

SUBJECT: CHEMISTRY  
CLASS : XII  
SET-B

Time Allowed: 3 Hrs

Max. Marks: 70

Name of the Student: \_\_\_\_\_

Day & Date: Monday 1.12.2025

Name & Sign of Invigilator: \_\_\_\_\_

Read the following instructions carefully.

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

SECTION A (10)

- Q1. Which one of the following sets correctly represents the increase in the paramagnetic property of the ions? 1
- $Ti^{3+} < Fe^{2+} < Cr^{3+} < Mn^{2+}$
  - $Ti^{3+} < Mn^{2+} < Fe^{2+} < Cr^{3+}$
  - $Mn^{2+} < Fe^{2+} < Cr^{3+} < Ti^{3+}$
  - $Ti^{3+} < Cr^{3+} < Fe^{2+} < Mn^{2+}$
- Q2. An organic compound 'X' on treatment with  $NH_3$  gives Y which on heating gives 'Z'. Z when treated with  $Br_2$  in the presence of  $KOH$  produces ethyl amine. Compound 'X' is 1
- $CH_3COOH$
  - $CH_3CH_2COOH$
  - $CH_3(CH_2)_2COOH$
  - $CH_3CH(CH_3)COOH$
- Q3. Which of the following is not correct? 1
- In haloarenes, the electron pairs on halogen atom are in conjugation with pi-electrons of the ring.
  - The carbon-magnesium bond is covalent and non-polar in nature.
  - During  $S_N1$  reaction, the carbocation formed in the slow step being  $sp^2$  hybridised is planar.
  - Out of  $CH_2=CH-Cl$  and  $C_6H_5CH_2Cl$ ,  $C_6H_5CH_2Cl$  is more reactive towards  $S_N1$  reaction.
- Q4. Which of the following statement is true? 1
- Molecularity of reaction can be zero or a fraction. ✗
  - Molecularity has no meaning for complex reactions.
  - Molecularity of a reaction is an experimental quantity.
  - Reactions with the molecularity three are very rare but are fast. ✗
- Q5. How many Faradays are required to reduce 1 mol of  $KMnO_4$  to  $Mn^{2+}$ ? 1
- 4
  - 3
  - 6
  - 5
- Q6. Which of the following will not give iodoform test? 1
- Ethanol
  - Ethanal
  - Pentan-3-one
  - Pentan-2-one

Q7 The reduction of ethanenitrile with sodium and alcohol gives :

- a. 1-aminopropane
- b. 1-aminoethane
- c. Ethanoic acid
- d. Ethanamide

Q8. A compound undergoes complete tetramerization in a given organic solvent. The van't Hoff factor is:

- a. 4.0
- b. 0.25
- c. 0.125
- d. 2.0

Q9 Which one of the following reactions is not explained by the open chain Structure of glucose:

- a. Formation of pentaacetate of glucose with acetic anhydride.
- b. Formation of addition product with 2,4DNP reagent
- c. Silver mirror form at ion with Tollen's reagent
- d. Existence of alpha and beta forms of glucose

Q10 The half-life for a zero order reaction equals :

- (a)  $\frac{2k}{R}$
- (c)  $\frac{R^2}{2k}$

- (b)  $\frac{1}{2} \frac{k}{R^2}$
- (d)  $\frac{R}{2k}$

~~$R = R_0 - k t$~~   
 $\frac{R_0}{R}$

~~$R = R_0 + k = t + 1/2$~~

Q11 Allyl phenyl ether can be prepared by heating

- a.  $C_6H_5Br + CH_2=CH-CH_2ONa$
- b.  $CH_2=CHCH_2Br + C_6H_5ONa$
- c.  $C_6H_5CH=CHBr + CH_3ONa$
- d.  $CH_2=CHBr + C_6H_5CH_2ONa$

Q12. The ions of metals of Group 12 (Zn, Cd and Hg) have completely filled d orbitals and so they :

- a. behave like semiconductors
- b. are very high melting solids
- c. do not behave like transition metals
- d. behave like superconductors

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
- e. A and R are false

Q13 **Assertion:** It is difficult to replace chlorine by -OH in chlorobenzene in comparison to that in chloroethane.

(a) **Reason:** Carbon - Chlorine (C - Cl) bond in chlorobenzene has a partial double bond character due to resonance.

(Q14) **Assertion (A):** Boiling points of alcohols are much higher than those of alkanes, halo alkanes or ethers of comparable molecular masses.

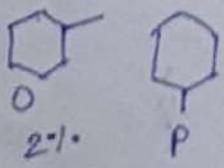
**Reason (R):** Strong intermolecular hydrogen bonding exists in Alcohols.

