



7 Match the Following

39. Match List I with List II [Main April 10, 2023 (II)]

List I

- (A) 16g of CH₄(g)
 (B) 1g of H₂(g)
 (C) 1 mole of N₂(g)
 (D) 0.5 mol of SO₂(g)

List II

- (I) Weighs 28g
 (II) 60.2 × 10²³ electrons
 (III) Weighs 32g
 (IV) Occupies 11.4 L volume at STP

Choose the correct answer from the options given below:

- (a) A-I, B-III, C-II, D-IV (b) A-II, B-III, C-IV, D-I
 (c) A-II, B-IV, C-III, D-I (d) A-II, B-IV, C-I, D-III



10 Subjective Problems

40. A plant virus is found to consist of uniform cylindrical particles of 150 Å in diameter and 5000 Å long. The specific volume of the virus is 0.75 cm³/g. If the virus is considered to be a single particle, find its molar mass. [1999 - 3 Marks]
41. Find [1980]
- (i) The total number of neutrons and
 (ii) The total mass of neutron in 7 mg of ¹⁴C.
 (Assume that mass of neutron = mass of hydrogen atom)





Topic-2: Stoichiometry, Equivalent Concept, Neutralization and Redox Titration



1 MCQs with One Correct Answer

1. What is the mass ratio of ethylene glycol (C₂H₆O₂, molar mass = 62 g/mol) required for making 500 g of 0.25 molal aqueous solution and 250 mL of 0.25 molar aqueous solution? [Main Jan. 25, 2023 (II)]
 (a) 1 : 1 (b) 3 : 1 (c) 2 : 1 (d) 1 : 2
2. C(s) + O₂(g) → CO₂(g) + 400 kJ
 C(s) + $\frac{1}{2}$ O₂(g) → CO(g) + 100 kJ
 [Main July 29, 2022 (II)]
 When coal of purity 60% is allowed to burn in presence of insufficient oxygen, 60% of carbon is converted into 'CO' and the remaining is converted into 'CO₂'.
 The heat generated when 0.6 kg of coal is burnt is _____.
 (a) 1600 kJ (b) 3200 kJ
 (c) 4400 kJ (d) 6600 kJ
3. 250 g solution of D-glucose in water contains 10.8% of carbon by weight. The molality of the solution is nearest to
 (Given: Atomic Weights are H, 1u ; C, 12u ; O, 16u)
 [Main July 27, 2022 (I)]
 (a) 1.03 (b) 2.06 (c) 3.09 (d) 5.40
4. SO₂Cl₂ on reaction with excess of water results into acidic mixture
 SO₂Cl₂ + 2H₂O → H₂SO₄ + 2HCl
 16 moles of NaOH is required for the complete neutralisation of the resultant acidic mixture.
 The number of moles of SO₂Cl₂ used is:
 [Main July 25, 2022 (I)]
 (a) 16 (b) 8 (c) 4 (d) 2
5. Production of iron in blast furnace follows the following equation [Main June 29, 2022 (I)]
 Fe₃O₄(s) + 4CO(g) → 3Fe(l) + 4CO₂(g)
 when 4.640 kg of Fe₃O₄ and 2.520 kg of CO are allowed to react then the amount of iron (in g) produced is :
 [Given : Molar Atomic mass (g mol⁻¹): Fe = 56
 Molar Atomic mass (g mol⁻¹) : O = 16
 Molar Atomic mass (g mol⁻¹): C = 12
 (a) 1400 (b) 2200
 (c) 3360 (d) 4200
6. A commercially sold conc. HCl is 35% HCl by mass. If the density of this commercial acid is 1.46 g/mL, the molarity of this solution is : [Main June 26, 2022 (I)]
 (Atomic mass : Cl = 35.5 amu, H = 1 amu)
 (a) 10.2 M (b) 12.5 M (c) 14.0 M (d) 18.2 M
7. If a rocket runs on a fuel (C₁₅H₃₀) and liquid oxygen, the weight of oxygen required and CO₂ released for every litre of fuel respectively are: [Main June 24, 2022 (I)]
 (Given: density of the fuel is 0.756 g/mL)
 (a) 1188 g and 1296 g (b) 2376 g and 2592 g
 (c) 2592g and 2376 g (d) 3429 g and 3142 g
8. Complete combustion of 1.80 g of an oxygen containing compound (C_xH_yO_z) gave 2.64 g of CO₂ and 1.08 g of H₂O. The percentage of oxygen in the organic compound is:
 [Main Feb. 25, 2021 (I)]
 (a) 50.33 (b) 53.33
 (c) 51.63 (d) 63.53
9. The ammonia (NH₃) released on quantitative reaction of 0.6 g urea (NH₂CONH₂) with sodium hydroxide (NaOH) can be neutralized by: [Main Jan. 07, 2020 (II)]
 (a) 200 mL of 0.4 N HCl (b) 200 mL of 0.2 N HCl
 (c) 100 mL of 0.2 N HCl (d) 100 mL of 0.1 N HCl
10. The minimum amount of O₂(g) consumed per gram of reactant is for the reaction : (Given atomic mass : Fe = 56, O = 16, Mg = 24, P = 31, C = 12, H = 1)
 [Main April 10, 2019 (II)]
 (a) 4 Fe(s) + 3 O₂(g) → 2 Fe₂O₃(s)
 (b) P₄(s) + 5 O₂(g) → P₄O₁₀(s)
 (c) C₃H₈(g) + 5 O₂(g) → 3 CO₂(g) + 4 H₂O(l)
 (d) 2 Mg(s) + O₂(g) → 2 MgO(s)

