

St. Paul's School

Class XII – Half-Yearly Examination (2024-2025)

Chemistry (043)

Time: 3 Hrs

Max. Marks: 70

General instructions:

- (i) There are 33 questions in this question paper with internal choice.
- (ii) Section A consists of 16 multiple-choice questions carrying 1 mark each.
- (iii) Section B consists of 5 short answer questions carrying 2 marks each.
- (iv) Section C consists of 7 short answer questions carrying 3 marks each.
- (v) Section D consists of 2 case-based questions carrying 4 marks each.
- (vi) Section E consists of 3 long answer questions carrying 5 marks each.
- (vii) All questions are compulsory.
- (viii) Use of log tables and calculators is not allowed.

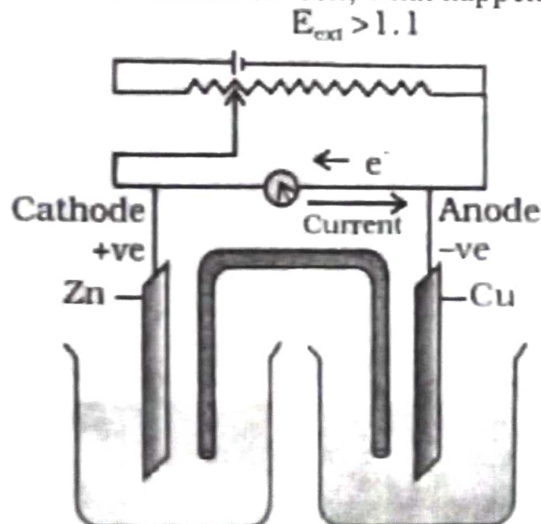
SECTION A

1. Which of the following solvents, the $C_4H_9NH_3^+X^-$ is soluble 1
(a) ether (c) water
(b) acetone (d) bromine water

2. Which of the following alkyl halides will undergo SN_1 reaction most readily? 1
(a) $(CH_3)_3C-F$ (c) $(CH_3)_3C-Br$
(b) $(CH_3)_3C-Cl$ (d) $(CH_3)_3C-I$

3. The difference between the electrode potentials of two electrodes, when no current is drawn through the cell, is called 1
(a) Cell potential (c) Potential difference
(b) Electromotive Force (d) Cell voltage

4. Looking at the setup of an electrochemical cell, what happens when $E_{ext} > 1.1$ V 1



- (a) Zn dissolves at the anode & copper deposits at the cathode
- (b) Current travels from Cu to Zn

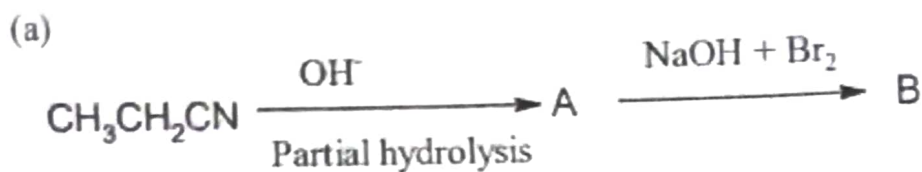
- (c) Zinc deposits at the anode and copper dissolves at the cathode.
 (d) No current is obtained
5. Fittig reaction can be used to prepare:
 (a) Toluene (c) Diphenyl
 (b) Acetophenone (d) Chlorobenzene
6. Alkene $RCH=CH_2$ reacts readily with B_2H_6 and the product on oxidation with alkaline hydrogen peroxide gives
 (a) RCH_2CHO (c) $RCOCH_3$
 (b) RCH_2CH_2OH (d) RCH_2OHCH_3
7. Propan-1-ol and Propan-2-ol can be distinguished by
 (a) Silver nitrate test (c) Lucas test
 (b) Br_2 water test (d) Baeyer test
8. The addition of HCN to carbonyl compounds is an example of
 (a) Electrophilic addition (c) Nucleophilic addition
 (b) Nucleophilic substitution (d) Electrophilic substitution
9. Clemmensen reduction is carried with
 (a) $LiAlH_4$ in ether (c) NH_2NH_2 /glycol and KOH
 (b) Zn-Hg and HCl (d) Zn-Hg and HNO_3
10. Which of the following is an example of a solid solution?
 (a) seawater (c) sugar solution
 (b) smoke (d) 22-carat gold
11. The limiting molar conductivity of NH_4OH is equal to -
 (a) $\Lambda_m^\circ NH_4Cl + \Lambda_m^\circ NaCl + \Lambda_m^\circ NaOH$
 (b) $\Lambda_m^\circ NaOH + \Lambda_m^\circ NaCl - \Lambda_m^\circ NH_4Cl$
 (c) $\Lambda_m^\circ NaOH - \Lambda_m^\circ NH_4Cl - \Lambda_m^\circ HCl$
 (d) $\Lambda_m^\circ NH_4Cl + \Lambda_m^\circ NaOH - \Lambda_m^\circ NaCl$
12. Phenol is less acidic than _____
 (a) o-nitro phenol (c) o-methyl phenol
 (b) ethanol (d) o-methoxy phenol
13. Given below are two statements labelled Assertion (A) and Reason (R)
Assertion (A): Nitration of benzoic acid gives m-nitrobenzoic acid.
Reason (R): Carboxyl group increases the electron density at the meta position.
 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.

