

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 product of oxidation of SO_3^{2-} with MnO_4^- in acidic medium is :

- (A) SO_2 (B) SO_4^{2-}
(C) S^{2-} (D) $\text{S}_2\text{O}_3^{2-}$

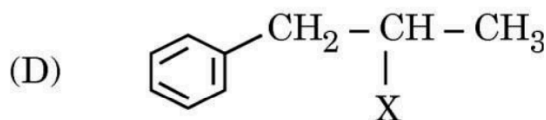
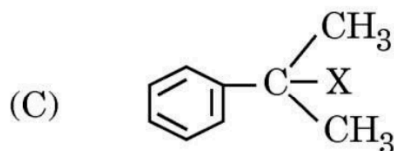
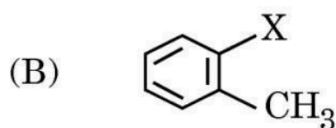
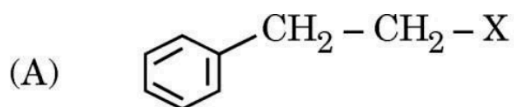
2. The coordination number of Co in $[\text{Co}(\text{en})_3]^{3+}$ is :

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

3. Which one of the following complexes is non-ionisable ?

- (A) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ (B) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
(C) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ (D) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$

4. Which of the following is a benzylic halide ?



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

5. Phenol is less acidic than :

- (A) ethanol (B) o-nitrophenol
(C) o-methoxyphenol (D) o-methylphenol

6. $(\text{CH}_3)_3\text{C}-\text{O}-\text{CH}_3$ reacts with HI to give :

- (A) $(\text{CH}_3)_3\text{C}-\text{I} + \text{CH}_3\text{OH}$ (B) $(\text{CH}_3)_3\text{C}-\text{I} + \text{CH}_3-\text{I}$
(C) $(\text{CH}_3)_3\text{C}-\text{OH} + \text{CH}_3-\text{I}$ (D) $(\text{CH}_3)_3\text{C}-\text{OH} + \text{CH}_3\text{OH}$

7. Aspirin is formed by the acetylation of :

- (A) Benzoic acid (B) Phenol
(C) Salicylic acid (D) Phthalic acid

8. An azeotropic solution of two liquids has boiling point higher than either of them when it :

- (A) is saturated (B) shows positive deviation from Raoult's law
(C) shows negative deviation from Raoult's law (D) shows no deviation from Raoult's law

9. During electrolysis of aqueous CuCl_2 :

- (A) $\text{H}_2(\text{g})$ is liberated at cathode (B) Cu is formed at cathode
(C) $\text{O}_2(\text{g})$ is liberated at anode (D) $\text{Cl}_2(\text{g})$ is liberated at cathode

10. Half-life period of a first order reaction is 1386 seconds. The rate constant (k) of the reaction is :

- (A) $0.5 \times 10^{-2} \text{ s}^{-1}$ (B) $5.0 \times 10^{-2} \text{ s}^{-1}$
(C) $5 \times 10^{-4} \text{ s}^{-1}$ (D) $0.5 \times 10^{-3} \text{ s}^{-1}$

11. The relative lowering of vapour pressure of an aqueous solution containing non-volatile solute is 0.0225. The mole fraction of the non-volatile solute is :

- (A) 0.80 (B) 0.725
(C) 0.15 (D) 0.0225

12. The rate of the reaction $2A + B_2 \rightarrow 2AB$ is given by $\text{Rate} = k[A]^2[B_2]$. The value of rate constant (k) can be increased by :

- (A) increasing the concentration of A (B) increasing the concentration of B
(C) increasing the temperature (D) all the above three

13. Assertion (A): Aromatic primary amines can be prepared by Gabriel phthalimide synthesis.

Reason (R): Alkyl halide undergoes nucleophilic substitution with anion formed by phthalimide.

- (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): Uracil base is present in RNA.

Reason (R): RNA undergoes self-replication.

- (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): Diazonium salts of aliphatic amines are more stable than those of aromatic amines.

Reason (R): Diazonium salts of aromatic amines show 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.