11. A sample of NaClO_3 is converted by heat to NaCl with a loss of 0.16 g of oxygen. The residue is dissolved in water and precipitated as AgCl . The mass of AgCl (in g) obtained will be: (Given: Molar mass of $\text{AgCl} = 143.5 \text{ g mol}^{-1}$)
[Main Online April 15, 2018 (I)]
 (a) 0.35 (b) 0.54 (c) 0.41 (d) 0.48
12. 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 :
[Main 2017]
 (a) 1186 (b) 84.3
 (c) 118.6 (d) 11.86
13. Excess of NaOH (aq) was added to 100 mL of FeCl_3 (aq) resulting into 2.14 g of $\text{Fe}(\text{OH})_3$. The molarity of FeCl_3 (aq) is :
[Main Online April 8, 2017]
 (Given molar mass of $\text{Fe} = 56 \text{ g mol}^{-1}$ and molar mass of $\text{Cl} = 35.5 \text{ g mol}^{-1}$)
 (a) 0.2 M (b) 0.3 M (c) 0.6 M (d) 1.8 M
14. The volume of 0.1 N dibasic acid sufficient to neutralize 1 g of a base that furnishes 0.04 mole of OH^- in aqueous solution is :
[Main Online April 10, 2016]
 (a) 400 mL (b) 600 mL
 (c) 200 mL (d) 800 mL
15. 5 L of an alkane requires 25 L of oxygen for its complete combustion. If all volumes are measured at constant temperature and pressure, the alkane is :
[Main Online April 9, 2016; Similar Online April 25, 2013]
 (a) Isobutane (b) Ethane
 (c) Butane (d) Propane
16. 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:
[Main 2016]
 (a) C_4H_8 (b) C_4H_{10} (c) C_3H_6 (d) C_3H_8
17. The molecular formula of a commercial resin used for exchanging ions in water softening is $\text{C}_8\text{H}_7\text{SO}_3^- \text{Na}^+$ (Mol. wt. 206). What would be the maximum uptake of Ca^{2+} ions by the resin when expressed in mole per gram resin ?
[Main 2015]
 (a) $\frac{2}{309}$ (b) $\frac{1}{412}$ (c) $\frac{1}{103}$ (d) $\frac{1}{206}$
18. A sample of a hydrate of barium chloride weighing 61 g was heated until all the water of hydration is removed. The dried sample weighed 52 g. The formula of the hydrated salt is : (atomic mass, $\text{Ba} = 137 \text{ amu}$, $\text{Cl} = 35.5 \text{ amu}$)
[Main Online April 10, 2015]
 (a) $\text{BaCl}_2 \cdot 4\text{H}_2\text{O}$ (b) $\text{BaCl}_2 \cdot 3\text{H}_2\text{O}$
 (c) $\text{BaCl}_2 \cdot \text{H}_2\text{O}$ (d) $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
19. $\text{A} + 2\text{B} + 3\text{C} \rightleftharpoons \text{AB}_2\text{C}_3$
 Reaction of 6.0 g of A, 6.0×10^{23} atoms of B, and 0.036 mol of C yields 4.8 g of compound AB_2C_3 . If the atomic mass of A and C are 60 and 80 amu, respectively, the atomic mass of B is (Avogadro no. = 6×10^{23}):
[Main Online April 11, 2015]
 (a) 50 amu (b) 60 amu
 (c) 70 amu (d) 40 amu
20. Dissolving 120 g of a compound of mol. wt. 60 in 1000 g of water gave a solution of density 1.12 g/mL. The molarity of the solution is:
[Main Online April 9, 2014]
 (a) 1.00 M (b) 2.00 M
 (c) 2.50 M (d) 4.00 M
21. The amount of BaSO_4 formed upon mixing 100 mL of 20.8% BaCl_2 solution with 50 mL of 9.8% H_2SO_4 solution will be:
[Main Online April 12, 2014]
 ($\text{Ba} = 137$, $\text{Cl} = 35.5$, $\text{S} = 32$, $\text{H} = 1$ and $\text{O} = 16$)
 (a) 23.3 g (b) 11.65 g
 (c) 30.6 g (d) 33.2 g
22. 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 :
[Main 2013]
 (a) C_2H_4 (b) C_3H_4 (c) C_6H_5 (d) C_7H_8
23. Mixture X = 0.02 mol of $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ and 0.02 mol of $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ was prepared in 2 litre of solution.
[2003S]
 1 litre of mixture X + excess $\text{AgNO}_3 \longrightarrow \text{Y}$.
 1 litre of mixture X + excess $\text{BaCl}_2 \longrightarrow \text{Z}$
 No. of moles of Y and Z are
 (a) 0.01, 0.01 (b) 0.02, 0.01
 (c) 0.01, 0.02 (d) 0.02, 0.02
24. An aqueous solution of 6.3 g oxalic acid dihydrate is made up to 250 mL. The volume of 0.1 N NaOH required to completely neutralize 10 mL of this solution is **[2001S]**
 (a) 40 mL (b) 20 mL
 (c) 10 mL (d) 4 mL
25. In the standardization of $\text{Na}_2\text{S}_2\text{O}_3$ using $\text{K}_2\text{Cr}_2\text{O}_7$ by iodometry, the equivalent weight of $\text{K}_2\text{Cr}_2\text{O}_7$ is **[2001S]**
 (a) (molecular weight)/2 (b) (molecular weight)/6
 (c) (molecular weight)/3 (d) same as molecular weight
26. The normality of 0.3 M phosphorous acid (H_3PO_3) is,
[1999 - 2 Marks]
 (a) 0.1 (b) 0.9 (c) 0.3 (d) 0.6
27. The equivalent weight of MnSO_4 is half of its molecular weight when it is converted to : **[1988 - 1 Mark]**
 (a) Mn_2O_3 (b) MnO_2
 (c) MnO_4^- (d) MnO_4^{2-}
28. In which mode of expression, the concentration of a solution remains independent of temperature?
[1988 - 1 Mark]
 (a) Molarity (b) Normality
 (c) Formality (d) Molality
29. A molal solution is one that contains one mole of a solute in:
[1986 - 1 Mark]
 (a) 1000 g of the solvent
 (b) one litre of the solvent
 (c) one litre of the solution
 (d) 22.4 litres of the solution

