

GENERAL INSTRUCTIONS

- i) All the questions are compulsory.
- ii) Question nos. 1 to 5 carry 1 mark each.
Question nos. 6 to 10 carry 2 marks each.
Question nos. 11 to 22 carry 3 marks each.
Question no. 23 (a value based) question carries 4 marks.
Question nos. 24 to 26 carry 5 marks each.
- iii) Use of calculator is not permitted.
For calculations you may ask for the log book if required.

1. What is reverse osmosis? Give its application. (1)
2. Why does a mercury cell give a constant voltage throughout its life ? (1)
3. For the reaction $A \rightarrow B$ the rate of reaction becomes three times when the concentration of A is increased by twenty seven times. What is the order of the reaction? (1)
4. What is meant by activity and selectivity of a catalyst? (1)
5. Assign IUPAC name : $[\text{Co}(\text{H}_2\text{O})_2(\text{NH}_3)_4]\text{Cl}_2$ (1)
6. A Copper crystal has a face centred cubic lattice structure. Atomic radius of the copper atom is 128×10^{-10} cm. Calculate the density of copper. Atomic mass of copper is 63.5 u. ($N_A = 6.022 \times 10^{23}$) (2)
7.
 - a) Give an example for a lyophobic sol.
 - b) What are emulsions?
 - c) Why is adsorption always exothermic?
 - d) What is activated charcoal? (2)
8.
 - a) What is the role of depressant in froth floatation process? Which type of ores can be concentrated by this method?
 - b) Describe the method of refining nickel giving reactions also. (1,1)
9. Give reason for the following : -
 - a) Why is H_2O a liquid while H_2S is a gas?
 - b) ICl is more reactive than I_2 . Explain.
 - c) $\text{N}-\text{N}$ bond is weaker than $\text{P}-\text{P}$ bond.
 - d) $K_{a2} \ll K_{a1}$ for sulphuric acid. (2)
10. Account for the following:
 - a) Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidising in nature. (At. mass of Cr = 24, Mn = 25)
 - b) All the scandium salt are white in colour. (At. mass of Sc = 21) (1,1)

(OR)

 - a) What is lanthanide contraction? What are its consequences?
 - b) Why is the highest oxidation state of a metal exhibited in its oxide and fluoride only? (1,1)
11.
 - a) What is the difference between semiconductors obtained by doping ${}_{14}\text{Si}$ with ${}_{13}\text{Al}$ or with ${}_{15}\text{P}$?
 - b) Atoms of element B form hcp lattice and those of the element A occupy $2/3^{\text{rd}}$ of tetrahedral voids. What is the formula of the compound formed by the elements A and B?
 - c) In terms of band theory what is the difference between a conductor and an insulator. (1,1,1)
12.
 - a) Analysis shows that nickel oxide has the formula $\text{Ni}_{0.98}\text{O}$. What fraction of the nickel exist as Ni^{2+} ions?
 - b)
 - i) Define the term Crystal lattice.
 - ii) What are paramagnetic substances?
 - iii) How does the electrical conductivity of metallic conductors vary with temperature?
 - iv) Why is the window of glass buildings thicker at the bottom. (1,2)
13.
 - a) Two liquids A and B boil at 110°C and 130°C respectively. Which of them has higher vapour pressure at 50°C ?
 - b) Calculate the mole fraction of $\text{C}_2\text{H}_6\text{O}_2$ (Molecular mass = 62) in an aqueous solution containing 20 percentage of it by mass. (Molecular mass of $\text{H}_2\text{O} = 18$) (1,2)

