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 **49 questions.** All questions are **compulsory.**

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

iii. **Section A** – questions number **1 to 15** are case based questions

iv. **Section B** – questions number **16 to 31** are multiple choice questions

v. **Section C** – questions number **32 to 37** are very short answer

vi. **Section D** – questions number **38 to 44** are short answer

vii. **Section E** – questions number **45 to 49** 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. Batteries and fuel cells are very useful forms of galvanic cell. Any battery or cell that we use as a source of electrical energy is basically a galvanic cell. However, for a battery to be of practical use it should be reasonably light, compact and its voltage should not vary appreciably during its use. There are mainly two types of batteries: primary batteries and secondary batteries. In the primary batteries, the reaction occurs only once and after use over a period of time the battery becomes dead and cannot be reused again, whereas the secondary batteries are rechargeable. Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. To solve this problem, galvanic cells are designed in such a way that energy of combustion

of fuels is directly converted into electrical energy, and these are known as fuel cells. One such fuel cell was used in the Apollo space programme.

Question 2.

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Answer the following questions :

Question 3.

Question 4.

Question 5.

Question 6.

Question 7.

Question 8.

Question 9.

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Question 14.

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

Batteries and fuel cells are very useful forms of galvanic cell. Any battery or cell that we use as a source of electrical energy is basically a galvanic cell. However, for a battery to be of practical use it should be reasonably light, compact and its voltage should not vary appreciably during its use. There are mainly two types of batteries primary batteries and secondary batteries.

In the primary batteries, the reaction occurs only once and after use over a period of time the battery becomes dead and cannot be reused again, whereas the secondary batteries are rechargeable.

Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. To solve this problem, galvanic cells are designed in such a way that energy of combustion of fuels is directly converted into electrical energy, and these are known as fuel cells. One such fuel cell was used in the Apollo space programme.

(1)

How do primary batteries differ from secondary batteries ?

[1 Marks]

(2)

The cell potential of Mercury cell is 1·35 V, and remains constant during its life. Give reason.

[1 Marks]

(3)

Write the reactions involved in the recharging of the lead storage battery.

[2 Marks]

(4)

Write two advantages of fuel cells over other galvanic cells.

[2 Marks]

Question 15.

The Valence Bond Theory (VBT) explains the formation, magnetic behaviour and geometrical shapes of coordination compounds whereas" The Crystal Field Theory" for coordination compounds is based on the effect of different crystal fields (provided by 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. The crystal field theory attributes the colour of the coordination compounds to d-d transition of the electron. Coordination compounds find extensive applications in metallurgical processes, analytical and medicinal chemistry

(1)

What is crystal field splitting energy ?

[1 Marks]

(2)

Give reason for the violet colour of the complex $[Ti(H_2O)_6]^{3+}$ on the basis of crystal field theory.

[1 Marks]

(3)

Explain why $[Fe(CN)_6]^{3-}$ is an inner orbital complex, whereas $[Fe(H_2O)_6]^{3+}$ is an outer orbital complex. [Atomic No. : Fe = 26]

[2 Marks]

(4)

$[Cr(NH_3)_6]^{3+}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic. Explain why. [Atomic No. : Cr = 24, Ni = 28]

[2 Marks]

Section B

Question 16.

Which one of the following first row transition elements is expected to have the highest third ionization enthalpy ?

[1 Marks]

(A) Manganese (Z = 25)

(B) Vanadium (Z = 23)

(C) Chromium (Z = 24)

(D) Iron (Z = 26)

Question 17.

Two among the three components of DNA are β-D-2-deoxyribose and a heterocyclic base. The third component is :

[1 Marks]

(A) Phosphoric acid

(B) Adenine

(C) Sulphuric acid

(D) Uracil

Question 18.

For an electrolyte undergoing association in a solvent, the vant factor :

[1 Marks]

(A) has negative value

(B) has zero value

(C) is always greater than one

(D) is always less than one

Question 19.

For the reaction X + 2Y → P, the differential form equation of the rate law is :

[1 Marks]

(A) -d[P]/dt = -d[X]/dt

(B) -2d[Y]/dt = +d[P]/dt

(C) 2d[P]/dt = -d[Y]/dt

(D) +d[X]/dt =-d[P]/dt

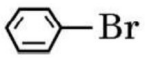
Question 20.

