CHAPTER 1

Some Basic Concepts of Chemistry

1. In a compound C, H and N atoms are present in 9 : 1 : 3.5 by weight. Molecular weight of compound is 108. Molecular formula of compound is **[2002]**
(a) $C_2H_6N_2$ (b) C_3H_4N
(c) $C_6H_8N_2$ (d) $C_9H_{12}N_3$.

2. With increase of temperature, which of these changes? **[2002]**
(a) molality
(b) weight fraction of solute
(c) molarity
(d) mole fraction.

3. Number of atoms in 558.5 gram Fe (at. wt. of Fe = 55.85 g mol^{-1}) is **[2002]**
(a) twice that in 60 g carbon
(b) 6.023×10^{22}
(c) half that in 8 g He
(d) $558.5 \times 6.023 \times 10^{23}$

4. What volume of hydrogen gas, at 273 K and 1 atm. pressure will be consumed in obtaining 21.6 g of elemental boron (atomic mass = 10.8) from the reduction of boron trichloride by hydrogen? **[2003]**
(a) 67.2 L (b) 44.8 L
(c) 22.4 L (d) 89.6 L

5. 25ml of a solution of barium hydroxide on titration with a 0.1 molar solution of hydrochloric acid gave a litre value of 35ml. The molarity of barium hydroxide solution was
(a) 0.14 (b) 0.28 **[2003]**
(c) 0.35 (d) 0.07

6. 6.02×10^{20} molecules of urea are present in 100 ml of its solution. The concentration of urea solution is **[2004]**
(a) 0.02 M (b) 0.01 M
(c) 0.001 M (d) 0.1 M
(Avogadro constant, $N_A = 6.02 \times 10^{23}$ mol^{-1})

7. To neutralise completely 20 mL of 0.1 M aqueous solution of phosphorous acid (H_3PO_3), the value of 0.1 M aqueous KOH solution required is **[2004]**
(a) 40 mL (b) 20 mL
(c) 10 mL (d) 60 mL

8. The ammonia evolved from the treatment of 0.30 g of an organic compound for the estimation of nitrogen was passed in 100 mL of 0.1 M sulphuric acid. The excess of acid required 20 mL of 0.5 M sodium hydroxide solution for complete neutralization. The organic compound is **[2004]**
(a) urea (b) benzamide
(c) acetamide (d) thiourea

9. Two solutions of a substance (non electrolyte) are mixed in the following manner. 480 ml of 1.5 M first solution + 520 ml of 1.2 M second solution. What is the molarity of the final mixture? **[2005]**
(a) 2.70 M (b) 1.344 M
(c) 1.50 M (d) 1.20 M

10. If we consider that 1/6, in place of 1/12, mass of carbon atom is taken to be the relative atomic mass unit, the mass of one mole of the substance will **[2005]**
(a) be a function of the molecular mass of the substance
(b) remain unchanged
(c) increase two fold
(d) decrease twice

11. How many moles of magnesium phosphate, $Mg_3(PO_4)_2$ will contain 0.25 mole of oxygen atoms? **[2006]**
(a) 1.25×10^{-2} (b) 2.5×10^{-2}
(c) 0.02 (d) 3.125×10^{-2}

12. Density of a 2.05M solution of acetic acid in water is 1.02 g/mL. The molality of the solution is **[2006]**

(a) 2.28 mol kg^{-1} (b) 0.44 mol kg^{-1}

(c) 1.14 mol kg^{-1} (d) 3.28 mol kg^{-1}

13. The density (in g mL^{-1}) of a 3.60 M sulphuric acid solution that is 29% H_2SO_4 (molar mass = 98 g mol^{-1}) by mass will be

(a) 1.45 (b) 1.64 **[2007]**

(c) 1.88 (d) 1.22

14. In the reaction, **[2007]**

$2A\ell(s) + 6HC\ell(aq) \rightarrow$

$2A\ell^{3+}(aq) + 6C\ell^{-}(aq) + 3H_2(g)$

(a) 11.2 L $H_2(g)$ at STP is produced for every mole HC*l*(aq) consumed

(b) 6 L HC*l*(aq) is consumed for every 3 L $H_2(g)$ produced

(c) 33.6 L $H_2(g)$ is produced regardless of temperature and pressure for every mole A*l* that reacts

(d) 67.2 $H_2(g)$ at STP is produced for every mole A*l* that reacts.

