1

SOME BASIC CONCEPTS OF CHEMISTRY

MCQs with One Correct Answer

1. Which of the following statements is correct about the reaction given below ?

$$4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(g)$$

(a) Total mass of iron and oxygen in reactants = total mass of iron and oxygen in product therefore, it follows law of conservation of mass.

(b) Total mass of reactants = total mass of product; therefore, law of multiple proportions is followed.

(c) Amount of Fe_2O_3 can be increased by reducing the amount of any one of the reactants (iron or oxygen).

(d) Amount of Fe_2O_3 produced will decrease if the amount of any one of the reactants (iron or oxygen) is taken in excess.

2. Which of the following statements indicates that law of multiple proportion is being followed.

(a) Sample of carbon dioxide taken from any source will always have carbon and oxygen in the ratio 1 : 2.

(b) Carbon forms two oxides namely CO_2 and CO, where masses of oxygen which combine with fixed mass of carbon are in the simple ratio 2 : 1.

(c) When magnesium burns in oxygen, the amount of magnesium taken for the reaction is equal to the amount of magnesium in magnesium oxide formed.

(d) At constant temperature and pressure, 200 mL of hydrogen will combine with 100 mL oxygen to produce 200 mL of water vapour.

3. The number of water molecules in 250 mL of water is closest to [Given, density of water is 1.0 g mL^{-1}; Avogadro's number = 6.023×10^{23}]

(a) 83.6×10^{23} (b) 13.9×10^{23}

(c) 1.5×10^{23} (d) 33.6×10^{23}

4. A metal oxide has the formula Z_2O_3. It can be reduced by hydrogen to give free metal and water. 0.1596 g of the metal oxide requires 6 mg of hydrogen for complete reduction. The atomic weight of the metal is

(a) 27.9 (b) 159.6 (c) 79.8 (d) 55.8

5. 4 g of a hydrated crystal of formula $A.xH_2O$ has 0.8 g of water. If the molar mass of the anhydrous crystal (A) is 144 g mol^{-1}, The value of x is

(a) 4 (b) 1 (c) 2 (d) 3

6. A solution of 20.2 g of 1,2-dibromopropane in MeOH upon heating with excess Zn produces 3.58 g of an unsaturated compound *X*. The yield (%) of *X* is closest to [Atomic weight of Br is 80]

(a) 18 (b) 85 (c) 89 (d) 30

7. 5.0 g of a certain element X forms 10.0 g of its oxide having the formula X_4O_6. The atomic mass of X is

(a) 12.0 amu (b) 24.0 amu
(c) 30.0 amu (d) 32.0 amu

8. The maximum number of molecules are present in

(a) 15 L of H_2 gas at STP
(b) 5 L of N_2 gas at STP
(c) 0.5 g of H_2 gas
(d) 10 g of O_2 gas

9. Number of moles of MnO_4^- required to oxidize one mole of ferrous oxalate completely in acidic medium will be

(a) 0.6 moles (b) 0.4 moles
(c) 7.5 moles (d) 0.2 moles

10. A metallic chloride contain 47.22% metal. Calculate the equivalent weight of metal.

(a) 39.68 (b) 31.76 (c) 36.35 (d) 33.46

11. The number of moles of water present in a spherical water droplet of radius 1.0 cm is [**Given:** density of water in the droplet = 1.0 g cm^{-3}]

(a) $\frac{\pi}{18}$ (b) $\frac{2\pi}{27}$ (c) 24π (d) $\frac{2\pi}{9}$

12. If potassium chlorate is 80% pure, then 48 g of oxygen would be produced from (atomic mass of K =39)

(a) 153.12 g of $KClO_3$ (b) 122.5 g of $KClO_3$
(c) 245 g of $KClO_3$ (d) 98 g of $KClO_3$

13. 10 g $CaCO_3$ were dissolved in 250 mL of 100 M HCl or the solution was boiled. What volume of 2M KOH would be required to equivalence point after boiling? Assume no change in volume during boiling.

