

- 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]
30. 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]
31. 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]
32. 8.0575×10^{-2} kg of Glauber's salt is dissolved in water to obtain 1 dm³ 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]
33. 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]
34. 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 1.5g 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]
35. 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]
36. 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]
37. 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]
38. 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]
39. 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]
40. (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]
41. 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]
42. 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 AO_3^- in acid medium. What is the value of n ? [1984 - 2 Marks]
43. 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]
44. 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)

45. (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]
46. A mixture contains NaCl and unknown chloride MCl .
 (i) 1 g of this is dissolved in water. Excess of acidified AgNO_3 solution is added to it. 2.567 g of white ppt. is formed.
 (ii) 1 g of original mixture is heated to 300°C . Some vapours come out which are absorbed in acidified AgNO_3 solution, 1.341 g of white precipitate was obtained.
 Find the molecular weight of unknown chloride. [1980]
47. 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]
48. 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. [$\text{H} = 1, \text{Mg} = 24, \text{Al} = 27$] [1978]



Answer Key

Topic-1 : Measurement, Mole Concept and Percentage Composition

1. (a) 2. (d) 3. (b) 4. (a) 5. (a) 6. (c) 7. (d) 8. (c) 9. (4) 10. (55.55)
 11. (15.05) 12. (24) 13. (4.14) 14. (Carbon (C-12)) 15. (6.02×10^{24}) 16. (b,c)

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

1. (a) 2. (a) 3. (b) 4. (d) 5. (b) 6. (d) 7. (a) 8. (d) 9. (a) 10. (a)
 11. (222) 12. (18) 13. (1.875) 14. (18.75) 15. (2992) 16. (6.47) 17. (8.09) 18. (85) 19. (6.0) 20. (10.43)
 21. (6.5) 22. (39.6) 23. (0.58) 24. (12.15) 25. (4.87) 26. (59.33) 27. (b)