

CHEMISTRY

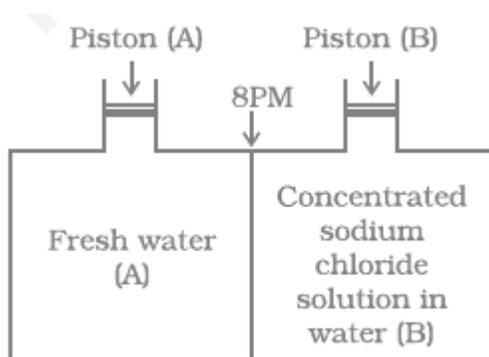
Time Allowed: 3 hours

Maximum Marks: 70

General Instructions:

- (i) All questions are compulsory.
- (ii) Questions No. 1 to 5 are very short answer type questions and carry 1 mark each.
- (iii) Questions No. 6 to 10 are short-answer questions and carry 2 marks each.
- (iv) Questions No. 11 to 22 are also short-answer questions and carry 3 marks each.
- (v) Questions No. 23 is a value based question and carry 4 marks.
- (vi) Questions No. 24 to 26 are long-answer questions and carry 5 marks each.
- (vii) Use Log Tables, if necessary. Use of calculators is **not** allowed.

1. In which type of defect are cations present in interstitial sites? 1
2. Consider the following figure:



What will happen if a pressure equal to osmotic pressure is applied on piston B?

1

3. How can we convert freshly prepared precipitate into colloidal solution? 1
4. Zone refining is based on which process? 1
5. Name any two peroxides of sulphur. 1
6. Concentration terms such as mass percentage, ppm, mole fraction and molality are independent of temperature; however molarity is a function of temperature. Explain. 2
7. The reaction between $\text{H}_2(\text{g})$ and $\text{O}_2(\text{g})$ is highly feasible yet allowing the gases to stand at room temperature in the same vessel does not lead to the formation of water. Explain. 2
8. Although carbon and hydrogen are better reducing agents but they are not used to reduce metallic oxides at high temperatures. Why? 2
9. Explain why is OH group in phenols more strongly held as compared OH group in alcohols. 2

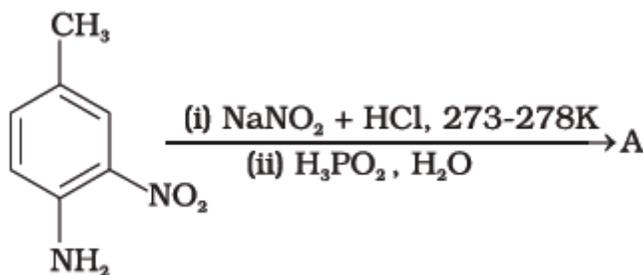
OR

- Why is the reactivity of all the three classes of alcohols with conc. HCl and ZnCl_2 (Lucas reagent) different? 2
10. Amino acids can be classified as α -, β -, γ -, δ - and so on depending

upon the relative position of amino group with respect to carboxyl group. Which type of amino acids form polypeptide chain in proteins?

2

11. Give the structure of 'A' in the following reaction.



3

12. What are Ideal solutions? What are the properties of ideal solutions?

3

13. Write the structures of the isomers of alcohols with molecular formula $\text{C}_4\text{H}_{10}\text{O}$. Which of these exhibits optical activity?

3

14. A compound Z with molecular formula $\text{C}_3\text{H}_9\text{N}$ reacts with $6\text{H}_5\text{SO}_2\text{Cl}$ to give a solid, insoluble in alkali. Identify Z.

3

15. Aldopentoses named as ribose and 2-deoxyribose are found in nucleic acids. What is their relative configuration?

3

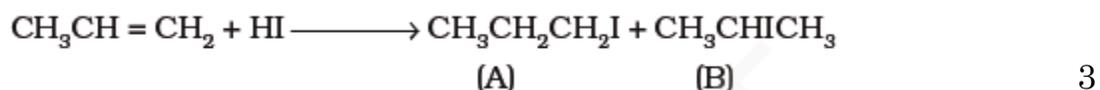
16. In a compound, nitrogen atoms (N) make cubic close packed lattice and metal atoms (M) occupy one-third of the tetrahedral voids present. Determine the formula of the compound formed by M and N?

3

17. Why molecularity is applicable only for elementary reactions and order is applicable for elementary as well as complex reactions? 3
18. How does the precipitation of colloidal smoke take place in Cottrell precipitator? 3

OR

- How will you distinguish between dispersed phase and dispersion medium in an emulsion? 3
19. Explain why ozone is thermodynamically less stable than oxygen. 3
20. Name three oxoacids of nitrogen. Write the disproportionation reaction of that oxoacid of nitrogen in which nitrogen is in +3 oxidation state. 3
21. Name the type of isomerism when ambidentate ligands are attached to central metal ion. Give two examples of ambidentate ligands. 3
22. Which of the products will be major product in the reaction given below? Explain.



