

2019

**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 1-10 are Very short Answer (VSA) type of 1 mark each.)*

1. Why is Henry's law not applicable to dissolution of hydrogen chloride gas in water? 1
2. In the electrode of first kind  $Cl_2 / Cl^-$ , the electrode material  $Cl_2$  is a nonconductor. How can the electron transfer be carried out with the ion ( $Cl^-$ )? 1
3. In Haber's process of ammonia synthesis, presence of traces of  $H_2S$  retards the rate of the reaction. Why? 1

P.T.O.

4. When copper is extracted from pyrite ore, the molten copper metal in the Bessemer converter is contaminated with basic  $FeO$  impurity. Suggest a flux that can be used to remove the impurity as slag. 1
5. What is the most common oxidation state of the Actinoids? 1
6. Write the Fischer structure of (R)-2-Bromobutane. 1
7. Identify the monomers of the polymer 1
- $$\left( -CH_2 - \underset{\text{CH}_3}{\text{CH}} - CH_2 - \underset{\text{CH}_3}{\text{CH}} - \right)_n$$
8. An amine is synthesized by Gabriel phthalimide synthesis. Compare its basicity with aniline. 1
9. Why are ketones less reactive than aldehydes? 1
10. How will you synthesize the isomeric ether of benzyl alcohol by Williamson synthesis? 1

*Questions 11-14 are Objective type carrying 1 mark each. Choose and rewrite the best answer out of the given alternatives.*

11. Oxidation in alkaline medium using  $KMnO_4$ , the oxidation number of manganese changes from 1
- A. +7 to +2
- B. +2 to +7
- C. +7 to +4
- D. +7 to +5

12. Chlorobenzene can be converted to Toluene by 1
- A. reaction with  $\text{CH}_3\text{MgBr}$
  - B. reaction with  $\text{CH}_3\text{Cl}$  and Na in dry ether
  - C. hydrolysis followed by reaction with  $\text{CH}_3\text{ONa}$
  - D. reaction with  $\text{CH}_3\text{ONa}$
13. Which of the hydrides of group 16 elements is least reducing ? 1
- A.  $\text{H}_2\text{S}$
  - B.  $\text{H}_2\text{O}$
  - C.  $\text{H}_2\text{Se}$
  - D.  $\text{H}_2\text{Te}$
14. The reduction potential of the couples  $\text{A}^+/\text{A}$  and  $\text{B}^+/\text{B}$  are  $-1.66\text{V}$  and  $0.80\text{V}$  respectively. Which of the following reactions will occur when the two systems are combined ? 1
- A.  $\text{A}^+ + \text{B}^+ \longrightarrow \text{A} + \text{B}$
  - B.  $\text{A}^+ + \text{B} \longrightarrow \text{A} + \text{B}^+$
  - C.  $\text{A} + \text{B}^+ \longrightarrow \text{A}^+ + \text{B}$
  - D.  $\text{A} + \text{B} \longrightarrow \text{A}^+ + \text{B}^+$

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

15. What is meant by imperfections in solids? What is the effect of interstitial defect on the density of a solid? 2
16. Define van't Hoff factor. What would be the value of van't Hoff factor for a dilute aqueous solution of  $\text{Na}_2\text{SO}_4$ ? 2
17. Elements A and B form a crystalline compound. In the crystal, atoms of element A form cubic closed packed structure and atoms of element B occupy  $1/3$ rd of tetrahedral voids. Calculate the formula of the compound. 2
18. Calculate the elevation in boiling point when 300g of urea,  $\text{CO}(\text{NH}_2)_2$  is dissolved in 2500g of water. (Given:  $K_b$  for water =  $0.52 \text{ K Kg mol}^{-1}$ ) 2
19. Spelter (impure zinc) contains Pb, Fe and Cd as impurities. How can you refine the impure zinc? 2
20. On the basis of VSEPR theory deduce the geometry of  $\text{XeF}_2$ . 2
21. Benzyl chloride,  $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$  is a primary halide but it undergoes  $\text{S}_{\text{N}}1$  reaction as fast as tertiary halides. Give reason. 2
22. Ketones are normally not reducing. Fructose however is reducing towards Fehling's solution and Tollen's reagent in spite of the fact that it has ketonic group. Give reason. 2
23. What is vulcanization? How does it improve the quality of rubber? 2

24. A protein has the amino acid sequence Ala-Gly-Val-Gly-Leu-Ser as a part of polypeptide chain. In the  $\alpha$ -Helix structure, the  $-\text{NH}_2$  group of which amino acid will form H-bond with the CO group of Alanine? What will happen to this hydrogen bond when the protein is denatured? 2

Question Nos. 25-31 are Short Answer (SA-I) types of 3 marks each.

25. State Kohlrausch law of independent migration of ions. How is the law used to determine the degree of dissociation of a weak electrolyte? 3
26. Write three features which distinguish physisorption from chemisorption. 3
27. Why is  $\text{Cu}_2\text{I}_2$  colourless? Calculate the magnetic moment (spin only) value of the trivalent ion of element with atomic number 22. 3
28. Tetrahedral heteroleptic complex cannot exhibit geometrical isomerism but may show optical isomerism. Explain with example. 3
29. (i) Coupling reaction of benzene diazonium chloride with phenol is carried out in basic condition, but the same basic condition cannot be used in the coupling reaction with aniline. Explain.
- (ii) Write the IUPAC name of the nitro compound,  $\text{C}_4\text{H}_9\text{NO}_2$  which does not react with nitrous acid. 2+1 = 3

30. Compare the narcotic and non-narcotic analgesic drugs in terms of effectiveness and side effects. 3
31. Describe Reimer-Tiemann reaction with an example. What will be the acidity of the product as compare to the substrate? 3

*Question from 32-34 are Essay (E) type of 5 marks each.*

32. The rate of a reaction is expressed as  $-\frac{dC}{dt} = K$ .
- (i) Obtain an expression for the concentration (C) at time (t) if the initial concentration value is  $C_0$ .
- (ii) Calculate half-life period  $\left(t_{1/2}\right)$  given that the reaction starts with a concentration of  $0.1 \text{ mol L}^{-1}$  and rate constant  $2.5 \times 10^{-4} \text{ mol L}^{-1}\text{S}^{-1}$ .
- (iii) Give a qualitative plot of concentration against time. 2+2+1=5
33. (i) How is  $\text{H}_2\text{SO}_4$  manufactured by contact process ?
- (ii) What are interhalogen compounds ? Why are they, in general, more reactive than the halogens?
- (iii) Why is  $\text{N}_2$  very inert ? 2+2+1=5

34. (i) An organic compound 'A' (molecular formula,  $C_6H_{10}O$ ) forms hydrazone and reduces Tollens' reagent. When treated with  $CH_3MgBr$  followed by hydrolysis 'A' gives a chiral compound 'B'. Compound 'B' on oxidation with potassium dichromate/acid gives compound 'C'. Compound 'C' undergoes haloform reaction and gives cyclopentane carboxylic acid as oxidation product. Identify A,B,C and write the sequence of the reactions.
- (ii) Write the mechanism of esterification reaction of benzoic acid with ethanol in the presence of concentrated sulphuric acid. 3+2=5