The compound which undergoes SN_1 reaction most rapidly is

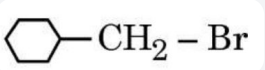
;

[1 Marks]

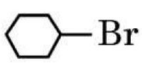
(A)



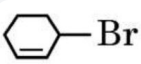
(B)



(C)



(D)



Question 21.

Acetic acid reacts with PCl_5 to give :

[1 Marks]

(A) CCl_3 -COOH

(B) Cl -CH_2 -COOH

(C) Cl -CH_2 -COCl

(D) CH_3- COCl

Question 22.

The formation of cyanohydrin from an aldehyde is an example of :

[1 Marks]

(A) nucleophilic addition

(B) electrophilic addition

(C) electrophilic substitution

(D) nucleophilic substitution

Question 23.

In the Arrhenius equation, when log k is plotted against 1/T, a straight line is obtained whose :

[1 Marks]

(A) slope is A and intercept is -Ea/R.

(B) slope is A/R and intercept is E_a.

(C) slope is -Ea/RT and intercept is log A.

(D) slope is -Ea /2.303 R and intercept is log A.

Question 24.

The reaction of an alkyl halide with sodium alkoxide forming ether is known as :

[1 Marks]

(A) Reimer-Tiemann reaction

(B) Williamson synthesis

(C) Kolbe reaction

(D) Wurtz reaction

Question 25.

The correct order of the ease of dehydration of the following alcohols by the action of conc. H_2SO_4 is :

[1 Marks]

(A) $(CH_3)_2CH$- OH > $(CH_3)_3C$- OH > CH_3CH_2- OH

(B) $(CH_3)_2CH$- OH > CH_3CH_2- OH > $(CH_3)_3C$- OH

(C) CH_3CH_2 -OH > $(CH_3)_2CH$- OH > $(CH_3)_3C$ -OH

(D) $(CH_3)_3C$- OH > $(CH_3)_2CH$- OH > CH_3CH_2- OH

Question 26.

Which functional groups of glucose interact to form cyclic hemiacetal leading to pyranose structure ?

[1 Marks]

(A) Ketone group and hydroxyl group at C- 4

(B) Aldehyde group and hydroxyl group at C- 4

(C) Ketone group and hydroxyl group at C- 5

(D) Aldehyde group and hydroxyl group at C- 5

Question 27.

Assertion (A) : When NaCl is added to water a depression in freezing point is observed.

Reason (R) : NaCl undergoes dissociation in water.

[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 28.

Assertion (A) : Separation of Zr and Hf is difficult.

Reason (R) : Zr and Hf have similar radii due to lanthanoid contraction.

[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).

Question 29.

Assertion (A) : The pK_a of ethanoic acid is lower than that of Cl -CH_2- COOH.

Reason (R) : Chlorine shows electron withdrawing (I) effect which increases the acidic character of Cl -CH 2- COOH.

[1 Marks]

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

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

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

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

Question 30.

Assertion (A) : Aniline is a stronger base than ammonia.

Reason (R) : The unshared electron pair on nitrogen atom in aniline becomes less available for protonation due to resonance.

[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 true, but Reason (R) is false.

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

Question 31.

Which of the following compounds will give a ketone on oxidation with chromic anhydride (CrO_3) ?

[1 Marks]

(A) CH_3 -CH_2 -CH (OH)-CH_3

(B) $(CH_3)_3C$- OH

(C) CH3CH2CH2OH

(D) (CH3)2CH -CH2OH

Section C

Question 32.

Calculate the potential of Iron electrode in which the concentration of

Fe2+ ion is 0·01 M.

(E°Fe2+/Fe = 0·45 V at 298 K)

[Given : log 10 = 1]

[2 Marks]

Question 33.

Define molecularity of the reaction. State any one condition in which a bimolecular reaction may be kinetically of first order

[2 Marks]

Question 34.

What happens when D-glucose is treated with the following reagents?

