{Total mass of solution}}$
- (b) Mass percent = $\frac{\text{Mass of component}}{\text{Total mass of solution}} \times 100$

$$(c) \text{ ppm by mass} = \frac{\text{Mass of component}}{\text{Total mass of solution}} \times 10^6$$

$$(d) \text{ Mole fraction} = \frac{\text{Moles of component}}{\text{Total moles in solution}}$$

$$\Rightarrow x_B = \frac{n_B}{n_A + n_B}$$

$$(e) \text{ Molality}(m) = \frac{\text{Moles of solute}}{\text{Wt. of solvent in kg}}$$

$$= \frac{W_B}{M_B} \times \frac{1000}{W_A \text{ (g)}}$$

$$= \frac{1000 \times \text{molarity}}{1000 \times d_{\text{soln}} \text{ (g mL}^{-1}\text{)} - \text{molarity} \times M_B}$$

$$= \frac{1000\chi_B}{\chi_A M_A}$$

(II) Concentration terms which are affected by temperature (volume based).

- (a) Strength in $\text{g L}^{-1} = \frac{W_B \text{ (g)}}{V_{\text{soln.}} \text{ (L)}}$
- (b) Molarity (M) = $\frac{n_B}{V_{\text{soln.}} \text{ (L)}} = \frac{1000 W_B}{M_B \cdot V_{\text{soln.}} \text{ (mL)}}$
- $$= \frac{1000 md}{1000 + mM_B} = \frac{10 \times x\% (w/w) \times d}{M_B}$$

- **Dilution of solution :** Molarity of final solution (M_f) if V_1 mL of solution of M_1 molarity is diluted by adding x mL of water, then

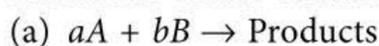
$$M_f = \frac{M_1 V_1}{V_1 + x}$$

*By R.C. Grover, having 45+ years of experience in teaching chemistry.

○ **Mixing of different solutions of the same solute**

$$M_f V_f = M_1 V_1 + M_2 V_2 + \dots$$

○ **Reactions of two solutions**



$$\frac{(MV)_A}{(MV)_B} = \frac{a}{b}$$

(b) W_B g of a substance of molar mass M_B , if completely reacts with V_A mL of another solution of molarity M_A (n_A and n_B are n factors of A and B respectively).

$$\frac{n_B W_B}{M_B} \times 1000 = M_A V_A n_A$$

(c) **Acid-base reaction:** A is for acid and B is for base, b is basicity of acid and a is acidity of base.

(i) If $b(MV)_A = a(MV)_B$, the final solution is neutral with $\text{pH} = 7$

(ii) If $b(MV)_A > a(MV)_B$, the final solution is acidic ($\text{pH} < 7$) and molarity of final solution

$$M_f = \frac{b(MV)_A - a(MV)_B}{b(V_A + V_B)}$$

(iii) If $b(MV)_A < a(MV)_B$, the final solution is basic ($\text{pH} > 7$) and molarity of final solution

$$M_f = \frac{a(MV)_B - b(MV)_A}{a(V_A + V_B)}$$

MULTIPLE CHOICE QUESTIONS

1. One amu corresponds to MeV energy.

- (a) 831.49 (b) 931.48
(c) 6.6×10^{-34} (d) 6.022×10^{23}

2. How many molecules of HCl gas will be produced by reacting 112 L of H_2 (0°C , 1 atm) with 213 g of Cl_2 ?

- (a) 3.61×10^{24} (b) 6.13×10^{23}
(c) 6.13×10^{24} (d) 1.63×10^{24}

3. 20 mL of 0.4 M AgNO_3 (molar mass = 170 g) is reacted with 15 mL of 0.6 M BaCl_2 (molar mass = 208.4 g). The mass of AgCl (molar mass = 143.5 g) produced is

- (a) 11.48 g (b) 18.14 g
(c) 14.18 g (d) 1.148 g

4. 85 g CaCO_3 (limestone sample), on heating produces exactly the same amount of CO_2 which converts 30 g of MgO to MgCO_3 . The percentage purity of limestone sample is

- (a) 80% (b) 82.4%
(c) 88.24% (d) 84.8%

5. Mole fraction of acetic acid in an aqueous sample is 0.1, the molality of the solution is

- (a) 7.16 (b) 1.67 (c) 6.17 (d) 5.25

6. The density of 4 M NaOH solution is 1.6 g mL^{-1} . The molality of the solution is

- (a) 2.77 (b) 14.28 (c) 7.14 (d) 57.14

7. Which of the following varies with temperature?

- (a) Molality (b) Mole fraction
(c) Molarity (d) Mass per cent

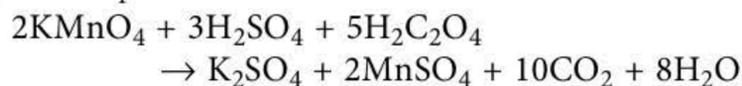
8. 1.5 moles of each of XY_2 and XY_3 if weigh 96 g and 120 g respectively. The atomic masses of X and Y respectively are

- (a) 4, 8 (b) 8, 16 (c) 32, 16 (d) 32, 64

9. Volume of 0.5 M HCl required for complete reaction of 10 g equimolar mixture of Na_2CO_3 (molar mass = 106 g) and NaHCO_3 (molar mass = 84 g) is

- (a) 135.8 mL (b) 315.8 mL
(c) 831.5 mL (d) 513.8 mL

10. KMnO_4 reacts with oxalic acid solution :



What mass of KMnO_4 in aqueous solution will suffice to completely react with 100 mL of $M/10$ oxalic acid solution?

- (a) 10.53 g (b) 0.632 g
(c) 3.105 g (d) 3.501 g

11. Three samples of NaCl (molar mass = 58.5 g) solutions of molarities 3 M, 5 M and 7 M are mixed in equal volumes. The same volume of water is now added to the solution. The molarity of the final solution is

- (a) 3.0 M (b) 5.0 M (c) 2.5 M (d) 7.5 M

12. What volume of H_2SO_4 of 98% mass/mass solution of density 1.8 g mL^{-1} will be used for preparing 5 L of 0.2 M H_2SO_4 ?

- (a) 11.11 mL (b) 44.44 mL
(c) 33.33 mL (d) 55.55 mL

13. What mass of a tribasic acid of molar mass 98 g mol^{-1} will completely neutralise 100 mL of $M/2$ NaOH solution?

- (a) 1.633 g (b) 16.33 g
(c) 13.63 g (d) 31.36 g

14. 200 mL of $M/5$ dibasic acid is mixed with 150 mL of $M/2$ monoacid base. The pH of the resulting solution is likely to be

- (a) more than 7 (b) less than 7
(c) equal to 7 (d) uncertain.