Q15 **Assertion (A):**  $[Cr(H_2O)_6]Cl_2$  and  $[Fe(H_2O)_6]Cl_2$  are examples of homoleptic complexes.

**Reason (R):** All the ligands attached to the metal are the same.

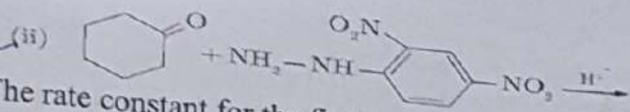
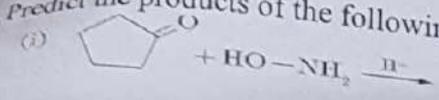
Q16 **Assertion (A):** During the nitration of aniline, 47% of the product formed is meta-substituted.

**Reason (R):** During the nitration of aniline, anilinium ion is formed that has the meta-directing  $-NH_3^+$  group.



SECTION B

Predict the products of the following reactions :



1+1

10

13  
28

2

Q18. The rate constant for the first order decomposition of  $N_2O_5$  is given by the following equation :

$$\log k = 23.6 - \frac{2 \times 10^4 K}{T}$$

$16.628 \times 10^4$

2

Q19

Calculate  $E_a$  for this reaction. [ $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$ ]  
An alkyl halide (A) of molecular formula  $C_6H_{13}Cl$  on treatment with alcoholic KOH gives two isomeric alkenes (B) and (C) of molecular formula  $C_6H_{12}$ . Both alkenes on hydrogenation give 2,3-dimethylbutane. Write the structures of (A), (B) and (C).

Q20

1.00 molal aqueous solution of trichloroacetic acid ( $CCl_3COOH$ ) is heated to its boiling point. The solution has the boiling point of  $100.8^\circ C$ . Determine the van't Hoff factor for trichloroacetic acid. ( $K_b$  for water =  $0.512 \text{ K kg mol}^{-1}$ )

$0.39$

Q21

The presence of Carbonyl group in glucose is confirmed by its reaction with hydroxylamine. Identify the type of carbonyl group present and its position. Give a chemical reaction in support of your answer.

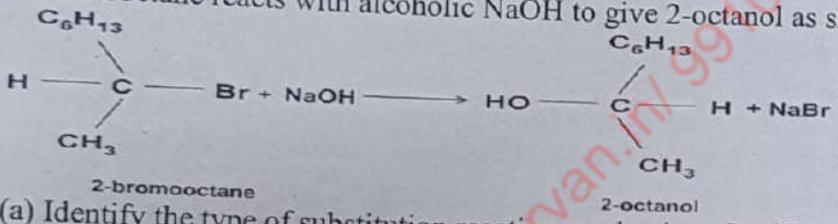
OR

Write down the structures and names of the products formed when D-glucose is treated with:  
(i) Bromine water  
(ii) Hydrogen Iodide (Prolonged heating).

SECTION C

Q22

2-bromooctane reacts with alcoholic NaOH to give 2-octanol as shown below.



(a) Identify the type of substitution reaction mechanism. Justify your answer.  
(b) Two compounds X and Y are enantiomers of each other. Name one physical property that: (i) is the same for X and Y. (ii) is different for X and Y.

Q23

0.3 g of acetic acid ( $M = 60 \text{ gmol}^{-1}$ ) dissolved in 30 g of benzene shows depression in freezing point equal to  $0.45^\circ C$ . Calculate the percentage association of acid if it forms a dimer in the solution. (Given :  $K_f$  for benzene =  $5.12 \text{ K/kg/mol}$ )

OR

If benzoic acid ( $M = 122 \text{ gmol}^{-1}$ ) is associated into a dimer when dissolved in benzene and the osmotic pressure of a solution of 6.1 g of benzoic acid in 100 mL benzene is 6.5 atm at  $27^\circ C$ , then what is the percentage association of benzoic acid ?

(Given :  $R = 0.0821 \text{ LatmK}^{-1} \text{ mol}^{-1}$ )

Q24

A metal complex having composition  $Cr(NH_3)_4Cl_2Br$  has been isolated in two forms A and B. The form A reacts with  $AgNO_3$  to give a white precipitate readily soluble in dilute aqueous ammonia whereas B gives a pale yellow precipitate soluble in concentrated ammonia.

- (i) Write the formulae of isomers A and B.
- (ii) State the hybridisation of chromium in each of them.
- (iii) Calculate the magnetic moment (spin only value) of the isomer A.

Q25

(i) Explain that  $[Co(NH_3)_5Cl]SO_4$  and  $[Co(NH_3)_5SO_4]Cl$  are ionization isomers.  
(ii)  $[Fe(H_2O)_6]^{3+}$  is strongly paramagnetic whereas  $[Fe(CN)_6]^{3-}$  is weakly paramagnetic. Explain.