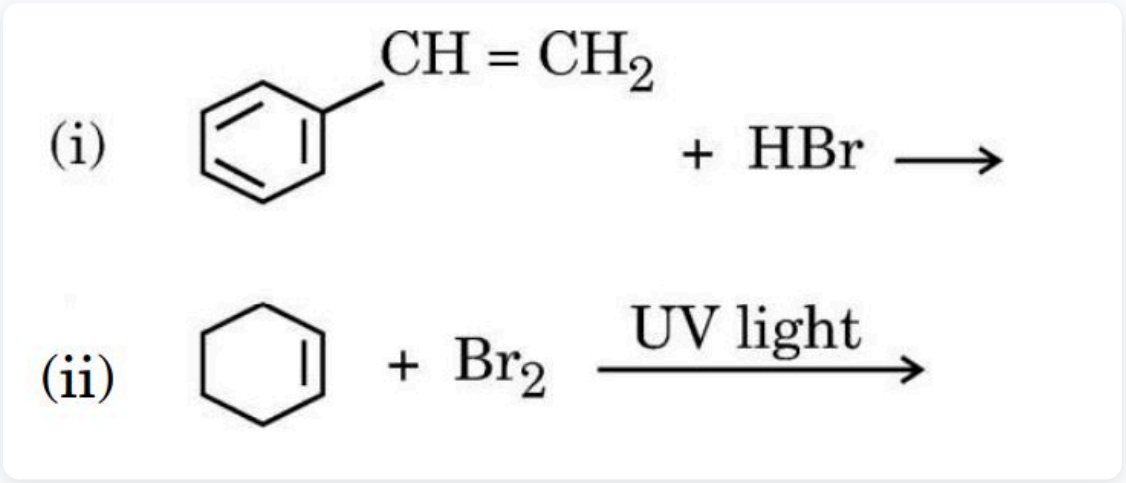
(a) HI (b) Conc. HNO_3

[2 Marks]

Question 35.

Draw the structures of major monohalo products in each of the following reactions:

[2 Marks]



Question 36.

Give reasons for the following:

(i) Grignard reagent should be prepared under anhydrous conditions.

(ii) Alkyl halides give alcohol with aqueous KOH whereas in the presence of alcoholic KOH, alkenes are formed.

[2 Marks]

Question 37.

Write the chemical equation when :

(i) Butan-2-one is treated with Zn(Hg) and conc. HCl.

(ii) Two molecules of benzaldehyde are treated with conc. NaOH.

[2 Marks]

Section D

Question 38.

When a certain conductivity cell was filled with 0·05 M KCl solution, it has a resistance of 100 ohm at 25ºC. When the same cell was filled with 0·02 M $AgNO_3$ solution, the resistance was 90 ohm. Calculate the conductivity and molar conductivity of AgNO3 solution.

(Given : Conductivity of 0·05 M KCl solution = 1·35 * 10 $^{-2}$ ohm-1cm^{-1})

[3 Marks]

Question 39.

The following initial rate data were obtained for the reaction : 2NO (g) + Br_2 (g) → 2NOBr (g)

(a) What is the order with respect to NO and Br_2 in the reaction ?

(b) Calculate the rate constant (k).

(iii) Determine the rate of reaction when concentration of NO and Br_2 are 0·4 M and 0·2 M, respectively.

[3 Marks]

Expt. No.	[NO]/mol L^{-1}	[Br_2]/mol L^{-1}	Initial Rate (mol L^{-1} s^{-1})
1	0·05	0·05	$1·0 \times 10^{-3}$
2	0·05	0·15	$3·0 \times 10^{-3}$
3	0·15	0·05	$9·0 \times 10^{-3}$

Question 40.

(a) Write the formula for the following coordination compound : Potassium tetrahydroxidozincate (II)

(b) Arrange the following complexes in the increasing order of conductivity of their solution : $[Cr(NH_3)_5Cl]Cl_2$, $[Cr(NH_3)_3Cl_3]$, $[Cr(NH_3)_6]C_3$

(c) Identify the type of isomerism exhibited by the following complexes :

(i) $[Co(NH_3)_5NO_2]^{2+}$

(ii) $[Co(en)_3]Cl_3$

[3 Marks]

Question 41.

(a) Which of the following is an allylic halide ?

(i) CH_3 -CH=CH-Br

(ii) CH_2=CH-CH (Br)-CH_3

(b) Out of chlorobenzene and 2,4,6-trinitrochlorobenzene, which is more reactive towards nucleophilic substitution and why ?

(c) Which isomer of C_4H_9Cl has the lowest boiling point ?

[3 Marks]

Question 42.