30. If 0.50 mole of BaCl_2 is mixed with 0.20 mol of Na_3PO_4 , the maximum number of moles of $\text{Ba}_3(\text{PO}_4)_2$ that can be formed is [1981 - 1 Mark]
(a) 0.70 (b) 0.50 (c) 0.20 (d) 0.10
31. M is molecular weight of KMnO_4 . The equivalent weight of KMnO_4 when it is converted into K_2MnO_4 is [1980]
(a) M (b) $M/3$ (c) $M/5$ (d) $M/7$
32. 2.76 g of silver carbonate on being strongly heated yields a residue weighing [1979]
(a) 2.16 g (b) 2.48 g (c) 2.32 g (d) 2.64 g
33. 27 g of Al will react completely with how many grams of oxygen? [1978]
(a) 8 g (b) 16 g (c) 32 g (d) 24 g
-  **2 Integer Value Answer**
34. The stoichiometric reaction of 516 g of dimethyldichlorosilane with water results in a tetrameric cyclic product X in 75% yield. The weight (in g) of X obtained is _____. [Adv. 2023]
[Use, molar mass (g mol^{-1}): H = 1, C = 12, O = 16, Si = 28, Cl = 35.5]
35. H_2S (5 moles) reacts completely with acidified aqueous potassium permanganate solution. In this reaction, the number of moles of water produced is x , and the number of moles of electrons involved is y . The value of $(x + y)$ is _____. [Adv. 2023]
-  **3 Numeric / New Stem Based Questions**
36. 1 g of a carbonate (M_2CO_3) on treatment with excess HCl produces 0.01 mol of CO_2 . The molar mass of M_2CO_3 is _____ g mol^{-1} . (Nearest integer) [Main April 13, 2023 (II)]
37. The volume of hydrogen liberated at STP by treating 2.4 g magnesium with excess of hydrochloric acid is _____ $\times 10^{-2}$ L. Given: Molar volume of gas is 22.4 L at STP. Molar mass of magnesium is 24 g mol^{-1} . [Main April 11, 2023 (II)]
38. A solution of sugar is obtained by mixing 200 g of its 25% solution and 500 g of its 40% solution (both by mass). The mass percentage of the resulting sugar solution is _____. (Nearest integer) [Main April 11, 2023 (I)]
39. 0.5 g of an organic compound (X) with 60% carbon will produce _____ $\times 10^{-1}$ g of CO_2 on complete combustion. [Main April 08, 2023 (I)]
40. If 5 moles of BaCl_2 is mixed with 2 moles of Na_3PO_4 , the maximum number of moles of $\text{Ba}_3(\text{PO}_4)_2$ formed is..... (Nearest integer) [Main April 06, 2023 (I)]
41. On complete combustion, 0.492 g of an organic compound gave 0.792 g of CO_2 . The % of carbon in the organic compound is _____ (Nearest integer) [Main Jan. 31, 2023 (I)]
42. Zinc reacts with hydrochloric acid to give hydrogen and zinc chloride. The volume of hydrogen gas produced at STP from the reaction of 1.5 g of zinc with excess HCl is _____ L (Nearest integer) (Given : Molar mass of Zn is 65.4 g mol^{-1} and Molar volume of H_2 at STP = 22.7 L) [Main Jan. 31, 2023 (I)]
43. Assume carbon burns according to following equation : $2\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}(\text{g})$
When 12 g carbon is burnt in 48 g of oxygen, the volume of carbon monoxide produced is _____ $\times 10^{-1}$ L at STP [nearest integer]
[Given : Assume CO as ideal gas, Mass of C is 12 g mol^{-1} , Mass of O is 16 g mol^{-1} and molar volume of an ideal gas at STP is 22.7 L mol^{-1}] [Main Jan. 31, 2023 (II)]
44. A 300 mL bottle of soft drink has 0.2 M CO_2 dissolved in it. Assuming CO_2 behaves as an ideal gas, the volume of the dissolved CO_2 at STP is _____ mL. (Nearest integer) Given: At STP, molar volume of an ideal gas is 22.7 L mol^{-1} . [Main Jan. 30, 2023 (I)]
45. The strength of 50 volume solution of hydrogen peroxide is _____ g/L (Nearest integer). Given: Molar mass of H_2O_2 is 34 g mol^{-1} Molar volume of gas at STP = 22.7 L. [Main Jan. 30, 2023 (II)]
46. When 0.01 mol of an organic compound containing 60% carbon was burnt completely, 4.4 g of CO_2 was produced. The molar mass of compound is _____ g mol^{-1} (Nearest integer) [Main Jan. 29, 2023 (II)]
47. The volume of HCl, containing 73 g L^{-1} , required to completely neutralise NaOH obtained by reacting 0.69 g of metallic sodium with water, is _____ mL. (Nearest Integer) (Given : molar Masses of Na, Cl, O, H are 23, 35.5, 16 and 1 g mol^{-1} respectively) [Main Jan. 29, 2023 (II)]
48. When $\text{Fe}_{0.93}\text{O}$ is heated in presence of oxygen, it converts to Fe_2O_3 . The number of correct statement/s from the following is _____. [Main Jan. 24, 2023 (I)]
- The equivalent weight of $\text{Fe}_{0.93}\text{O}$ is $\frac{\text{Molecular weight}}{0.79}$
 - The number of moles of Fe^{2+} and Fe^{3+} in 1 mole of $\text{Fe}_{0.93}\text{O}$ is 0.79 and 0.14 respectively.
 - $\text{Fe}_{0.93}\text{O}$ is metal deficient with lattice comprising of cubic closed packed arrangement of O^{2-} ions.
 - The % composition of Fe^{2+} and Fe^{3+} in $\text{Fe}_{0.93}\text{O}$ is 85% and 15% respectively.
49. On complete combustion of 0.492 g of an organic compound containing C, H and O, 0.7938 g of CO_2 and 0.4428 g of H_2O was produced. The % composition of oxygen in the compound is _____. [Main July 28, 2022 (I)]
50. In the given reaction,
 $\text{X} + \text{Y} + 3\text{Z} \rightleftharpoons \text{XYZ}_3$
if one mole of each of X and Y with 0.05 mol of Z gives compound XYZ_3 . (Given : Atomic masses of X, Y and Z are 10, 20 and 30 amu, respectively). The yield of XYZ_3 is _____ g. (Nearest integer) [Main July 28, 2022 (I)]