(iii) Write the formula for the complex: Pentaamminenitrito-O-Cobalt (III) ion.

3

15

Q26 (i) Give chemical tests to distinguish between the following pairs of compound.  
 Pentan-2-one and Pentan-3-one  
 (ii) Arrange the following in the increasing order of their property indicated

a. Acetaldehyde, Acetone, Methyl tert butyl ketone (reactivity towards  $\text{NH}_2\text{OH}$ ).  
 b. Ethanol, ethanoic acid, ethanal (boiling point)

Q27 The activation energy of a reaction is  $75.24 \text{ kJ mol}^{-1}$  in the absence of a catalyst and  $50.14 \text{ kJ mol}^{-1}$  with a catalyst. How many times will the rate of reaction grow in the presence of the catalyst if the reaction proceeds at  $25^\circ\text{C}$ ? ( $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ ) [Antilog  $4.40 = 2.512 \times 10^4$ ]

Q28 (i) Using  $E^\circ$  values of X and Y given below, predict which is better for coating the surface of iron to prevent corrosion.  
 Given  $E^\circ_{\text{X}^{2+}/\text{X}} = -2.36\text{V}$ ,  $E^\circ_{\text{Y}^{2+}/\text{Y}} = -0.14\text{V}$ ,  $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44\text{V}$   
 (ii) Predict whether the following reaction would occur spontaneously at  $298 \text{ K}$   
 $\text{Co(s)} + \text{Fe}^{2+}(\text{aq}) \rightarrow \text{Co}^{2+} + \text{Fe(s)}$  Given  $[\text{Co}^{2+}] = 1.0\text{M}$ ;  $[\text{Fe}^{2+}] = 1.0\text{M}$ ;  $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44\text{V}$   
 $E^\circ_{\text{Co}^{2+}/\text{Co}} = -0.278 \text{ V}$

OR

A  $0.05\text{M}$   $\text{NaOH}$  solution offered a resistance of  $31.6\Omega$  in a conductivity cell at  $298\text{K}$ . If the cell constant of the conductivity cell is  $0.367 \text{ cm}^{-1}$ , find out the conductivity and molar conductivity of the sodium hydroxide solution.

SECTION D

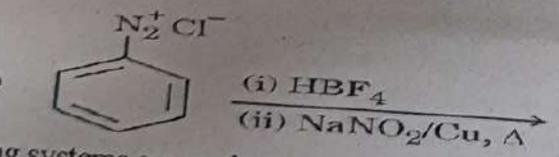
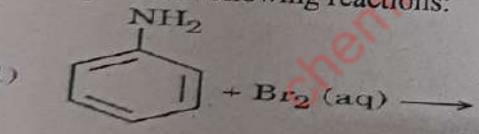
Q29 Amines are usually formed from nitro compounds, halides, amides, imides, etc. They exhibit hydrogen bonding which influences their physical properties. In alkyl amines, a combination of electron releasing, steric and hydrogen bonding factors influence the stability of the substituted ammonium cations in protic polar solvents and thus affect the basic nature of amines. In aromatic amines, electron releasing and withdrawing groups, respectively increase and decrease their basic character. Influence of the number of hydrogen atoms at nitrogen atom on the type of reactions and nature of products is responsible for identification and distinction between primary, secondary and tertiary amines. Presence of amino group in aromatic ring enhances reactivity of the aromatic amines. Aryl diazonium salts provide advantageous methods for producing aryl halides, cyanides, phenols and arenes by reductive removal of the diazo group.

Answer the following questions :

(i) Arrange the following in the increasing order of their  $\text{pK}_b$  values in aqueous solution :  
 $\text{C}_2\text{H}_5\text{NH}_2$ ,  $(\text{C}_2\text{H}_5)_2\text{NH}$ ,  $(\text{C}_2\text{H}_5)_3\text{N}$   
 (ii) Aniline on nitration gives a substantial amount of m-nitroaniline, though amino group is o/p directing. Why?

(iii) What is carbylamine reaction?

(iv) Complete the following reactions:



$K = \frac{357}{31600}$   
 $\lambda_m = \frac{18850}{79}$

$3 > 2 > 1$  OR  $3 > 2 > 1$

$1 < 2 < 3$   
 $\text{pK}_b \propto \frac{1}{K}$

$273 + 25 = 298$   
 $\frac{75.24 - 50.14}{8.314 \times 298} = \ln \frac{k_2}{k_1}$   
 $\ln \frac{k_2}{k_1} = 10.1$   
 $\frac{k_2}{k_1} = 2.512 \times 10^4$

Excell 2  
 $-0.162$   
 $\frac{R}{F} \ln \frac{1}{A}$   
 $K = \frac{1}{8}$

1+1+2

Q30. Living systems are made up of various complex biomolecules like carbohydrates, proteins, nucleic acids, lipids, etc. Carbohydrates are optically active polyhydroxy aldehydes or ketones or molecules which provide such units on hydrolysis. They are broadly classified into three groups monosaccharides, oligosaccharides and polysaccharides. Monosaccharides are held together by glycosidic linkages to form disaccharides like sucrose, maltose or polysaccharides like starch and cellulose. Another biomolecule : proteins are polymers of amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids. Structure and shape of proteins can be studied at four different levels i.e. primary, secondary, tertiary and quaternary, each level being more complex than the previous one.

