CHEMISTRY

Time : 3 hrs **Max. Marks: 70**

General Instructions :

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

SECTION-A

1. For determination of molar mass of polymers and proteins, which colligative property is used ?

(A) Relative lowering in vapour pressure

(B) Elevation in boiling point

(C) Osmotic pressure

(D) Depression in freezing point

2. For the given cell, $Mg|Mg^{2+}||Cu^{2+}|Cu$

(A) Mg is cathode

(B) Cu is anode

(C) The cell reaction is $Mg + Cu^{2+} \longrightarrow Mg^{2+} + Cu$

(D) Cu is the oxidising agent

3. The half-life for a zero order reaction having 0.02 M initial concentration of reactant is 100 s. The rate constant (in mol L^{-1} s^{-1}) for the reaction is

(A) 1.0×10^{-4} (B) 2.0×10^{-4} (C) 2.0×10^{-3} (D) 1.0×10^{-2}

4. Which of the following reactions are disproportionation reaction?

(1) $2Cu^{+} \longrightarrow Cu^{2+} + Cu^{0}$

(2) $3MnO_4^{2-} + 4H^{+} \longrightarrow 2MnO_4^{-} + MnO_2 + 2H_2O$

(3) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$

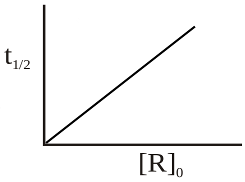
(4) $2MnO_4^{-} + 3Mn^{2+} + 2H_2O \longrightarrow 5MnO_2 + 4H^{\oplus}$

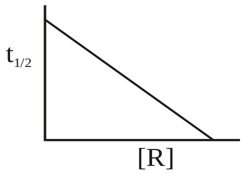
Select the correct option from the following :-

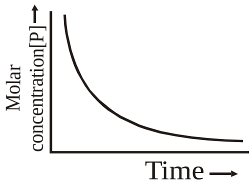
(A) (1) and (2) only (B) (1), (2) and (3)

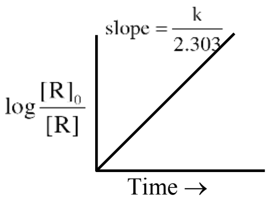
(C) (1), (3) and (4) (D) (1) and (4) only

5. Which of the following graph is correct for a first order reaction?

(A) 

(B) 

(C) 

(D) 

6. The correct IUPAC name of $[Pt(NH_3)_2Cl_2]$ is :-

(A) Diamminedichloridoplatinum (II)

(B) Diamminedichloridoplatinum (IV)

(C) Diamminedichloridoplatinum (0)

(D) Dichloridodiammineplatinum (IV)

7. Lucas test is used to distinguish between –

(A) 1^o, 2^o and 3^o alcohols

(B) 1^o, 2^o and 3^o amines

(C) Aldehydes and ketones

(D) Alkenes and alkynes

8. Which of the following alcohol contains C_{sp^3} – OH bond?

(A) Allylic alcohol

(B) Vinylic alcohol

(C) Phenols

(D) None of these

9. The pair $[Co(NH_3)_4Cl_2]Br_2$ and $[Co(NH_3)_4Br_2]Cl_2$ will show

(A) Linkage isomerism

(B) Hydrate isomerism

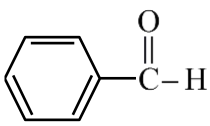
(C) Ionization isomerism

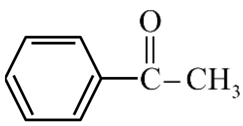
(D) Coordinate isomerism

10. Which of the following compounds is most reactive towards nucleophilic addition reactions ?

(A) $CH_3-\overset{\overset{\displaystyle O}{||}}{C}-H$

(B) $CH_3-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$

(C) 

(D) 

11. Which of the following is a disaccharide ?

(A) Starch

(B) Maltose

(C) Fructose

(D) Glucose

12. The reagent which does not react with both, acetone and benzaldehyde ?

(A) Sodium hydrogen sulphite

(B) Phenyl hydrazine

(C) Fehling's solution

(D) Grignard reagent

13. **Assertion (A) :** Hofmann's bromamide reaction is given by amide.

Reason (R) : Primary amines less basic than secondary amines.