51. 56.0 L of nitrogen gas is mixed with excess of hydrogen gas and it is found that 20 L of ammonia gas is produced. The volume of unused nitrogen gas is found to be ____ L.
[Main July 25, 2022 (II)]
52. Blister copper is produced by reaction of copper oxide with copper sulphide.
 $2\text{Cu}_2\text{O} + \text{Cu}_2\text{S} \rightarrow 6\text{Cu} + \text{SO}_2$
 When 2.86×10^3 g of Cu_2O and 4.77×10^3 g of Cu_2S are used for reaction, the mass of copper produced is ____ g. (nearest integer)
 (Atomic mass of Cu = 63.5 a.m. u)
 S = 32.0 a.m. u
 O = 16.0 a.m. u
 [Main June 30, 2022 (I)]
53. The neutralization occurs when 10 mL of 0.1 M acid 'A' is allowed to react with 30 mL of 0.05 M base $\text{M}(\text{OH})_2$. The basicity of the acid 'A' is _____. [M is a metal]
[Main June 25, 2022 (II)]
54. Number of grams of bromine that will completely react with 5.0 g of pent-1-ene is _____ $\times 10^{-2}$ g. (Atomic mass of Br = 80 g/mol) (Nearest Integer)
[Main June 25, 2022 (I)]
55. 1 L aqueous solution of H_2SO_4 contains 0.02 m mol H_2SO_4 . 50% of this solution is diluted with deionized water to give 1 L solution (A). In solution (A), 0.01 m mol of H_2SO_4 are added. Total m mols of H_2SO_4 in the final solution is _____ $\times 10^3$ m mols.
[Main June 25, 2022 (I)]
56. Sodium oxide reacts with water to produce sodium hydroxide. 20.0 g of sodium oxide is dissolved in 500 mL of water. Neglecting the change in volume, the concentration of the resulting NaOH solution is _____ $\times 10^{-1}$ M. (Nearest integer)
 [Atomic mass : Na = 23.0, O = 16.0, H = 1.0]
 [Main Aug. 31, 2021 (II)]
57. When 10 mL of an aqueous solution of Fe^{2+} ions was titrated in the presence of dil H_2SO_4 using diphenylamine indicator, 15 mL of 0.02 M solution of $\text{K}_2\text{Cr}_2\text{O}_7$ was required to get the end point. The molarity of the solution containing Fe^{2+} ions is $x \times 10^{-2}$ M. The value of x is _____. (Nearest integer)
[Main July 25, 2021 (I); Similar March 17, 2021 (I)]
58. If the concentration of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) in blood is 0.72 g L^{-1} , the molarity of glucose in blood is _____ $\times 10^{-3}$ M. (Nearest integer)
 [Given : Atomic mass of C = 12, H = 1, O = 16 u]
 [Main July 22, 2021 (II)]
59. When 35 mL of 0.15 M lead nitrate solution is mixed with 20 mL of 0.12 M chromic sulphate solution, _____ $\times 10^{-5}$ moles of lead sulphate precipitate out. (Round off to the Nearest Integer).
[Main March 16, 2021 (II)]
60. The NaNO_3 weighed out to make 50 mL of an aqueous solution containing 70.0 mg Na^+ per mL is _____. (Rounded off to the nearest integer)
[Main Feb. 26, 2021 (II)]
 [Given : Atomic weight in g mol^{-1} - Na : 23; N : 14; O : 16]
61. 4.5 g of compound A (MW = 90) was used to make 250 mL of its aqueous solution. The molarity of the solution is $x \times 10^{-1}$. The value of x is _____ (Rounded off to the nearest integer)
[Main Feb. 24, 2021 (I)]
62. The volume, in mL, of 0.02 M $\text{K}_2\text{Cr}_2\text{O}_7$ solution required to react with 0.288 g of ferrous oxalate in acidic medium is _____. (Molar mass of Fe = 56 g mol^{-1})
[Main Sep. 05, 2020 (II)]
63. The mass of ammonia in grams produced when 2.8 kg of dinitrogen quantitatively reacts with 1 kg of dihydrogen is _____.
[Main Sep. 04, 2020 (I)]
64. The mole fraction of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) in an aqueous binary solution is 0.1. The mass percentage of water in it, to the nearest integer, is _____. [Main Sep. 03, 2020 (I)]
65. 10.30 mg of O_2 is dissolved into a liter of sea water of density 1.03 g/mL . The concentration of O_2 in ppm is _____.
[Main Jan. 09, 2020 (II)]
66. NaClO_3 is used, even in spacecrafts, to produce O_2 . The daily consumption of pure O_2 by a person is 492 L at 1 atm, 300 K. How much amount of NaClO_3 , in grams, is required to produce O_2 for the daily consumption of a person at 1 atm, 300 K?
 $\text{NaClO}_3(\text{s}) + \text{Fe}(\text{s}) \rightarrow \text{O}_2(\text{g}) + \text{NaCl}(\text{s}) + \text{FeO}(\text{s})$
 $R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$
 [Main Jan. 08, 2020 (II)]
67. The molarity of HNO_3 in a sample which has density 1.4 g/mL and mass percentage of 63% is _____. (Molecular Weight of $\text{HNO}_3 = 63$)
[Main Jan. 09, 2020 (I)]
- Question Stem for Question Nos. 68 and 69**
 A sample (5.6 g) containing iron is completely dissolved in cold dilute HCl to prepare a 250 mL of solution. Titration of 25.0 mL of this solution requires 12.5 mL of 0.03 M KMnO_4 solution to reach the end point. Number of moles of Fe^{2+} present in 250 mL solution is $x \times 10^{-2}$ (consider complete dissolution of FeCl_2). The amount of iron present in the sample of y% by weight. (Assume : KMnO_4 reacts only with Fe^{2+} in the solution)
 Use : Molar mass of iron as 56 g mol^{-1})
68. The value of x is _____. [Adv. 2021]
69. The value of y is _____. [Adv. 2021]
70. The ammonia prepared by treating ammonium sulphate with calcium hydroxide is completely used by $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ to form a stable coordination compound. Assume that both the reactions are 100% complete. If 1584 g of ammonium sulphate and 952 g of $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ are used in the preparation, the combined weight (in grams) of gypsum and the nickel-ammonia coordination compound thus produced is _____.
 (Atomic weights in g mol^{-1} : H = 1, N = 14, O = 16, S = 32, Cl = 35.5, Ca = 40, Ni = 59)
[Adv. 2018]
71. Galena (an ore) is partially oxidized by passing air through it at high temperature. After some time, the passage of air is stopped, but the heating is continued in a closed furnace such that the contents undergo self-reduction. The weight (in kg) of Pb produced per kg of O_2 consumed is _____. (Atomic weights in g mol^{-1} : O = 16, S = 32, Pb = 207)
[Adv. 2018]