(a) Write the mechanism of the following reaction

(b) Write the main product in each of the following reactions :

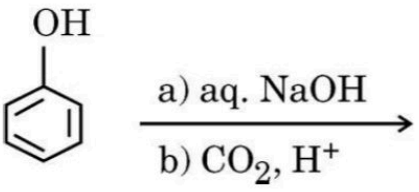
[3 Marks]

(a) Write the mechanism of the following reaction :

$$CH_3CH_2OH \xrightarrow[443\ K]{H^+} CH_2 = CH_2$$

(b) Write the main product in each of the following reactions :

(i) $$CH_3 - CH_2 - CH = CH_2 \xrightarrow[b)\ 3H_2O_2/OH^-]{a)\ B_2H_6}$$

(ii) 

Question 43.

Answer the following: (any three)

(a) What is peptide linkage ?

(b) What type of bonds hold a DNA double helix together ?

(c) Which one of the following is a polysaccharide ? Sucrose, Glucose, Starch, Fructose

(d) Give one example each for water-soluble vitamins and fat-soluble vitamins.

[3 Marks]

Question 44.

Compound (A) ($C_6H_{12}O_2$) on reduction with $LiAlH_4$ gives two compounds (B) and (C). The compound (B) on oxidation with PCC gives compound (D) which upon treatment with dilute NaOH and subsequent heating gives compound (E). Compound (E) on catalytic hydrogenation gives compound (C). The compound (D) is oxidized further to give compound (F) which is found to be a monobasic acid (Molecular weight = 60). Identify the compounds (A), (B), (C), (D), (E) and (F).

[3 Marks]

Section E

Question 45.

(i) At the same temperature, CO_2 gas is more soluble in water than O_2 gas. Which one of them will have higher value of K_h and why?

(ii) How does the size of blood cells change when placed in an aqueous solution containing more than 0.9% (mass/volume) sodium chloride?

(iii) 1 molal aqueous solution of an electrolyte A_2B_3 is 60% ionized. Calculate the boiling point of the solution.

(Given : Kb for H_2O = 0·52 K kg mol $^{-1}$)

[5 Marks]

Question 46.

(i) The vapour pressures of A and B at 25ºC are 75 mm Hg and 25 mm Hg, respectively. If A and B are mixed such that the mole fraction of A in the mixture is 0.4, then calculate the mole fraction of B in vapour phase.

(ii) Define colligative property. Which colligative property is preferred for the molar mass determination of macromolecules?

(iii) Why are equimolar solutions of sodium chloride and glucose not isotonic?

[5 Marks]

Question 47.

(i) Account for the following:

(1) The melting and boiling points of Zn, Cd and Hg are low.

(2) Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidizing.

(3) E^o value of Cu^{2+}/Cu is +0.34 V.

(ii) Complete and balance the following chemical equations:

[5 Marks]

(1) $KMnO_4 \xrightarrow{heat}$

(2) $Cr_2O_7^{2-} + 6\,I^- + 14\,H^+ \longrightarrow$

Question 48.

(i) Out of Cu_2Cl_2 and $CuCl_2$, which is more stable in aqueous solution and why?

(ii) Write the general electronic configuration of f-block elements.

(iii) Predict which of the following will be coloured in aqueous solution and why ? Sc^{3+} , Fe^{3+} , Zn^{2+}

[Atomic number : Sc = 21, Fe = 26, Zn = 30]

(iv) How can you obtain potassium dichromate from sodium chromate ?

(v) Why do transition metals and their compounds show catalytic activities ?

[5 Marks]

Question 49.

Answer any five questions of the following:

(a) N,N-diethyl-benzenesulphonamide is insoluble in alkali. Give reason.

(b) Aniline does not undergo Friedel-Crafts reaction. Why ?

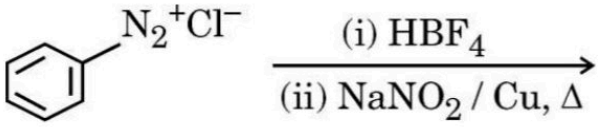
(c) Write a simple chemical test to distinguish between methylamine and aniline.

(d) Write the chemical reaction involved in Gabriel phthalimide synthesis.

(e) How will you convert aniline to p-bromoaniline ?

[5 Marks]

(f) Complete the following reaction :



(g) Write the structures of A and B in the following reaction :

