CBSE EXAMINATION PAPER-2024

CHEMISTRY

(Solved)

Time allowed : 3 hours | Maximum Marks : 74

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **40 questions.** All questions are **compulsory.**

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

iii. **Section A** – questions number **1 to 6** are case based questions

iv. **Section B** – questions number **7 to 22** are multiple choice questions

v. **Section C** – questions number **23 to 28** are very short answer

vi. **Section D** – questions number **29 to 35** are short answer

vii. **Section E** – questions number **36 to 40** 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 involvement of (n-1)d electrons in the behaviour of transition elements impart certain distinct characteristics to these elements. Thus, in addition to variable oxidation states, they exhibit paramagnetic behaviour, catalytic properties and tendency for the formation of coloured ions. The transition metals react with a number of non-metals like oxygen, nitrogen and halogens. KMnO4 and K2Cr2O7 are common examples. The two series of inner transition elements, lanthanoids and actinoids, constitute the f-block of the periodic table. In the lanthanoids, there is regular decrease in atomic size with increase in atomic number due to the imperfect shielding effect of 4f-orbital electrons which causes contraction.

Question 2.

The involvement of (n 1)d electrons in the behaviour of transition elements impart certain distinct characteristics to these elements. Thus, in addition to variable oxidation states, they exhibit paramagnetic behaviour, catalytic properties and tendency for the formation of coloured ions. The transition metals react with a number of non-metals like oxygen, nitrogen and halogens. KMnO 4 examples. and K 2 Cr 2 O 7 are common The two series of inner transition elements, lanthanoids and actinoids, constitute the f-block of the periodic table. In the lanthanoids, there is regular decrease in atomic size with increase in atomic number due to the imperfect shielding effect of 4f-orbital electrons which causes contraction. Answer the following questions :

Question 3.

The involvement of (n 1)d electrons in the behaviour of transition elements impart certain distinct characteristics to these elements. Thus, in addition to variable oxidation states, they exhibit paramagnetic behaviour, catalytic properties and tendency for the formation of coloured ions. The transition metals react with a number of non-metals like oxygen, nitrogen and halogens. KMnO 4 examples. and K 2 Cr 2 O 7 are common The two series of inner transition elements, lanthanoids and actinoids, constitute the f-block of the periodic table. In the lanthanoids, there is regular decrease in atomic size with increase in atomic number due to the imperfect shielding effect of 4f-orbital electrons which causes contraction. Answer the following questions :

Question 4.

The involvement of (n 1)d electrons in the behaviour of transition elements impart certain distinct characteristics to these elements. Thus, in addition to variable oxidation states, they exhibit paramagnetic behaviour, catalytic properties and tendency for the formation of coloured ions. The transition metals react with a number of non-metals like oxygen, nitrogen and halogens. KMnO 4 examples. and K 2 Cr 2 O 7 are common The two series of inner transition elements, lanthanoids and actinoids, constitute the f-block of the periodic table. In the lanthanoids, there is regular decrease in atomic size with increase in atomic number due to the imperfect shielding effect of 4f-orbital electrons which causes contraction. Answer the following questions :

Question 5.

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

The involvement of (n-1)d electrons in the behaviour of transition elements impart certain distinct characteristics to these elements. Thus, in addition to variable oxidation states, they exhibit paramagnetic behaviour, catalytic properties and tendency for the formation of coloured ions. The transition metals react with a number of non-metals like oxygen, nitrogen and halogens. $KMnO_4$ examples. and $K_2Cr_2O_7$ are common

The two series of inner transition elements, lanthanoids and actinoids, constitute the f-block of the periodic table. In the lanthanoids, there is regular decrease in atomic size with increase in atomic number due to the imperfect shielding effect of 4f-orbital electrons which causes contraction.

(1)

Why do transition metals and their compounds act as good catalysts ?

[1 Marks]

(2)

What is the cause of contraction in the atomic size of lanthanoids ?

[1 Marks]

(3)

In aqueous media, which is a stronger reducing agent Cr^{2+} or Fe^{2+} and why ?

[2 Marks]

(4)

Define lanthanoid contraction. How does it affect the atomic radii of the third transition series and the second transition series ?