(a) 50 mL (b) 25 mL (c) 75 mL (d) 60 mL

14. The density of 3M solution of sodium chloride is 1.252 g mL^{-1}. The molality of the solution will be :
(molar mass, NaCl = 58.5 g mol^{-1})

(a) 260 m (b) 2.18 m (c) 2.79 m (d) 3.00 m

15. 2 g of a mixture of CO and CO_2 on reaction with excess I_2O_5 produced 2.54 g of I_2. What would be the mass % of CO_2 in the original mixture?

(a) 60 (b) 30 (c) 70 (d) 35

16. 3.0 g of oxalic acid [$(CO_2H)_2.2H_2O$] is dissolved in a solvent to prepare a 250 mL solution. The density of the solution is 1.9 g/mL. The molality and normality of the solution, respectively, are closest to

(a) 0.10 and 0.38
(b) 0.10 and 0.19
(c) 0.05 and 0.19
(d) 0.05 and 0.09

17. How many moles of P_4O_6 and P_4O_{10} will be produced by the combustion of 12.4 g of phosphorous (atomic mass 31) in 12.8 g of oxygen, leaving no P_4 or O_2?

(a) 0.1 and 0.3 mol
(b) 0.15 mol and 0.25 mol
(c) 0.05 mol each
(d) 0.1 mol each

18. 5 g sample contain only Na_2CO_3 and Na_2SO_4. This sample is dissolved and the volume made up to 250 mL. 25 mL of this solution neutralizes 20 mL of 0.1 M H_2SO_4. Calculate the % of Na_2SO_4 in the sample.

(a) 42.4 (b) 57.6 (c) 36.2 (d) 0.576

19. 1 mole of equimolar mixture of ferric oxalate and ferrous oxalate requires x mole of $KMnO_4$ in acidic medium for complete oxidation. x is:

(a) 0.5 mole (b) 0.9 mole
(c) 1.2 mole (d) 4.5 mole

20. 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?

(a) 2.70 M (b) 1.344 M
(c) 1.50 M (d) 1.20 M

Numeric Value Answer

21. A mixture of HCOOH and $H_2C_2O_4$ is heated with concentrated H_2SO_4. The gas produced is collected and on treating with KOH solution, the volume of gas decreases by one-sixth. Calculate the molar ratio of the two acids ($HCOOH : H_2C_2O_4$) in the original mixture.

22. One gram of a metallic chloride was found to contain 0.835 g of chlorine. Its vapour density is 85.5. If its molecular formula is M_xCl_y, then what is value of $(x + y)$?

23. 0.7875 g of crystalline barium hydroxide is dissolved in water. For the neutralization of this solution 20 mL of $N/4$ HNO_3 is required. How many moles of water of crystallization are present in one mole of this base? (Given : Atomic mass Ba = 137, O = 16, N = 14, H = 1)

24. A mixture contains 1.0 mole each of NaOH, Na_2CO_3 and $NaHCO_3$. When half of mixture is titrated with HCl, it required x mole of HCl in presence of phenolphthalein. In another experiment, half of mixture required y mole of same HCl in presence of methyl orange. Find the value of $(x+y)$.

25. A 0.276 g impure sample of copper ore is dissolved and Cu^{2+} is titrated with KI solution. I_2 liberated required 40 mL of 0.1M $Na_2S_2O_3$ solution for titration. What is the % of impurities in the ore?

26. Density of a sulphuric acid solution is 1.225g/mL. and it is 40% H_2SO_4 by weight. Determine molarity of this solution.

27. A 16.24 mL sample of vinegar of density 1.06 g/mL required 48.24 mL of 0.36 N solution of a standard alkali. Determine percentage weight of acetic acid in vinegar.

28. How much volume of sulphur dioxide at STP will be obtained by completely burning 10 g of pure sulphur?

29. How much volume of 4.0 M HNO_3 is required to prepare 60 mL of 0.2 M HNO_3 from a stock solution of 4.0 M HNO_3?

30. The minimum number of moles of O_2 required for complete combustion of 1 mole of propane and 2 moles of butane is _____.

