CBSE EXAMINATION PAPER-2025

CHEMISTRY

(Solved)

Time allowed : 3 hours | Maximum Marks : 82

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **39 questions.** All questions are **compulsory.**

ii. This question paper is divided into **5 sections.**

iii. **Section A** – questions number **1 to 3** are case based questions

iv. **Section B** – questions number **4 to 19** are multiple choice questions

v. **Section C** – questions number **20 to 25** are very short answer

vi. **Section D** – questions number **26 to 33** are short answer

vii. **Section E** – questions number **34 to 39** are long answer

viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

ix. Use of calculator is NOT allowed.

Section A

Question 1. The Crystal Field Theory (CFT) of coordination compounds is based on the effect of different crystal fields (provided by the ligands taken as point charges) on the degeneracy of d-orbital energies of the central metal atom/ion. The splitting of the d-orbitals provides different electronic arrangements in strong and weak crystal fields. In tetrahedral coordination entity formation, the d-orbital splitting is smaller as compared to the octahedral entity.

Question 2.

The Crystal Field Theory (CFT) of coordination compounds is based on the effect of different crystal fields (provided by the ligands taken as point charges) on the degeneracy of d-orbital energies of the central metal atom/ion. The splitting of the d-orbitals provides different electronic arrangements in strong and weak crystal fields. In tetrahedral coordination entity formation, the d-orbital splitting is smaller as compared to the octahedral entity.

Answer the following questions :

(1)

On the basis of CFT, explain why $[Ti(H_2O)_6]Cl_3$ complex iscoloured ? What happens on heating the complex $[Ti(H_2O)_6]Cl_3$?

Give reason.[Atomic no. : Ti = 22]

[2 Marks]

(2)

What is crystal field splitting energy ?

[1 Marks]

(3)

On the basis of Δ_o and P (pairing energy), how can youdifferentiate between a strong field ligand and a weak fieldligand ?

[1 Marks]

(4)

Why are low spin tetrahedral complexes rarely observed ?

[1 Marks]

Question 3.

Amines are usually formed from amides, imides, halides, nitro compounds, etc. They exhibit hydrogen bonding which influences their physical properties. In alkyl amines, a combination of electron

releasing, steric and H-bonding factors influence the stability of the substituted ammonium cations in protic polar solvents and thus affect the basic nature of amines. Alkyl amines are found to be stronger bases than ammonia. Amines being basic in nature, react with acids to form salts. Aryldiazonium salts, undergo replacement of the diazonium group with a variety of nucleophiles to produce aryl halides, cyanides, phenols and arenes.

Answer the following questions :

(1)

How can you convert the following ?

(i) Ethanoic acid to methanamine

(ii) Propanenitrile to 1-aminopropane

[2 Marks]

(2)

Why is pKb value of aniline more than that of methylamine ?

[1 Marks]

(3)

Arrange the following in increasing order of their basic strength in aqueous solution :

CH_3 -NH_2 , $(CH_3)_2NH$, $(CH_3)_3N$

[1 Marks]

(4)

Give the structures of A and B in the following reaction :

$$C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow[273\,K]{HNO_2} B$$

[1 Marks]

Section B

Question 4.

Which of the following transition metal ion is not coloured?

[1 Marks]

(A) Cu^{+}

(B) Ni^{2+}

(C) Co^{2+}

(D) V^{3+}

Question 5.

Which of the following solutions will have the highest boiling point in water?

[1 Marks]

(A) 1% $CaCl_2$

(B) 1% KCl

(C) 1% urea

(D) 1% glucose

Question 6.

During electrolysis of dilute H_2SO_4, using platinum electrodes, the gas evolved at the anode is:

[1 Marks]

(A) O_2 gas

(B) SO_3 gas

(C) SO_2 gas

(D) H_2 gas

Question 7.

The activation energy (E_a) of a reaction can be determined from the slope of which of the following plots?

[1 Marks]

(A) ln k vs. T

(B) In k /t vs. T

(C) T /In k vs.1/ T

(D) In k vs. 1/T

Question 8.

Which of the following represents the fraction of molecules with energies equal to or greater than E_a?

[1 Marks]

(A) $+E_a/RT$

(B) $e^{-E_a/RT}$

(C) $e^{+E_a/RT}$

(D) $-E_a/RT$

Question 9.

The number of moles of AgCl precipitated when excess $AgNO_3$ solution is mixed with one mole of $[Co(NH_3)_3Cl_3]$ is:

[1 Marks]

(A) 0

(B) 3

(C) 1

(D) 2

Question 10.

Which of the following haloalkanes react with aqueous KOH most rapidly by SN_1 reaction?

[1 Marks]

(A) 2-Chlorobutane

(B) 2-Bromo-2-Methylpropane

(C) 1-Bromobutane

(D) 2,2-Dimethyl-1-Chloropropane

Question 11.

The reaction R – OH + Na $\longrightarrow$ $RO^{-}Na^{+}$ + 1/2 H_2 (g) suggests that alcohols are:

[1 Marks]

(A) Amphoteric

(B) Basic

(C) Acidic

(D) Neutral

Question 12.