16. Assertion (A): Acetanilide ($\text{C}_6\text{H}_5\text{—NHCOCH}_3$) is less basic than aniline.

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

- (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

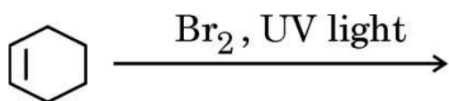
17. Define the following terms :

- (a) Essential amino acids
- (b) Nucleotide

18. (a) In the following pair of compounds, which compound undergoes S_N1 reaction faster and why?



(b) Write the major product in the following:



19. A first order reaction has a rate constant $1.25 \times 10^{-3} \text{ s}^{-1}$. How long will 5 g of this reactant take to reduce to 2.5 g ?

[$\log 2 = 0.301$, $\log 3 = 0.4771$, $\log 4 = 0.6021$]

20. (a) What is lanthanoid contraction ? Actinoid contraction is greater from element to element than lanthanoid contraction. Why ?

OR

(b) Why do transition metals have high enthalpy of atomization ? Which element of 3d-series has lowest enthalpy of atomization?

21. A 4% solution of urea (molar mass = 60 g mol^{-1}) is isotonic with 5.2% solution of an unknown organic substance. Calculate the molecular weight of the unknown organic substance.

Section C

22. The rate of a gaseous reaction triples when temperature is increased from 17°C to 27°C. Calculate the energy of activation for this reaction.

[Given : $2.303 R = 19.15 \text{ JK}^{-1} \text{ mol}^{-1}$, $\log 3 = 0.48$]

23. Calculate emf of the following cell :

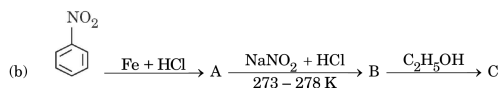


Given: $E_{\text{Zn}^{2+}/\text{Zn}}^0 = -0.76 \text{ V}$, $E_{\text{Sn}^{2+}/\text{Sn}}^0 = -0.14 \text{ V}$

[$\log 10 = 1$]

24. The vapour pressure of a solvent at 283 K is 100 mm Hg. Calculate the vapour pressure of a dilute solution containing 1 mole of a strong electrolyte AB in 50 moles of the solvent at 283 K (assuming complete dissociation of solute AB).

25. Write the structures of A, B and C in the following reactions:



26. Write the reaction involved in the following :

- Wolff-Kishner reduction
- Decarboxylation reaction
- Cannizzaro reaction

27. Give the equations of reactions for the preparation of : (any three)

- Phenol from chlorobenzene
- Salicylaldehyde from phenol
- 2-Methoxyacetophenone from anisole
- Picric acid from phenol

28. Give reasons for the following :

- Chlorine is ortho/para directing in electrophilic aromatic substitution reactions, though chlorine is an electron withdrawing group.
- Racemic mixture is optically inactive.
- Allyl chloride is hydrolysed more readily than n-propyl chloride.

29(a). Case study: Transition metals have incomplete d-subshell either in neutral atom or in their ions. The presence of partly filled d-orbitals in their atoms makes transition elements different from that of the non-transition elements. With partly filled d-orbitals, these elements exhibit certain characteristic properties such as display of a variety of oxidation states, formation of coloured ions and entering into complex formation with a variety of ligands. The transition metals and their compounds also exhibit catalytic properties and paramagnetic behaviour. The transition metals are very hard and have low volatility. An examination of the $E_{M^{2+}/M}^0$ values shows the varying trends :

$E_{M^{2+}/M}^0$	
V	- 1.18
Cr	- 0.91
Mn	- 1.18
Fe	- 0.44
Co	- 0.28
Ni	- 0.25
Cu	+ 0.34
Zn	- 0.76

(a) On what basis can we say that Cu is a transition element but Zn is not ? (Atomic number : Cu = 29, Zn = 30)

29(b). (b) Why do transition elements show variety of oxidation states ?

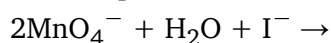
29(c). (c) (i) Why do $E_{M^{2+}/M}^0$ values show irregular trend from Vanadium to Zinc ?

(ii) How is the variability in oxidation states of transition metals different from that of the non-transition elements ?

