Chapter 1

Some Basic Concepts of Chemistry

TYPE A : MULTIPLE CHOICE QUESTIONS

1. The weight of a single atom of oxygen is : ***[1997]***

(a) 1.057×10^{23} g (b) 3.556×10^{23} g

(c) 2.656×10^{-23} g (d) 4.538×10^{-23} g

2. Volume of a gas at NTP is 1.12×10^{-7} cc. The number of molecule in it is : ***[1998]***

(a) 3.01×10^{12} (b) 3.01×10^{18}

(b) 3.01×10^{24} (d) 3.01×10^{30}

3. The oxide of an element contains 67.67% oxygen and the vapour density of its volatile chloride is 79. Equivalent weight of the element is: ***[1998]***

(a) 2.46 (b) 3.82

(c) 4.36 (d) 4.96

4. 60 gm of an organic compound on analysis is found to have C = 24 g, H = 4 g and O = 32 g. The empirical formula of compound is: ***[1998]***

(a) CH_2O (b) CHO

(c) C_2H_2O (d) $C_2H_2O_2$

5. The molar concentration of 20 g of NaOH present in 5 litre of solution is : ***[1998]***

(a) 0.1 moles/litre (b) 0.2 moles/litre

(c) 1.0 moles/litre (d) 2.0 moles/litre

6. The normality of solution obtained by mixing 10 ml of N/5 HCI and 30 ml of N/10 HCl is : ***[1999]***

(a) $\frac{N}{15}$ (b) $\frac{N}{5}$

(c) $\frac{N}{7.5}$ (d) $\frac{N}{8}$

7. The empirical formula of a compound is CH_2O. Its molecular weight is 180. The molecular formula of compound is : ***[1999]***

(a) C_4HO_4 (b) $C_3H_6O_3$

(c) $C_6H_{12}O_6$ (d) $C_5H_{10}O_5$

8. 0.4 moles of HCl and 0.2 moles of $CaCl_2$ were dissolved in water to have 500 mL of solution, the molarity of Cl^- ion is: ***[2000]***

(a) 0.8 M (b) 1.6 M

(c) 1.2 M (d) 10.0 M

9. 10^{21} molecules are removed from 200 mg of CO_2. The moles of CO_2 left are : ***[2001]***

(a) 2.88×10^{-3} (b) 28.8×10^{-3}

(c) 288×10^{-3} (d) 28.8×10^{3}

10. The weight of NaCl decomposed by 4.9g of H_2SO_4, if 6 g of sodium hydrogen sulphate and 1.825 g of HCl, were produced in the reaction is:

(a) 6.921 g (b) 4.65 g ***[2001]***

(c) 2.925 g (d) 1.4 g

11. Temperature does not affect : ***[1997, 2001]***

(a) Molality (b) Formality

(c) Molarity (d) Normality

12. The molarity of H_2SO_4 solution, which has a density 1.84 g/cc. at 35° C and contains 98% by weight, is : ***[2001]***

(a) 1.84 M (b) 18.4 M

(c) 20.6 M (d) 24.5 M

13. The normality of orthophosphoric acid having purity of 70 % by weight and specific gravity 1.54 is : ***[2001]***

(a) 11 N (b) 22 N

(c) 33 N (d) 44 N

14. The weight of one molecule of a compound of molecular formula $C_{60}H_{122}$ is ***[2002]***

(a) 1.2×10^{-20} g (b) 5.025×10^{23} g

(c) 1.4×10^{-21} g (d) 6.023×10^{-20} g

15. During electrolysis of water the volume of O_2 liberated is 2.24 dm^3. The volume of hydrogen liberated, under same conditions will be ***[2008]***

(a) 2.24 dm^3 (b) 1.12 dm^3

(c) 4.48 dm^3 (d) 0.56 dm^3

16. Calculate the millimoles of SeO_3^{2-} in solution on the basis of following data : ***[2009]***

70ml of $\frac{M}{60}$ solution of $KBrO_3$ was added to SeO_3^{2-} solution. The bromine evolved was removed by boiling and excess of $KBrO_3$ was back titrated with 12.5 mL of $\frac{M}{25}$ solution of $NaAsO_2$.

The reactions are given below.