[2 Marks]

Question 6. Proteins are the most abundant biomolecules of the living system. Proteins are the polymers of about twenty different -amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids. In zwitter ionic form, amino acids show amphoteric behaviour as they react both with acids and bases. On the basis of their molecular shape, proteins are classified into two types : Fibrous and Globular proteins. 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. The secondary or tertiary structure of proteins get disturbed on change of pH or temperature and they are not able to perform their functions. This is called denaturation of proteins.

(1) What are essential amino acids ?

[1 Marks]

(2) What is meant by zwitter ionic form of amino acids ?

[1 Marks]

(3)

(i) Give one example each for Fibrous protein and Globular protein.

(ii) What type of linkages hold monomers of proteins together?

[2 Marks]

(4)

(i) What is the structural feature which characterises a reducing sugar ?

(ii) What is the structural difference between nucleoside and nucleotide?

[2 Marks]

Section B

Question 7.

Which of the following does not show variable oxidation states?

[1 Marks]

(A) Cu

(B) Mn

(C) Sc

(D) Fe

Question 8.

The type of isomerism shown by the complex $[CoCl_2(en)_2]^+$ is:

[1 Marks]

(A) Ionisation isomerism

(B) Coordination isomerism

(C) Linkage isomerism

(D) Geometrical isomerism

Question 9.

Which of the following is diamagnetic in nature?

[Atomic number : Co = 27]

[1 Marks]

(A) Co_3^+, octahedral complex with strong field ligand

(B) Co_3^+, octahedral complex with weak field ligand

(C) Co_3^+, in a tetrahedral complex

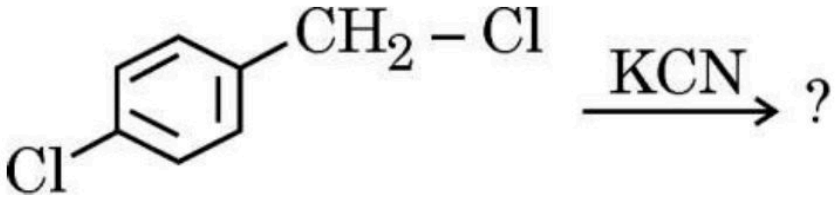
(D) Co_3^+, in a square planar complex

Question 10.

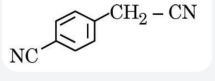
Consider the following reaction:

The major product of the reaction is:

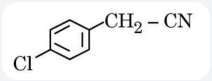
[1 Marks]



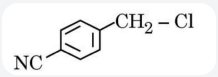
(A)



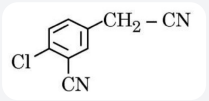
(B)



(C)



(D)



Question 11.

Which one of the following compounds has the lowest pK_a value?

[1 Marks]

(A) m-Nitrophenol

(B) p-Cresol

(C) p-Nitrophenol

(D) 2,4,6-Trinitrophenol

Question 12.

$(CH_3)_2CH\text{-}O\text{-}CH_3$ when treated with HI gives:

[1 Marks]

(A) $(CH_3)_2CH$ - OH + CH_3 -I

(B) $(CH_3)_2CH$ -I + CH_3OH

(C) $(CH_3)_2CH$ -I + CH_3 -I

(D) $(CH_3)_2CH$ - OH + CH_3OH

Question 13.

Which of the following compounds on treatment with benzene sulphonyl chloride forms an alkali-soluble precipitate?

[1 Marks]

(A) CH_3CONH_2

(B) $(CH_3)_3N$

(C) $(CH_3)_2NH$

(D) $CH_3CH_2NH_2$

Question 14.

The order of increasing basicities of CH_3NH_2 (I), $(CH_3)_2NH$ (II), $(CH_3)_3N$ (III) and $C_6H_5NH_2$ (IV) in aqueous media is:

[1 Marks]

(A) IV < III < I < II

(B) I < II < III < IV

(C) II < III < I < IV

(D) II < I < IV < III

Question 15.

The vitamin which plays an important role in coagulating blood is:

[1 Marks]

(A) Vitamin A

(B) Vitamin E

(C) Vitamin D

(D) Vitamin K

Question 16.

When a catalyst increases the rate of a chemical reaction, then the rate constant (k):

[1 Marks]

(A) may increase or decrease depending on the order of the reaction

(B) increases

(C) remains constant

(D) decreases

Question 17.