15. The molality of a urea solution in which 0.0100 g of urea, $[(NH_2)_2CO]$ is added to 0.3000 dm^3 of water at STP is : **[2011RS]**

(a) 5.55×10^{-4}m (b) 33.3 m

(c) 3.33×10^{-2} m (d) 0.555 m

16. A gaseous hydrocarbon gives upon combustion 0.72 g of water and 3.08 g. of CO_2. The empirical formula of the hydrocarbon is : **[2013]**

(a) C_2H_4 (b) C_3H_4

(c) C_6H_5 (d) C_7H_8

17. Experimentally it was found that a metal oxi has formula $M_{0.98}O$. Metal M, present as M and M^{3+} in its oxide. Fraction of the metal whi exists as M^{3+} would be :

(a) 7.01% (b) 4.08% **[2013]**

(c) 6.05% (d) 5.08%

18. 3 g of activated charcoal was added to 50 mL of acetic acid solution (0.06N) in a flask. After an hour it was filtered and the strength of the filtrate was found to be 0.042 N. The amount of acetic acid adsorbed (per gram of charcoal) is : **[JEE M 2015]**

(a) 42 mg (b) 54 mg

(c) 18 mg (d) 36 mg

19. At 300 K and 1 atm, 15 mL of a gaseous hydrocarbon requires 375 mL air containing 20% O_2 by volume for complete combustion. After combustion the gases occupy 330 mL. Assuming that the water formed is in liquid form and the volumes were measured at the same temperature and pressure, the formula of the hydrocarbon is: **[JEE M 2016]**

(a) C_4H_8 (b) C_4H_{10}

(c) C_3H_6 (d) C_3H_8

20. The most abundant elements by mass in the body of a healthy human adult are :

Oxygen (61.4%) ; Carbon (22.9%), Hydrogen (10.0%) ; and Nitrogen (2.6%). The weight which a 75 kg person would gain if all ^1H atoms are replaced by ^2H atoms is **[JEE M 2017]**

(a) 15 kg (b) 37.5 kg

(c) 7.5 kg (d) 10 kg

21. 1 gram of a carbonate (M_2CO_3) on treatment with excess HCl produces 0.01186 mole of CO_2. The molar mass of M_2CO_3 in g mol^{-1} is : **[JEE M 2017]**

(a) 1186 (b) 84.3

(c) 118.6 (d) 11.86

Answer Key														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
(c)	(c)	(a)	(a)	(d)	(b)	(a)	(a)	(b)	(d)	(d)	(a)	(d)	(a)	(a)
16	17	18	19	20	21									
(d)	(b)	(c)	(d)	(c)	(b)									

SOLUTIONS

1. **(c)**

R.N.A	Percentage	Simplest ratio	
C	9	$\frac{9}{12}=\frac{3}{4}$	3
H	1	$\frac{1}{1}=1$	4
N	3.5	$\frac{3.5}{14}=\frac{1}{4}$	1

Empirical formula $= C_3H_4N$

$(C_3H_4N)_n = 108$

$(12\times3+4\times1+14)_n = 108$

$(54)_n = 108$

$n = \frac{108}{54} = 2$

$\therefore$ molecular formula $= C_6H_8N_2$

2. **(c)** Among all the given options molarity is correct because the term molarity involve volume which increases on increasing temperature.

3. **(a)** Fe (no. of moles) $= \frac{558.5}{55.85} = 10$ moles

C (no. of moles) in 60 g of C $= 60/12 = 5$ moles.

4. **(a)** $2BCl_3 + 3H_2 \rightarrow 2B + 6HCl$

or $BCl_3 + \frac{3}{2}H_2 \rightarrow B + 3HCl$

Now, since 10.8 gm boron requires hydrogen

$= \frac{3}{2}\times 22.4$ L at N.T.P

hence 21.6 gm boron requires hydrogen

$\frac{3}{2}\times\frac{22.4}{10.8}\times 21.6 = 67.2$ L at N.T. P.