I. $SeO_3^{2-} + BrO_3^- + H^+ \rightarrow SeO_4^{2-} + Br_2 + H_2O$

II. $BrO_3^- + AsO_2^- + H_2O \rightarrow Br^- + AsO_4^{3-} + H^+$

(a) 1.6×10^{-3} (b) 1.25
(c) 2.5×10^{-3} (d) None of these

17. The reaction of calcium with water is represented by the equation

$$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$$

What volume of H_2 at STP would be liberated when 8 gm of calcium completely reacts with water? ***[2010]***

(a) $0.2\ cm^3$ (b) $0.4\ cm^3$
(c) $2240\ cm^3$ (d) $4480\ cm^3$

18. A solution is prepared by dissolving 24.5 g of sodium hydroxide in distilled water to give 1 L solution. The molarity of NaOH in the solution is ***[2010]***

(a) 0.2450 M (b) 0.6125 M
(c) 0.9800 M (d) 1.6326 M

(Given that molar mass of NaOH = 40.0 g mol^{-1})

19. Which of the following pairs of solutions are expected to be isotonic, temperature being the same? ***[2011]***

(a) 0.1 M glucose and 0.1M $C_6H_5N^+H_3Cl^-$
(b) 0.1 M NaCl and 0.05 M $BaCl_2$
(c) 0.1 M Na_2SO_4 and 0.1 M KNO_3
(d) 0.1 M $BaCl_2$ and 0.075 M $FeCl_3$

20. For preparing 0.1 N solution of a compound from its impure sample of which the percentage purity is known, the weight of the substance required will be ***[2012]***

(a) less than the theoretical weight
(b) more than the theoretical weight
(c) same as the theoretical weight
(d) none of these

21. In a hydrocarbon, mass ratio of hydrogen and carbon is 1:3, the empirical formula of hydrocarbon is ***[2012]***

(a) CH_4 (b) CH_2
(c) C_2H (d) CH_3

22. The vapour density of a mixture containing NO_2 and N_2O_4 is 27.6. Mole fraction of NO_2 in the mixture is ***[2012]***

(a) 0.8 (b) 0.6
(c) 0.4 (d) 0.2

23. An aqueous solution of 6.3 g of oxalic acid dihydrate is made up to 250 ml. The volume of 0.1 N NaOH required to completely neutralise 10 ml of this solution is ***[2013]***

(a) 20 ml (b) 40 ml
(c) 10 ml (d) 4 ml

24. $KMnO_4$ reacts with oxalic acid according to the equation: ***[2013]***

$$2MnO_4^- + 5C_2O_4^- + 16H^+ \rightarrow 2Mn^{++} + 10CO_2 + 8H_2O$$

Here 20 mL of 0.1 M $KMnO_4$ is equivalent to:

(a) 20 mL of 0.5 M $H_2C_2O_4$
(b) 50 mL of 0.5 M $H_2C_2O_4$
(c) 50 mL of 0.1 M $H_2C_2O_4$
(d) 20 mL of 0.1 M $H_2C_2O_4$

25. Calculate the normality of 10 volume H_2O_2? ***[2013]***

(a) 1.7 N (b) 12 N
(c) 30.3 N (d) 0.0303 N

26. Which has the maximum number of molecules among the following ? ***[2014]***

(a) 44 g CO_2 (b) 48 g O_3
(c) 8 g H_2 (d) 64 g SO_2

27. Sulphur forms the chlorides S_2Cl_2 and SCl_2. The equivalent mass of sulphur in SCl_2 is ***[2015]***

(a) 8 g/mol (b) 16 g/mol
(c) 64.8 g/mol (d) 32 g/mol

28. Arrange the following in the order of increasing mass (atomic mass: O = 16, Cu = 63, N = 14)

I. one atom of oxygen
II. one atom of nitrogen
III. 1×10^{-10} mole of oxygen
IV. 1×10^{-10} mole of copper ***[2016]***

(a) II < I < III < IV (b) I < II < III < IV
(c) III < II < IV < I (d) IV < II < III < I

29. Volume of water needed to mix with 10 mL 10N HNO_3 to get 0.1 N HNO_3 is : ***[2017]***

(a) 1000 mL (b) 990 mL
(c) 1010 mL (d) 10 mL

TYPE B : ASSERTION REASON QUESTIONS

Directions for (Qs. 30-32) : These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following five responses.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is incorrect but the Reason is correct.