72. How many millilitres of 0.5 M H_2SO_4 are needed to dissolve 0.5 g of copper(II) carbonate? [1999 - 3 Marks]
73. One gram of commercial AgNO_3 is dissolved in 50 mL of water. It is treated with 50 mL of a KI solution. The silver iodide thus precipitated is filtered off. Excess of KI in the filtrate is titrated with (M/10) KIO_3 solution in presence of 6M HCl till all I^- ions are converted into ICl . It requires 50 mL of (M/10) KIO_3 solution. 20 mL of the same stock solution of KI requires 30 mL of (M/10) KIO_3 under similar conditions. Calculate the percentage of AgNO_3 in the sample. (Reaction : $\text{KIO}_3 + 2\text{KI} + 6\text{HCl} \rightarrow 3\text{ICl} + 3\text{KCl} + 3\text{H}_2\text{O}$) [1992 - 4 Marks]
74. A 1.0 g sample of Fe_2O_3 solid of 55.2% purity is dissolved in acid and reduced by heating the solution with zinc dust. The resultant solution is cooled and made upto 100.0 mL. An aliquot of 25.0 mL of this solution requires 17.0 mL of 0.0167 M solution of an oxidant for titration. Calculate the number of electrons taken up by the oxidant in the reaction of the above titration. [1991 - 4 Marks]
75. Calculate the molality of 1 litre solution of 93% H_2SO_4 (weight/volume). The density of the solution is 1.84 g/mL. [1990 - 1 Marks]
76. A sample of hydrazine sulphate ($\text{N}_2\text{H}_6\text{SO}_4$) was dissolved in 100 mL of water, 10 mL of this solution was reacted with excess of ferric chloride solution and warmed to complete the reaction. Ferrous ion formed was estimated and it required 20 mL of M/50 potassium permanganate solution. Estimate the amount of hydrazine sulphate in one litre of the solution. [1988 - 3 Marks]
- Reaction :
 $4\text{Fe}^{3+} + \text{N}_2\text{H}_4 \rightarrow \text{N}_2 + 4\text{Fe}^{2+} + 4\text{H}^+$
 $\text{MnO}_4^- + 5\text{Fe}^{2+} + 8\text{H}^+ \rightarrow \text{Mn}^{2+} + 5\text{Fe}^{3+} + 4\text{H}_2\text{O}$
77. Hydroxylamine reduces iron (III) according to the equation:
 $2\text{NH}_2\text{OH} + 4\text{Fe}^{3+} \rightarrow \text{N}_2\text{O}(\text{g}) \uparrow + \text{H}_2\text{O} + 4\text{Fe}^{2+} + 4\text{H}^+$
 Iron (II) thus produced is estimated by titration with a standard permanganate solution. The reaction is :
 $\text{MnO}_4^- + 5\text{Fe}^{2+} + 8\text{H}^+ \rightarrow \text{Mn}^{2+} + 5\text{Fe}^{3+} + 4\text{H}_2\text{O}$
 A 10 mL sample of hydroxylamine solution was diluted to 1 litre. 50 mL of this diluted solution was boiled with an excess of iron (III) solution. The resulting solution required 12 mL of 0.02 M KMnO_4 solution for complete oxidation of iron (II). Calculate the weight of hydroxylamine in one litre of the original solution. (H = 1, N = 14, O = 16, K = 39, Mn = 55, Fe = 56) [1982 - 4 Marks]
78. A 1.00 g sample of H_2O_2 solution containing X per cent H_2O_2 by weight requires X mL of a KMnO_4 solution for complete oxidation under acidic conditions. Calculate the normality of the KMnO_4 solution. [1981 - 3 Marks]
79. 4.215 g of a metallic carbonate was heated in a hard glass tube and the CO_2 evolved was found to measure 1336 mL at 27°C and 700 mm pressure. What is the equivalent weight of the metal? [1979]
80. What weight of AgCl will be precipitated when a solution containing 4.77 g of NaCl is added to a solution of 5.77 g of AgNO_3 ? [1978]
81. Igniting MnO_2 converts it quantitatively to Mn_3O_4 . A sample of pyrolusite is of the following composition : MnO_2 80%, SiO_2 and other inert constituents 15%, rest being water. The sample is ignited in air to constant weight. What is the percentage of Mn in the ignited sample? [1978]
 [O = 16, Mn = 54.9]



