

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)



Time Allowed: 3 Hours

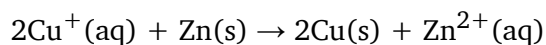
Maximum Marks: 70

General Instructions

- (i) This question paper contains **33 questions**. All questions are compulsory.
- (ii) Section A: Questions 1 to 16 are multiple choice questions, carrying 1 mark each.
- (iii) Section B: Questions 17 to 21 are very short answer questions, carrying 2 marks each.
- (iv) Section C: Questions 22 to 28 are short answer questions, carrying 3 marks each.
- (v) Section D: Questions 29 to 30 are case-based questions, carrying 4 marks each.
- (vi) Section E: Questions 31 to 33 are long answer questions, carrying 5 marks each.
- (vii) Attempt one alternative where an internal choice is provided. Follow the instructions within each question.
- (viii) Use of calculators is not allowed.

Section A

1. In an electrochemical cell, the following reaction takes place:



$$E^\circ_{\text{cell}} = 1.28 \text{ V}$$

As the reaction progresses, what will happen to the overall voltage of the cell?

- | | |
|--|---|
| (A) Voltage will remain constant. | (B) It will decrease as $[\text{Zn}^{2+}]$ increases. |
| (C) It will increase as $[\text{Cu}^+]$ increases. | (D) It will increase as $[\text{Zn}^{2+}]$ increases. |

2. Out of Ti^{3+} , Cr^{3+} , Fe^{2+} and Ni^{2+} ions, the one which is the most stable ion in aqueous solution is:

[Atomic number: Ti = 22, Cr = 24, Fe = 26, Ni = 28]

- | | |
|----------------------|----------------------|
| (A) Ti^{3+} | (B) Cr^{3+} |
| (C) Fe^{2+} | (D) Ni^{2+} |

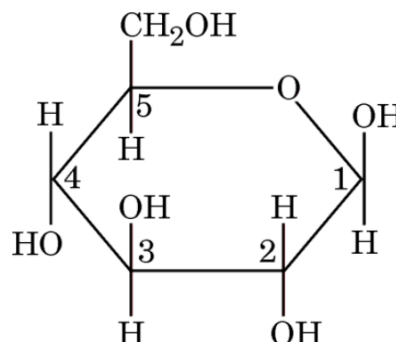
3. Hoffmann Bromamide degradation reaction is given by:

- | | |
|---------------------------------|------------------------|
| (A) R-NO_2 | (B) R-NH_2 |
| (C) $\text{R-CH}_2\text{-NH}_2$ | (D) R-CO-NH_2 |

4. The value of Henry's constant K_H is:

- | | |
|--|---|
| (A) greater for gases with higher solubility | (B) greater for gases with lower solubility |
| (C) constant for all gases | (D) not related to the solubility of gases |

5. In the Haworth structure of the following carbohydrate, various carbon atoms have been numbered. The anomeric carbon is numbered as:

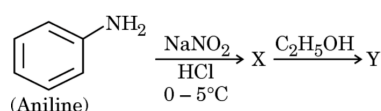


- | | |
|-------|-------|
| (A) 1 | (B) 2 |
| (C) 3 | (D) 5 |

6. Out of the following statements, the correct statement is:

- | | |
|---|--|
| (A) La is actually not an element of transition series. | (B) Zr and Hf have almost identical atomic radii. |
| (C) Lanthanoids are radioactive. | (D) Ionic radius increases from La^{3+} to Lu^{3+} . |

7. In the given reaction sequence, the structure of Y would be:



- | | |
|-----|-----|
| (A) | (B) |
| (C) | (D) |

- | | |
|-------------------|-------------------|
| (A) Structure (A) | (B) Structure (B) |
| (C) Structure (C) | (D) Structure (D) |