30. **Assertion :** Atoms can neither be created nor destroyed.

Reason : Under similar condition of temperature and pressure, equal volume of gases does not contain equal number of atoms. ***[2002]***

31. **Assertion :**Equivalent weight of a base

$$= \frac{\text{Molecular weight}}{\text{Acidity}}$$

Reason : Acidity is the number of replaceable hydrogen atoms in one molecule of the base. ***[2008]***

32. **Assertion :**One molal aqueous solution of glucose contains 180g of glucose in 1 kg water.

Reason : Solution containing one mole of solute in 1000 g of solvent is called one molal solution. ***[2008]***

Directions for (Qs.33-34) : Each of these questions contains an Assertion followed by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

33. **Assertion :** The normality of 0.3 *M* aqueous solution of H_3PO_3 is equal to 0.6 *N*.

Reason : Equivalent weight of H_3PO_3

$$= \frac{\text{Molecular weight of } H_3PO_3}{3}$$ ***[2011, 13]***

34. **Assertion :** Equal moles of different substances contain same number of constituent particles. ***[2017]***

Reason : Equal weights of different substances contain the same number of constituent particles.

HINTS & SOLUTIONS

Type A : Multiple Choice Questions

1. **(c)** Weight of single atom of oxygen

$$= \frac{16}{6.02 \times 10^{23}} = 2.656 \times 10^{-23}\,g$$

2. **(a)** No. of molecules

$$= \frac{6.02 \times 10^{23} \times 1.12 \times 10^{-7}}{22400}$$

$$= \frac{6.02 \times 10^{-7} \times 1.12 \times 10^{23}}{2.24 \times 10^{4}} = 3.01 \times 10^{12}$$

3. **(b)** Equivalent weight of an element is its weight which reacts with 8 gm of oxygen to form oxide.
Thus eq. weight of the given element

$$= \frac{32.33}{67.67} \times 8 = 3.82$$

4. **(a)** Ratio of no. of atoms $= \frac{24}{12} : \frac{4}{1} : \frac{32}{16}$
$= 2 : 4 : 2 = 1 : 2 : 1$
Empirical formula = CH_2O.

5. **(a)** molar concentration $= \frac{\text{Mole}}{\text{Vol. in L}} = \frac{20/40}{5}$

$$= \frac{20}{5 \times 40} = 0.1 \text{ mole/litre.}$$

6. **(d)** Normality of a mixture of two or more acids is given by

$$N = \frac{N_1V_1 + N_2V_2}{V_1 + V_2}$$

$$= \frac{\frac{1}{5} \times 10 + \frac{1}{10} \times 30}{10 + 30} = \frac{5}{40} = \frac{1}{8} \text{ or } \frac{N}{8}$$

7. **(c)** Empirical formula weight
$= 12 + 2 + 16 = 30$

$$n = \frac{180}{30} = 6$$

Molecular formula = $(CH_2O)_6 = C_6H_{12}O_6$.

8. **(b)** $\underset{0.4\,\text{moles}}{HCl} \rightleftharpoons H^+ + \underset{0.4\,\text{moles}}{Cl^-}$

$\underset{0.2\,\text{moles}}{CaCl_2} \rightleftharpoons Ca^{2+} + \underset{2 \times 0.2 = 0.4\,\text{moles}}{2Cl^-}$

Total Cl^- moles = 0.4 + 0.4 = 0.8 moles

$$\text{Molarity} = \frac{\text{Moles}}{\text{Vol.in L}}$$

$$\therefore \text{Molarity of } Cl^- = \frac{0.8}{0.5} = 1.6 \text{ M.}$$

9. **(a)** No. of moles $= \frac{\text{Wt. in g}}{\text{Mol. wt}}$

No. of moles in 200 mg $= \frac{200}{1000 \times 44}$
$= 4.5 \times 10^{-3}$ moles

No. of moles in 10^{21} molecules

$$= \frac{10^{21}}{6.02 \times 10^{23}} = 1.67 \times 10^{-3} \text{ moles}$$

No. of moles left $= (4.5 - 1.67) \times 10^{-3}$
$= 2.88 \times 10^{-3}$

10. **(c)** $\underset{x\,g}{NaCl} + \underset{4.9\,g}{H_2SO_4} \longrightarrow \underset{6\,g}{NaHSO_4} + \underset{1.825\,g}{HCl}$

According to law of conservation of mass "*mass is neither created nor destroyed during a chemical change*"

$\therefore$ Mass of the reactants = Mass of products

$x + 4.9 = 6 + 1.825$

or $x = 2.925$ g

11. **(a)** Temperature does not affect molality as it does not depend upon volume factor.