23. Bharath went to his grandfather's house in winter this year. As usual, he wants to go for fishing. His grandmother told him that

there will be no fishes in the lake as it is winter. On visiting the lake, he noticed that there are no fishes on the surface of the water whereas in summer they were on the surface and hence he was able to catch fishes.

- a. Why are fishes on the surface of the water in summer?
- b. What value can be derived from this? 4

24. a. Consider a cell given below



Write the reactions that occur at cathode and anode.

- b. Write the Nernst equation for the cell reaction in the Daniel cell. How will the E_{Cell} be affected when concentration of Zn^{2+} ions is increased? 5

OR

- a. What advantage do the fuel cells have over primary and secondary batteries?
- b. When acidulated water (dil. H_2SO_4 solution) is electrolysed, will the pH of the solution be affected? Justify your answer. 5

25. a. Answer the following questions :

1. Which element of the first transition series has highest second ionization enthalpy?
2. Which element of the first transition series has highest third ionization enthalpy?
3. Which element of the first transition series has lowest enthalpy of atomization?

b. Identify the metal and justify your answer:

1. Carbonyl M (CO)₅

2. MO₃F

5

OR

a. Transition metals can act as catalysts because these can change their oxidation state. How does Fe(III) catalyse the reaction between iodide and persulphate ions?

b. Mention any three processes where transition metals act as catalysts.

5

26. a. Why are carboxylic acids more acidic than alcohols or phenols although all of them have hydrogen atom attached to a oxygen atom (—O—H)?

b. Can Gatterman-Koch reaction be considered similar to Friedel Craft's acylation? Give your opinion.

5

OR

An aromatic compound 'A' (Molecular formula C₈H₈O) gives positive 2, 4-DNP test. It gives a yellow precipitate of compound 'B' on treatment with iodine and sodium hydroxide solution. Compound 'A' does not give Tollen's or Fehling's test. On drastic oxidation with potassium permanganate it forms a carboxylic acid 'C' (Molecular formula C₇H₆O₂), which is also formed along with the yellow compound in the above reaction. Identify A, B and C and write all the reactions involved.

5

ANSWERS

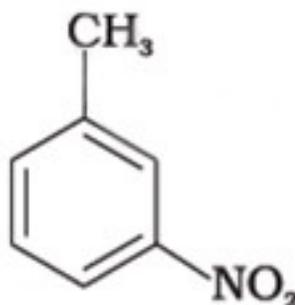
1. Frenkel defect
2. Water will move from side B to side A.-
3. By peptisation
4. Impurities are more soluble in molten metal than in solid metal.
5. H_2SO_5 and $\text{H}_2\text{S}_2\text{O}_8$
6. Molarity of a solution is defined as the number of moles of solute dissolved in one litre of solution. Since volume depends on temperature and undergoes a change with change in temperature, the molarity will also change with change in temperature. On the other hand, mass does not change with change in temperature, as a result other concentration terms given in the question remain unchanged by changing temperature. According to the definition of all these terms, mass of the solvent used for making the solution is related to the mass of solute.
7. This is because activation energy for the reaction is very high at room temperature.
8. It is because at high temperature carbon and hydrogen react with metals to form carbides and hydrides respectively.

9. Reasons for the -OH group in phenol for being more strongly attached as compared to alcohols:
- Due to the partial double bond character of the Ph-OH bond due to resonance stabilising effect.
 - Also the Carbon atom attached to -OH group is sp² hybridised and hence the Ph-OH is less reactive and more strongly attached to phenol than as in alcohol.

OR

- Secondary and tertiary alcohols react with SN₁ mechanism.
 - Primary alcohols cannot ionize to form primary carbocation because they are too unstable.
10. Amino acids can be classified as α-, β-, γ-, δ- and so on depending upon the relative position of amino group with respect to carboxyl group. Which type of amino acids form polypeptide chain in proteins?

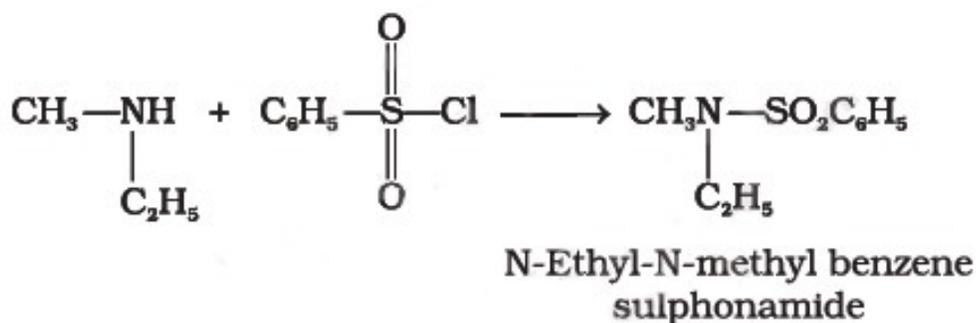
11. The structure of 'A' in the reaction is



12. The solutions which obey Raoult's law over the entire range of concentration are known as ideal solutions. The ideal solutions have two other important properties. The enthalpy of mixing of the pure

components to form the solution is zero and the volume of mixing is also zero.