9 Assertion and Reason / Statement Type Questions

Each Question contains Assertion and Reason statements. In the light of the given statements in the question choose the correct answer from the options given below.

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

82. **Assertion :** In the titration of Na_2CO_3 with HCl using methyl orange indicator, the volume required at the equivalence point is twice that of the acid required using phenolphthalein indicator.

Reason : Two moles of HCl are required for the complete neutralization of one mole of Na_2CO_3 . [1991 - 2 Marks]



10 Subjective Problems

83. Calculate the molarity of water if its density is 1000 kg/m^3 . [2003 - 2 Marks]
84. Hydrogen peroxide solution (20 mL) reacts quantitatively with a solution of KMnO_4 (20 mL) acidified with dilute H_2SO_4 . The same volume of the KMnO_4 solution is just decolourised by 10 mL of MnSO_4 in neutral medium simultaneously forming a dark brown precipitate of hydrated MnO_2 . The brown precipitate is dissolved in 10 mL of 0.2 M sodium oxalate under boiling condition in the presence of dilute H_2SO_4 . Write the balanced equations involved in the reactions and calculate the molarity of H_2O_2 . [2001 - 5 Marks]
85. An aqueous solution containing 0.10 g KIO_3 (formula weight = 214.0) was treated with an excess of KI solution. The solution was acidified with HCl. The liberated I_2 consumed 45.0 mL of thiosulphate solution to decolourise the blue starch-iodine complex. Calculate the molarity of the sodium thiosulphate solution. [1998 - 5 Marks]
86. A 3.00 g sample containing Fe_3O_4 , Fe_2O_3 and an inert impure substance, is treated with excess of KI solution in presence of dilute H_2SO_4 . The entire iron is converted into Fe^{2+} along with the liberation of iodine. The resulting solution is diluted to 100 mL. A 20 mL of the diluted solution requires 11.0 mL of 0.5 M $\text{Na}_2\text{S}_2\text{O}_3$ solution to reduce the iodine present. A 50 mL of the diluted solution, after complete extraction of the iodine requires 12.80 mL of 0.25 M KMnO_4 solution in dilute H_2SO_4 medium for the oxidation of Fe^{2+} . Calculate the percentages of Fe_2O_3 and Fe_3O_4 in the original sample. [1996 - 5 Marks]
87. 8.0575×10^{-2} kg of Glauber's salt is dissolved in water to obtain 1 dm^3 of a solution of density 1077.2 kg m^{-3} . Calculate the molarity, molality and mole fraction of Na_2SO_4 in the solution. [1994 - 3 Marks]