14. Given below are two statements labelled Assertion (A) and Reason (R) 1
Assertion (A): The solubility of aldehydes and ketones in water decreases with an increase in the size of the alkyl group
Reason (R): The larger alkyl groups increase the non-polar character of the molecule, which prevents hydrogen bonding with water.
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.
15. Given below are two statements labelled Assertion (A) and Reason (R) 1
Assertion (A): Osmotic pressure is a colligative property.
Reason (R): Osmotic pressure depends on the nature of solute particles.
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.
16. Given below are two statements labelled Assertion (A) and Reason (R) 1
Assertion (A): Phenol does not react with HI to form iodobenzene.
Reason (R): Phenol gives effervescence with sodium hydrogen carbonate
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.

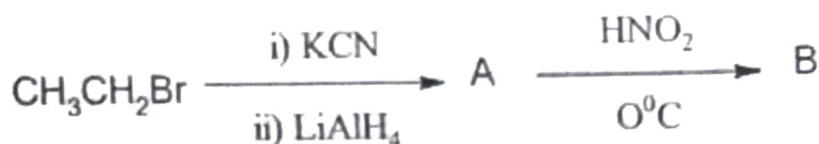
SECTION B

17. The conductivity of an aqueous solution of NaCl in a cell is $92 \Omega^{-1} \text{ cm}^{-1}$ the resistance offered by this cell is 247.8Ω . Calculate the cell constant. 2
18. Give reasons: 2
(a) Measurement of the osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.
(b) The elevation of the boiling point of 1 M KCl solution is nearly double than that of 1 M sugar solution.
19. Henry's law constant for the solubility of methane in benzene at 298 K is $4.27 \times 10^5 \text{ mm Hg}$. Find the solubility of methane in benzene at 298 K under 760 mm Hg. 2

20. Write the structures of A and B in the following:



(b)



21. Draw the structures of the following organic compounds:

- (a) 4-tertbutyl-3-iodoheptane.
 (b) p-Bromochlorobenzene

SECTION C

22. Explain the following:

- (a) Azeotrope
 (b) Colligative properties
 (c) Reverse osmosis

23. The conductivity of $0.001028 \text{ molL}^{-1}$ acetic acid is $4.95 \times 10^{-5} \text{ Scm}^{-1}$. Calculate its dissociation constant if $\Lambda^\circ\text{m}$ for acetic acid is $390.5 \text{ S cm}^2 \text{ mol}^{-1}$.

24. Calculate the mass of ascorbic acid ($\text{C}_6\text{H}_8\text{O}_6$) to be dissolved in 75 g of acetic acid, to lower its freezing point by 1.5°C . ($K_f = 3.9 \text{ Kkgmol}^{-1}$)

25. Write the chemical test to distinguish between the following pairs of compounds:

- (a) Aniline and benzylamine
 (b) Methylamine and aniline
 (c) Secondary and tertiary amines

26. Write the name of the reaction, structure, and IUPAC name of the product formed when

- (a) Phenol reacts with CHCl_3 in the presence of NaOH followed by hydrolysis.
 (b) $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{ONa}$ reacts with $\text{C}_2\text{H}_5\text{Br}$

27. Give reasons for the following observations:

- (a) p-dichlorobenzene has a higher melting point than those of o and m -isomers.
 (b) Haloarenes are less reactive than haloalkanes towards nucleophilic substitution reaction.

(c) The treatment of alkyl chloride with aqueous KOH leads to the formation of alcohol but in the presence of alcoholic KOH, alkene is the major product.

28. Convert the following in not more than two steps.

3

- (a) Propanone to Propene
- (b) Toluene into Benzaldehyde
- (c) Propanone to Propane

SECTION D

29. Read the passage given below and answer the questions that follow.

1x4

Faraday's laws of electrolysis, foundational to electrochemistry, describe the relationship between electric charge and the amount of substance deposited or dissolved at electrodes. These laws are crucial in several applications:

Electroplating: They enable precise control over metal thickness in coatings, essential in industries like automotive and jewellery.

Electrometallurgy and Electrorefining: They guide the efficient extraction and purification of metals such as aluminium and copper.

Electrosynthesis: Faraday's laws optimize the production of chemicals like chlorine and hydrogen through controlled electrolysis.

Battery Design: They determine the theoretical capacity of batteries and fuel cells, vital for energy storage technologies.

