COMMON PRE-BOARD EXAMINATION 2023-24

Subject: CHEMISTRY (043)

Class XII

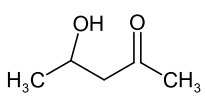Time: 3 Hrs.   Max. Marks: 70

### *General Instructions:*

Read the following instructions carefully:

(a) There are 33 questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case-based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

SECTION A

**The following questions are multiple-choice questions with one correct answer.
Each question carries 1 mark. There is no internal choice in this section.**

1. The quantity of charge required to obtain one mole of Aluminium from Al_2O_3 is _____.   1

    (a) 1F   (b) 6F   (c) 3F   (d) 2F

2. Write the IUPAC name of the compound.   1

    (a) 4-Hydroxypentan-2-one   (b) 2-Hydroxypentan-4-one

    (c) 2-Oxo-pentan-2-ol   (d) 4-Oxo-pentan-4-one

3. The two forms of D-glucopyranose obtained from the solution of D-glucose are called: 1

    (a) Isomer   (b) Anomer   (c) Epimer   (d) Enantiomer

4. Rosenmund reduction of an acyl chloride gives: 1

    (a) Acetaldehyde   (b) Ethanol   (c) Acetic acid   (d) Acetone

5. Identify the product. 1
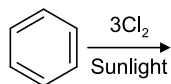
(a) Chlorobenzene (b) DDT (c) BHC (d) p-Dichlorobenzene

6. The magnetic nature of elements depends on the presence of unpaired electrons. Identify the configuration of the transition element, which shows the highest magnetic moment. 1

(a) $3d^6$ (b) $3d^7$ (c) $3d^8$ (d) $3d^9$

7. The half-life of a reaction is doubled when the initial concentration is doubled. The order of reaction is: 1

(a) 1 (b) 2 (c) 4 (d) 0

8. Which of the following compounds will dissolve in an alkali solution after it undergoes a reaction with Hinsberg's reagent? 1

(a) $(CH_3)_3N$ (b) CH_3NH_2 (c) $(C_2H_5)_2NH$ (d) $C_6H_5NHC_6H_5$

9. The compound which reacts fastest with Lucas reagent at room temperature is: 1

(a) Butan-2-ol (b) Butan -1-ol

(c) 2-methyl propan-1-ol (d) 2-methyl propan-2-ol

10. Which of the following statements is **not** correct for the catalyst? 1

(a) It catalyses the forward and backward reactions to the same extent.
(b) It alters ΔG of the reaction.
(c) It is a substance that does not change the equilibrium constant of a reaction.
(d) It provides an alternate mechanism by reducing activation energy between reactants and products.

11. Ethers have lower boiling points than their corresponding isomeric alcohols because: 1

(a) The density of ether is less than that of alcohol.
(b) Alcohol mixes with water but ether does not.
(c) There is no hydrogen bonding in ether.
(d) There are two methyl groups in ether.

12. Zirconium (Zr, Atomic number 40) and Hafnium (Hf, Atomic number 72) are transition series metals of group 4. They are found together in nature and are difficult to separate from each other. Which of the following is the reason for the above? 1

(a) The almost identical radii of the atoms.
(b) The elements belong to the same group.
(c) The elements belong to adjacent periods.
(d) The presence of the same number of unpaired electrons in both the elements.

13. Given below are two statements labelled as Assertion (A) and Reason (R).

    Assertion (A): Phenol is more reactive than benzene towards electrophilic substitution reaction.

    Reason (R): In the case of phenol, the intermediate carbocation is more resonance stabilized.

    Select the most appropriate answer from the options given below:

    (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.

    1

14. Given below are two statements labelled as Assertion (A) and Reason (R).

    Assertion (A): Aromatic aldehydes and formaldehyde undergo Cannizzaro reaction.

    Reason (R): Aromatic aldehydes are almost as reactive as formaldehyde.

    Select the most appropriate answer from the options given below:

    (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.

    1

15. Given below are two statements labelled as Assertion (A) and Reason (R).

    Assertion (A): A solution of sucrose in water is dextrorotatory. But on hydrolysis in the presence of a little hydrochloric acid, it becomes laevorotatory.

    Reason (R): Sucrose on hydrolysis gives unequal amounts of glucose and fructose. As a result of this, a change in the sign of rotation is observed.

    Select the most appropriate answer from the options given below:

    (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.

