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**PRE BOARD-1 (SESSION: 2023-2024)**  
**CHEMISTRY THEORY (043)**

**MM:70**

**Time: 3 hours**

General Instructions: Read the following instructions carefully.

- a) There are 33 questions in this question paper with internal choice.
- b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each .
- c) SECTION B consists of 5 very short answer questions carrying 2 marks each.
- d) SECTION C consists of 7 short answer questions carrying 3 marks each.
- e) SECTION D consists of 2 case- based questions carrying 4 marks each.
- f) SECTION E consists of 3 long answer questions carrying 5 marks each.
- g) All questions are compulsory.
- h) Use of log tables and calculators is not allowed

**SECTION A**

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section .

1. Which of the following will give Aldol condensation?

- (a)  $\text{CH}_3\text{CHO}$
- (b)  $(\text{CH}_3)_3\text{CCHO}$
- (c)  $\text{HCHO}$
- (d)  $\text{C}_6\text{H}_5\text{CHO}$

2.  $\text{KMnO}_4$  is coloured due to -

- (a) d-d transition
- (b) charge transfer from ligand to metal
- (c) unpaired electron in d orbital of Mn
- (d) charge transfer from metal to ligand

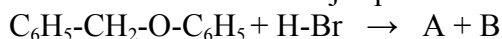
3. Which of the following solutions will have the highest conductivity at 298 K ?

- (a) 0.01 M HCl solution
- (b) 0.01 M  $\text{CH}_3\text{COOH}$  solution
- (c) 0.1 M  $\text{CH}_3\text{COOH}$  solution
- (d) 0.1 M HCl solution

4. When benzene diazonium chloride reacts with phenol , it forms a dye . This reaction is called -

- (a) Diazotisation
- (b) Coupling reaction
- (c) Alkylation reaction
- (d) Condensation reaction

5. What would be the major product of the following reaction ?



- (a)  $\text{A} = \text{C}_6\text{H}_5\text{CH}_2\text{OH}$  ,  $\text{B} = \text{C}_6\text{H}_6$
- (b)  $\text{A} = \text{C}_6\text{H}_5\text{CH}_2\text{OH}$  ,  $\text{B} = \text{C}_6\text{H}_5\text{Br}$
- (c)  $\text{A} = \text{C}_6\text{H}_5\text{CH}_3$  ,  $\text{B} = \text{C}_6\text{H}_5\text{Br}$
- (d)  $\text{A} = \text{C}_6\text{H}_5\text{CH}_2\text{Br}$  ,  $\text{B} = \text{C}_6\text{H}_5\text{OH}$

6. Which of the following is the strongest base in aqueous solution ?

- (a)  $\text{NH}_3$
- (b)  $\text{CH}_3\text{NH}_2$

- (c)  $(\text{CH}_3)_2\text{NH}$   
(d)  $(\text{CH}_3)_3\text{NH}$

7. Which of the following is a diamagnetic ion (atomic no of Sc, V, Mn and Cu are 21, 23, 25 and 29 respectively)

- (a)  $\text{V}^{2+}$   
(b)  $\text{Sc}^{3+}$   
(c)  $\text{Cu}^{2+}$   
(d)  $\text{Mn}^{2+}$

8. The main product formed when phenol is heated with conc. nitric acid -

- (a) o-Nitro phenol  
(b) Benzene  
(c) Picric acid  
(d) Methoxy benzene

9. Hydrolysis of sucrose is called -

- (a) Inversion  
(b) Hydration  
(c) Esterification  
(d) Saponification

10. The rate constant, the activation energy and the Arrhenius parameter of a chemical reaction at  $25^\circ\text{C}$  are  $3.0 \times 10^{-4} \text{ s}^{-1}$ ,  $104.4 \text{ kJ mol}^{-1}$  and  $6.0 \times 10^{14} \text{ s}^{-1}$  respectively. The value of rate constant as  $T \rightarrow \infty$  is