8. Out of 2-Bromobutane, 1-Bromobutane, 2-Bromopropane and 1-Bromopropane, the molecule which is chiral in nature is:

- (A) 2-Bromobutane (B) 1-Bromobutane
(C) 2-Bromopropane (D) 1-Bromopropane

9. Which of the following properties of transition metals enables them to behave as catalysts?

- (A) High melting point (B) High ionisation enthalpy
(C) Alloy formation (D) Variable oxidation states

10. What amount of electric charge is required for the oxidation of 1 mole of FeO to Fe₂O₃?

- (A) 1F (B) 2F
(C) 3F (D) 4F

11. Alkenes are formed by heating alcohols with conc. H₂SO₄. The first step in the reaction is:

- (A) formation of carbocation (B) formation of ester
(C) protonation of alcohol molecule (D) elimination of water

12. Polyhalogen compounds have wide application in industries and agriculture. DDT is also a very important polyhalogen compound. It is a:

- (A) greenhouse gas (B) fertilizer
(C) biodegradable insecticide (D) non-biodegradable insecticide

13. **Assertion (A):** Acetanilide is less basic than aniline.

Reason (R): Acetylation of aniline results in decrease of electron density on nitrogen.

- (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.

14. **Assertion (A):** Cuprous salts are diamagnetic.

Reason (R): Cuprous ion has completely filled 3d-orbitals.

- (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.

15. **Assertion (A):** n-Butyl chloride has higher boiling point than n-Butyl bromide.

Reason (R): C–Cl bond is more polar than C–Br bond.

- (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.

16. **Assertion (A):** Electrolysis of aqueous NaCl gives H₂ at cathode and Cl₂ at anode.

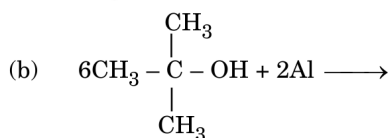
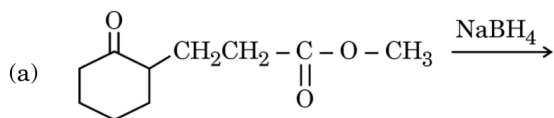
Reason (R): Chlorine has higher oxidation potential than H₂O.

- (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.

Section B

17. What is meant by essential amino acids? Why are amino acids amphoteric in nature?

18. Write the structures of the main products of the following reactions:



19. Name and define the cell which was used for providing electric power in the Apollo space programme. Also write its one advantage.

20. $\text{PdCl}_2 \cdot 2\text{KCl}$ does not give precipitate of AgCl with AgNO_3 solution. Write the structural formula and IUPAC name of the complex.

21. (a) The reaction between $\text{A}_2(\text{g})$ and $\text{B}_2(\text{g})$ was carried out in a sealed isothermal container. The rate law for the reaction was found to be:

$$\text{Rate} = k[\text{A}_2][\text{B}_2]$$

If 1 mole of $\text{A}_2(\text{g})$ was added to the reaction chamber and the temperature was kept constant, then predict the change in rate of the reaction and the rate constant.

OR

(b) Reactant 'A' underwent a decomposition reaction. The concentration of 'A' was measured periodically and recorded in the table given below:

Time/Hours	[A]/M
0	0.88
1	0.44
2	0.22
3	0.11

Based on the above data, predict the order of the reaction and write the expression for the rate law.

Section C

22. Give explanation for each of the following observations:

- (a) With the same d-orbital configuration (d^4), Mn^{3+} ion is an oxidising agent whereas Cr^{2+} ion is a reducing agent.
- (b) Actinoid contraction is greater from element to element than that among lanthanoids.
- (c) Transition metals form large number of interstitial compounds with H, B, C and N.

23. An aromatic compound 'A' with molecular formula C_8H_8O gives positive 2,4-DNP test. It gives yellow precipitate of compound 'B' on treatment with sodium hypoiodite. Compound 'A' does not react with Tollen's or Fehling's reagent; on drastic oxidation with $KMnO_4$ it forms a carboxylic acid 'C'. Elucidate the structures of A, B and C. Also give their IUPAC names.