    1

16. Given below are two statements labelled as Assertion (A) and Reason (R).

    Assertion (A): Electrolysis of the aqueous solution of NaCl gives chlorine gas at the anode instead of oxygen gas.

    Reason (R): Formation of oxygen gas at the anode requires overpotential.

    Select the most appropriate answer from the options given below:

    (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.

    1

SECTION B

This section contains 5 questions with internal choice in one question.

The following questions are very short answer types and carry 2 marks each.

17. Molecularity is applicable only for elementary reactions but order is applicable for elementary and complex reactions. Justify.

    2

18. Addition of 1 mol of NaCl to 1 litre of water, the boiling point of water increases, while the addition of 1 mol of methyl alcohol to one litre of water decreases its boiling point. Give reason.

    2

19. Arrange the following in order of increasing property indicated:

    i. $(CH_3)_3CCl$, $(CH_3)_2CHCl$, $CH_3CH_2Cl \rightarrow$ Reactivity towards S_N1 reaction.

    ii. CH_3Cl, CH_3CH_2Br, $(CH_3)_2CHBr \rightarrow$ Boiling point

    2

20. Write the equations involved in the following reactions:

    i. Stephen reaction

    ii. Etard reaction

    2

    OR

    Write the products formed when ethanal reacts with the following reagents:

    i. CH_3MgBr/H_3O^+

    ii. Zn-Hg/Con.HCl

21. Differentiate between hormones and vitamins with respect to their source and function.

    2

SECTION C

This section contains 7 questions with internal choice in one question.

The following questions are short answer type and carry 3 marks each.

22. Answer the following questions:

    3

    (a) Out of these complexes $[Fe(C_2O_4)_3]^{3-}$ and $[Fe(H_2O)_6]^{3+}$, which is more stable and why?

    (b) Using **VBT**, predict the geometry and magnetic nature of $Ni(CO)_4$.

    (*Atomic number of Ni=28)*

    OR

    (i) Write the IUPAC name and draw the structures of optical isomers of $[PtCl_2(en)_2]^{2+}$.

    (ii) Arrange the following complexes in the order of increasing electrical conductivity:

    $[Co(NH_3)_5Cl]Cl_2$, $[Co(NH_3)_6]Cl_3$, $[Co(NH_3)_4Cl_2]Cl$, $[Co(NH_3)_3Cl_3]$

23. (a) Calculate the emf of the given cell at 298K.

Fe(s)/Fe^{2+}(0.001 M) II H$^+$(1M)/H$_2$(g) (1 bar)/Pt(s)

[E^0$_{Fe^{2+}/Fe}$ = -0.44V, log10=1]

(b) Why does the cell voltage of a mercury cell remain constant during its lifetime?

3

24. Write the chemical equations for the following conversions:

i. Propene into n-propyl bromide

ii. Methyl bromide to ethanoic acid

iii. Chloroethane to butane

3

25. An organic compound with molecular formula $C_5H_{10}O$ does not reduce Tollens' reagent but forms an addition compound with sodium hydrogen sulphite and gives a positive iodoform test. On vigorous oxidation, it gives ethanoic acid and propanoic acid. Identify the compound and justify your answer.

3

26. Explain the following terms as applied to protein:

i. Denaturation

ii. Peptide linkage

iii. Globular protein

3

27. Answer the following:

i. Butan-1-ol optically inactive but Butan-2-ol is optically active.

ii. The Williamson synthesis cannot be used with tertiary alkyl halides.

iii. Phenol has a much lower pKa value than ethanol.

3

28. A first-order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy (Ea) for the reaction. [R = 8.314 J K^{-1} mol^{-1}]

[Given: log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021]

3

SECTION D

The following questions are case -based questions.
Each question carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

29. The magnitude of the splitting of Δ_O depends on the nature of ligands, and it affects the energy of transition; which in turn influences the frequency of maximum absorption in the spectrum.

Complex species	$[TiCl_6]^{3-}$	$[TiF_6]^{3-}$	$[Ti(H_2O)_6]^{3+}$	$[Ti(CN_6)]^{3-}$
Wave number (cm^{-1})	13,000	18,900	20,400	22,300

Answer the following questions:

(a) Arrange the complex ions in increasing order of their crystal field splitting energy (Δ_O).

1

(b) Write the electronic configuration of Ti in $[TiCl_6]^{3+}$ ion in an octahedral field.

1

(c) Give reason:

$[Ti(H_2O)_6]^{3+}$ is coloured but it becomes colourless on heating.

OR

Different colours are observed in octahedral and tetrahedral complexes for the same metal and the same ligands.