(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. **Assertion (A) :** Transition metals have low melting points.

Reason (R) : The involvement of greater number of (n – 1)d and ns electrons in the interatomic metallic bonding.

(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. **Assertion (A) :** KCN reacts with methyl chloride to give methyl isocyanide.

Reason (R) : CN^{-} is an ambident nucleophile.

(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. **Assertion (A) :** Sucrose is a non-reducing sugar.

Reason (R) : Sucrose has glycosidic linkage.

(A) Both Assertion and Reason are correct statements, and Reason is the correct explanation of the Assertion.

(B) Both Assertion and Reason are correct statements, and Reason is not the correct explanation of the Assertion.

(C) Assertion is correct, but Reason is incorrect statement.

(D) Assertion is incorrect, but Reason is correct statement.

SECTION-B

17. For the reaction,

$$2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g),$$

the rate of formation of NO_2 (g) is 2.8×10^{-3} M s^{-1}. Calculate the rate of disappearance of $N_2O_5(g)$.

18. The conductivity of 0.001 mol L^{-1} solution of CH_3COOH is 3.905×10^{-5} S cm^{-1}.

Calculate its molar conductivity and degree of dissociations (a).

Given l°(H^+) = 349.6 S cm^2 mol^{-1} and l°(CH_3COO^-) = 40.9 S cm^2 mol^{-1}.

19. Complete the following chemical equations:

(a) $MnO_4^-(aq) + S_2O_3^{2-}(aq) + H_2O\ (l) \longrightarrow$

(b) $Cr_2O_7^{2-}(aq) + Fe^{2+}(aq) + H^+(aq) \longrightarrow$

20. (a) Write the IUPAC names of the following :

$[Co(NH_3)_5(ONO)]^{2+}$

(b) Write the IUPAC names of the following :

$K_2[NiCl_4]$

OR

(a) What is chelate complex? Give on example.

(b) What are heteroleptic complexes ? Give one example.

21. An Organic compound (A) with molecular formula C_3H_7NO on heating with Br_2 and KOH forms a compound (B). Compound (B) on heating with $CHCl_3$ and alcoholic KOH produces a foul smelling compound (C) and on reacting with $C_6H_5SO_2Cl$ forms a compound (D) which is soluble in alkali. Write the structures of (A), (B), (C) and (D).

SECTION-C

22. **(a)** Calculate $E^\circ_{cell} = 0.261V$ for the following reaction at 298 K:

$2Cr(s) + 3Fe^{2+}(0.01M) \rightarrow 2Cr^{3+}(0.01M) + 3Fe(s)$

Given : $E_{cell} = 0.261V$

(b) Using the E° values of A and B, predict which one is better for coating the surface of iron [$E°(Fe^{2+}/Fe) = -0.44$ V] to prevent corrosion and why ?

Given : $E°(A^{2+}/A) = -2.37$ V : $E°(B^{2+}/B) = -0.14$V

23. **Give reasons :**

(a) E^0 value for $\mathbf{Mn^{3+}/Mn^{2+}}$ couple is much more positive than that for $\mathbf{Fe^{3+}/Fe^{2+}}$.

(b) Iron has higher enthalpy of atomization than that of copper.

(c) Sc^{3+} is colourless in aqueous solution whereas $\mathbf{Ti^{3+}}$ is coloured.

24. **(a)** Using valence bond theory, predict the hybridization and magnetic character of following :

$[CoF_6]^{3-}$ [Atomic number of Co = 27]

(b) Write IUPAC name of the following complex : $[CoBr_2(en)_2]^+$

(c) How many ions are produced from the complex $[Co(NH_3)_6]Cl_2$ in solution ?

25. (a) Distinguish between:

(i) $C_6H_5–CH=CH–COCH_3$ and $C_6H_5–CH=CH–CO\ CH_2CH_3$

(ii) CH_3CH_2COOH and HCOOH

(b) Arrange the following in the increasing order of their boiling points :

CH_3CH_2OH, CH_3COCH_3, CH_3COOH

26. Give the structures of A and B in the following sequence of reactions :

(a) $CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{NaOBr} B$

(b) $C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow[0°–5°C]{NaNO_2+HCl} B$

(c) $C_6H_5N_2^+Cl^- \xrightarrow[\Delta]{CuCN} A \xrightarrow{H_2O/H^+} B$

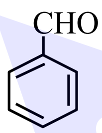
27. (a) Write Nernst equation for the reaction at 25°C :

$2Al(s) + 3Cu^{2+}(aq) \longrightarrow 2Al^{3+}(aq) + 3Cu(s)$

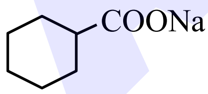
(b) What are secondary batteries ? Given an example.