- (a)  $2.0 \times 10^{18} \text{ s}^{-1}$   
(b)  $6.0 \times 10^{14} \text{ s}^{-1}$   
(c) infinity  
(d)  $3.6 \times 10^{30} \text{ s}^{-1}$

11. The IUPAC name of iso butyl bromide is -

- (a) 1-Bromo -3-methyl butane  
(b) 3-Bromo -2-methyl propane  
(c) 2-Bromo -2-methyl propane  
(d) 1-Bromo -2-methyl propane

12. For the given rate expression -

$r = k [\text{A}] [\text{B}]$ , the unit of rate constant is

- (a)  $\text{mol}^{-1} \text{ L s}^{-1}$   
(b)  $\text{mol}^{-1} \text{ L s}$   
(c)  $\text{mol}^{-1} \text{ L}^{-1}$   
(d)  $\text{mol}^{-2} \text{ L s}^{-2}$

13. Given below are two statements labelled as Assertion (A) and Reason (R)

**Assertion (A):** Nitric acid and water form maximum boiling azeotrope.

**Reason (R):** Azeotropes are binary mixture having the same composition in liquid and vapour phase.

Select the most appropriate answer from the options given below:

- a. Both A and R are true and R is the correct explanation of A  
b. Both A and R are true but R is not the correct explanation of A.  
c. A is true but R is false.  
d. A is false but R is true.

14. Given below are two statements labelled as Assertion (A) and Reason (R)

**Assertion (A):** N-Ethylbenzene sulphonamide is soluble in alkali.

**Reason (R):** Hydrogen attached to nitrogen in sulphonamide is strongly acidic.

Select the most appropriate answer from the options given below:

- a. Both A and R are true and R is the correct explanation of A
- b. Both A and R are true but R is not the correct explanation of A.
- c. A is true but R is false.
- d. A is false but R is true.

15. Given below are two statements labelled as Assertion (A) and Reason (R)

**Assertion (A):** Alcohols react both as nucleophiles and electrophiles.

**Reason (R):** The bond between C–O is broken when alcohols react as nucleophiles

Select the most appropriate answer from the options given below:

- a. Both A and R are true and R is the correct explanation of A
- b. Both A and R are true but R is not the correct explanation of A.
- c. A is true but R is false.
- d. A is false but R is true.

16. Given below are two statements labelled as Assertion (A) and Reason (R)

**Assertion (A):**  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  is coloured while  $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$  is colourless .

**Reason (R):** d-d transition is not possible in  $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$  .

Select the most appropriate answer from the options given below:

- a. Both A and R are true and R is the correct explanation of A
- b. Both A and R are true but R is not the correct explanation of A.
- c. A is true but R is false.
- d. A is false but R is true.

## SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

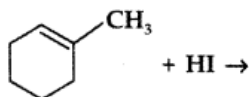
17. Calculate the mass of ascorbic acid (vitamin C ,  $\text{C}_6\text{H}_8\text{O}_6$ ) to be dissolved in 75 g of acetic acid to lower its freezing point by  $1.5^\circ\text{C}$ . (  $K_f$  for  $\text{CH}_3\text{COOH} = 3.9 \text{ K kg mol}^{-1}$  )

18(a) The conversion of molecule A to B follow second order kinetics .If concentration of A is increased to three times , how will it affects the rate of formation of B ?

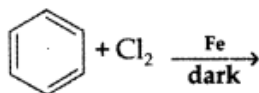
(b) Define pseudo first order reaction with an example .

19. Draw the structure of major monohalogen product formed in the following reactions -

(a)



(b)



20. Arrange the following compounds in an increasing order of their property as indicated :

(a) Acetaldehyde , Acetone , Methyl tert-butyl ketone (reactivity towards HCN)

(b)  $\text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{COOH}$  ,  $\text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{COOH}$  ,  $(\text{CH}_3)_2\text{CHCOOH}$  (acidic strength )

or

Write the reactions involved in the following reactions –

- (a) Clemmensen reduction
- (b) Cannizzaro reaction

21. What happens when D – glucose is treated with the following reagents -

- (a) Bromine water
- (b) HI

### SECTION C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22 (a) Give two differences between order and molecularity of reaction .