5. **(d)** $25\times N = 0.1\times 35$; $N = 0.14$

$Ba(OH)_2$ is diacid base

hence $N = M\times 2$ or $M = \frac{N}{2}$

$M = 0.07$ M

6. **(b)** Moles of urea present in 100 ml of sol.$=$

$\frac{6.02\times10^{20}}{6.02\times10^{23}}$

$\therefore M = \frac{6.02\times10^{20}\times1000}{6.02\times10^{23}\times100} = 0.01M$

[$\because$ M = Moles of solute present in 1L of solution]

7. **(a)** $N_1V_1 = N_2V_2$

(Note : H_3PO_3 is dibasic $\therefore$ M = 2N)

$20\times0.2 = 0.1\times V$ (Thus. 0.1 M = 0.2 N)

$\therefore V = 40$ ml

8. **(a)** H_2SO_4 is dibasic.

$0.1\,M_{H_2SO_4} = 0.2N_{H_2SO_4}$ [

$\because M = 2\times N$]

M_{eq} of H_2SO_4 taken $= = 100\times0.2 = 20$

M_{eq} of H_2SO_4 neutralised by

$NaOH = 20\times0.5 = 10$

M_{eq} of H_2SO_4 neutralised by

$NH_3 = 20 - 10 = 10$ % of

$N_2 = \frac{1.4\times M_{eq}\text{ of acid neutrialised by }NH_3}{\text{wt. of organic compound}}$

$= \frac{1.4\times10}{0.3} = 46.6$

% of nitrogen in urea $= \frac{14\times2\times100}{60} = 46.6$

[Mol. wt of urea =60]

Similarly % of Nitrogen in Benzamide

$= \frac{14\times100}{121} = 11.5\%$ $[C_6H_5CONH_2 = 121]$

Acctamide $= \frac{14\times1\times100}{59} = 23.4\%$

$[CH_3CONH_2 = 59]$

Thiourea $= \frac{14\times2\times100}{76} = 36.8\%$

$[NH_2CSNH_2 = 76]$

Hence the compound must be urea.

9. (b) TIPS / Formulae

From the molarity equation.

$M_1V_1 + M_2V_2 = MV$

Let M be the molarity of final mixture,

$$M = \frac{M_1V_1 + M_2V_2}{V} \text{ where } V = V_1 + V_2$$

$$M = \frac{480 \times 1.5 + 520 \times 1.2}{480 + 520} = 1.344 \text{ M}$$

10. (d) Relative atomic mass =

$$\frac{\text{Mass of one atom of the element}}{1/12^{\text{th}} \text{ part of the mass of one atom of Carbon} - 12}$$

$$\text{or } \frac{\text{Mass of one atom of the element}}{\text{mass of one atom of the C} - 12} \times 12$$

Now if we use $^1/_6$ in place of $^1/_{12}$ the formula becomes

Relative atomic mass =

$$\frac{\text{Mass of one atom of element}}{\text{Mass of one atom of carbon}} \times 6$$

$\therefore$ Relative atomic mass decrease twice

11. (d) 1 Mole of $Mg_3(PO_4)_2$ contains 8 mole of oxygen atoms

$\therefore$ 8 mole of oxygen atoms $\equiv$ 1 mole of $Mg_3(PO_4)_2$ mole of $Mg_3(PO_4)_2$

0.25 mole of oxygen atom $\equiv \frac{1}{8} \times 0.25$ mole of $Mg_3(PO_4)_2$

$= 3.125 \times 10^{-2}$ mole of $Mg_3(PO_4)_2$

12. (a) TIPS / Formulae

Apply the formula $d = M\left(\frac{1}{m} + \frac{M_2}{1000}\right)$

$$\therefore 1.02 = 2.05\left(\frac{1}{m} + \frac{60}{1000}\right)$$

On solving we get, m = 2.288 mol/kg

13. (d) Since molarity of solution is 3.60 M. It means 3.6 moles of H_2SO_4 is present in its 1 litre solution.

