

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 equilibrium $\text{Cr}_2\text{O}_7^{2-} \rightleftharpoons 2\text{CrO}_4^{2-}$:

- (A) exists in basic medium (B) exists in acidic medium
(C) exists in neutral medium (D) does not exist

2. Which of the following is the strongest acid?

- (A) $\text{p-Cl-C}_6\text{H}_4\text{COOH}$ (B) $\text{p-OH-C}_6\text{H}_4\text{COOH}$
(C) $\text{C}_6\text{H}_5\text{COOH}$ (D) $\text{p-NO}_2\text{-C}_6\text{H}_4\text{COOH}$

3. Maltose is made up of:

- (A) glucose and fructose (B) glucose and galactose
(C) glucose and glucose (D) glucose and ribose

4. The system that forms maximum boiling azeotrope is:

- (A) CS_2 and acetone (B) Benzene and toluene
(C) Ethanol and acetone (D) Chloroform and acetone

5. A zero-order reaction is one whose rate is independent of:

- (A) Presence of light (B) Concentration of the reactant
(C) Temperature of the reaction (D) Pressure of the reaction

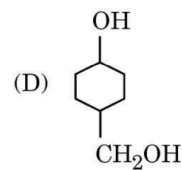
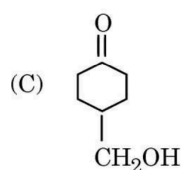
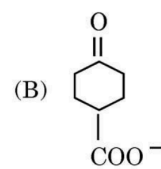
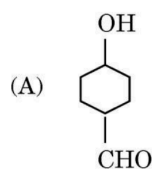
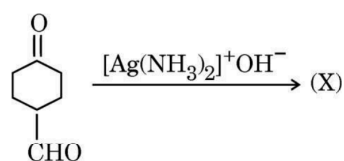
6. In the Arrhenius equation, when $\log k$ is plotted against $1/T$, a straight line is obtained whose:

- (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 $\log A$

7. Which of the following is most reactive towards nucleophilic substitution reaction?

- (A) Chlorobenzene ($\text{C}_6\text{H}_5\text{-Cl}$) (B) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-Cl}$
(C) $\text{CH}_2=\text{CH-Cl}$ (D) $\text{CH}_2=\text{CH-CH}_2\text{-Cl}$

8. The product (X) obtained in the following reaction is:



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

9. Which of the following has the highest boiling point?

- (A) CH_3CHO (B) CH_3COCl
(C) CH_3COCH_3 (D) CH_3COOH

10. Phenol does not undergo nucleophilic substitution reaction easily due to:

- | | |
|--|---|
| (A) Partial double bond character of C–OH bond | (B) Partial double bond character of C–C bond |
| (C) Acidic nature of phenol | (D) Instability of phenoxide ion |

11. The suitable Grignard reagent used for the synthesis of $(\text{CH}_3)_2\text{CH}-\text{CH}_2-\text{OH}$ with methanal is:

- | | |
|--|---|
| (A) $(\text{CH}_3)_2\text{CH}-\text{CH}_2\text{MgBr} / \text{H}_2\text{O}$ | (B) $\text{CH}_3\text{MgBr} / \text{H}_2\text{O}$ |
| (C) $(\text{CH}_3)_2\text{CHMgBr} / \text{H}_2\text{O}$ | (D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr} / \text{H}_2\text{O}$ |

12. All proteins on hydrolysis give:

- | | |
|-------------|---------------------------|
| (A) Enzymes | (B) α -amino acids |
| (C) Glucose | (D) Polypeptides |

13. Assertion (A): Fluoroacetic acid is stronger acid than chloroacetic acid.

Reason (R): This is due to greater electron withdrawing nature of F than Cl.

- | | |
|--|---|
| (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): p-nitroaniline is a weaker base than p-toluidine.

Reason (R): The electron donating $-\text{NO}_2$ group in p-nitroaniline makes it a weaker base.

- | | |
|--|---|
| (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): $\Delta_{\text{mix}}H$ for an ideal solution is not equal to zero.

Reason (R): A–B interactions in an ideal solution are same as between A–A and B–B interactions.

- | | |
|--|---|
| (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): Separation of Zr and Hf is difficult.

Reason (R): Zr and Hf are radioactive.

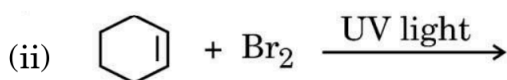
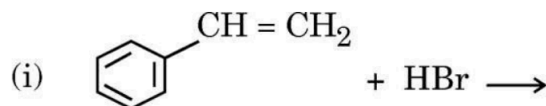
- | | |
|--|---|
| (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). | (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). |
| (C) Assertion (A) is true, but Reason (R) is false.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

Section B

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

- (a) $\text{H}_2\text{N}-\text{OH}$
 (b) $(\text{CH}_3\text{CO})_2\text{O}$

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

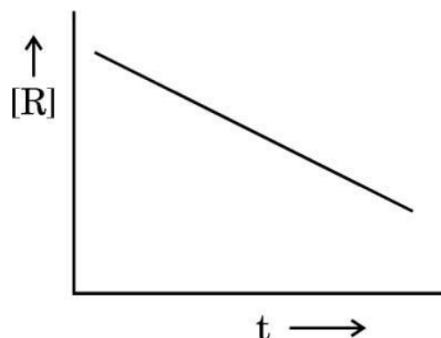


OR

(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.