14. a) How many Faradays of charge required to convert one mole of $\text{Cr}_2\text{O}_7^{2-}$ to Cr^{3+} ?
 b) The measured resistance of a conductance cell containing 7.5×10^{-3} M solution of KCl at 25°C was 1005 ohms. Calculate.
 i) Specific conductance.
 ii) Molar conductance of the solution. Given that cell constant = 1.25 cm^{-1} . (1,2)
15. a) Distinguish between order and molecularity of a reaction. (two points only)
 b) Write the general rate equation for a third order reaction and derive the unit for the rate constant when the order of reaction is three.
 c) Give an example for a pseudo first order reaction. (1,1,1)
16. a) Give difference between chemisorptions and physisorption. (two points).
 b) What is an adsorption isotherm? Describe Freundlich adsorption isotherm. (Both graphically and mathematically) (1,2)
17. a) Give any two anomalies shown by fluorine.
 b) Name the process for the manufacture of sulphuric acid.
 Give chemical equation for the reactions involved in the process. (1,2)
18. Answer the following questions : -
 a) Only Xenon is known to form established chemical compounds with fluorine. Why?
 b) Draw the structure of XeF_2 and H_3PO_4
 c) Arrange the following as indicated : --
 $\text{NH}_3, \text{PH}_3, \text{AsH}_3, \text{SbH}_3, \text{BiH}_3$ (increasing order of thermal stability)
 $\text{HF}, \text{HCl}, \text{HBr}, \text{HI}$ (Increasing order of acidic character) (1,1,1)
19. Describe the preparation of potassium dichromate from iron chromite ore.
 What is the effect of increasing pH on solution of potassium dichromate. (3)
20. a) Give an example for a hexadentate ligand.
 b) Suggest an experiment to show that $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$ are ionisation isomers.
 c) What are organo metallics ? (1,1,1)
21. a) The reaction $\text{Cr}_2\text{O}_3 + 2 \text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2 \text{Cr}$. ($\Delta G = -421 \text{ K J}$)
 It is thermodynamically feasible? Why doesn't it take place at room temperature?
 b) With the help of reactions only explain Bayer's process to concentrate the ore of aluminium.
 c) What is reason for adding : -
 i) cryolite to alumina in electrolytic reduction by Hall's process.
 ii) Lime stone to haematite ore in the extraction of iron. (1,1,1)
22. Explain the formation of $(\text{Co}(\text{NH}_3)_6)^{2+}$ on the basis of valence bond theory and predict its magnetic nature and the shape (At. No. of Co = 27) (2, 1/2, 1/2)
 (OR)
 a) Draw a labelled diagram to show the splitting of d-orbitals in an octahedral crystal field.
 b) Give IUPAC name of the linkage isomer of $(\text{Pt}(\text{NH}_3)_3(\text{ONO}))\text{Br}$.
 c) What is meant by spectro chemical series? (1,1,1)
23. Kabir observed that his classmate Abhay was showing a change in behaviour since past couple of weeks . Abhay stayed aloof, did not play and mingle with friends and became irritable. Kabir shared his concern for Abhay with their class teacher. The teacher called Abhay's parents and advised them to consult a doctor. The doctor advised some medicines for Abhay.
 a) Name the type of medicines the doctor might have prescribed.
 b) In addition to the medicine the doctor gave some advise to the family.
 What could be this advise?
 c) Comment on the values shown by Kabir and the teacher. (4)
24. a) "Addition of a non-volatile solute to a volatile solvent lowers the freezing point".
 Explain the statement with the help of a graph.
 b) State Henry's law. At the same temperature hydrogen is more soluble in water than helium. Which of them will have a higher value of KH?
 c) Under what condition Van't Hoff factor is equal to 1?
 d) A solution is made by dissolving 30g of a non-volatile solute in 90g of water. It has a vapour pressure of 2.8 kpa at 298k, the vapour pressure of pure water is 3.64 kpa. Calculate the molar mass of the solute. (1,1,1,2)
 (OR)