12. **(b)** 100 gm solution contains 98 gm H_2SO_4.

$\frac{100}{1.84}$ c.c contains 98 gm H_2SO_4.

1000 c.c solution contains

$$= \frac{98}{100} \times 1.84 \times 1000 \text{ gm } H_2SO_4$$

$$= \frac{98}{100} \times \frac{1.84 \times 1000}{98} \text{ moles of } H_2SO_4$$

$= 18.4$ M.

13. **(c)** 70% by weight means
Wt. of solute = 70 g
Wt of solution = 100 g

$$\therefore V_{cc} \text{ of solution} = \frac{\text{mass}}{\text{density}} = \frac{100}{1.54}$$

We know that

$$N = \frac{W \times 1000}{\text{Eq. Wt} \times V_{cc}}$$

$$= \frac{70 \times 3}{98} \times \frac{1000 \times 1.54}{100} = 33\,N$$

14. (c) M.W. = 60 × 12 + 122 = 842

Weight of one molecule = $\frac{842}{6.02\times10^{23}}$ gm

$= 140 \times 10^{-23}$ gm $= 1.4 \times 10^{-21}$ gm

15. (c) $\underset{2\text{ vol.}}{2H_2O} \xrightarrow{\text{Electrolysis}} \underset{2\text{ vol.}}{2H_2} + \underset{1\text{ vol.}}{O_2}$

Thus, the volume of hydrogen liberated is twice that of the volume of oxygen liberated. When 2.24 dm^3 of oxygen is liberated the volume of hydrogen liberated will be 2 × 2.24 dm^3 or 4.48 dm^3

16. (c) (I) $\overset{+4}{SeO_3^{2-}} + \overset{+5}{BrO_3^-} + H^+ \rightarrow \overset{+6}{SeO_4^{2-}} + \overset{0}{Br_2} + H_2O$

(II) $\overset{+5}{BrO_3^-} + \overset{+3}{AsO_2^-} + H_2O \rightarrow \overset{-1}{Br^-} + \overset{+5}{AsO_4^{3-}} + H^+$

In reaction (II)

gm. eq. of BrO_3^- = gm. eq. of AsO_2^-

$n_{BrO_3^-} \times 6 = n_{AsO_2^-} \times 2$

$= \frac{12.5}{1000} \times \frac{1}{25} \times 2 = 10^{-3}$

$n_{BrO_3^-} = \frac{10^{-3}}{6}$

In reaction (I)

moles of BrO_3^- consumed

$= \frac{70}{1000} \times \frac{1}{60} - \frac{10^{-3}}{6} = 10^{-3}$

gm eq. of SeO_3^{2-} = gm. eq. of BrO_3^-

$n_{SeO_3^{2-}} \times 2 = 10^{-3} \times 5$;

$n_{SeO_3^{2-}} = 2.5 \times 10^{-3}$

17. (d) $Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$

According to the stoichiometry of reaction, 40 gm of Ca on complete reaction with water liberates = 2 gm H_2

∴ 8 gm of Ca, on complete reaction with water liberates = $\frac{2}{40} \times 8$ gm H_2

= 0.40 gm H_2

$= \frac{0.40}{2} \times 22400\,cm^3$

= 4480 cm^3 of H_2 at S.T.P.

18. (b) Given W_{NaOH} = 24.5 g

No. of moles of NaOH = $\frac{24.5}{40}$ moles

= 0.6125 moles

\ Molarity of solution

$= \frac{0.6125\text{ moles}}{1L} = 0.6125\,M$

19. (d) Effective molarity of $BaCl_2$ = 3 × 0.1 = 0.3 ; effective molarity of $FeCl_3$ = 4 × 0.075 = 0.3

20. (b) More than theoretical weight since impurity will not contribute.