A 1% solution of solute 'X' is isotonic with 6% solution of sucrose (molar mass = 342 g mol^{-1}). The molar mass of solute 'X' is

[1 Marks]

(A) 34·2 g mol^{-1}

(B) 3·42 g mol^{-1}

(C) 114 g mol^{-1}

(D) 57 g mol^{-1}

Question 18.

During the electrolysis of aqueous NaCl, the cathodic reaction is:

[1 Marks]

(A) Oxidation of H_2O

(B) Reduction of H_2O

(C) Oxidation of Cl^- ion

(D) Reduction of Na^+ ion

Question 19.

Assertion (A): Addition of ethylene glycol to water lowers its freezing point.

Reason (R): Ethylene glycol is insoluble in water due to lack of its ability to form hydrogen bonds with water molecules.

[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.

Question 20.

Assertion (A): Order of reaction and molecularity are always same for complex reactions.

Reason(R): Order is determined experimentally and molecularity is applicable only for elementary reactions.

[1 Marks]

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

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

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

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

Question 21.

Assertion (A): The boiling point of ethanol is higher than that of dimethyl ether.

Reason (R): Ethanol molecules are associated through hydrogen bonding whereas in dimethyl ether, it is not possible.

[1 Marks]

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

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

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

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

Question 22.

Assertion (A): Aniline does not undergo Friedel-Crafts reaction.

Reason (R): Friedel-Crafts reaction is an electrophilic substitution reaction.

[1 Marks]

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

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

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

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

Section C

Question 23. Define molal depression constant. How is it related to enthalpy of fusion?

[2 Marks]

Question 24.

What type of deviation is shown by ethanol and acetone mixture? Give reason.What type of azeotropic mixture is formed by that deviation ?

[2 Marks]

Question 25.

(a) In a reaction, if the concentration of reaction 'X' is tripled rate of reaction becomes twenty-seven times? What is the order of the reaction .

(b) State a condition under which a bimolecular reaction is kinetically a first-order reaction. Give an example of such a reaction.

[2 Marks]

Question 26.

Complete the following ionic equations:

(a) $2Mno^{-}{}_{4} + 5SO_3^{2-} + 6H^{+} \rightarrow$

(b) $Cr_2O_7^{2-} + 14H^{+} + 6Fe^{2+}$

[2 Marks]

Question 27.

(a) Which halogen compound will react faster in S_n2 reactions, and why?

CH_3- CH_2 -I or CH_3 - CH_2 - Br

(b) Why is chloroform stored in closed dark coloured bottles?

[2 Marks]

Question 28.

Give the reaction of glucose with the following :

(a) HCN

(b) Conc. HNO_3

[2 Marks]

Section D

Question 29.

A solution is prepared by dissolving 5 g of a non-volatile solute in 200 g of water. It has a vapour pressure of 31·84 mm Hg at 300 K. Calculate the molar mass of the solute.

(Vapour pressure of pure water at 300 K = 32 mm Hg)

[3 Marks]

Question 30.

A first-order reaction is 25 complete in 40 minutes. Calculate the value of rate constant. In what time will the reaction be 80 % complete ?

Given : log 2 = 0·30, log 3 = 0·48, log 4 = 0·60, log 5 = 0·69

[3 Marks]

Question 31.

(a) What type of nucleophilic substitution (SN1 or SN2) occurs in the hydrolysis of 2-Bromo butane to form (±)-Butan-2-ol ? Give reason.

(b) What happens when chlorobenzene and methyl chloride are treated with sodium metal in dry ether ?

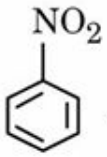
[3 Marks]

Question 32.

Give the structures of A, B and C in the following reactions :

[3 Marks]

(a) $CH_3CH_2Cl \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[0°C]{HNO_2} C$

(b)  $\xrightarrow{Fe/HCl} A \xrightarrow[273\ K]{NaNO_2 + HCl} B \xrightarrow{C_6H_5OH} C$

Question 33.

(a) Write the equations of the reactions involved in the following :

(i) Reimer-Tiemann reaction

(ii) Kolbe's reaction

(b) Name the reagent used in the bromination of phenol to form 2,4,6-Tribromophenol.

[3 Marks]

Question 34.

How will you bring about the following conversions ?