ANSWER KEY																			
1	(a)	**4**	(d)	**7**	(b)	**10**	(b)	**13**	(b)	**16**	(c)	**19**	(b)	**22**	(5)	**25**	(8)	**28**	(7)
2	(b)	**5**	(c)	**8**	(a)	**11**	(b)	**14**	(c)	**17**	(c)	**20**	(b)	**23**	(8)	**26**	(5)	**29**	(3)
3	(a)	**6**	(b)	**9**	(b)	**12**	(a)	**15**	(b)	**18**	(b)	**21**	(4)	**24**	(3)	**27**	(6)	**30**	(18)

Hints & Solutions

CHAPTER 1

Some Basic Concepts of Chemistry

1. **(a)** Law of mass conservation states that matter can neither be created nor destroyed, or in a chemical reaction, the total mass of the reactants is equal to the total mass of the products.

$$4\,Fe\,(s) + 3\,O_2\,(g) \rightarrow 2FeO_3\,(g)$$

56×4 32×3 2×160

$= 224g$ $= 96\ g$ $= 320\ g$

2. **(b)** Statement (b) is correct according to the law of multiple proportions.

3. **(a)** Given: Density of water $= 1.0\ g\,mL^{-1}$

Volume of water $= 250\ mL$

$\therefore$ Mass of water = Density × Volume

$= 1.0 \times 250 = 250\ g$

18 g of water contains

$= 6.023 \times 10^{23}$ molecules

$\therefore$ 250 g of water contains

$$= \frac{6.023 \times 10^{23}}{18} \times 250 = 83.65 \times 10^{23} \text{ molecules}$$

4. **(d)** The reaction may given as

$$Z_2O_3 + 3H_2 \longrightarrow 2Z + 3H_2O$$

0.1596 g of Z_2O_3 react with $H_2 = 6\ mg = 0.006\ g$

$\therefore$ 1 g of H_2 react with

$$= \frac{0.1596}{0.006} = 26.6g \text{ of } Z_2O_3$$

$\therefore$ Eq. wt. of $Z_2O_3 = 26.6$ (from the definition of eq. wt.)

Eq. wt. of Z + Eq. wt. of O = E + 8 = 26.6

$\Rightarrow$ Eq. wt. of Z = 26.6 – 8 = 18.6

Valency of metal in $Z_2O_3 = 3$

$$\text{Eq. wt. of metal} = \frac{\text{Atomic wt.}}{\text{valency}}$$

$\therefore$ At. wt. of Z = 18.6 × 3 = 55.8

5. **(c)** $\because$ Given of weight of hydrated crystal = 4 g

Weight of water = 0.8

$\therefore$ Weight of anhydrous salt = 4 – 0.8 = 3.2

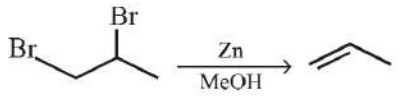
$\because$ 3.2 g anhydrous salt = 0.8 g of water

$\therefore$ 144 g anhydrous salt

$$= \frac{0.8}{3.2} \times 144 = 36 \text{ g of water}$$

$$\therefore\ x = \frac{36}{18} = 2$$

6. **(b)**



1,2-Dibromopropane Prop-1-ene (X)

Moles of 1, 2-dibromo propane

$$= \frac{20.2}{202} = 0.01 \text{ mole}$$

$$\text{Moles of prop-1-ene} = \frac{358}{42} = 0.085 \text{ mole}$$

$$\% \text{ yield} = \frac{0.085}{0.1} \times 100 = 85\%$$

7. **(b)** Using the relationship

$$\frac{\text{Mol. mass of oxide}}{\text{Mass of metal in molar mass}} = \frac{\text{mass of oxide}}{\text{mass of metal}}$$

$$\frac{4x+96}{4x} = \frac{10}{5} \Rightarrow x = 24$$

8. **(a)** No. of molecules in different cases

(a) $\because$ 22.4 litre at STP contains

$= 6.023 \times 10^{23}$ molecules of H_2

$\therefore$ 15 litre at STP contains $= \frac{15}{22.4} \times 6.023 \times 10^{23}$