Answer the following questions :

- (i) What is the difference between a glycosidic linkage and peptide linkage ?  
 (ii) Which amino acids are called essential amino acids ?  
 (iii) What are the common types of secondary structures of proteins ? Write any two forces which stabilise the secondary and tertiary structures of protein.

OR

- (iii) Define denaturation of protein with an example. During denaturation which structures of protein lose their biological activity ?

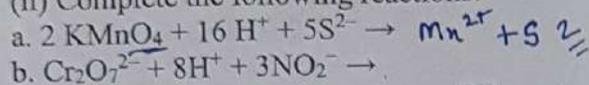
SECTION E

5

Q31 (i) Give reasons:

- a. Transition metals and their compounds show catalytic activities.  
 b. Separation of a mixture of Lanthanoid elements is difficult.  
 c. Zn, Cd and Hg are soft and have low melting point. 3

(ii) Complete the following reactions:

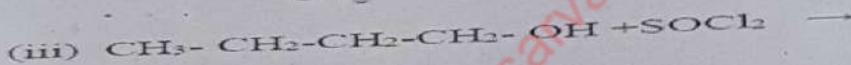
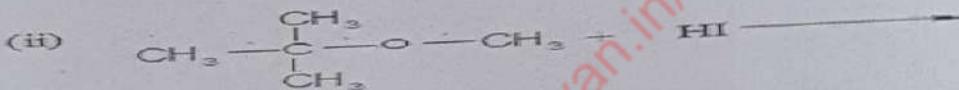
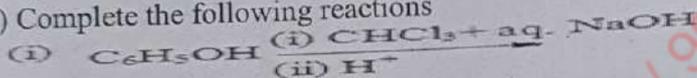


OR

(i) Give reasons:

- a. Transition metals form alloys.  
 b.  $\text{Cu}^{2+}$  salts are coloured while  $\text{Zn}^{2+}$  salts are white. 3  
 c. Transition metals form interstitial compounds.  
 d. Zinc is not regarded as a transition element.  
 e. Cobalt(II) is stable in aqueous solution but in the presence of complexing reagents it is easily oxidized.

Q32. (i) Complete the following reactions

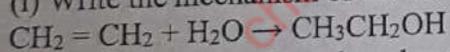


(ii) How would you convert the following

- a. Propene to propan-1-ol  
 b. Formaldehyde to propan-1-ol

OR

(i) Write the mechanism of the following reaction:

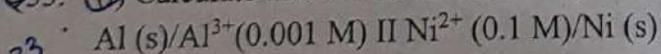


(ii) What happens when phenol reacts with

- a. Conc.  $\text{HNO}_3$ , and  
 b.  $\text{CO}_2$  in presence of aqueous NaOH followed by acidification?

(iii) Why does the reaction of  $\text{CH}_3\text{ONa}$  with  $(\text{CH}_3)_3\text{CBr}$  give 2-methylpropene and not  $(\text{CH}_3)_3\text{C-O-CH}_3$  ?

Q33. (i) Calculate the emf of the following cell at 298 K:



[Given:  $E^0_{\text{Al}^{3+}/\text{Al}} = -1.66 \text{ V}$ ,  $E^0_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V}$ ,  $\log 10 = 1$ ]

[1.3904]

(ii) With the help of a graph explain why it is not possible to determine for a weak electrolyte by extrapolating the molar conductivity versus  $C^{1/2}$  curve as for strong electrolyte.

OR

- (i) Calculate the electrode potential of a zinc wire dipped in 0.1 M  $\text{ZnSO}_4$  solution at 298 K. The standard electrode potential of zinc is -0.76 volt.
- (ii) Three electrolytic cells A, B and C containing solutions of  $\text{ZnSO}_4$ ,  $\text{AgNO}_3$  and  $\text{CuSO}_4$  respectively are connected in series. A steady current of 1.5 amperes was passed through them until 1.45g of silver deposited at the cathode of cell B. How long did the current flow? What mass of copper and zinc were deposited? (At mass Zn=65.3; Cu=63.5; Ag=108)

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