(b) A first-order reaction takes 69.3 min for 50% completion. What is the time needed for 80% of the reaction to get completed? (Given:  $\log 5 = 0.6990$ ,  $\log 8 = 0.9030$ ,  $\log 2 = 0.3010$  )

or

(a) Define Activation energy.

(b) The rate of chemical reaction doubles for an increase of 10K in absolute temperature from 298 K . Calculate  $E_a$ . ( $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ )

23. Account for the following -

- (a) Ethylamine is soluble in water whereas aniline is not.
- (b) Although amino group is o and p – directing in aromatic electrophilic substitution reactions, aniline on nitration gives a substantial amount of m- nitroaniline.
- (c) Aniline does not undergo Friedel -Crafts reaction.

24. (a) Draw all the isomers (geometrical and optical) of –  $[\text{Co Cl}_2(\text{en})_2]^+$

(b) How does the magnitude of  $\Delta_o$  decide the actual configuration for  $d^5$  orbitals in a coordination entity ?

25 .What happens when –

- (a) Anisole is treated with  $\text{CH}_3\text{Cl}$  /anhydrous  $\text{AlCl}_3$  .
- (b) Phenol is oxidized with  $\text{Na}_2\text{Cr}_2\text{O}_7/\text{H}^+$
- (c)  $(\text{CH}_3)_3\text{C-OH}$  is heated with  $\text{Cu}$  /573K .

Write chemical equation in support of your answer .

26.(a) When a co-ordination compound  $\text{CrCl}_3.6\text{H}_2\text{O}$  is mixed with  $\text{AgNO}_3$ , 3 moles of  $\text{AgCl}$  are precipitated per mole of the compound . Write

- (i) Structural formula of the complex
- (ii) IUPAC name of the complex
- (b) Write the state of hybridization and the shape of the following complex entities :  $\text{K}_2[\text{Ni}(\text{CN})_4]$

27. Give reason for the following –

- (a) Chloroform is stored in closed dark brown bottles.
- (b)  $(\pm)$  Butan-2-ol is optically inactive .
- (c) C-X bond length in haloarenes is smaller than C-X bond length in haloalkanes .

28. State Kohlrausch law of independent migration of ions. How molar conductivity varies for weak and strong electrolytes on dilution?

### Section D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

29. Osmosis plays a significant role in the absorption of water by plant roots from the soil and its movement to different parts of the plant body. When placed in water containing more than 0.9% (mass/volume) salt, blood cells collapse due to loss of water by osmosis. In animals' circulation of water to all parts of the body takes place due to osmosis. Osmosis helps in plant growth and germination of seeds. The phenomenon of osmosis is also useful in some industrial processes. It is employed commercially for the desalination of seawater so that it may become useful for drinking purposes. (Reverse osmosis) The Reverse Osmosis process is very popular for the purification of drinking water in households.

The osmotic pressure of a solution is the excess pressure that must be applied to a solution to prevent osmosis, i.e., to stop the passage of solvent molecules through a Semipermeable membrane into the solution. Osmotic pressure is colligative property as it depends on the number of solute molecules and not on their identity. For dilute solutions, it has been found experimentally that osmotic pressure is proportional to the molarity,  $C$  of the solution at a given temperature  $T$ . Thus:  $\pi = CRT$  Here  $\pi$  is the osmotic pressure and  $R$  is the gas constant.

Answer following questions:

- (a) What is reverse osmosis ?
- (b) Name the membrane used in Reverse osmosis .
- (c) What do you expect to happen when Red blood corpuscles (RBC's) are placed in –
  - (i) 1% NaCl solution                      (ii) 0.5% NaCl solution
- or
- (c) Measurement of osmotic pressure method is preferred for the determination of molar mass of macromolecules . Why ?

