

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 the ring structure of fructose, the anomeric carbon is

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

2. Which of the following is the correct expression of K_f which depends upon the nature of solvent?

$$(A) K_f = \frac{M_1 \times T_f^2}{R \times 1000 \times \Delta_{fus} H} \quad (B) K_f = \frac{R \times M_1 \times \Delta_{fus} H}{1000 \times T_f^2}$$

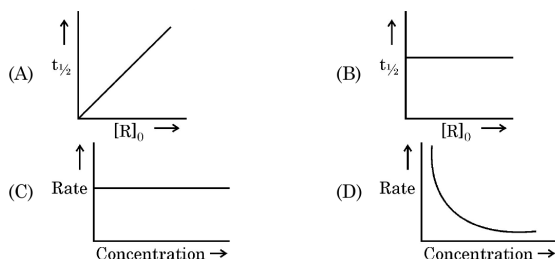
$$(C) K_f = \frac{R \times T_f^2 \times \Delta_{fus} H}{1000 \times M_1} \quad (D) K_f = \frac{R \times M_1 \times T_f^2}{1000 \times \Delta_{fus} H}$$

- (A) Option (A) (B) Option (B)
(C) Option (C) (D) Option (D)

3. Which of the following transition metals has lowest enthalpy of atomisation?

- (A) Cr (B) V
(C) Mn (D) Fe

4. Which of the following curve represents the first order reaction?



- (A) Graph (A) (B) Graph (B)
(C) Graph (C) (D) Graph (D)

5. Aniline on direct nitration yields

- (A) 51%-ortho, 47%-para, 2%-meta derivatives (B) 51%-meta, 47%-ortho, 2%-para derivatives
(C) 51%-para, 47%-meta, 2%-ortho derivatives (D) 51%-ortho, 47%-meta, 2%-para derivatives

6. Which of the following is 'not' true about enantiomers?

- (A) They have the same chemical reactivity. (B) They have the same specific rotation.
(C) They have the same melting or boiling point. (D) They have the same refractive index.

7. The secondary valency of Co in $[\text{Co}(\text{en})_3]^{3+}$ is

- (A) 4 (B) 3
(C) 5 (D) 6

8. At low temperature, phenol on reaction with Br_2 in CS_2 gives

- (A) 2, 4, 6-Tribromophenol (B) a mixture of ortho- and para-bromophenol
(C) ortho-bromophenol only (D) para-bromophenol only

9. How the conductivity varies on decreasing concentration for both weak and strong electrolytes?

- (A) It increases for weak electrolyte and decreases for strong electrolyte. (B) It decreases for weak electrolyte and increases for strong electrolyte.
(C) It increases for both weak and strong electrolytes. (D) It decreases for both weak and strong electrolytes.

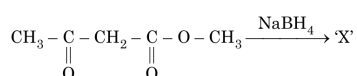
10. $\text{CH}_3\text{-NH}_2$ on reaction with $(\text{CH}_3\text{CO})_2\text{O}$ gives

- (A) CH_3CONH_2 (B) $\text{CH}_3\text{COONHCH}_3$
(C) $\text{CH}_3\text{-NH-CO-CH}_3$ (D) $\text{CH}_3\text{-CO-CH}_2\text{-NH}_2$

11. The activation energy of a reaction can be determined from the slope of which of the following curves?

- (A) $\ln k$ vs T (B) $\ln k$ vs $\frac{1}{T}$
(C) $\frac{\ln k}{T}$ vs T (D) $\ln k$ vs $\frac{T}{1}$

12. Identify 'X' in the following reaction:



'X' is

- (A) $\text{CH}_3-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\overset{\text{O}}{\underset{\text{O}}{\parallel}}\text{C}-\text{O}-\text{CH}_3$ (B) $\text{CH}_3-\overset{\text{O}}{\underset{\text{O}}{\parallel}}\text{C}-\text{CH}_2-\text{CH}_2-\text{OH}$
(C) $\text{CH}_3-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{CH}_2-\text{OH}$ (D) $\text{CH}_3-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{COOH}$

- (A) Option (A) (B) Option (B)
(C) Option (C) (D) Option (D)

13. **Assertion (A):** The presence of -OH group in phenols directs the incoming group at ortho- and para- positions.

Reason (R): -OH group in phenols deactivates the aromatic ring.

Select the correct answer from the codes (A), (B), (C) and (D).

- (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):** Actinoids show irregularities in their electronic configurations.

Reason (R): Due to varying stabilities of f^0 , f^7 and f^{14} occupancies of the 5f orbitals.

Select the correct answer from the codes (A), (B), (C) and (D).