24. Arrange the following compounds as asked:

- (a) in decreasing order of pK_b values

$C_2H_5NH_2$, $(C_2H_5)_2NH$, $C_6H_5NHCH_3$, $C_6H_5NH_2$

- (b) increasing order of boiling point

C_2H_5OH , $C_2H_5NH_2$, $(CH_3)_2NH$

- (c) increasing order of solubility in water

$C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$

25. (a) Account for the following:

- (i) Allyl chloride is hydrolysed more readily than n-propyl chloride.
- (ii) Isocyanides are formed when alkyl halides are treated with silver cyanide.
- (iii) Methyl chloride reacts faster with OH^- ion in S_N2 reaction than t-butyl chloride.

OR

(b) Complete the following reactions by writing the structural formulae of 'A' and 'B':

- (i) $CH_3CH=CH_2 \xrightarrow{[HBr/Peroxide]}$ 'A' $\rightarrow$ [aq. KOH] 'B'
- (ii) $CH_3CH_2CHClCH_3 \xrightarrow{[alc. KOH]}$ 'A' $\rightarrow$ [HBr] 'B'
- (iii) 'A' $\xrightarrow{[Mg]}$ $CH_3CH_2MgCl \xrightarrow{[H_2O/H^+]}$ 'B' (Main product)

26. (a) Can sodium propoxide and t-butyl chloride be used for the preparation of t-butyl propyl ether? Give suitable explanation. Justify your answer by suggesting the appropriate starting material required for the preparation of t-butyl propyl ether.

(b) Give the IUPAC name of the above mentioned ether.

27. An aqueous solution of NaOH was made and its molar mass from the measurement of osmotic pressure at $25^\circ C$ was found to be 28 g mol^{-1} . Calculate the percentage dissociation of NaOH in this solution.

[Atomic mass: Na = 23.0 u, O = 16.0 u, H = 1.0 u]

28. Calculate the cell voltage of the voltaic cell which is set up by joining the following half-cells at $25^\circ C$:

Al/Al^{3+} (0.002 M) and Ni/Ni^{2+} (0.002 M)

Given: $E^\circ_{Ni^{2+}/Ni} = -0.25 \text{ V}$, $E^\circ_{Al^{3+}/Al} = -1.66 \text{ V}$, $\log 5 = 0.6990$

29. According to the generally accepted definition of the ideal solution there are equal interaction forces acting between molecules belonging to the same or different species. (This is equivalent to the statement that the activity of the components equals the concentration.) Strictly speaking, this condition is fulfilled only in exceptional cases for mixtures (optical isomers, isotopic mixtures of an element, hydrocarbon mixtures). It is still usual to talk about ideal solutions as limiting cases in reality since very dilute solutions behave ideally with respect to the solvent. This view is further supported by the fact that Raoult's law empirically found for describing the behaviour of the solvent in dilute solutions can be deduced thermodynamically via the assumption of ideal behaviour of the solvent.

Answer the following questions:

- (a) Give one example of miscible liquid pair which shows negative deviation from Raoult's law. What is the reason for such deviation?
- (b) (i) State Raoult's law for a solution containing volatile components.

OR

- (b) (ii) Raoult's law is a special case of Henry's law. Comment.
- (c) Write two characteristics of an ideal solution.

30. Ribose and 2-deoxyribose have an important role in biology. Among the most important derivatives are those with phosphate groups attached at the 5 position. Mono-, di- and tri-phosphate forms are important, as well as 3-5 cyclic monophosphates. Purines and pyrimidines form an important class of compounds with ribose and deoxyribose. When these purine and pyrimidine derivatives are coupled to a ribose sugar, they are called nucleosides.

Answer the following questions:

- (a) What products would be formed when DNA is hydrolysed? How is DNA different from RNA with reference to a structure?
- (b) Differentiate between nucleotide and nucleoside.
- (c) (i) Mention two important functions of nucleic acid.

