2025

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 Sort Answer (VSA) types of 1 mark each.

1. What is a fuel cell? 1

2. What is meant by primary structure of a nucleic acid? 1

3. Write the reaction that occurs at the anode during electrolysis of an aqueous solution containing Na_2SO_4 and $CuSO_4$ using Pt electrodes. 1

4. What are mixed ethers? 1

5. Define activation energy. 1

6. What are simple tertiary amines? 1

7. Write down the differential rate equation of a first order reaction. 1

8. What are essential amino acids? 1

9. A ligand has two different donor atoms and either of the two ligetes in the complex. Name the type of ligand. 1

10. What are chiral molecules? 1

P.T.O.

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

11. A chloroalkane is prepared by shaking an alcohol, $C_4H_{10}O$ with concentrated HCl at room temperature. The IUPAC name of the chloroalkane is   1

    (A)   2-chloro-2-methylpropane.   (B)   1-chloro-2-methylpropane.

    (C)   2-chlorobutane.   (D)   1-chlorobutane.

12. When methanamine is heated with $CHCl_3$ and alcoholic KOH solution, a very poisonous compound is formed. The poisonous compound is   1

    (A) $CH_3 - CN$ (B) $CH_3 - CH_2 - CN$

    (C) $CH_3 - CH_2 - NC$ (D) $CH_3 - NC$

13. Glycerol is a   1

    (A)   trihydric phenol.   (B)   monohydric alcohol.

    (C)   trihydric alcohol.   (D)   dihydric alcohol.

14. The molarity of a commercial sulphuric acid (density 1.787 g/ml) labelled as 98% by weight is   1

    A.   17.87M.   B.   14.87M.

    C.   11.787M.   D.   1.787 M.

15. When lead storage cell is charged   1

    A.   sulphuric acid is consumed. B.   sulphuric acid is formed.

    C.   lead sulphate is formed.   D.   lead is consumed.

16. Which one of the following first row transition elements is expected to have the highest $E^0_{M^{+3}/M^{+2}}$ value? $\qquad$ 1

    A.   Cr ($z = 24$)   B.   Mn ($z = 25$)

    C.   Fe ($z = 26$)   D.   Co ($z = 27$)

17. Which one of the following statements is the nature of the paramagnetic $[CoF_6]^{-3}$ complex?   1

    A.   Cobalt involves d^2sp^3 hybridisation.

    B.   Cobalt involves sp^3d^2 hybridisation.

    C.   F is in zero oxidation state.

    D.   Co is in +2 oxidation state.

Question Nos. 18-27 are Short Answer (SA-II) types and each carries 2 marks.

18. On electrolysis of $CuSO_4$ solution, copper is deposited on an area of 100cm² and thickness 10^{-2}cm at the cathode surface. How much charge is required to deposit copper? (Density of copper 0.95g cm⁻³)   2

19. What are inner-transition elements? Write down the general electronic configuration of d-block elements.   2

20. State the hybridisation and shape of the complex $[Cr(NH_3)_6]^{+3}$.   2

21. At 300K the osmotic pressure of a solution containing 85g per litre of AB_3 (molecular weight 170) in water is 40 atm. Calculate the degree of dissociation of the equilibria $AB_3 \rightleftharpoons A^{+3}+3B^-$.   2

22. The rate of certain reaction depends on concentration of the reactant 'A' according to equation, $-\dfrac{d[A]}{dt} = \dfrac{k_1[A]}{1+k_2[A]}$.

What is the order the reaction when (a) concentration of the reactant 'A' is very high and (b) concentration of the reactant A is very low?   2

23. Neopentyl chloride,

$$H_3C - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2Cl$$ is highly resistant towards

nucleophillic substitution by S_N2 path. Give reason. 2

24. All sugars are carbohydrates but all carbohydrates are not sugars. Justify it. 2

25. Illustrate Kolbe's reaction with a suitable example. 2

26. The rate expression of the decomposition of hydrogen peroxide catalysed by iodide ion in alkaline medium to form water and oxygen is

$$-\frac{d[H_2O_2]}{dt} = K[H_2O_2][I^-]$$

Write the possible mechanism of the reaction. 2

27. Alcohols undergo acid catalyzed dehydration but aldols (β-hydroxy aldehydes) undergo dehydration in the presence of a base. Give reason. 2

Question Nos. 28-33 are Short Answer (SA-I) types and each carries 3 marks.