(c) How does molar conductivity vary with increase in concentration for strong electrolyte and weak electrolyte ?

28. (a) Write the major products in the following :

(i) 

$\xrightarrow[273–283\ K]{HNO_3+H_2SO_4}$

(ii) 

$+ NaOH \xrightarrow[\Delta]{CaO}$

(iii) $CH_3–\underset{\displaystyle H}{\underset{|}{C}}=O \xrightarrow{NH_2OH}$

OR

(b) (i) Oxidation of propanal is easier than propanone. Why ?

(ii) How can you distinguish between Acetophenone and Benzophenone ?

(iii) Draw the structure of the following derivative :

2,4-Dinitrophenylhydrazone of Propanone

SECTION-D

29. Alcohols and phenols react with active metals such as sodium, potassium and aluminium to yield corresponding alkoxides/phenoxides and hydrogen. The acidic character of alcohols is due to the polar nature of O–H bond. An electron-releasing group ($-CH_3$, $-C_2H_5$) increases electron density on oxygen tending to decrease the polarity of O–H bond. The hydroxyl group, in phenol is directly attached to the sp^2 hybridised carbon of benzene ring which acts as an electron withdrawing group.

(a) Why boiling points of alcohols are higher than hydrocarbons and ethers of comparable molecular mass? Explain.

OR

(b) Arrange the following alcohols in increasing order of their reactivity towards dehydration reaction.

CH_3–CH_2–OH, $(CH_3)_2$CH–OH, $(CH_3)_3$C–OH

(c) (i) Why phenol are more acidic than alcohol?

(ii) What happened when phenol react with conc. HNO_3 ?

30. When a non-volatile solute is added to a solvent, the freezing point of the formed solution is always lower than that of pure solvent. This difference in freezing point is known as depression in freezing point. If ΔT_f^o is the freezing point temperature of pure solvent and T_f is the freezing point temperature of the solution when non-volatile solute is dissolved in it, then depression in freezing point (ΔT_f) is given by

$$\Delta T_f = \Delta T_f^o - T_f$$

For dilute solutions, $\Delta T_f = K_f\, m$ [where, m = molal concentration of the solution]

Answer the following questions :

(a) Why the freezing point of solution is always lower than that of pure solvent ?

(b) Define the proportionality constant (K_f)

(c) Calculate the depression in freezing point of 5% glucose in water.

OR

(i) Write the formula relating depression in freezing point with molar mass of solute.

(ii) Write the unit of K_f.

SECTION-E

31. (a) Write the product when D-glucose reacts with conc. HNO_3.

(b) Amino acids show amphoteric behaviour. Why ?

(c) Write one difference between α-helix and β-pleated structures of proteins.

(d) Write one reaction of D-Glucose which cannot be explained by its open chain structure.

(e) Give one example each for water-soluble vitamins and fat-soluble vitamins?

32. Give reasons :

(a) Grignard reagent should be prepared under anhydrous conditions,

(b) Chloroform is stored in dark coloured bottles filled up to the brim.

(c) Ethyl iodide undergoes SN^2 reaction faster than ethyl bromide

(d) (±) 2-Butanol is optically inactive.

(e) C–X bond length in halobenzene is smaller than C–X bond length in CH_3–X.

33. (a) What is the effect of temperature on the rate constant of a reaction ?

(b) For a reaction A + B $\rightarrow$ Product, the rate law is given by, Rate = $k[A]^2 [B]^{1/2}$. What is the order of the reaction ?

(c) How order and molecularity are different for complex reactions ?

(d) A first order reaction has a rate constant $2 \times 10^{-3} s^{-1}$. How long will 6 g of this reactant take to reduce to 2g ?

(e) What is the effect of adding catalyst on activation energy ?