OR

(c) (i) Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidizing. Why ? (Atomic number : Cr = 24, Mn = 25)

(ii) Complete the following ionic equation :



30(a). Case study: Carbohydrates are essential for life in both plants and animals. Carbohydrates are used as storage molecules as starch in plants and glycogen in animals. Chemically they are polyhydroxy aldehydes or ketones. On the basis of their behaviour on hydrolysis, carbohydrates are classified as monosaccharides, oligosaccharides and polysaccharides. All monosaccharides are reducing sugars, i.e., they are oxidized by Tollens' reagent and Fehling's solution. A monosaccharide like glucose is aldohexose and its molecular formula was found to be $C_6H_{12}O_6$. After reacting with different reagents like HI, H_2N-OH , Bromine water, $(CH_3CO)_2O$, etc. its structure was found to contain one aldehyde group, one primary alcoholic group ($-CH_2OH$) and four secondary alcoholic groups ($>CHOH$). Despite having the aldehyde group, glucose does not give some of the reactions of aldehyde group like Schiff's test, $NaHSO_3$ addition. This explains the existence of glucose in two cyclic hemiacetal forms which differ only in the configuration of the hydroxyl group at C-1.

(a) What are reducing sugars ?

30(b). (b) Classify the following into monosaccharide and disaccharide : Fructose, Sucrose, Lactose, Galactose

30(c). (c) Name the polysaccharide which is known as 'animal starch'. Why is it called 'animal starch' ?

OR

(c) (i) Name the isomers of glucose which in the cyclic form differ only in the configuration of the $-OH$ group at C-1.

(ii) Presence of which functional group was detected when glucose reacted with Br_2 water ?

Section E

31. (a) (i) The resistance of 0.05 M CH_3COOH solution is found to be 100 ohm. If the cell constant is 0.0354 cm^{-1} , calculate the molar conductivity of the acetic acid solution.
- (ii) State Faraday's first law of electrolysis. How much charge in Faraday is required for the reduction of 1 mol of MnO_4^- to Mn^{2+} ?

OR

- (b) (i) The conductivity of $0.0025 \text{ mol L}^{-1}$ acetic acid is $5.25 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its degree of dissociation if Λ_m^0 for acetic acid is $390 \text{ S cm}^2 \text{ mol}^{-1}$.

(ii) Write anode, cathode and overall reaction of lead storage battery.

32. Answer any five of the following :

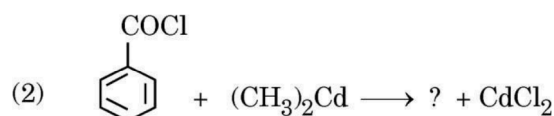
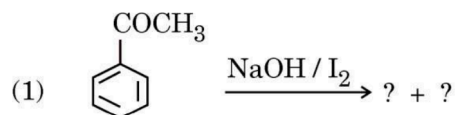
- (a) How is the crystal field splitting energy for octahedral complex (Δ_o) related to that of tetrahedral complex (Δ_t) ?
- (b) Write the IUPAC name of the following complex : $[\text{PtCl}_2(\text{en})_2](\text{NO}_3)_2$
- (c) Write the geometry and magnetic behaviour of the complex $[\text{Ni}(\text{CO})_4]$ on the basis of Valency Bond Theory (VBT).
- (d) What type of isomerism is shown by the complex $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$?
- (e) For the coordination compound on the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_o < P$. Is the coordination compound a high spin or low spin complex ?
- (f) Out of $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$, which complex is heteroleptic and why ?
- (g) Draw the structures of optical isomers of $[\text{PtCl}_2(\text{en})_2]^{2+}$.

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

(1) Oxidation of aldehydes is easier as compared to ketones.

(2) The alpha (α) hydrogen atoms of aldehydes are acidic in nature.

(ii) Write the products in the following reactions :



(iii) Give a simple chemical test to distinguish between ethanoic acid and ethanal.

OR

(b) (i) Draw structure of the 2,4-dinitrophenylhydrazone of benzaldehyde.

(ii) Arrange the following in increasing order of their reactivity towards HCN : CH_3COCH_3 , $(\text{CH}_3)_3\text{C}-\text{COCH}_3$, CH_3CHO

(iii) How can you convert phenyl magnesium bromide to benzoic acid ?

(iv) Give a simple chemical test to distinguish between benzaldehyde and ethanal.

(v) Write the main product in the following reaction : $\text{CH}_3-\text{CO}-\text{CH}_2-\text{COOC}_2\text{H}_5 \xrightarrow[\text{(ii) H}^+]{\text{(i) NaBH}_4} ?$

- End of Question Paper -