28. (a) Write the electrode reactions that take place in mercury cell. Why is it more advantageous than dry cells ? 2+1=3

Or

(b) What are the advantages of using a salt bridge in cell? Why does the conductivity of a solution decreases with dilution? 2+1=3

29. (a) Explain the following observations giving appropriate reasons:

(i) Outer orbital complexes are strongly paramagnetic.

(ii) Inner orbital complexes are either diamagnetic or weakly paramagnetic.

(iii) Tetrahedral complexes are rarely observed. 1+1+1=3

Or

(b) The formula of a coordination compound is $CoCl_3.4H_2O$. Its precipitates as silver chloride on adding excess of silver nitrate solution and it molar conductance corresponds to a total of 2 ions.

(i) Predict its structure and give IUPAC name of the complex.

(ii) Predict the magnetic moment of the complex.   1+1+1=3

30. (a) Write three points of differences between order and molecularity of a chemical reaction.   1+1+1=3

Or

(b) What are the characteristics of a first order reaction? Write any three points.   1+1+1=3

31. (a) Arrange the following in increasing order of basic strength and give reason for the order.

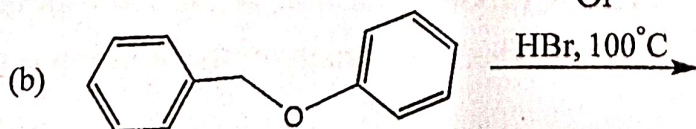NH_3, CH_3NH_2, $C_6H_5NH_2$.   1+2=3

Or

(b) Amino group in aniline is o,p-directing but nitration with nitrating mixture gives about 50% m-nitroaniline. Give reason. How can p-nitroaniline be obtained as the major product?   2+1=3

32. Give the major product and write a plausible mechanism of   1+2=3

(a)

Or

(b)
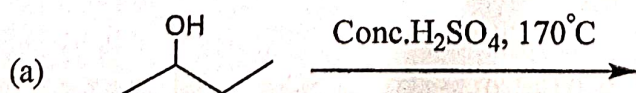
33. (a) You are carrying out Wurtz reaction by treating a mixture of chloromethane and chloroethane with sodium metal in dry ether. Identify the products formed in the reaction? 3

Or

(b) Benzene cannot be converted to n-Propylbenzene by Friedel Craft's alkylation but the conversion can be carried out using Wurtz-Fittig method. Explain it. 3

Question Nos. 34-36 are Essay (E) types and each carries 5 marks.

34. (a) Write the steps with chemical equations involved in the preparation of potassium dichromate from its chromite ore. What happens when acidified potassium dichromate reacts with oxalic acid? Give its ionic reaction. 3+2=5

Or

(b) In the elements of lanthanides, there is a decrease in the atomic and ionic radii with increase in atomic numbers. What are the causes and consequences of this phenomenon? 3+2=5

35. (a) (i) Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. Why is it so ?

(ii) Explain why aquatic species are more comfortable in cold water rather than in warm water. 4+1=5

Or

(b) Describe determination of molar mass of a non- volatile solute by measuring the relative lowering of vapour pressure. Which of 1 molar or 1 molal solution is more concentrated when the density of the solution is greater than 1? 4+1=5

36. (a) An unsymmetrical alkene (A), C_9H_{10} on ozonolysis followed by reduction with Zn/H_2O gives a mixture of two products B and C. When subjected to haloform test, B does not respond but C gives positive result. Identify A, B, C and write the reaction. Which name reactions will B and C undergo when they are treated with aqueous KOH?   1+1+1+1+1=5

Or

(b) A nitrile compound, (A), C_7H_5N on reduction with $SnCl_2$/HCl followed by hydrolysis in acid medium gives compound B. On heating with aqueous KOH followed by acidification, compound B forms a mixture of compounds C and D. Compound D can also be obtained by treating B with $LiAlH_4$. Identify A, B, C and D to write the sequence of reactions. What will happen when the mixture of C and D is heated with concentrated sulphuric acid?   1+1+1+1+1=5

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