

SECTION-A

Question no 1 to 16 are Multiple Choice Questions, carrying 1 mark each.

16x1

1. A solution of phenol and aniline:
(A) obeys Raoult's law
(B) do not forms azeotropes
(C) shows positive deviation from Raoult's law
(D) shows negative deviation from Raoult's law
2. Which of the following is independent of temperature?
(A) Molarity (B) Molality
(C) Solubility (D) Osmotic pressure
3. A galvanic cell can behave like an electrolytic cell when:
(A) $E_{\text{cell}} = E_{\text{ext}}$ (B) $E_{\text{ext}} > E_{\text{cell}}$
(C) $E_{\text{cell}} > E_{\text{ext}}$ (D) $E_{\text{cell}} = 0$
4. E_{Red}° values of three metals X, Y and Z are -1.2V, 0.5 V and -3.0 V respectively. The order of reducing power of metals will be -
(A) $X < Y < Z$ (B) $Y < X < Z$
(C) $X < Z < Y$ (D) $Z < X < Y$
5. A reaction is first order with respect to reactant 'A' and second order with respect to reactant 'B'. When concentration of reactants 'A' and 'B' increased to thrice its original value, rate of reaction will become -
(A) 3 times (B) 24 times
(C) 9 times (D) 27 times

$$r = k[A]^1[B]^2$$

$$(C) \quad 9 \text{ times} = k[3A][3B]^2$$

$$(D) \quad 27 \text{ times} = 27kAB^2$$



6. Element of first transition series which does not exhibit variable oxidation state is :

(A) Sc ($z = 21$)

(B) Cr ($z = 24$)

(C) Mn ($z = 25$)

(D) Cu ($z = 29$)

7. The spin-only magnetic moment value of Cr^{3+} ion is -

(A) 2.87 B.M.

(B) 3.87 B.M.

(C) 4.89 B.M.

(D) 0.00 B.M.

8. Oxidation number and coordination number of 'Pt' in complex $[\text{Pt}(\text{en})_2(\text{H}_2\text{O})_2]^{4+}$ are respectively:

(A) 2, 4

(B) 4, 4

(C) 4, 6

(D) 6, 4

9. Which of the following alkyl halide undergoes $\text{S}_\text{N}1$ reaction most readily?

(A) $(\text{CH}_3)_3\text{C-F}$

(B) $(\text{CH}_3)_3\text{C-Cl}$

(C) $(\text{CH}_3)_3\text{C-Br}$

(D) $(\text{CH}_3)_3\text{C-I}$

10. Among the following, most stable complex is :

(A) $[\text{FeCl}_6]^{3-}$

(B) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$

(C) $[\text{Fe}(\text{NH}_3)_6]^{3+}$

(D) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

11. Which of the following compound have highest K_a value?

(A) Ethanol

(B) Phenol

(C) 2-Nitrophenol

(D) 4-Nitrophenol

12. The correct increasing order of boiling point is:

(A) Propan-1-ol, Propan-2-ol, Butan-1-ol

(B) Propan-2-ol, Propan-1-ol, Butan-1-ol

(C) Propan-2-ol, Butan-1-ol, Propan-1-ol

(D) Butan-1-ol, Propan-2-ol, Propan-1-ol

For question number 13 to 16 two statements are given – one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the order codes (a), (b), (c) and (d) as given below.

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

13. Assertion (A) : Soda bottles are sealed under high pressure.

Reason (R): Solubility of gas in liquid increases with decrease in temperature.

14. Assertion (A): Catalyst increases rate of chemical reactions.

Reason (R): Catalyst increases activation energy to form activated complex.

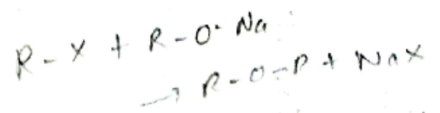
15. Assertion (A): Zr and Hf have almost similar atomic radii.