88. Upon mixing 45.0 mL of 0.25 M lead nitrate solution with 25.0 mL of 0.10 M chromic sulphate solution, precipitation of lead sulphate takes place. How many moles of lead sulphate are formed? Also, calculate the molar concentrations of the species left behind in the final solution. Assume that lead sulphate is completely insoluble. [1993 - 3 Marks]
89. A 2.0 g sample of a mixture containing sodium carbonate, sodium bicarbonate and sodium sulphate is gently heated till the evolution of CO_2 ceases. The volume of CO_2 at 750 mm Hg pressure and at 298 K is measured to be 123.9 mL. A 1.5 g of the same sample requires 150 mL of (M/10) HCl for complete neutralisation. Calculate the % composition of the components of the mixture. [1992 - 5 Marks]
90. A solution of 0.2 g of a compound containing Cu^{2+} and $\text{C}_2\text{O}_4^{2-}$ ions on titration with 0.02 M KMnO_4 in presence of H_2SO_4 consumes 22.6 mL of the oxidant. The resultant solution is neutralized with Na_2CO_3 , acidified with dil. acetic acid and treated with excess KI. The liberated iodine requires 11.3 mL of 0.05 M $\text{Na}_2\text{S}_2\text{O}_3$ solution for complete reduction. Find out the molar ratio of Cu^{2+} to $\text{C}_2\text{O}_4^{2-}$ in the compound. Write down the balanced redox reactions involved in the above titrations. [1991 - 5 Marks]
91. A mixture of $\text{H}_2\text{C}_2\text{O}_4$ (oxalic acid) and NaHC_2O_4 weighing 2.02 g was dissolved in water and solution made upto one litre. Ten millilitres of the solution required 3.0 mL of 0.1 N sodium hydroxide solution for complete neutralization. In another experiment, 10.0 mL of the same solution, in hot dilute sulphuric acid medium, require 4.0 mL of 0.1 N potassium permanganate solution for complete reaction. Calculate the amount of $\text{H}_2\text{C}_2\text{O}_4$ and NaHC_2O_4 in the mixture. [1990 - 5 Marks]
92. A solid mixture (5.0 g) consisting of lead nitrate and sodium nitrate was heated below 600 °C until the weight of the residue was constant. If the loss in weight is 28.0 per cent, find the amount of lead nitrate and sodium nitrate in the mixture. [1990 - 4 Marks]
93. An equal volume of a reducing agent is titrated separately with 1M KMnO_4 in acid neutral and alkaline media. The volumes of KMnO_4 required are 20 mL in acid, 33.4 mL in neutral and 100 mL in alkaline media. Find out the oxidation state of manganese in each reduction product. Give the balanced equations for all the three half reactions. Find out the volume of 1M $\text{K}_2\text{Cr}_2\text{O}_7$ consumed; if the same volume of the reducing agent is titrated in acid medium. [1989 - 5 Marks]
94. A sugar syrup of weight 214.2 g contains 34.2 g of sugar ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$). Calculate: (i) molal concentration and (ii) mole fraction of sugar in the syrup. [1988 - 2 Marks]
95. (i) What is the weight of sodium bromate and molarity of solution necessary to prepare 85.5 mL of 0.672 N solution when the half-cell reaction is
- $$\text{BrO}_3^- + 6\text{H}^+ + 6\text{e}^- \rightarrow \text{Br}^- + 3\text{H}_2\text{O}$$
- (ii) What would be the weight as well as molarity if the half-cell reaction is:
- $$2\text{BrO}_3^- + 12\text{H}^+ + 10\text{e}^- \rightarrow \text{Br}_2 + 6\text{H}_2\text{O}$$
- [1987 - 5 Marks]
96. Five mL of 8N nitric acid, 4.8 mL of 5N hydrochloric acid and a certain volume of 17M sulphuric acid are mixed together and made upto 2litre. Thirty mL of this acid mixture exactly neutralise 42.9 mL of sodium carbonate solution containing one gram of $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ in 100 mL of water. Calculate the amount in gram of the sulphate ions in solution. [1985 - 4 Marks]
97. 2.68×10^{-3} moles of a solution containing an ion A^{n+} require 1.61×10^{-3} moles of MnO_4^- for the oxidation of A^{n+} to $A\text{O}_3^-$ in acid medium. What is the value of n ? [1984 - 2 Marks]
98. The density of a 3 M sodium thiosulphate solution ($\text{Na}_2\text{S}_2\text{O}_3$) is 1.25 g per mL. Calculate (i) the percentage by weight of sodium thiosulphate, (ii) the mole fraction of sodium thiosulphate and (iii) the molalities of Na^+ and $\text{S}_2\text{O}_3^{2-}$ ions. [1983 - 5 Marks]
99. 4.08 g of a mixture of BaO and an unknown carbonate MCO_3 was heated strongly. The residue weighed 3.64 g. This was dissolved in 100 mL of 1 N HCl. The excess acid required 16 mL of 2.5 N NaOH solution for complete neutralization. Identify the metal M . [1983 - 4 Marks] (At. wt. H = 1, C = 12, O = 16, Cl = 35.5, Ba = 138)
100. 3 g of a salt of molecular weight 30 is dissolved in 250 g of water. The molality of the solution is [1983 - 1 Mark]
101. (i) A sample of $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ is strongly heated in air. The residue is Mn_3O_4 .
(ii) The residue is dissolved in 100 mL of 0.1 N FeSO_4 containing dilute H_2SO_4 .
(iii) The solution reacts completely with 50 mL of KMnO_4 solution.
(iv) 25 mL of the KMnO_4 solution used in step (iii) requires 30 mL of 0.1 N FeSO_4 solution for complete reaction. Find the amount of $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ present in the sample. [1980]
102. (a) One litre of a sample of hard water contains 1 mg of CaCl_2 and 1 mg of MgCl_2 . Find the total hardness in terms of parts of CaCO_3 per 10^6 parts of water by weight.
(b) A sample of hard water contains 20 mg of Ca^{++} ions per litre. How many milli-equivalent of Na_2CO_3 would be required to soften 1 litre of the sample?
(c) 1 g of Mg is burnt in a closed vessel which contains 0.5 g of O_2 .
(i) Which reactant is left in excess?
(ii) Find the weight of the excess reactants?
(iii) How many milliliters of 0.5 N H_2SO_4 will dissolve the residue in the vessel. [1980]

