2023

CHEMISTRY

(Theory)

Full Marks : 70

Pass Marks : 21

Time : Three hours

All the questions are compulsory.

The figures in the right margin indicate full marks for the questions.

Question Nos. 1 – 10 are Very Short Answer (VSA) types of 1 mark each.

1. Why is the solubility of calcium carbonate in water decrease with increase in temperature? 1

2. In vulcanisation of rubber, sulphur is used as a crosslinking agent. Where do S 1

3. What is meant by broad spectrum antibiotics? 1

4. State Kohlrausch law of independent migration of ions. 1

5. What are the signs of ΔH and of ΔS when a gas is adsorbed by an adsorbent? 1

6. Give the basic principle of van Arkel method for refining of titanium. 1

7. Ammonia forms the complex ion $[Cu(NH_3)_4]^{+2}$ with copper ions in alkaline solutions but not in acidic solutions. Give reason. 1

8. Name the only vitamin which can be synthesized in the skin of our body using the sunlight. 1

9. Primary amine is a product obtained by treating an amide with bromine in an aqueous or ethanolic solution of sodium hydroxide. What is the name of this reaction ? 1

10. What are inter-halogen compounds? 1

Question Nos. 11 –14 are Objective types carrying 1 mark each. Choose and rewrite the best answer out of the given alternatives.

11. Which of the following 1m aqueous solution will have the lowest freezing point? 1

(A) $C_6H_{12}O_6$

(B) K_2SO_4

(C) $MgSO_4$

(D) $Al_2(SO_4)_3$

12. IUPAC name of the complex ion $[Co\ (en)_2Cl(ONO)]^+$ is – 1

(A) chloridobis(ethane-1,2-diamine)nitritocobalt (III) ion

(B) bis(ethane-1,2-diamine)chloridonitrocobalt(III) ion

(C) chloridobis(ethane-1,2-diamine) nitrocobalt(III) ion

(D) bis(ethane-1,2-diamine)chloridonitritocobalt(III)ion

13. The basicity of orthophosphoric acid is – 1

(A) 1

(B) 2

(C) 3

(D) 4

14. Which one of the following ionic species will impart colour to an aqueous solution? 1

(A) Cr^{3+}

(B) Zn^{2+}

(C) Cu^{+}

(D) Ti^{4+}

Question Nos. 15 – 24 are Short Answer (SA-II) types and each carries 2 marks.

15. Explain why the molar conductance of an electrolytic solution increases with dilution. 2

16. The standard electrode potentials of $E^{0}_{Fe+2/Fe}$ and $E^{0}_{Fe+3/Fe+2}$ are – 0.441V and +0.771V. Calculate the emf of the reaction $Fe + 2Fe^{+3} \rightarrow 3Fe^{+2}$. 2

17. Give the product obtained when roasted coper pyrites on smelting with silica. 2

18. Alkyl halides though polar are insoluble in water. Give reason. 2

19. Starting from propanoic acid how is ethylamine prepared? 2

20. Write any two points of differences between n-type semiconductor and p-type semiconductor. 2

21. Describe Reimer-Tiemann reaction for preparation of salicylaldehyde from phenol. 2

22. What are analgesics? Give an example. 2

23. Nylon 6, 6 is synthesised by condensation polymerisation of two monomers. Write the monomers and give the reaction. 2

24. What are lyophilic and lyophobic colloids? Which of these sols can be easily coagulated on addition of small amount of electrolytes? 2

Question Nos. ***25 – 31*** *are Short Answer (SA-I) types and each carries* ***3*** *marks.*

25. The elevation in boiling points of water containing 2.84g and 5.89g of KCl in 125g of water are 0.27K and 0.59K respectively. Calculate the values of Van't Hoff factorin each case and explain the nature of the electrolyte.($K_b = 0.514 K\ gmol^{-1}$). 3

26. $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ both are complexes of Co (III) in which $[Co(NH_3)_6]^{3+}$ is diamagnetic while $[CoF_6]^{3-}$ is paramagnetic .Predict the magnetic moments of these complexes. 3

27. What are carbohydrates? Classify them on the basis of hydrolysis. 3

28. Convert C_6H_5COOH to C_6H_5OH. 3

29. Give reasons for –

(i) Most of the transition metal ions exhibit paramagnetic behaviour.

(ii) Actinoids have greater range of oxidation states.

(iii) $[CuCl_4]^{2-}$ and $[CuI_4]^{2-}$ both are complexes of Cu(II) in which the species $[CuCl_4]^{2-}$ is exists while $[CuI_4]^{2-}$ does not. 3

30. An element has atomic number 24 g mol^{-1} and density 7.2 g cm^{-3}. If the edge length of its unit cell is 220 pm, predict (a) type of the crystal (b) co-ordination number and (c) atomic packing factor of the crystal. 3

31. An alkyl halide, X, of formula $C_6H_{13}Cl$ on treatment with potassium tertiary butoxide gives two isomeric alkenes Y and Z (C_6H_{12}). Both alkenes on hydrogenation give 2, 3 -dimethylbutane. Predict the structures of X, Y and Z. 3

Question nos. 32 – 34 are Essay (E) types and each carries 5 marks.

32. (a) At 400K, the rate of a chemical reaction increases 100 times in presence of a catalyst. How much activation energy is decreased by the presence of catalyst?

(b) The formation of nitrogen dioxide gas by the combination of nitrogen gas and oxygen gas is an elementary reaction. Predict the (i) molecularity (ii) order and (iii) units of the rate constant in terms pressure of this elementary reaction. 2+3=5

33. (a) Write the theory involved in the manufacture of sulphuric acid by contact process.

(b) What happens when chlorine reacts with dry slaked lime?

(c) Explain the bleaching action chlorine. 3+1+1=5

34. (a) An aromatic hydrocarbon (mol. Formula C_7H_8) undergoes oxidation with $KMnO_4$ to give a compound A. On treatment with thionyl chloride the compound A is converted to compound "B". The compound "B" which upon reduction with H_2/Pd forms a compound "C". Write the structures of A,B, and C with justification.

(b) Write the product obtained by heating benzoic acid with ammonia at high pressure. 4+1=5