Reason (R): This is due to lanthanoid contraction

16. Assertion (A): Haloalkanes are very slightly soluble in water.

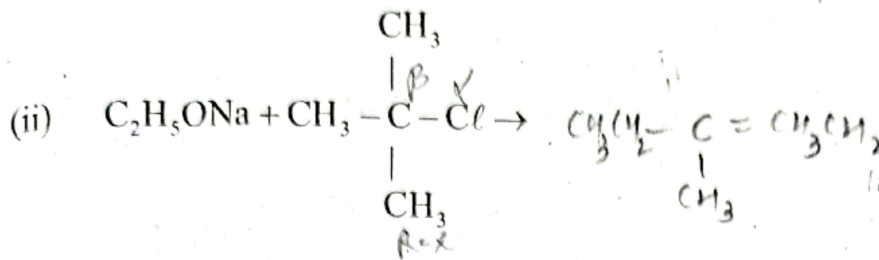
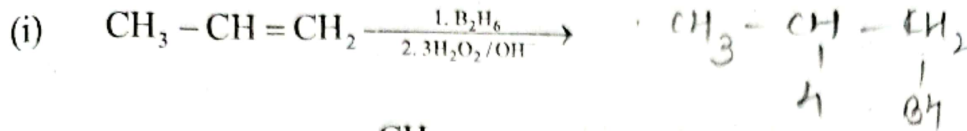
Reason (R): Haloalkanes ^(c) form hydrogen bonding with water molecules.

SECTION-B



17. Write the structures of major products formed in following reactions:

2x1



18. (A) The activation energy of a first order reaction is zero. If the rate constant at 280 K is $3.8 \times 10^3 s^{-1}$, then calculate the rate constant at 300 K.

2

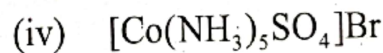
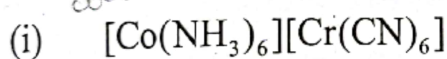
OR

(B) A first order reaction is 75% complete in 40 minutes. Calculate half-life of the reaction. (Given: $\log 2 = 0.30$, $\log 3 = 0.48$, $\log 4 = 0.60$)

2

19. Name the type of isomerism exhibited by following complexes:

4x1/2



20. Molar conductivities of NH_4Cl , $NaOH$ and $NaCl$ at infinite dilution are 129.8, 248.1 and 126.4 $S cm^2 mol^{-1}$ respectively. Calculate the limiting molar conductivity of NH_4OH .

21. Explain the following :

2x

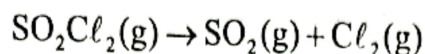
(i) $[Ni(H_2O)_6]^{2+}$ is green in colour while $[Ni(CN)_4]^{2-}$ is colourless. (Atomic number of Ni - 28)

(ii) Geometrical isomerism is not possible in tetrahedral complexes having two different types of unidentate ligands coordinated with the central metal ion. Explain.



SECTION-C

22. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume:



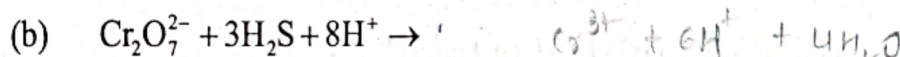
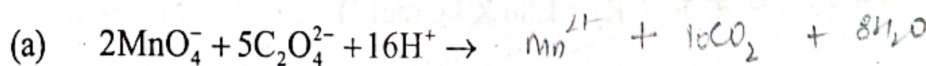
Experiment	Time/s	Total Pressure/atm
1	0	0.5
2	100	0.6

Calculate the rate of reaction when total pressure is 0.65 atm.

(Given: $\log 2 = 0.30$, $\log 5 = 0.70$)

23. (i) Give an example of disproportionation reaction involving any transition element. 1

(ii) Complete the following: 2



24. Account for the following:

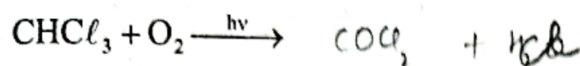
(i) With the same d-orbital configuration (d^4), Mn^{3+} ion is an oxidising agent whereas Cr^{2+} ion is a reducing agent.

(ii) Zn, Cd and Hg are not regarded as transition elements.

(iii) Transition elements exhibit catalytic properties.