- (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):** The pentaacetate of glucose does not react with $\text{H}_2\text{N-OH}$.

Reason (R): It indicates the absence of free -CHO group in glucose.

Select the correct answer from the codes (A), (B), (C) and (D).

- (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):** It is not possible to separate the components of an azeotrope by fractional distillation.

Reason (R): Minimum boiling azeotrope is formed by the solutions showing large positive deviation from Raoult's law.

Select the correct answer from the codes (A), (B), (C) and (D).

- (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

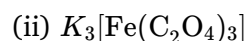
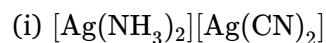
17. What type of deviation is shown by a mixture of chloroform and acetone from Raoult's law? Give reason. What will happen to the boiling point of the solution on mixing chloroform and acetone?

18. Following reaction takes place in one step:



How will the rate of above reaction change if the volume of the reaction vessel is decreased to one third of its original volume? Will there be any change in the order of reaction with the reduced volume?

19(a). Write IUPAC names of the following coordination compounds:



OR

19(b). (i) Give a chemical test to show that $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$ and $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$ are ionisation isomers.

(ii) What is meant by the 'Chelate effect'? Give an example.

20. Differentiate between the following:

(i) Fibrous protein and Globular protein

(ii) Peptide linkage and Phosphodiester linkage

21. Why are haloarenes less reactive towards nucleophilic substitution reaction? Give two reasons.

22. Calculate the boiling point of a solution containing 0.61 g of benzoic acid (Molar mass = 122 g mol^{-1}) in 5 g of CS_2 in which it dimerises to the extent of 88%. The boiling point and K_b of CS_2 are 46.2°C and $2.3 \text{ K kg mol}^{-1}$ respectively.

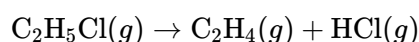
23. Write the reaction involved in the following:

- Reimer-Tiemann reaction
- Kolbe's reaction
- Friedel-Crafts acylation of anisole

24. Give reasons for the following:

- Carboxylic acids have higher boiling point than alcohols of comparable molecular masses.
- Alpha (α) hydrogens of aldehydes and ketones are acidic in nature.
- Nucleophilic addition of ammonia and its derivatives does not occur with carbonyl group in strongly acidic medium.

25. For the first order thermal decomposition reaction, following data was obtained:



S. No.	Time(s)	Total Pressure (atm)
1	0	0.30
2	30	0.50

Calculate rate constant. [Given: $\log 3 = 0.48$]

26. How do you explain the presence of following in open structure of glucose?

- all the six carbon atoms are in a straight chain.
- five -OH groups which are attached to different carbon atoms.
- an aldehyde group.

27. Compound 'X' with molecular formula $\text{C}_4\text{H}_9\text{Br}$ reacts with aqueous KOH to give an alcohol. The rate of this reaction depends only on the concentration of the compound 'X'. When an optically active isomer 'Y' of the compound 'X' was treated with aqueous KOH solution, the rate of reaction was found to be dependent on concentration of compound 'Y' and aqueous KOH both.

- Write down the structural formula of both 'X' and 'Y'.
- Out of 'X' and 'Y', which one will undergo racemisation and why?
- Out of 'X' and 'Y', which one will form product with inversion of configuration and why?

28(a). Answer the following:

- Why is the Equilibrium Constant (K_c) related to E_{cell}° and not to E_{cell} ?
- Two metals 'A' and 'B' have standard electrode potential values of -0.24 V and $+0.80 \text{ V}$ respectively. Which of these will liberate hydrogen gas from dil. H_2SO_4 ?
- Write the cell reaction which occurs in lead storage battery when it is in charging.

OR

28(b). What type of battery is Mercury cell? Why it is more advantageous than dry cell? Write overall reaction taking place in Mercury cell.

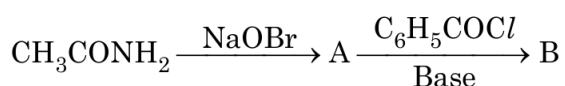
Section D

29(a). Read the passage carefully and answer the questions that follow:

The reaction of amines with mineral acids to form ammonium salts shows that these are basic in nature. Aliphatic amines are stronger bases than ammonia whereas aromatic amines are weaker bases than ammonia. Aliphatic and aromatic primary and secondary amines react with acid chlorides, anhydrides and esters by nucleophilic substitution reaction. The main problem encountered during electrophilic substitution reactions of aromatic amines is that of their high reactivity. Substitution tends to occur at ortho- and para-positions. Hinsberg reagent is used for the identification and distinction between primary, secondary and tertiary amines. Aryldiazonium salts, usually obtained from arylamines, undergo replacement of the diazonium group with a variety of nucleophiles to provide advantageous methods for producing aryl halides, cyanides, phenols and arenes.