At low temperature, phenol reacts with Br_2 in CS_2 to form:

[1 Marks]

(A) p-bromophenol

(B) 2,4,6-tribromophenol

(C) 2,4-dibromophenol

(D) o-and p-bromophenol

Question 13.

When alkyl iodide is treated with large excess of ammonia, the major product obtained is:

[1 Marks]

(A) Secondary amine

(B) Primary amine

(C) Tertiary amine

(D) Quaternary ammonium salt

Question 14.

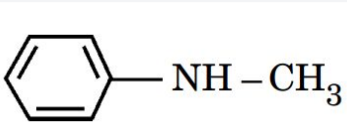
An amine ‘X’ reacts with Hinsberg reagent and the product obtained is soluble in alkali. The amine ‘X’ is:

[1 Marks]

(A)

$CH_3 - NH_2$

(B)



(C)

$(CH_3)_2NH$

(D)

$(CH_3)_3N$

Question 15.

α-helix structure refers to:

[1 Marks]

(A) primary structure of protein

(B) quaternary structure of protein

(C) tertiary structure of protein

(D) secondary structure of protein

Question 16.

Assertion (A) : A mixture of o-nitrophenol and p-nitrophenol can be separated by steam distillation.

Reason (R) : o-nitrophenol is steam volatile due to intermolecular hydrogen bonding

[1 Marks]

(A) Assertion (A) is false, but Reason (R) is true

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

Question 17.

Assertion (A) : Cooking time is reduced in pressure cooker.

Reason (R) : Boiling point of water inside the pressure cooker is elevated.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertio

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true

Question 18.

Assertion (A) : Actinoids show irregularities in their electronic configurations.

Reason (R) : Actinoids are radioactive in nature.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is false, but Reason (R) is true

(D) Assertion (A) is true, but Reason (R) is false.

Question 19.

Assertion (A) : Vitamin K can be stored in our body.

Reason (R) : Vitamin K is a water soluble vitamin.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true

Section C

Question 20.

What is meant by positive deviation from Raoult's law ? Give an example. What type of azeotrope is formed by positive deviation ?

[2 Marks]

Question 21.

State a condition under which a bimolecular reaction is kinetically first order reaction. Give an example. For which type of reactions, do order and molecularity have the same value ?

[2 Marks]

Question 22.

Write the IUPAC name of the complex $[Pt(en)_2Cl2]^{2+}$. Draw the structure of geometrical isomer of this complex which is optically inactive.

[2 Marks]

Question 23.

(i) Write the formula of the following coordination compound :
Pentaamminecarbonatocobalt(III)chloride

(ii) Write the IUPAC name of the linkage isomer of the complex $[Co(NH_3)_5(NO_2)]Cl_2$.

[2 Marks]

Question 24.

Why are haloarenes less reactive towards nucleophilic substitution reaction ? How does the presence of nitro (–NO2) group at ortho- and para-positions in haloarenes increase the reactivity towards

nucleophilic substitution reaction ?

[2 Marks]

Question 25.

The two strands in DNA are not identical but complementary. Explain. What products would be formed when DNA is hydrolysed ?

[2 Marks]

Section D

Question 26.

0.3 g of acetic acid (Molar mass = 60 g mol^{-1}) dissolved in 30 g of benzene shows a depression in freezing point equal to 0.45°C. Calculate the percentage association of acid if it forms a dimer in the solution.

(Given : Kf for benzene = 5.12 K kg mol^{-1})

[3 Marks]

Question 27.

Write the name of the cell which is generally used in inverters. Write the reactions taking place at anode and cathode of this cell, when it is in use.

[3 Marks]

Question 28.

Explain why electrolysis of an aqueous solution of NaCl gives H2gas at cathode and Cl2 gas at anode ? Write overall reaction.

(Given : $E°Na^+/Na + = – 2.71$ V , $E°H_2O/H_2$=-0.83V ,

$E°Cl_2/2Cl$=1.36V , $E°H^+/O_2/H_2O$=+1.23V

[3 Marks]

Question 29.

The following data were obtained during the first order thermal decomposition of $N_2O_5(g)$ at constant volume :

$2N_2O_5(g) \rightarrow 2N_2O_4(g)+O_2(g)$

Calculate rate constant.

[Given : log 2 = 0.3010, log 10 = 1]

[3 Marks]

S.No.	Time/s	Total Pressure/atm
1	0	0·5
2	100	0·625

Question 30.

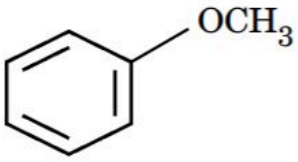
A compound (A) with molecular formula C_4H_9I which is a primary alkyl halide, reacts with alcoholic KOH to give compound (B). Compound (B) reacts with HI to give (C) which is an isomer of (A). When (A) reacts with Na metal in the presence of dry ether, it gives a compound (D), C_8H_{18}, which is different from the compound formed when n-butyl iodide reacts with sodium. Write the structures of (A), (B), (C) and (D). Write thechemical equation when compound (A) is reacted with alcoholic KOH.