25. (i) Write structural isomers of chlorobutane and arrange them in increasing order of their reactivity towards S_N^2 reaction. 2

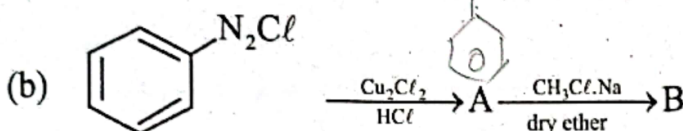
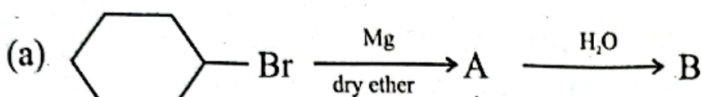
(ii) Complete the reaction:



OR

(i) Out of $CH_2=CH-CH_2-Cl$ and $CH_3-CH_2-CH_2-Cl$, which will undergo S_N^1 reaction faster and why? 1

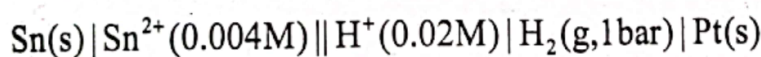
(ii) Complete the reactions by writing structures of A & B : 2



$\alpha = \frac{1}{1 - \frac{1}{273}}$
 $0^\circ = 273$
 $1^\circ = 273 + 1$
 $= 274K$

26. When 19.5 g of $F-CH_2-COOH$ (Molar mass = 78 g mol^{-1}) is dissolved in 500 g of water, the depression in freezing point is observed to be $1^\circ C$. Calculate the degree of dissociation of $F-CH_2-COOH$. (Given: K_f for water = $1.86 \text{ K kg mol}^{-1}$) $\alpha =$ 3

27. Write the cell reaction and calculate the e.m.f. of the following cell at 298 K :



(Given : $E_{Sn^{2+}/Sn}^0 = -0.14V$)

$Sn + 2H^+ \rightarrow Sn^{2+} + H_2$
 $E_{cell} = E_{cath}^0 - \frac{0.059}{n} \log \frac{[Sn^{2+}]}{[H^+]^2}$
 $R.O.R = k$

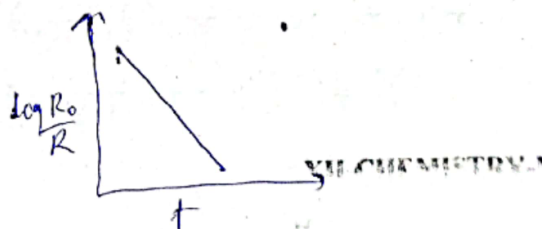
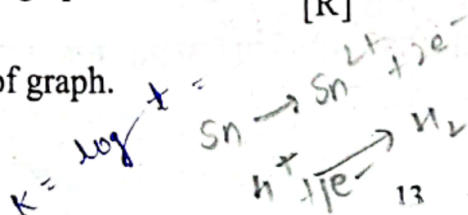
28. (i) Define rate constant. If rate constant (k) of a reaction is $6.95 \times 10^{-2} \text{ mol}^{-1} \text{ L s}^{-1}$, then what will be the order of reaction? 2

(ii) Which of the following can be zero? Justify. Order of reaction or Molecularity of reaction.

$R.O.R = k [A]^m [B]^n$

(iii) Draw a graph between $\log \frac{[R]_0}{[R]}$ versus time for a first order reaction and mention

slope of graph.



SECTION-D

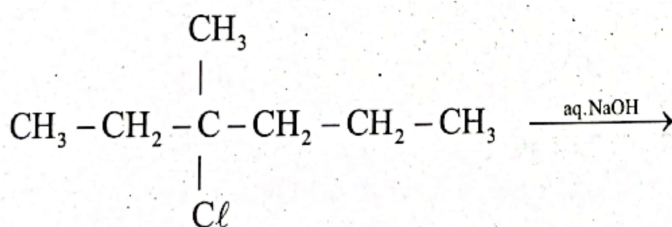
The following questions are case based questions. Read the passage carefully and answer the questions that follow.

29. Nucleophilic substitution reaction of haloalkane can be conducted according to both S_N^1 and S_N^2 mechanisms. S_N^1 is a two step reaction while S_N^2 is single step reaction. For any haloalkane which mechanism is followed depends on factors such as structure of haloalkane, properties of leaving group, nucleophilic reagent and solvent.

