CHEMISTRY (Theory)

Time allowed: 3 Hrs Maximum Marks: 70

General Instructions:
(i) All questions are compulsory.
(ii) Marks for each question are indicated against it.
(iii) Questions number 1 to 8 are very short-answer questions and carry 1 mark each.
(iv) Questions number 9 to 18 are short-answer questions and carry 2 marks each.
(v) Questions number 19 to 27 are also short-answer questions and carry 3 marks each.
(vi) Questions number 28 to 30 are long-answer questions and carry 5 marks each.
(vii) Use Log tables, if necessary. Use of calculators is not allowed.

1. Which crystal defect lowers the density of a solid?
2. Why do amines behave as nucleophiles?
3. Why are lower members of aldehydes easily miscible with water?
4. Mention all the oxidation states exhibited by chlorine in its compounds.
5. Mention two ways by which lyophilic colloids can be operated.
6. What are the reducing sugars? Give one example.
7. Define the term 'polymerization'.
8. What is tincture of iodine?
9. Define osmotic pressure. How is it that measurement of osmotic pressures is more widely used for determining molar masses of macromolecules than the rise in boiling point or fall in freezing point of their solutions?

OR

Derive an equation to express that relative lowering of vapor pressure for a solution is equal to the mole fraction of the solute in it when the solvent alone is volatile.

10. Define the following terms giving an example for each:
    (i) The order of a reaction
    (ii) The molecularity of a reaction.
11. What happens when bromine reacts with $CH_3 - C \equiv CH$? How would you justify this reaction?
12. Assign reasons for the following:
    (i) In liquid state hydrogen chloride is a stronger acid than hydrogen fluoride.
    (ii) Phosphorous (P_4) is much more reactive than nitrogen.
13. Discuss the relative stability in aqueous solutions of +2 oxidation state among the elements : Cr, Mn, Fe and Co. How would you justify this situation?
    (At. Nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)
14. Write the structure of the monomers of the following polymers:
    (i) PVC
    (ii) Polypropene
15. Write the IUPAC names of the following compounds:
    (i) $(CH_3)_3CCH_2Br$
    (ii)
16. Alcohols react both as nucleophiles as well as electrophiles. Write one reaction of each type and describe its mechanism.
17. How would you carry out the following conversions?
    (i) Ethyl magnesium chloride to propan-1-ol
    (ii) Benzyl chloride to benzyl alcohol
18. Why do soaps not function in hard water, for washing clothes? How are synthetic detergents better than soaps for this purpose?

19. Calculate the amount of KCL which must be added to 1 kg of water so that its freezing point is depressed by 2 K.
20. Niobium (Nb) crystallizes in a body-centered cubic (bcc) structures. If its density is 8.55 g cm^{-3}, calculate the atomic radius of niobium.
    (Atomic mass of Nb = 93 u; $N_A = 6.02 \times 10^{23}$ mol^{-1})

OR

    Explain with suitable examples the following:
    (a) n-type and p-type semiconductors
    (b) F-centres
    (c) Ferromagnetism
21. The rate constant for a first order reaction is 60 s^{-1}. How much time will it take to reduce the initial concentration of the reactant to $1/16^{th}$ of its initial value?
22. Explain what is observed when
    (i) A beam of light is passed through a colloidal solution.
    (ii) An electrolyte NaCl, is added to hydrated ferric oxide solution.
    (iii) An electric current is passed through a colloidal solution.
23. Describe the principle involved in the following metallurgical operations:
    (i) Zone refining
    (ii) Electrolytic refining
    (iii) Froth-floatation process of concentrating sulphide ores.
24. Account for the following:
    (i) pK_b of methylamine is less than that of aniline
    (ii) Aniline does not undergo Friedel-Crafts reaction.
    (iii) Ethylamine is freely soluble in water whereas aniline is only slightly soluble.
25. Write the IUPAC name and describe the magnetic behaviour (diamagnetic or paramagnetic) of the following coordination entities:
    (i) $[Cr(H_2O)_2(C_2O_4)_2]^-$
    (ii) $[Co(NH_3)_5Cl)]^{2+}$
    (iii) $[NiCl_4]^{2-}$
    (At. Nos: Cr = 24, Co = 27, Ni = 28)
26. Compare actinoids and lanthanoids with reference to their:
    (i) Electronic configurations of atoms
    (ii) Oxidation states of elements
    (iii) General chemical reactivity of elements
27. What happens when D-glucose is treated with the following reagents?
    (i) HNO_3
    (ii) Bromine water
    (iii) HI
28. (a) Depict the galvanic cell in which the following reaction takes place:

    $Zn(s) + 2\ Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2\ Ag(s)$

    Also indicate that in this cell
    (i) Which electrode is negatively charged?
    (ii) What are the carriers of the current in the cell?
    (iii) What is the individual reaction at each electrode?
    (b) Write the Nernst equation and determine the e.m.f. of the following cell at 298 K:

    $Mg(s)\ \left|Mg^{2+}(0.001M)\right|\ \left|Cu^{2+}(0.0001M)\right|\ Cu(s)$

    (Given $E^\circ_{Mg^{2+}/Mg} = -2.375$ V, $E^\circ_{Cu^{2+}/Cu} = +0.34$ V

OR

(a) Define conductivity and molar conductivity for the solution of an electrolyte. How do they vary when the concentration of electrolyte in the solution increases?

(b) Three conductivity cells A, B and C containing solutions of zinc sulphate, silver nitrate and copper sulphate respectively are connected in series. A steady current of 1.5 amperes is passed through them until 1.45 g of silver is deposited at the cathode of cell B. How long did the current flow? What mass of copper and what mass of zinc got deposited in their respected cells?
(Atomic mass: Zn = 65.4 u; Ag = 108 u, Cu = 63.5 u)

29. (a) Illustrate the following reactions giving one example for each:
    (i) Cannizzaro reaction
    (ii) Decarboxylation

(b) Complete the following reaction equations by giving the indicating missing substances:
    (i) $CH_3CHO \xrightarrow{H_2NCONHNH_2} \ldots\ldots..(?)$

    (ii)
    (iii)

OR

(a) State tests to distinguish between the following pairs of compounds:
    (i) Propanal and Propanone
    (ii) Phenol and benzoic acid

(b) How will you bring about the following conversions:
    (i) Propanone to propene
    (ii) Benzaldehyde to benzophenone
    (iii) Ethanol to 3-hydroxybutanal

30. (a) Assign reasons for the following:
    (i) Bi (V) is a stronger oxidizing agent than Sb (V).
    (ii) Of the noble gases only xenon is known to form established chemical compounds.

(b) Draw the structures of the following molecules:
    (i) $H_2S_2O_7$
    (ii) BrF_3
    (iii) XeF_2

OR

(a) Complete the following chemical reaction equations:
    (i) $Ca_3P_2 + H_2O \rightarrow$
    (ii) $XeF_4 + H_2O \rightarrow$

(b) How would you account for the following observations?
    (i) NH_3 is a stronger base than PH_3.
    (ii) Sulphur in vapor state exhibits paramagnetism
    (iii) Hydrogen fluoride has a higher boiling point than hydrogen chloride.