

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. The most stable oxidation state of Iron is:

- (A) +2 (B) +3
(C) +4 (D) -2

2. The product formed as a result of reaction of CH_3MgBr and CO_2 followed by hydrolysis is:

- (A) CH_3CHO (B) CH_3COCH_3
(C) HCOOH (D) CH_3COOH

3. Nucleotides are composed of a:

- (A) pentose sugar and phosphoric acid (B) nitrogenous base, pentose sugar and phosphoric acid
(C) nitrogenous base and phosphoric acid (D) pentose sugar and nitrogenous base

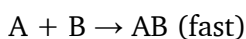
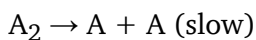
4. Which of the following alkyl halides will undergo $\text{S}_{\text{N}}1$ reaction most readily?

- (A) $(\text{CH}_3)_3\text{C-I}$ (B) $(\text{CH}_3)_3\text{C-Cl}$
(C) $(\text{CH}_3)_3\text{C-Br}$ (D) $(\text{CH}_3)_3\text{C-F}$

5. Phenol dimerises in benzene having van't Hoff factor 0.54. Its degree of association is:

- (A) 0.54 (B) 0.46
(C) 0.92 (D) 0.27

6. A reaction $\text{A}_2 + \text{B}_2 \rightarrow 2\text{AB}$ occurs by the following mechanism:



Its order would be:

- (A) 1 (B) 2
(C) Zero (D) $\frac{3}{2}$

7. Decarboxylation of sodium benzoate on heating with soda lime gives:

- (A) benzene (B) benzoic acid
(C) benzaldehyde (D) toluene

8. The IUPAC name of $\text{CH}_3\text{-CO-CH}_2\text{-CHO}$ is:

- (A) 1-oxobutanal-3-one (B) 1-oxobutanal
(C) 3-oxobutanal (D) 3-oxobutanone

9. Dehydration of tertiary alcohols with Cu at 573 K gives:

- (A) Alkyne (B) Alkene
(C) Aldehyde (D) Ketone

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

- (A) slope is $\frac{-E_a}{R}$ and intercept is E_a (B) slope is A and intercept is $\frac{-E_a}{R}$
(C) slope is $\frac{-E_a}{R}$ and intercept is $\log A$ (D) slope is $\frac{-E_a}{2.303 R}$ and intercept is $\log A$

11. Phenol on reaction with aqueous bromine at room temperature gives:

- (A) 2-bromophenol (B) 3-bromophenol
(C) 4-bromophenol (D) 2,4,6-tribromophenol

12. The specific sequence in which amino acids are arranged in a protein is called:

- (A) Secondary structure (B) Primary structure
(C) Tertiary structure (D) Quaternary structure

13. 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.

- (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): The pK_a of O_2N-CH_2-COOH is lower than that of CH_3-COOH .

Reason (R): $-NO_2$ group shows electron withdrawing effect which increases the acidic character of O_2N-CH_2-COOH .

- (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): Transition metals have high enthalpy of atomization.

Reason (R): This is because transition metals have low melting points.

- (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.

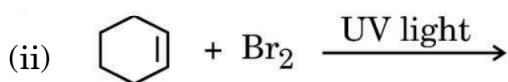
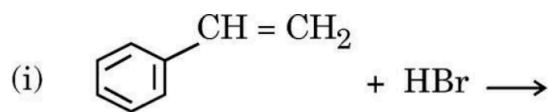
16. Assertion (A): When NaCl is added in water, elevation in boiling point is observed.

Reason (R): Elevation in boiling point is a colligative property.

- (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. (a) Draw the structures of major monohalo products in each of the following reactions:



OR

(b) 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.

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

- (a) Br_2 water
- (b) HCN

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- (a) Br_2 water
- (b) HCN

20. Write the chemical equations when:

- (a) Pentan-3-one is treated with $\text{H}_2\text{N}-\text{NH}_2$ followed by heating with KOH in high boiling solvent such as ethylene glycol.
- (b) Two molecules of $(\text{CH}_3)_3\text{C}-\text{CHO}$ are treated with conc. NaOH.

21. Write two differences between order of reaction and molecularity of reaction.

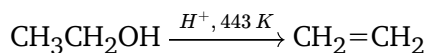
Section C

22. 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).