21. (a) Mass ratio of H : C = 1 : 12

However, given mass ratio of H : C = 1 : 3

Therefore, for every C atom, there are 4 H atoms, hence empirical formula = CH_4

22. (a) $V.D_{max}$ =

$X_{NO_2}\,(V.D)_{NO_2} + X_{N_2O_4}\,(V.D)_{N_2O_4}$

$27.6 = X \times 23 + (1-x) \times 46$

$\therefore\ X_{NO_2} = 0.8$

23. (b) Normality of oxalic acid

$= \frac{6.3\times1000}{63\times250} = 0.4\,N$

$N_1V_1 = N_2V_2$ $\quad 10 \times 0.4 = V \times 0.1 = 40$ ml.

24. (c) Meq of A = Meq of B.

0.1 M $KMnO_4$ = 0.5 N $KMnO_4$

∴ Meq of $KMnO_4$ = 20 × 0.5 = 10 (n factor = 5)

Meq of 50 ml of 0.1 M $H_2C_2O_4$ = 50 × 0.2 = 10

(0.1 M $H_2C_2O_4$ = 0.2 N $H_2C_2O_4$)

25. (a) Normality of 10V of H_2O_2

$\frac{68\times10}{22.4} = 17\times N \quad \therefore N = 1.78$

26. (c)

	No. of molecules
Moles of $CO_2 = \frac{44}{44} = 1$	N_A
Moles of $O_3 = \frac{48}{48} = 1$	N_A
Moles of $H_2 = \frac{8}{2} = 4$	$4N_A$
Moles of $SO_2 = \frac{64}{64} = 1$	N_A

27. (b) The atomic weight of sulphur =32

In SCl_2 valency of sulphur = 2

So equivalent mass of sulphur = $\frac{32}{2} = 16$

28. **(a)** Mass of 6.023×10^{23} atoms of oxygen = 16 g
Mass of one atom of oxygen

$$= \frac{16}{6.023 \times 10^{23}} = 2.66 \times 10^{-23} g$$

Mass of 6.023×10^{23} atoms of nitrogen = 14 g
Mass of one atom of nitrogen

$$= \frac{14}{6.023 \times 10^{23}} = 2.32 \times 10^{-23} g$$

Mass of 1×10^{-10} mole of oxygen = 16×10^{-10}
Mass of 1 mole of copper = 63 g
Mass of 1 mole of oxygen = 16 g
Mass of 1×10^{-10} mole of copper

$$= 63 \times 1 \times 10^{-10}$$
$$= 63 \times 10^{-10}$$

So, the order of increasing mass is
II < I < III < IV.

29. **(b)** Given $N_1 = 10N$, $V_1 = 10$ ml, $N_2 = 0.1N$, $V_2 = ?$

$$N_1V_1 = N_2V_2$$

or $10 \times 10 = 0.1 \times V_2$

or $V_2 = \frac{10 \times 10}{0.1}$, $V_2 = 1000$ ml

Volume of water to be added

$$= V_2 - V_1 = 1000 - 10 = 990 \text{ ml.}$$

Type B : Assertion Reason Questions

30. **(d)** Atoms can be created and can be destroyed. At N.T.P., number of molecules or atoms contained in same volume remains equal.

31. **(c)** Yes, Eq. wt of a base = $\frac{\text{Molecular weight}}{\text{Acidity}}$

Thus, assertion is correct.
Acidity is the number of replacable –OH groups (not hydrogen atoms) present in a molecule . Thus, reason is false.

32. **(a)** Molality = $\frac{\text{No.of moles of solute}}{\text{Wt of solvent in kg.}}$

Here, No. of moles = $\frac{\text{Molecular mass}}{\text{Wt of solvent}}$

$$= \frac{180}{180} = 1$$

$\therefore$ Molality = $\frac{1}{1} = 1$

Hence assertion and reason, both are correct, and reason is the correct explanation of assertion.

33. **(c)** Assertion is true, reason is false.

Eq. wt. of $H_3PO_3 = \frac{\text{mol.wt}}{2}$ [$\because$ Basicity of $H_3PO_3 = 2$]

34. **(c)** Equal moles of different substances contain same number of constituent particles but equal weights of different substances do not contain the same number of consituent particles.