(a) Benzoic acid to Benzaldehyde

(b) Ethanal to Propanone

(c) Acetophenone to Benzoic acid

(d) Bromobenzene to 1-Phenylethanol

[3 Marks]

Question 35.

The conductivity of 0·2 M solution of KCl is 2·48 10^{-2} S cm^{-1}. Calculate its molar conductivity and degree of dissociation (α).

Given :

$\lambda°_{k^+}$ = 73.5 S cm^2 mol^{-1}

$\lambda°cl^-$ = 76.5 S cm^2 mol^{-1}

[3 Marks]

Section E

Question 36.

(i) Calculate emf of the following cell at 25ºC :

Zn (s) $|Zn^{2+}$ (0·001M)| Cd^{2+} (0·1 M) Cd (s)

Given:E °zn^{2+}/zn= -0·76 V, E°cd^{2+}/Cd = - 0·40 V [log 10 = 1]

(ii) State faraday 's second law of electrolysis How will the ph of aqueous NaCl solution be affected when it is electrolyzed?

[5 Marks]

Question 37.

(i) Calculate the $\Delta_r G°$ and log Kc for the following cell reaction :

Fe (s) + Ag^+ (aq) ⇌ Fe^{2+} (aq) + Ag (s)

Given: E° fe^{2+}/fe = -0.44V, E°Ag^+/Ag= +0.80V, 1F = 96500 C mol^{-1}

(ii) Write any two advantages of the fuel cells over primary and secondary batteries ?

(iii) How many Faradays are required for the oxidation of 1 mole of H_2O to O_2 ?

[5 Marks]

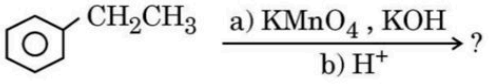
Question 38.

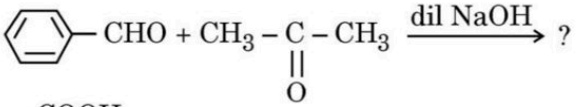
(i) Write the major product(s) in the following reactions :

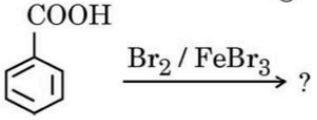
(ii) Give simple chemical tests to distinguish between the following pairs of compounds :

[5 Marks]

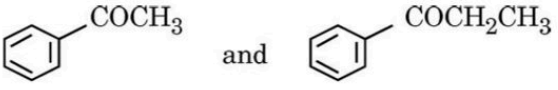
(i) Write the major product(s) in the following reactions :

(1) 

(2) 

(3) 

(ii) Give simple chemical tests to distinguish between the following pairs of compounds :

(1) 

(2) Pentanal and Pentan-3-one

Question 39.

(i) Give reasons for the following :

(1) In semicarbazide, only one NH_2 group is involved in the formation of semicarbazone.

(2) Acetaldehyde is more reactive than acetone towards addition of HCN.

(ii) (1) Arrange the following in decreasing order of their acidic strength :

CH_3COOH, $O_2N\ CH_2\ COOH$, HCOOH

(2) Name the reagent in the following reaction :

CH_3- CH = CH-CH_2-CN $\longrightarrow$ CH_3- CH = CH- CH_2 CHO

(iii) Write the reaction involved in Hell-Volhard-Zelinsky reaction.

[5 Marks]

Question 40.

Attempt any five of the following:

(a) Write the IUPAC name of the complex : $[Co(H_2O)(CN)(en)_2]^{2+}$

(b) Why is geometrical isomerism not possible in tetrahedral complexes having two different types of unidentate ligands coordinated with the central metal ion ?

(c) Arrange the following complex ions in increasing order of their crystal field splitting energy (Δ_o) :

$[Co(NH_3)_6]^{3+}$, $[CoF_6]^{3-}$, $[Co(CN)_6]^{3-}$

(d) Write the hybridization and magnetic character of the complex $[Ni(CO)_4]$ on the basis of valence bond theory. [Atomic No. : Ni = 28]

(e) Out of $[CoF_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$, which one complex is :

(i) more stable ?

(ii) the high spin complex ?

(f) What is the difference between an ambidentate ligand and bidentate ligand ?

(g) Write the electronic configuration of d^5 in terms of t_2g and eg in an

octahedral field when :

(i) $\Delta_o > P$, and (ii) $\Delta_o < P$

[5 Marks]