$= 4.03 \times 10^{23}$ molecules of H_2

(b) $\because$ 22.4 litre at STP contains

$= 6.023 \times 10^{23}$ molecules of N_2

$\because$ 5 litre at STP contains $= \frac{5}{22.4} \times 6.023 \times 10^{23}$

$= 1.344 \times 10^{23}$ molecules of N_2

(c) $\because$ 2 g of $H_2 = 6.023 \times 10^{23}$ molecules of H_2

$\because$ 0.5 g of $H_2 = \frac{0.5}{2} \times 6.023 \times 10^{23}$

$= 1.505 \times 10^{23}$ molecules of H_2

(d) Similarly 10 g of O_2 gas

$= \frac{10}{32} \times 6.023 \times 10^{23}$ molecules of O_2

$= 1.88 \times 10^{23}$ molecules of O_2

Thus (a) will have maximum number of molecules

9. **(b)** $5\begin{matrix}COO^- \\ | \\ COO^-\end{matrix} + 2\,MnO_4^- + 16\,H^+ \longrightarrow$

oxalate ion

$$2\,Mn^{2+} + 10CO_2 + 8H_2O$$

From above equation 2 moles MnO_4 required to oxide 5 moles of oxalate.

Thus number of moles of MnO_4 required to oxidise one mole of oxalate $= 2/5 = 0.4$

10. **(b)** Suppose weight of metallic chloride = 100 g

Then weight of metal = 47.22 g

Weight of chlorine = 100 – 47.22 = 52.78 g

$\therefore$ Equivalent weight of metal

$$= \left(\frac{\text{Mass of Metal}}{\text{Mass of chloride}}\right) \times 35.5$$

$$= \frac{47.22}{52.78} \times 35.5 = 31.76$$

11. **(b)** Volume of a spherical water droplet

$$= \frac{4}{3}\pi r^3 = \frac{4}{3}\pi (1)^3$$

$$V = \frac{4}{3}\pi \text{ cm}^3$$

Mass of spherical water droplet

$$= P \times V = 1 \times \frac{4}{3}\pi = \frac{4}{3}\pi \text{ g}$$

18 g of water = 1 mol

no. of moles of water in a spherical water droplet

$$= \frac{4\pi}{3 \times 18} = \frac{2\pi}{27}$$

12. **(a)** $\underset{\substack{2 \times 122.5\text{ g} \\ 245}}{2KClO_3} \xrightarrow{\text{heat}} 2KCl + \underset{\substack{3 \times 32\text{ g} \\ 96}}{3O_2}$

48 g of oxygen will be produced from 122.5 g of $KClO_3$

$\therefore$ Amount of 80% $KClO_3$ needed

$$= \frac{100}{80} \times 122.5 = 153.12 \text{ g}$$

13. **(b)** Meq. of $CaCO_3 = \frac{10}{50} \times 1000 = 200$

Meq. of HCl = 250 × 1 = 250

Meq. of HCl left in the solution = 250 – 200 = 50

$\therefore$ Meq. of KOH requred V × 2 = 50

$\therefore$ V = 25 mL

14. **(c)** The relation between molarity (M) and molality (m) is

$$d = M\left(\frac{1}{m} + \frac{M_2}{1000}\right), \quad M_2 = \text{Mol. mass of solute}$$