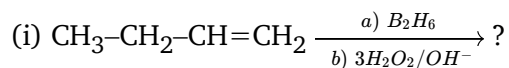
23. Answer the following: (any three)

- What is peptide linkage?
- What type of bonds hold a DNA double helix together?
- Which one of the following is a polysaccharide?
Sucrose, Glucose, Starch, Fructose
- Give one example each for water-soluble vitamins and fat-soluble vitamins.

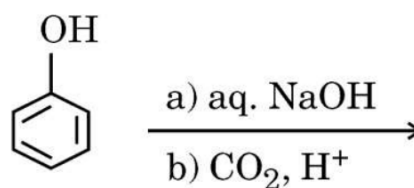
24. (a) Write the mechanism of the following reaction:



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



(ii)



25. (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:

$[\text{Cr}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$, $[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$, $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$

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

(i) $[\text{Co}(\text{NH}_3)_5\text{NO}_2]^{2+}$

(ii) $[\text{Co}(\text{en})_3]\text{Cl}_3$

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

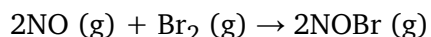
(i) $\text{CH}_3\text{--CH=CH--Br}$

(ii) $\text{CH}_2\text{=CH--CH(Br)--CH}_3$

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

(c) Which isomer of $\text{C}_4\text{H}_9\text{Cl}$ has the lowest boiling point?

27. The following initial rate data were obtained for the reaction:



Expt. No.	$[\text{NO}]/\text{mol L}^{-1}$	$[\text{Br}_2]/\text{mol L}^{-1}$	Initial Rate ($\text{mol L}^{-1} \text{s}^{-1}$)
1	0.05	0.05	1.0×10^{-3}
2	0.05	0.15	3.0×10^{-3}
3	0.15	0.05	9.0×10^{-3}

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

(b) Calculate the rate constant (k).

(c) Determine the rate of reaction when concentration of NO and Br_2 are 0.4 M and 0.2 M, respectively.

28. When a certain conductivity cell was filled with 0.05 M KCl solution, it has a resistance of 100 ohm at 25°C . 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 AgNO_3 solution.

(Given: Conductivity of 0.05 M KCl solution = $1.35 \times 10^{-2} \text{ ohm}^{-1} \text{ cm}^{-1}$)

29. 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.

Answer the following questions:

29(a). What is crystal field splitting energy?

29(b). Give reason for the violet colour of the complex $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ on the basis of crystal field theory.

29(c). $[\text{Cr}(\text{NH}_3)_6]^{3+}$ is paramagnetic while $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic. Explain why. [Atomic No.: Cr = 24, Ni = 28]

OR

Explain why $[\text{Fe}(\text{CN})_6]^{3-}$ is an inner orbital complex, whereas $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is an outer orbital complex. [Atomic No.: Fe = 26]

30. 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.

Answer the following questions:

30(a). How do primary batteries differ from secondary batteries?

30(b). The cell potential of Mercury cell is 1.35 V, and remains constant during its life. Give reason.

30(c). Write the reactions involved in the recharging of the lead storage battery.

OR

Write two advantages of fuel cells over other galvanic cells.

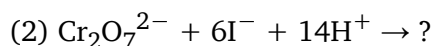
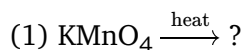
31. (a) (i) Account for the following:

(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° value of Cu^{2+}/Cu is + 0.34 V.

(ii) Complete and balance the following chemical equations:

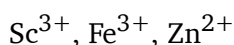


OR

(b) (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?



[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?

32. (a) (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: K_b for H_2O = $0.52 \text{ K kg mol}^{-1}$)

OR

(b) (i) The vapour pressures of A and B at 25°C 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?

33. Answer any five questions of the following:

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

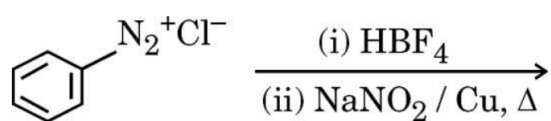
(b) Aniline does not undergo Friedel-Crafts reaction. Why?

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

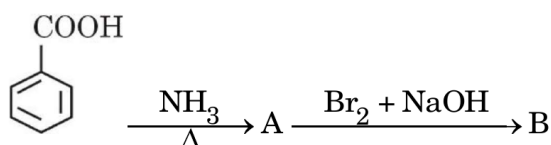
(d) Write the chemical reaction involved in Gabriel phthalimide synthesis.

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

(f) Complete the following reaction:



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



- End of Question Paper -