- (i) Out of S_N^1 and S_N^2 mechanisms, which results into the inversion of configuration? 1
- (ii) Define - racemic mixture. 1
- (iii) Among 1-Bromopropane, 2-Bromopropane, 1-Bromobutane, 2-Bromobutane which: 1
- (a) is optically active?
- (b) will undergo S_N^2 reaction at fastest rate? 2

OR

Write mechanism of following reaction:



30. The spontaneous flow of solvent through a semi-permeable membrane from a pure solvent to a solution or from a dilute solution to a concentrated solution is called osmosis. The phenomenon of osmosis can be demonstrated by taking two eggs of same size. In an egg, the membrane below the shell and around the egg material is semi-permeable. The outer hard shell can be removed by putting the egg in dilute hydrochloric acid. After removing the hard shell, one egg is placed in the distilled water and the other in a saturated salt solution. After some time egg placed in distilled water swells up while the egg placed in salt solution shrinks. The external pressure applied to stop the osmosis is termed as osmotic pressure (a colligative property)

- (i) Why osmotic pressure is a colligative property? 1
- (ii) What happens when a pressure higher than osmotic pressure is applied through semi-permeable membrane on solution side? 1

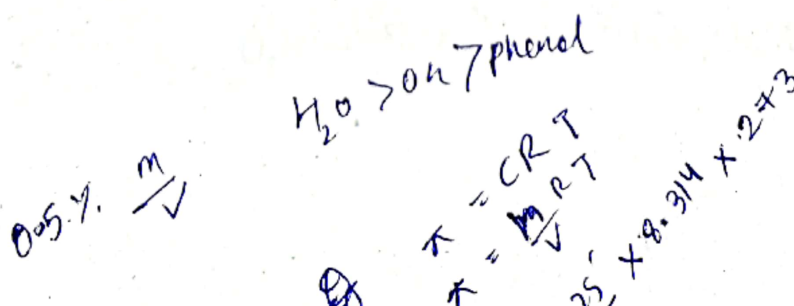
OR

What will happen when RBCs are placed in 0.5% (m/v) NaCl solution? 1

- (iii) A solution containing 15 g of urea (molar mass = 60 g mol⁻¹) per litre of solution in water is isotonic with a solution of glucose (molar mass = 180 g mol⁻¹) in water. Calculate the mass of glucose present in one litre of solution. 2

SECTION-E

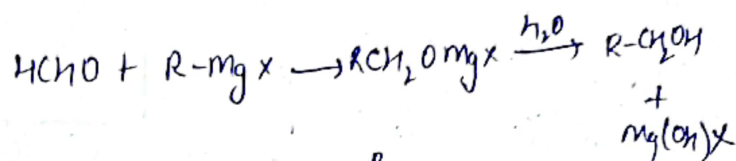
31. (A) (i) Write the mechanism of acid catalyzed hydration of alkene. 2
- (ii) Give simple chemical test to distinguish between Butan-1-ol and Butan-2-ol. 1
- (iii) Explain following:
- (a) The C-O bond length in phenol is slightly less than C-O bond length in methanol.
- (b) Ortho-Nitrophenol is more acidic than Ortho-Methoxyphenol.



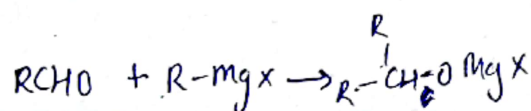
OR

- (B) (i) How will you synthesise following alcohols using appropriate Grignard's reagent?

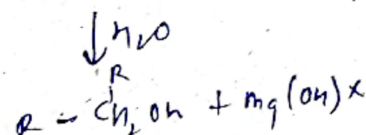
(a) Ethanol



(b) Propan-2-ol



Mention relevant chemical reactions.



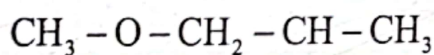
- (ii) Mention examples of following reactions:

(a) Swarts reaction

2.