On putting value

$$1.252 = 3\left(\frac{1}{m} + \frac{58.5}{1000}\right)$$

on solving $m = 2.79$

15. **(b)** $5CO + I_2O_5 \rightarrow 5CO_2 + I_2$

1 mol of $I_2 \equiv 1$ mol of $I_2O_5 \equiv 5$ mol of CO

Hence, mol of $CO = 5 \times \frac{2.54}{254} = 0.05$

Mass of $CO = 0.05 \times 28 = 1.4$ g

Mass of $CO_2 = 2 - 1.4 = 0.6$ g

Mass % of $CO_2 = \frac{0.6}{2} \times 100 = 30\%$

16. **(c)** Given mass of oxalic acid = 3 g

Molar mass of oxalic acid,

$(COOH)_2.2H_2O = 126$

We know that, density $= \frac{\text{Mass}}{\text{Volume}}$

V = 250mL

$\rho = \frac{M}{V} \Rightarrow M = \rho \times V$

$\therefore$ Mass of solvent = Density × Volume

$$\text{Molality (m)} = \frac{n_{solute}}{m_{solvent}} = \frac{m/M}{\rho V}$$

$$= \frac{3/126}{1.9 \times 250 \times 10^{-3}}$$

$$= \frac{10^3}{42 \times 19 \times 25}$$

m = 0.05

n_f of oxalic acid = 2

Normality (N) = Molality × n_f

$$N = \frac{n}{V(\text{in L})} \times n_f$$

$$= \frac{3/126}{250 \times 10^{-3}} \times 2$$

$$= \frac{40}{42} \times 2 = 0.19$$

17. **(c)** Moles of $P_4 = \frac{12.4}{4 \times 31} = 0.1$

Moles of $O_2 = \frac{12.8}{32} = 0.4$

Let x moles of P_4 form P_4O_6.

Then, moles of O_2 required $= x \times 3 + (0.1 - x) \times 5 = 0.4$ (given) $\Rightarrow x = 0.05$

18. **(b)** Only Na_2CO_3 reacts with H_2SO_4;

$Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2CO_3$

m-moles of Na_2CO_3 = m-moles of H_2SO_4

$= 20 \times 0.1 = 2$

m-moles of Na_2CO_3 in 250 mL solution

$$= \frac{250}{25} \times 2 = 20$$

wt. of $Na_2CO_3 = 20 \times 106 \times 10^{-3} = 2.12$ g

$$\% \text{ of } Na_2CO_3 = \frac{2.12}{5} \times 100 = 42.4$$

$\therefore$ $\% Na_2SO_4 = 100 - 42.4 = 57.6$

19. **(b)** $\underset{(n=6)}{Fe_2(C_2O_4)_3} + \underset{(n=5)}{MnO_4^-} + H^+ \longrightarrow 2Fe^{3+} + 6CO_2 + H_2O$

$\underset{(n=3)}{FeC_2O_4} + \underset{(n=5)}{MnO_4^-} + H^+ \longrightarrow Fe^{3+} + 2CO_2 + H_2O$

Total equivalents of $(Fe_2(C_2O_4)_3 + FeC_2O_4)$

= equivalents of $KMnO_4$

$\therefore$ $0.5 \times 6 + 0.5 \times 3 = x \times 5$

moles of $KMnO_4 = x = 0.9$

20. **(b)** From the molarity equation.

$M_1V_1 + M_2V_2 = MV$

Let M be the molarity of final mixture,

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

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

21. **(4)** $\underset{a \text{ moles}}{HCOOH} \xrightarrow{H_2SO_4} H_2O + \underset{a \text{ moles}}{CO}$

$\underset{b \text{ moles}}{H_2C_2O_4} \xrightarrow{H_2SO_4} H_2O + \underset{b \text{ moles}}{CO} + \underset{b \text{ moles}}{CO_2}$

Total number of moles of gases formed

$= a + 2b$

Moles of gas (CO_2) absorbed by KOH = b

Hence, $b = \frac{1}{6}(a + 2b$ [$\because$ Volume $\propto$ No. of moles)

$a/b = 4$

22. **(5)** $M_xCl_y = MCl_y$ ($\because$ valency of Cl = 1)

Molar mass of $M_xCl_y = 85.5 \times 2 = 171$ g/mol

$(M)(x) + (35.5)(y) = 171$ ... (i)

$$\frac{\text{Mass of chlorine}}{\text{Mass of metalic chloride}} = \frac{0.835}{1}$$

$$= \frac{35.5\,y}{M(x) + (35.5)(y)}$$

On solving $y = 4$ and $x = 1$

$x + y = 5$

23. **(8)** $Ba(OH)_2 \cdot xH_2O(aq) + HNO_3(aq) \longrightarrow Ba(NO_3)_2 + H_2O(l)$