13. Write the structures of the isomers of alcohols with molecular formula $C_4H_{10}O$. Which of these exhibits optical activity?
14. Z is an aliphatic amine which gives a solid insoluble in base. This implies that reaction with $C_6H_5SO_2Cl$ must give a product without any replaceable hydrogen attached to nitrogen. In other words, the amine must be a secondary amine. i.e. Z is ethylmethylamine.



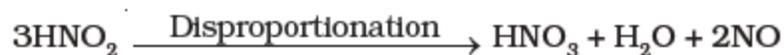
15. 'D' configuration
16. M_2N_3
17. A complex reaction proceeds through several elementary reactions. Numbers of molecules involved in each elementary reaction may be different, i.e. of each step may be different. Therefore, discussion of molecularity of overall complex reaction is meaningless. On the other hand, order of a complex reaction is determined by the slowest step in its mechanism and is not meaningless even in the case of complex reactions.

18. In Cottrell precipitator, charged smoke particles are passed through a chamber containing plates with charge opposite to the smoke particles. Smoke particles lose their charge on the plates and get precipitated.

OR

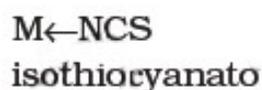
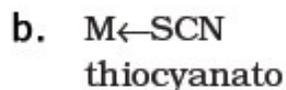
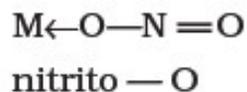
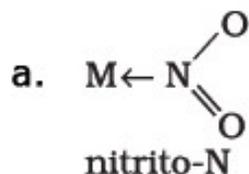
On adding dispersion medium, emulsions can be diluted to any extent. The dispersed phase forms a separate layer if added in excess.

19. Ozone is thermodynamically unstable with respect to oxygen since its decomposition into oxygen results in the liberation of heat (DH is negative) and an increase in entropy (DS is positive).
20. Three oxoacids of nitrogen are
- HNO₂, Nitrous acid
 - HNO₃, Nitric acid
 - Hyponitrous acid, H₂N₂O₂



21. Linkage isomerism.

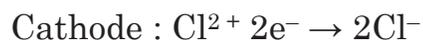
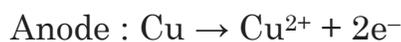
Examples:



22. $C_6H_5-CH_2-Cl$

23. a. According to Henry's law at low temperature gases are more soluble and hence as more oxygen gets dissolved in water fishes survive better even in depth of the river. In summer as the oxygen is less in water the fishes come to the surface.
- b. The value that I derive from this is wisdom is superior to knowledge

24. a. $Cu \mid Cu^{2+} \parallel Cl^- \mid Cl_2, Pt$



Cu is anode as it is getting oxidised.

Cl_2 is cathode as it is getting reduced.

b.

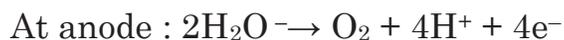


$$E_{\text{Cell}} = E_{\text{Cell}}^{\ominus} - \frac{0.059}{2} \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

E_{Cell} decreases when concentration of Zn^{2+} ions, $[Zn^{2+}]$ increases.

OR

- a. Standard hydrogen electrode is the reference electrode whose electrode potential is taken to be zero. The electrode potential of other electrodes is measured with respect to it.
- b. pH of the solution will not be affected as $[H^+]$ remains constant.



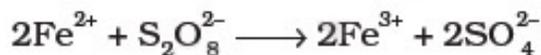
25. a. 1. Cu, because the electronic configuration of Cu is $3d^{10}4s^1$. So second electron needs to be removed from completely filled d-orbital.
2. Zn [Hint : As above]
3. Zn [Hint : No unpaired electron for metallic bonding]
- b. 1. $\text{Fe}(\text{CO})_5$ [Hint : EAN rule]
2. MnO_3F [Hint : Mn shows +7 oxidation state; d-electrons are not involved in bonding.]

OR

- a. Reaction between iodide and persulphate ions is :



Role of Fe (III) ions :



- b. 1. Vanadium (V) oxide in contact process for oxidation of SO_2 to SO_3 .
2. Finely divided iron in Haber's process in conversion of N_2 and H_2 to NH_3 .
3. MnO_2 in preparation of oxygen from KClO_3 .
26. a. Compare the stability of anion formed after the loss of H^+ ion. More stable the anion formed, more easy will be the dissociation of O—H bond, stronger will be the acids.
- b. No

OR