- 103.** A hydrocarbon contains 10.5 g of carbon per gram of hydrogen. 1 litre of the vapour of the hydrocarbon at 127 °C and 1 atmosphere pressure weighs 2.8 g. Find the molecular formula. [1980]
- 104.** A mixture contains NaCl and unknown chloride MCl.
- 1 g of this is dissolved in water. Excess of acidified AgNO₃ solution is added to it. 2.567 g of white ppt. is formed.
 - 1 g of original mixture is heated to 300 °C. Some vapours come out which are absorbed in acidified AgNO₃ solution, 1.341 g of white precipitate was obtained.
- Find the molecular weight of unknown chloride. [1980]
- 105.** 5 mL of a gas containing only carbon and hydrogen were mixed with an excess of oxygen (30 mL) and the mixture exploded by means of an electric spark. After the explosion, the volume of the mixed gases remaining was 25 mL. On adding a concentrated solution of potassium hydroxide, the volume further diminished to 15 mL of the residual gas being pure oxygen. All volumes have been reduced to N.T.P. Calculate the molecular formula of the hydrocarbon gas. [1979]
- 106.** A solution contains Na₂CO₃ and NaHCO₃. 10 mL of solution requires 2.5 mL of 0.1 M H₂SO₄ for neutralisation using phenolphthalein as an indicator. Methyl orange is then added when a further 2.5 mL of 0.2 M H₂SO₄ was required. Calculate the amount of Na₂CO₃ and NaHCO₃ in one litre of the solution. [1979]
- 107.** One gram of an alloy of aluminium and magnesium when treated with excess of dil. HCl forms magnesium chloride, aluminium chloride and hydrogen. The evolved hydrogen, collected over mercury at 0 °C has a volume of 1.20 litres at 0.92 atm. pressure. Calculate the composition of the alloy. [H = 1, Mg = 24, Al = 27] [1978]



Answer Key

Topic-1 : Measurement, Mole Concept and Percentage Composition

- | | | | | | | | | | |
|-----------|----------|-------------|----------|-------------|----------|-----------------------|--------------------------------|----------|----------|
| 1. (d) | 2. (c) | 3. (a) | 4. (c) | 5. (b) | 6. (d) | 7. (c) | 8. (d) | 9. (d) | 10. (d) |
| 11. (a) | 12. (d) | 13. (b) | 14. (a) | 15. (a) | 16. (c) | 17. (c) | 18. (56) | 19. (59) | 20. (12) |
| 21. (25) | 22. (25) | 23. (3) | 24. (46) | 25. (2) | 26. (18) | 27. (5418) | 28. (2) | 29. (3) | 30. (8) |
| 31. (5) | 32. (4) | 33. (15.05) | 34. (24) | 35. (4.14g) | | 36. (Carbon (C – 12)) | 37. (6.02 × 10 ²⁴) | | |
| 38. (b,c) | 39. (d) | | | | | | | | |

Topic-2 : Stoichiometry, Equivalent Concept, Neutralization and Redox Titration

- | | | | | | | | | | |
|-------------|------------|-------------|------------|-------------|------------|-------------|-------------|-------------|------------|
| 1. (c) | 2. (d) | 3. (b) | 4. (c) | 5. (c) | 6. (c) | 7. (c) | 8. (b) | 9. (c) | 10. (a) |
| 11. (d) | 12. (b) | 13. (a) | 14. (a) | 15. (d) | 16. (N) | 17. (b) | 18. (d) | 19. (a) | 20. (b) |
| 21. (b) | 22. (d) | 23. (a) | 24. (a) | 25. (b) | 26. (d) | 27. (b) | 28. (d) | 29. (a) | 30. (d) |
| 31. (a) | 32. (a) | 33. (d) | 34. (222) | 35. (18) | 36. (100) | 37. (224) | 38. (36) | 39. (11) | 40. (1) |
| 41. (44) | 42. (4) | 43. (227) | 44. (1362) | 45. (150) | 46. (200) | 47. (15) | 48. (4) | 49. (46) | 50. (2) |
| 51. (46) | 52. (3810) | 53. (3) | 54. (1143) | 55. (0) | 56. (13) | 57. (18) | 58. (4) | 59. (525) | 60. (13) |
| 61. (2) | 62. (50) | 63. (3400) | 64. (47) | 65. (10.00) | 66. (2130) | 67. (14.00) | 68. (1.875) | 69. (18.75) | 70. (2992) |
| 71. (6.47) | 72. (8.09) | 73. (85) | 74. (6.0) | 75. (10.43) | 76. (6.5) | 77. (39.6) | 78. (0.58) | 79. (12.15) | 80. (4.87) |
| 81. (59.33) | 82. (b) | 83. (55.55) | | | | | | | |