Mass of 3.6 moles of H_2SO_4

= Moles × Molecular mass

$= 3.6 \times 98 \text{ g} = 352.8 \text{ g}$

$\therefore$ 1000 ml solution has 352.8 g of H_2SO_4

Given that 29 g of H_2SO_4 is present in = 100 g of solution

$\therefore$ 352.8 g of H_2SO_4 is present in

$$= \frac{100}{29} \times 352.8 \text{ g of solution}$$

= 1216 g of solution

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{1216}{1000}$$

$= 1.216 \text{ g/ml} = 1.22 \text{ g/ml}$

14. (a) $2Al(s) + 6HCl(aq) \rightarrow 2Al^{3+}(aq) + 6Cl^-(aq) + 3H_2(g)$

$\because$ 6 moles of HCl produces = 3 moles of H_2

$= 3 \times 22.4$ L of H_2 at S.T.P

$\therefore$ 1 mole of HCl produces

$$= \frac{3 \times 22.4}{6} \text{ L of } H_2 \text{ at S.T.P}$$

$= 11.2$ L of H_2 at STP

15. (a) Molality = Moles of solute / Mass of solvent in kg

$$\text{Molality} = \frac{0.01/60}{0.3} = \frac{0.01}{60 \times 0.3};$$

d = 1 g/ml

$= 5.55 \times 10^{-4}$ m

16. (d) $\because$ 18 gm, H_2O contains = 2 gm H

$\therefore$ 0.72 gm H_2O contains

$$= \frac{2}{18} \times 0.72 \text{ gm} = 0.08 \text{ gm H}$$

$\because$ 44 gm CO_2 contains = 12 gm C

$\therefore$ 3.08 gm CO_2 contains

$$= \frac{12}{44} \times 3.08 = 0.84 \text{ gm C}$$

$$\therefore \text{C : H} = \frac{0.84}{12} : \frac{0.08}{1}$$

$= 0.07 : 0.08 = 7 : 8$

$\therefore$ Empirical formula = C_7H_8

17. (b) For one mole of the oxide

Moles of M = 0.98

Moles of $O^{2-} = 1$

Let moles of $M^{3+} = x$

$\therefore$ Moles of $M^{2+} = 0.98 - x$

On balancing charge

$(0.98 - x) \times 2 + 3x - 2 = 0$

$x = 0.04$

$\therefore$ % of $M^{3+} = \frac{0.04}{0.98} \times 100 = 4.08\%$

18. (c) Let the weight of acetic acid initially be w_1 in 50 ml of 0.060 N solution.

Let the N = (Normality = 0.06 N)

0.06 =

$\Rightarrow$ = 0.18 g = 180 mg.

After an hour, the strength of acetic acid = 0.042 N

so, let the weight of acetic acid be w_2

N =

0.042 =

$\Rightarrow$ $w_2 = 0.126$ g = 126 mg

So amount of acetic acid adsorbed per 3g = 180 – 126 mg = 54 mg

Amount of acetic acid adsorbed per g = 18

19. (d) $C_xH_{y(g)} + O_{2(g)} \rightarrow xCO_{2(g)} + H_2O(l)$

Volume of O_2 used = = 75 ml

$\therefore$ From the reaction of combustion

1 ml C_xH_y requires =

15 ml =

So, $4x + y = 20$

$x = 3$

$y = 8$

$\boxed{C_3H_8}$

20. (c) Percentage (by mass) of elements given in the body of a healthy human adult is :-

Oxygen = 61.4%, Carbon = 22.9%,

Hydrogen = 10.0% and Nitrogen = 2.6%

$\because$ Total weight of person = 75 kg

$\therefore$ Mass due to ^1H is $= 75 \times \frac{10}{100} = 7.5$ kg

If ^1H atoms are replaced by ^2H atoms.

Mass gain by person would be = 7.5 kg

21. (b) Given chemical eq^n

$M_2CO_3 + 2HCl \rightarrow 2MCl + H_2O + CO_2$

1gm 0.01186 mole

from the balanced chemical eq^n.

$nM_2CO_3 = nCO_2$

$\frac{1}{M_2CO_3} = 0.01186$

$\therefore$ $M_2CO_3 = \frac{1}{0.01186}$

$\Rightarrow$ M = 84.3 g/mol