Corrosion Protection: Used in cathodic protection to prevent metal corrosion in structures like pipelines.

Gas Production: These laws ensure efficient hydrogen and oxygen production, key in renewable energy sectors.

Faraday's laws thus enable precise control and efficiency in various industrial and scientific processes.

Answer the following questions:

- (a) What is an electrolytic cell?
- (b) State Faraday's first law of electrolysis.
- (c) How much charge in terms of Faraday is required for the reduction of 1 mol of $\text{Cr}_2\text{O}_7^{2-}$ to Cr^{3+} .
- (d) How much electricity is required in coulomb for the oxidation of 1 mol of FeO to Fe_2O_3 ?

30. Read the passage given below and answer the questions that follow.

1x4

Benzene diazonium chloride, often abbreviated as BDC, is an important organic compound with the chemical formula $\text{C}_6\text{H}_5\text{N}_2\text{Cl}$.

Properties

Benzene diazonium chloride is typically a colourless to pale yellow crystalline solid that is highly soluble in water. It is unstable at room temperature and must be stored at low temperatures (around 0°C) to prevent decomposition. The

compound decomposes readily, releasing nitrogen gas (N₂) and forming phenyl chloride or benzene, depending on the reaction conditions.

Reactivity and Applications

Benzene diazonium chloride is highly reactive and serves as an important intermediate in organic synthesis, particularly in the preparation of azo dyes, which are widely used in the textile industry. The compound undergoes various reactions such as:

Sandmeyer Reaction: This reaction is used to replace the diazonium group with a halogen atom, leading to the formation of chlorobenzene, bromobenzene, or iodobenzene.

Gattermann Reaction: In this reaction, benzene diazonium chloride reacts with copper powder and hydrochloric acid to produce chlorobenzene.

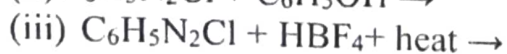
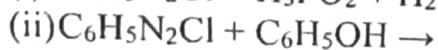
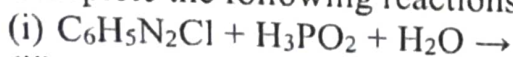
Coupling Reactions: Benzene diazonium chloride reacts with phenols and aromatic amines to form azo compounds, which are characterized by their vivid colours. **Reduction to Benzene:** When heated or treated with reducing agents, benzene diazonium chloride decomposes to benzene.

Safety and Handling

Due to its instability and potential to release nitrogen gas explosively, benzene diazonium chloride must be handled with care, particularly in its dry form. It is essential to work with this compound under controlled conditions, typically in a cold environment, to avoid accidental decomposition. Benzene diazonium chloride is a versatile compound in organic chemistry, pivotal for synthesizing various aromatic compounds and azo dyes. Its reactivity and wide range of applications make it a valuable intermediate, despite its handling challenges.

Answer the following questions:

(a) Complete the following reactions:



(b) Why Sandmeyer's reaction is preferred over Gattermann's reaction?

SECTION E

31. Account for the following:

- Racemic mixture is optically inactive.
- Ethyl iodide undergoes S_N2 reaction faster than ethyl bromide.
- Haloalkanes react with KCN to form alkyl cyanides as the main product while AgCN forms isocyanides as the major product.
- The thionyl chloride method is preferred for preparing alkyl chlorides from alcohols.
- Dry acetone is used in the Finkelstein reaction with NaI.

32. An organic compound (A) having molecular formula C_4H_8O gives an orange-red precipitate with 2, 4-DNP reagent. It does not reduce Tollens' reagent but gives a yellow precipitate of iodoform on heating with $NaOH$ and I_2 . Compound (A) on reduction with $NaBH_4$ gives compound (B) which undergoes dehydration reaction on heating with conc. H_2SO_4 to form compound (C). Compound (C) on Ozonolysis gives two molecules of ethanal. Identify (A), (B), and (C) and write their structures. Write the reactions of compound (A) with (i) $NaOH/I_2$ and (ii) $NaBH_4$. 5

OR

An organic compound (A) with molecular formula C_8H_8O forms an orange-red precipitate with 2,4-DNP reagent and gives a yellow precipitate on heating with iodine in the presence of sodium hydroxide. It neither reduces Tollens' or Fehling's reagent nor does it decolourise bromine water or Baeyer's reagent. On drastic oxidation with chromic acid, it gives a carboxylic acid (B) having molecular formula $C_7H_6O_2$. Identify the compounds (A) and (B) and explain the reactions involved.

33. [A] What happens when:
(Write chemical equations in support of your answer.)
(a) $(CH_3)_3C-OH$ is treated with Cu at $573K$.
(b) Anisole is treated with CH_3Cl /anhydrous $AlCl_3$.
(c) Phenol is treated with Zn dust.

3+2

[B] Write the mechanism for the formation of ethanol from ethene