Eq. of $Ba(OH)_2 \cdot x\,H_2O$ = eq. of HNO_3

$$\frac{0.7875}{(171+18x)} \times 2 = \frac{1}{4} \times \frac{20}{1000}$$

$x = 8$

24. **(3)** In HPh Eq. of NaOH + Eq. of Na_2CO_3 = Eq. of HCl

$(0.5)(1) + (0.5)(1) = (x)(1)\ x = 1$

In MeOH, Eq. of NaOH + Eq. of Na_2CO_3 + Eq. of $NaHCO_3$ = Eq. of HCl

$(0.5)(1) + (0.5)(2) + (0.5)(1) = (y)(1)$

$y = 2$

$x + y = 3$

25. **(8)** $\underset{n\text{-factor}=1}{Cu^{2+}} + KI \longrightarrow \underset{n\text{-factor}=2}{I_2} + Cu^{+}$

$$\underset{n-\text{factor}=2}{I_2} + \underset{n-\text{factor}=1}{Na_2S_2O_3} \longrightarrow NaI + Na_2S_4O_6$$

Eq. of Cu^{2+} = Eq. of I_2 produced = Eq. of I_2 reacted = Eq. of $Na_2S_2O_3$.

$$(x)(1) = \left(\frac{40}{1000}\right)(0.1)(1)$$

$x = 4 \times 10^{-3}$ mol

Mass of pure Cu $= 4 \times 10^{-3} \times 63.5 = 0.254$ g

$$\%\ \text{Purity} = \frac{0.254}{0.276} \times 100 = 92\%$$

$\%$ Impurity $= 8\%$

26. **(5)** Consider one litre of solution. Weight of solution = 1225 g;

Weight of solute $= 1225 \times 0.4 = 490$ g

$$\text{Moles of solute} = \frac{490}{98} = 5.0$$

Hence, molarity (M) = 5.0

27. **(6)** m.eq of acid in 16.24 mL of its solution $= 48.24 \times 0.36 = 17.366$

$\Rightarrow$ Mass of acetic acid

$= 17.366 \times 10{-}3 \times 60 = 1.042$ g

$\Rightarrow$ Mass of solution = 17.21 g

$\Rightarrow$ Mass percentage of acid

$$= \frac{1.042}{17.21} \times 100 = 6$$

28. **(7)** The reaction involved is: $S + O_2 \longrightarrow SO_2$ i.e., one mole of S combines with one mole of O_2 to produce one mole of SO_2.

$$\text{Moles of S} = \frac{10}{32} = 0.3125$$

$\Rightarrow$ Moles of $SO_2 = 0.3125$

$\Rightarrow$ Vol of $SO_2 = 0.3125 \times 22.4 = 7.0$L

29. **(3)** Molarity $\times$ Volume (in mL) = milimoles of solute (mmoles)

Therefore, mmoles of HNO_3 required $= 60 \times 0.2 = 12$

$$\Rightarrow \quad V(mL) = \frac{\text{m mole}}{\text{molarity}} = \frac{12}{4} = 3\ mL$$

30. **(18)** Complete combustion of hydrocarbons can be represented by the following reaction.

$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$$

For propane combustion reaction is

$$C_3H_8 + \left(3 + \frac{8}{4}\right)O_2 \longrightarrow 3CO_2 + \frac{8}{2}H_2O$$

$$\therefore C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

Similarly, for butane is

$$C_4H_{10} + \left(4 + \frac{10}{4}\right)O_2 \longrightarrow 4CO_2 + \frac{10}{2}H_2O$$

$$\therefore\ C_4H_{10} + \frac{13}{2}, O_2 \longrightarrow 4CO_2 + 5H_2O$$

$\because$ For 1 mol of C_4H_{10} required $O_2 = \frac{13}{2}$ mol

$\therefore$ For 2 mol of C_4H_{10} required O_2

$$= \frac{13}{2} \times 2 = 13\ \text{mol}$$

$\therefore$ Number of moles of O_2 required $= 5 + 13 = 18$