(b) Kolbe's reaction

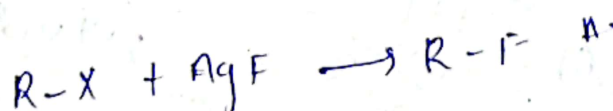
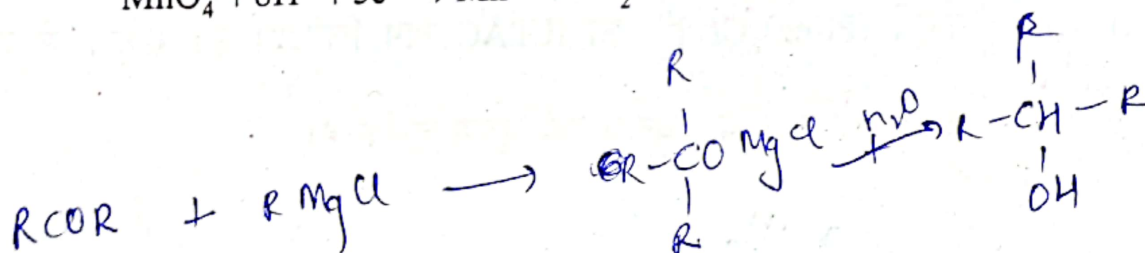
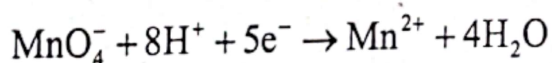
- (iii) Write the IUPAC name of following:



1 methoxy 3 methyl
propane.

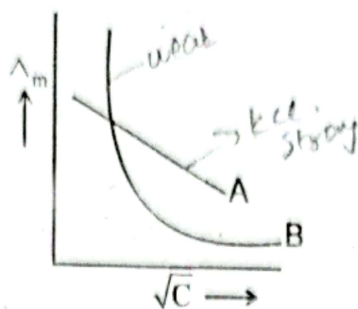
32. (A) (i) State Faraday's first law of electrolysis. How much electricity is required to reduce 1 mole of MnO_4^- ion according to reaction :

$$m = \frac{M \times I \times t}{nF}$$



(ii) Consider the following graph and answer the questions:

3



- (a) Identify the types of electrolytes shown by 'A' & 'B'.
- (b) Account for the variation shown by electrolyte 'B' with change in concentration.

$$\frac{129}{25} = 5.16$$

- (c) How limiting molar conductivity of electrolyte 'B' can be determined?

$$\Lambda^{\infty} = R \cdot K$$

OR

- (B) (i) Resistance of a of a conductivity cell filled with $0.1 \text{ mol L}^{-1} \text{ KCl}$ solution is 100Ω . If the resistance of same cell, when filled with $0.02 \text{ mol L}^{-1} \text{ KCl}$ solution is 520Ω , calculate the conductivity and molar conductivity of $0.02 \text{ mol L}^{-1} \text{ KCl}$ solution. The conductivity of $0.1 \text{ mol L}^{-1} \text{ KCl}$ solution is 1.29 Sm^{-1} .

$$\frac{R}{K} = \frac{100}{1.29}$$

$$\Lambda^{\infty} = R \cdot K$$

$$\Lambda^{\infty} = 100 \times \frac{1.29}{100}$$

$$\Lambda_m = \frac{1.29 \times 10^2 \times 1000 \times 0.02}{0.02}$$

$$K = \frac{\Lambda}{C}$$

$$\Lambda^{\infty} = \frac{1}{A} \cdot K$$

$$\Lambda^{\infty} = R \cdot K$$

$$\Lambda^{\infty} = 100 \times \frac{1.29}{100}$$

$$\Lambda^{\infty} = 1.29$$

- (ii) What are secondary batteries? Give an example

- (iii) Write two advantages of fuel cells.

$$\Lambda^{\infty} = R \cdot K$$

33. (A) (i) Write IUPAC name of complex $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$. Write the structure of geometrical isomer of the complex which is optically active.

$$K = 1000$$

$$10 - 2 = +2$$

$$K = \frac{K \times 1000}{C}$$



$$\Lambda_m = \frac{1}{3} = \frac{1}{A}$$



(ii) Explain the following for the complex $[\text{CoF}_6]^{3-}$:

3

(a) hybridisation

(b) geometry

(c) magnetic properties

(Atomic number: Co = 27)

OR

B) (i) When one mole of $\text{CoCl}_3 \cdot 5\text{NH}_3$ is treated with excess of silver nitrate, two moles of AgCl was obtained. Write the structural formula and IUPAC name of coordination compound. 2

(ii) On the basis of crystal field theory, write electronic configuration of central metal ion of complex $[\text{CoCl}_6]^{3-}$. (atomic number of Co = 27) 1

(iii) What are chelate ligands? Give an example. 2