Answer the following questions:

- (i) Why $\text{CH}_3\text{-NH}_2$ is a stronger base than $(\text{CH}_3)_3\text{N}$ in aqueous solution?
- (ii) Write structural formulae of the compound A and B:



29(b). A compound 'X' with molecular formula $\text{C}_3\text{H}_9\text{N}$ reacts with Hinsberg reagent to give a product insoluble in alkali. Identify 'X'.

OR

29(b). How can you convert aniline to benzonitrile?

29(c). Why is $-\text{NH}_2$ group of aniline acetylated before carrying out nitration?

30(a). Read the passage on VBT and CFT (d-orbital splitting under different crystal fields) and answer:

In octahedral crystal field, energies of which d-orbitals will be raised when ligands approach the central metal atom/ion? Give reason in support of your answer.

30(b). Using crystal field theory, write the electronic configuration of central metal atom/ion of the following:

- (i) $[\text{CoF}_6]^{3-}$
- (ii) $[\text{Co}(\text{NH}_3)_6]^{3+}$ [At. No.: Co = 27]

30(c). $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CO})_4]$ is diamagnetic though both are tetrahedral. Why? [Atomic No.: Ni = 28]

OR

30(c). Write hybridization and magnetic behaviour of the complex $[\text{Fe}(\text{CN})_6]^{3-}$. [Atomic No.: Fe = 26]

Section E

31(a). (i) From the given data of E° values, answer the following questions:

$E^\circ_{M^{2+}/M}$	V	Cr	Mn	Fe	Co	Ni	Cu
	-1.18	-0.91	-1.18	-0.44	-0.28	-0.25	+0.34

(I) Why $E^\circ_{M^{2+}/M}$ show irregular trend in the above values?

(II) Why is $E^\circ_{Cu^{2+}/Cu}$ value exceptionally positive?

(III) Why $E^\circ_{Mn^{2+}/Mn}$ value is highly negative?

(ii) Write the ionic equations for the oxidising action of potassium permanganate for its reaction with I^- in both acidic and alkaline solutions.

OR

31(b). Answer the following questions:

(i) Name a member of the lanthanoid series

(I) which exhibits +4 oxidation state

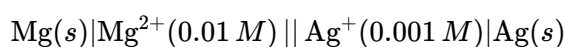
(II) which exhibits +2 oxidation state.

(ii) Why transition metals act as good catalyst?

(iii) Why Cr has higher melting point than Mn?

(iv) What happens when acidic solution of potassium permanganate is allowed to stand for sometime? Give the equation involved. What is this type of reaction called?

32(a). Calculate emf and ΔG for the following cell at 298 K:

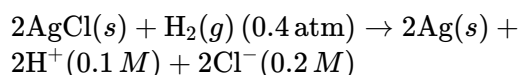


Given: $E^\circ_{Mg^{2+}/Mg} = -2.37 V$, $E^\circ_{Ag^+/Ag} = +0.80 V$

[1 F = 96500 C mol⁻¹, log 10 = 1]

OR

32(b). For the reaction:



Calculate emf of the cell at 25 °C.

Given: $\Delta G^\circ = -43500 \text{ J mol}^{-1}$

[log 10 = 1, 1 F = 96500 C mol⁻¹]

33(a). (i) An organic compound (X) has the molecular formula C₅H₁₀O. Draw structures for (X) if it:

(I) does not give Tollen's test but gives a positive iodoform test.

(II) does not give Tollen's test and iodoform test but undergoes Aldol condensation.

(III) undergoes Cannizzaro's reaction.

(ii) Show how each of the following compounds can be converted to benzoic acid:

(I) Acetophenone (II) Ethyl benzene

OR

33(b). Answer the following questions:

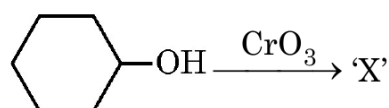
(i) Draw structure of the 2, 4-dinitrophenyl hydrazone derivative of benzaldehyde.

(ii) Arrange the following in increasing order of their reactivity towards HCN: Di-tert. butyl ketone, Acetaldehyde, Acetone.

(iii) Give a simple chemical test to distinguish between benzoic acid and ethyl benzoate.

(iv) Write the name of the reagent to convert Ethanenitrile to Ethanal.

(v) Draw the structure of 'X' in the following reaction:



- End of Question Paper -