[3 Marks]

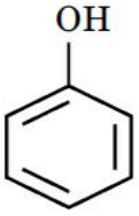
Question 31.

Write structure of the products of the following reactions :

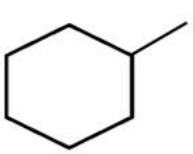
[3 Marks]

(a) 

$+ HI \longrightarrow$

(b) 

$+$ conc. $HNO_3 \longrightarrow$

(c) 

$+ HCHO \xrightarrow{H^+/H_2O}$

Question 32.

Give reasons for the following :

(a) Benzoic acid does not undergo Friedel-Crafts reaction.

(b) HCHO is more reactive than CH_3CHO towards addition of HCN.

(c) Vinyl group directly attached with carboxylic acid should decrease the acidity of corresponding carboxylic acid due to resonance, but on the contrary it increases the acidity.

[3 Marks]

Question 33.

Write the reaction of D-Glucose with the following :

(a) HCN (b) Br_2 water (c) $(CH_3CO)_2O$

[3 Marks]

Section E

Question 34.

Account for the following:

(I) The E° Mn^{2+}/Mn value for manganese is highly negative, whereas E° Mn^{3+}/Mn^{2+} is highly positive.

(II) Actinoids show wide range of oxidation states.

(III) Transition metals have high melting points

Complete the following ionic equations:

(I) $5SO_3^{2-} + 2MnO_4^- + 6H^+ \longrightarrow$

(II) $2MnO_4^- + H_2O + I^- \longrightarrow$.

[5 Marks]

Question 35.

Answer the following questions :

(i) Name two elements of 3d series for which the third ionisation enthalpies are quite high.

(ii) Out of $KMnO_4$ and K_2MnO_4, which one is paramagnetic and why ?

(iii) Write any one consequence of lanthanoid contraction.

(iv) How do you prepare potassium manganate from pyrolusite ore ?

(v) Why is the ability of oxygen more than fluorine to stabilise higher oxidation states of transition metals ?

[5 Marks]

Question 36.

(i) An organic compound (X) having molecular formula C5H10O can show various properties depending on its structures. Draw each of the structures if it :

(I) shows Cannizzaro reaction.

(II) reduces Tollens' reagent and has a chiral carbon.

(III) gives positive iodoform test.

(ii) Write the reaction involved in the following :

(I) Clemmensen reduction

(II) Etard reaction

[5 Marks]

Question 37.

Answer the following questions :

(i) Draw structure of the methyl hemiacetal of methanal.

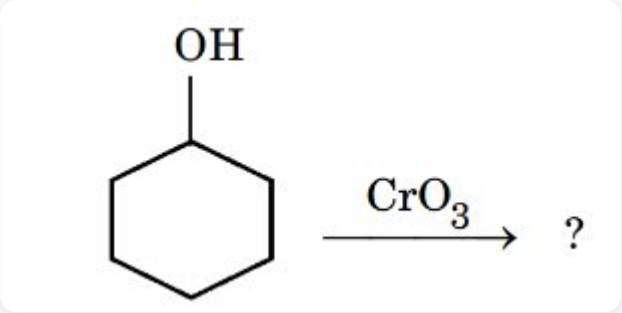
(ii) There are two – NH_2 groups in semicarbazide. However only one is involved in the formation of semicarbazones. Give reason.

(iii) How will you convert ethanol to 3-hydroxybutanal ?

(iv) Complete the following equation :

(v) Write the final product formed when phthalic acid is treated with NH_3 followed by strong heating.

[5 Marks]



Question 38.

Calculate the emf of the following cell at 25°C:

(I)$Zn(s)|Zn^{2+}$ (0.1 M) || H^+ (0.01 M)|$H_2(g)$ (1 bar),Pt(s).

[Given : $E°zn^{2+}/zn$=-0.76v v, $E°2H^+/H_2$=0.00V , log 10 =1]

(II)State Faraday's second law of electrolysis. How much electricity is required in terms of Faraday for the reduction of 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+}?

[5 Marks]

Question 39.

Answer the following questions :

(i) The conductivity of 0.20 M solution of KCl is 2.48×10^{-2} S cm^{-1}. Calculate its molar conductivity and degree of dissociation (α).

[Given: $\lambda^0(K^+)$ = 73.5 S cm^2 mol^{-1}, $\lambda^0(Cl^-)$ = 76.5 S cm^2 mol^{-1}]

(ii) Calculate ΔrG^0 of the following cell: $Mg(s) + Cu^{2+}(aq) \longrightarrow Mg^{2+}(aq) + Cu(s)$

[Given: $E^0(Mg^{2+}/Mg)$ = –2.37 V, $E^0(Cu^{2+}/Cu)$ = +0.34 V 1 F = 96500 C mol^{-1}]

(iii) What type of cell is mercury cell? Why is it more advantageous than dry cell?

[5 Marks]