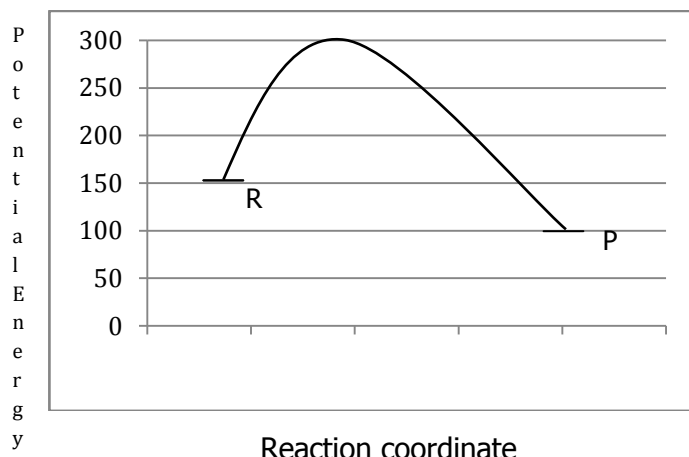
- a) i) How does osmotic pressure vary with temperature?
 ii) What are isotonic solutions?
 b) State Raoult's law for dilute solutions. Two liquids A and B on mixing produce a warm solution. Which type of deviation from Raoult's law does it show?
 c) What would be the value of Van't Hoff factor for potassium sulphate in water?
 d) 1g of a non-electrolyte solute dissolved in 50g of benzene lowered the freezing point of benzene by 0.40 K. K_f of benzene is $5.12 \text{ K Kg mol}^{-1}$.
 Find the molar mass of the solute. (1,1,1,2)

25. a) Write the overall reaction for the recharging of lead storage battery.
 b) From the following molar conductivities at infinite dilution for Ba(OH)_2 ; BaCl_2 ; and NH_4Cl are 257.6, 240.6, $129.8 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$ respectively calculate the molar conductivity of NH_4OH .
 c) Calculate the potential of the cell at 298 K for the following cell : -
 $\text{Cd(s)}/\text{Cd}^{++} (0.10 \text{ M}) // \text{H}^+ (0.20 \text{ M}) / \text{Pt. H}_2 (1 \text{ atm.})$
 $E^\circ_{\text{Cd}^{++}/\text{Cd}} = -0.403 \text{ V}$. (1,2,2)

(OR)

- a) Write the overall reaction for the recharging of lead storage battery.
 b) Calculate equilibrium constant of the reaction
 $\text{Cu(s)} + 2\text{Ag}^+(\text{aq.}) \rightarrow \text{Cu}^{2+}(\text{aq.}) + 2\text{Ag(s)}$ at 298K. $E^\circ_{\text{cell}} = 0.46\text{V}$
 c) Write Nernst equation and calculate cell potential
 $\text{Sn} | \text{Sn}^{2+} (0.050\text{M}) || \text{H}^+ (0.020\text{M}) | \text{H}_2 (1\text{bar}) | \text{Pt}$
 $E^\circ_{\text{Sn}^{2+}/\text{Sn}} = -0.14\text{V}$. (1,2,2)

26. a)

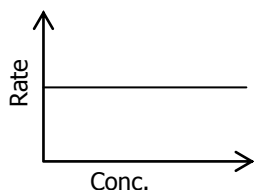


Answer the following questions on the basis of the above plot of potential energy vs reaction coordinate:

- i) What is the threshold energy for the reaction?
 ii) What is the activation energy for the forward reaction?
 iii) What is the activation energy for the backward reaction?
 iv) What is the enthalpy change for the forward reaction?
 b) The half life for radioactive decay of ^{14}C is 5730 yrs. Calculate the time required in which it would be reduced by 20 percent. (2,3)

(OR)

- a) In a reaction $2\text{A} \rightarrow \text{products}$, concentration of A decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. Calculate the rate during this interval.
 b) Following graph is a plot of the rate of a reaction vs concentration of reactant. What is the order of reaction : -



- c) The rate of a reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the energy of activation $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$.
 d) A first order reaction takes 40 minutes for 30 percent decomposition. Calculate half life time for the reaction. (1/2,1/2,2,2)