2

30. The study of the conductivity of electrolyte solutions is important for the development of electrochemical devices, for the characterisation of the dissociation equilibrium of weak electrolytes, and for the fundamental understanding of charge transport by ions. The conductivity of the electrolyte is measured for electrolyte solution with concentrations in the range of 10^{-3} to 10^{-1} mol L^{-1} as a solution in this range of concentrations can be easily prepared.

The molar conductivity (Λ_m) of strong electrolyte solutions can be nicely fit by Kohlrausch equation.

$$\Lambda_m = \Lambda^0_m - A\ c^{1/2}$$

Where Λ^0_m is the molar conductivity at infinite dilution and C is the concentration of the solution. The value of the constant 'A' for a given solvent and temperature depends on the type of electrolyte i.e., the charges on the cation and anion produced on the dissociation of the electrolyte in the solution.

The molar conductivity of weak electrolytes, on the other hand, is dependent on the degree of dissociation of the electrolyte. The molar conductivity at infinite dilution can be decomposed into the contributions of each ion.

$$\Lambda^0 m = v_+ \lambda^0_+ + v_- \lambda^0_-$$

Where, $\lambda +$ and $\lambda -$ are the ionic conductivities of positive and negative ions, respectively, and $V+$ and v_- are their stoichiometric coefficients in the salt molecular formula.

Answer the following questions:

(a) Give a reason why the conductivity of CH_3COOH decreases on dilution.

1

(b) The value of $\Lambda^0 m$ of $Al_2(SO_4)_3$ is 858 $Scm^2\ mol^{-1}$, while $\lambda^0 SO_4^{2-}$ is 160 $Scm^2\ mol^{-1}$. Calculate the limiting ionic conductivity of $Al^{3+.}$

1

2

(c) Represent the variation of Λ_m with concentration for strong and weak electrolytes graphically.

OR

The conductivity of the 0.001 M solution of CH_3COOH is 3.905 x 10^{-5} S cm^{-1}. Calculate its degree of dissociation.

Given: $\Lambda_0 CH_3COO^- = 40.9$ S cm^2 mol^{-1}, $\Lambda_0 H^+ = 349.6$ S cm^2 mol^{-1}

SECTION E

The following questions are long answer type and carry 5 marks each.

All questions have an internal choice.

31. Account for the following:

    (a) In a transition series of metals, the metal that exhibits the greatest number of oxidation states occurs in the middle of the series.

    (b) The $E°_{M^{2+}/M}$ for copper is positive (0.34 V).

    (c) The ionisation energies of 5d elements greater than 3d elements.

    (d) The transition metals (except for Zn, Cd, and Hg) are hard and have high melting and boiling points.

    (e) Transition elements and their compounds are generally found to be good catalysts in chemical reactions.

5

OR

    (i) Write the chemical equations involved in the preparation of $K_2Cr_2O_7$.

    (ii) Write the chemical equation for

        (a) the reaction of oxalic acid with acidified $KMnO_4$.

        (b) $KMnO_4$ when heated.

32. (a) On mixing liquid X and Y, the volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y?

    (b) 18 g of glucose, $C_6H_{12}O_6$ is dissolved in 1kg of water in a saucepan. At what temperature will this solution boil? (K_b for water = 0.52 K Kg mol^{-1})

    (c) Why do RBC (Red blood cells) shrink when placed in saline water?

5

OR

Give reasons for the following:

    (i) At higher altitudes, people suffer from a disease called anoxia.

    (ii) Measurement of the osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.

    (iii) Calculate the freezing point of a solution when 3g of $CaCl_2$ (M= 111 gmol^{-1}) was dissolved in 100g of water, assuming $CaCl_2$ undergoes complete ionisation. (K_f for water = 1.86 K kg mol^{-1})

33. a. Illustrate the following reactions giving suitable examples in each case.

5

    i) Gabriel phthalimide synthesis

    ii) Sandmeyer's reaction

  b. Write the structures of main products when benzene diazonium chloride reacts with:

    i) $H_3PO_2 + H_2O$ ii) KI

OR

Write the structures of the compounds A, B, C, D and E in each of the following reactions:

$$(C_7H_6O_2)\ A \xrightarrow{NH3/Heat} B \xrightarrow{Br2+KOH(aq)} C \xrightarrow{CHCl3+alc.KOH} D$$

$$B \xrightarrow{LiAlH_4\,/\,Ether} E$$

****