19. For a chemical reaction $\text{R} \rightarrow \text{P}$ the variation in the concentration $[\text{R}]$ vs time t plot is given as:



- (a) Predict the order of the reaction and write the unit of rate constant (k) for this order of reaction.
 (b) What is the slope of the curve?

20. Write the chemical equations when:

- (a) Ethanal is treated with 2,4-dinitrophenylhydrazine?
 (b) Propanone is treated with $\text{Zn}(\text{Hg})$ and conc. HCl ?

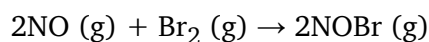
21. Calculate the potential of Iron electrode in which the concentration of Fe^{2+} ion is 0.01 M.

$$(E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.45 \text{ V at } 298 \text{ K})$$

[Given: $\log 10 = 1$]

Section C

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



Expt. No.	[NO]/mol L ⁻¹	[Br ₂]/mol L ⁻¹	Initial Rate (mol L ⁻¹ s ⁻¹)
1	0.05	0.05	1.0×10^{-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 Br₂ in the reaction?

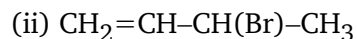
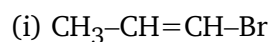
(b) Calculate the rate constant (k).

(c) Determine the rate of reaction when concentration of NO and Br₂ are 0.4 M and 0.2 M, respectively.

23. 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 AgNO₃ solution, the resistance was 90 ohm. Calculate the conductivity and molar conductivity of AgNO₃ solution.

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

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



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

(c) Which isomer of C₄H₉Cl has the lowest boiling point?

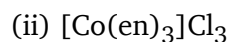
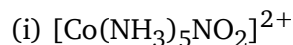
25. (a) Write the formula for the following coordination compound:

Potassium tetrahydroxidozincate (II)

(b) Arrange the following complexes in the increasing order of conductivity of their solution:

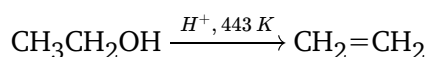


(c) Identify the type of isomerism exhibited by the following complexes:

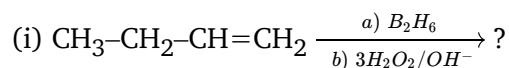


26. Compound (A) ($C_6H_{12}O_2$) on reduction with $LiAlH_4$ gives two compounds (B) and (C). The compound (B) on oxidation with PCC gives compound (D) which upon treatment with dilute NaOH and subsequent heating gives compound (E). Compound (E) on catalytic hydrogenation gives compound (C). The compound (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).

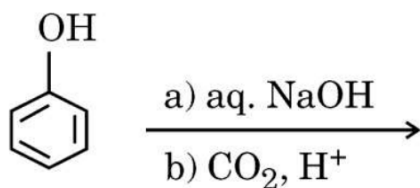
27. (a) Write the mechanism of the following reaction:



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



(ii)



28. 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.

29. 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:

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

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

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

OR

Write two advantages of fuel cells over other galvanic cells.

30. 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:

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

30(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.

30(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]

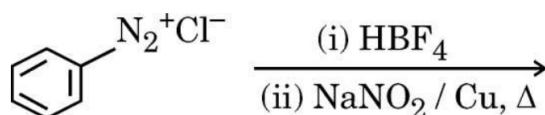
OR

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]

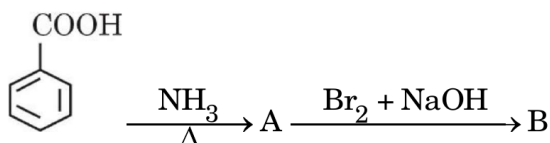
Section E

31. Answer any five questions of the following:

- N,N-diethyl-benzenesulphonamide is insoluble in alkali. Give reason.
- Aniline does not undergo Friedel-Crafts reaction. Why?
- Write a simple chemical test to distinguish between methylamine and aniline.
- Write the chemical reaction involved in Gabriel phthalimide synthesis.
- How will you convert aniline to p-bromoaniline?
- Complete the following reaction:



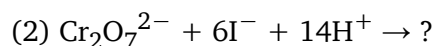
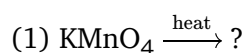
(g) Write the structures of A and B in the following reaction:



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

- The melting and boiling points of Zn, Cd and Hg are low.
- Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidizing.
- E° value of Cu^{2+}/Cu is + 0.34 V.

(ii) Complete and balance the following chemical equations:

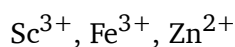


OR

(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?

33. (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 $\text{H}_2\text{O} = 0.52 \text{ K kg mol}^{-1}$)

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?

- End of Question Paper -