30. Protein primary structure is the linear sequence of amino acids in a peptide or protein. In contrast, Secondary structure refers to regular, recurring arrangements in the space of adjacent amino acid residues in a polypeptide chain. It is maintained by hydrogen bonds between amide hydrogens and carbonyl oxygens of the peptide back bone. The major secondary structures are  $\alpha$ -helix and  $\beta$ -pleated structures. The tertiary structure of protein represents overall folding of secondary structure. Two major type molecular shapes which are found naturally are fibrous and globular. Protein found in a biological system with a unique three-dimensional structure and biological activity is called a native protein. When a protein in its native form, is subjected to physical changes like change in temperature or chemical changes like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. The denaturation causes change in secondary and tertiary structures but primary structures remain intact. Examples of denaturation of protein are coagulation of egg white on boiling, curding of milk, formation of cheese when an acid is added to milk.

Answer following questions:

- (a) What type of bonding helps in stabilizing the  $\alpha$ -helix structure of proteins ?
- (b) Where does the water present in egg goes after boiling the egg ?
- (c) Give two differences between globular and fibrous protein.
- or
- (c) What is meant by a peptide linkage? Explain with one example .

## SECTION E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

31.(a) Write the reaction of anode and cathode during discharging of lead storage battery

(b) Calculate the emf of the following cell at 25 °C.



[Given,  $E^\circ_{\text{cell}} = +2.71\text{V}$  and  $\log 10^n = n$ ]

or

(a) What are fuel cells? Explain the electrode reactions involved in the working of  $\text{H}_2\text{—O}_2$  fuel cell.

(b) The conductivity of  $0.001\text{ mol L}^{-1}$  solution of  $\text{CH}_3\text{COOH}$  is  $3.905 \times 10^{-5}\text{ S cm}^{-1}$ . Calculate its molar conductivity and degree of dissociation ( $\alpha$ ). Given,  $\lambda^\circ(\text{H}^+) = 349.6\text{ S cm}^2\text{ mol}^{-1}$  and  $\lambda^\circ(\text{CH}_3\text{COO}^-) = 40.9\text{ S cm}^2\text{ mol}^{-1}$ .

32. (a) Give chemical tests to distinguish between the following pairs of compounds .

(i) Ethanal and Propanal

(ii) Phenol and Benzoic acid

(b) How will you bring about the following conversions?

(i) Benzoic acid to benzaldehyde

(ii) Ethanal to but-2-enal

(c) Carboxylic acids do not give characteristic reactions of carbonyl group. Explain why?

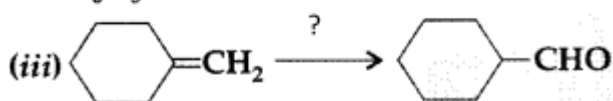
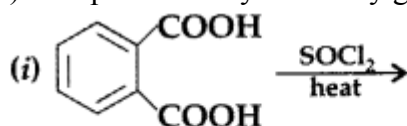
or

(a) Give chemical tests to distinguish between the following :

(i) Propanal and Propanone

(ii) Benzaldehyde and Acetophenone

(b) Complete each synthesis by giving missing reagents or products in the following :



33. Attempt any five of the following:

(a) Which of the following ions will have a magnetic moment value of 1.73 BM.  $\text{Sc}^{3+}$ ,  $\text{Ti}^{3+}$ ,  $\text{Ti}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Zn}^{2+}$

(b) In order to protect iron from corrosion, which one will you prefer as a sacrificial electrode, Ni or Zn? Why? (Given standard electrode potentials of Ni, Fe and Zn are -0.25 V, -0.44 V and -0.76 V respectively.)

(c) The second ionization enthalpies of chromium and manganese are 1592 and 1509 kJ/mol respectively. Explain the lower value of Mn.

(d) Give two similarities in the properties of Sc and Zn.

(e) What is actinoid contraction? What causes actinoid contraction?

(f) What is the oxidation state of chromium in chromate ion and dichromate ion?

(g) Write the ionic equation for reaction of KI with acidified  $\text{KMnO}_4$ .