OR

- (c) (ii) Name the linkage which joins two nucleotides. Name the base that is found in nucleotide of RNA but not in DNA.

31. (a) (i) Give reasons:

(I) $[\text{Ni}(\text{CO})_4]$ is diamagnetic whereas $[\text{NiCl}_4]^{2-}$ is paramagnetic. [Atomic number: Ni = 28]

(II) CO is a stronger complexing agent than NH_3 .

(III) The trans isomer of complex $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ is optically inactive.

(ii) Using Crystal Field theory, write the number of unpaired electrons in octahedral complexes of Fe^{2+} in the presence of:

(I) Strong field ligand

(II) Weak field ligand

[Atomic number: Fe = 26]

OR

(b) (i) Name the type of isomerism exhibited by the following compounds. Also draw their corresponding isomers.

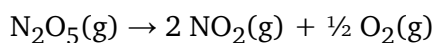
(I) $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$

(II) $[\text{Co}(\text{en})_3]^{3+}$

(III) $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$

(ii) Differentiate between weak field and strong field ligands. How does the strength of the ligand influence the spin of the complex?

32. (a) (i) The initial concentration of N_2O_5 in the first order reaction:



was $1.2 \times 10^{-2} \text{ mol L}^{-1}$. The concentration of N_2O_5 after 60 minutes was $0.2 \times 10^{-2} \text{ mol L}^{-1}$. Calculate the rate constant of the reaction at 318 K.

$[\log 6 = 0.778]$

(ii) Account for the following:

(I) We cannot determine the order of a reaction by taking into consideration the balanced chemical equation.

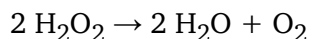
(II) A bimolecular reaction may become kinetically of first order under a specified condition.

OR

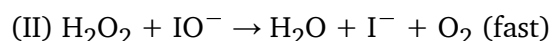
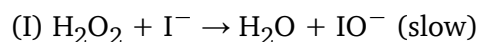
(b) (i) The rate of the chemical reaction doubles for an increase of 10 K in absolute temperature from 298 K. Calculate activation energy (E_a).

$[2.303 R = 19.15 \text{ J K}^{-1} \text{ mol}^{-1}, \log 2 = 0.3]$

(ii) For a reaction:



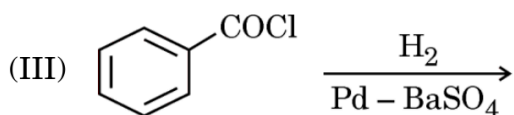
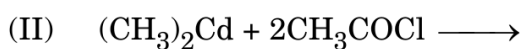
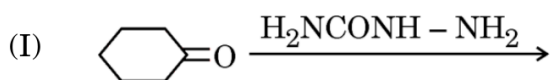
the proposed mechanism is as given below:



(1) Write rate law for the reaction.

(2) Write the overall order and molecularity of the reaction.

33. (a) (i) Complete the following reactions by writing the structure of the main products:



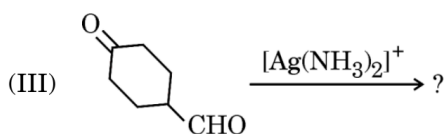
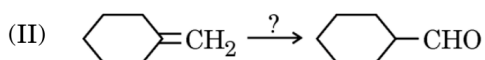
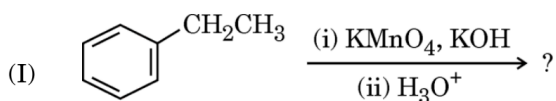
(ii) Give simple chemical test to distinguish between the following pairs of compounds:

(I) Ethyl benzoate and benzoic acid

(II) Propanal and propanone

OR

(b) (i) Complete each synthesis by giving missing starting material, reagent or products:



(ii) Carry out the following conversions:

(I) Benzaldehyde to Benzophenone

(II) Benzaldehyde to 3-phenyl propanol

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