

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 correct order for the increasing oxidizing power in 3d series of transition elements is :

- (A) $\text{MnO}_4^- < \text{Cr}_2\text{O}_7^{2-} < \text{VO}_2^+ < \text{MnO}_4^-$
 (B) $\text{Cr}_2\text{O}_7^{2-} < \text{VO}_2^+ < \text{MnO}_4^- < \text{VO}_2^+$
 (C) $\text{VO}_2^+ < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^- < \text{VO}_2^+$
 (D) $\text{VO}_2^+ < \text{MnO}_4^- < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$

2. The type of isomerism shown by the complex $[\text{CoCl}_2(\text{en})_2]^+$ is :

- (A) Linkage isomerism (B) Geometrical isomerism
 (C) Coordination isomerism (D) Ionization isomerism

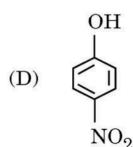
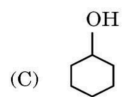
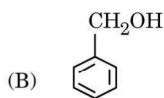
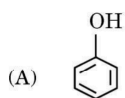
3. Which one of the following hybrid states is associated with low spin complex ?

- (A) sp^3d (B) sp^3
 (C) sp^3d^2 (D) d^2sp^3

4. Butanenitrile may be prepared by heating :

- (A) propyl chloride with KCN (B) butyl chloride with KCN
 (C) propyl alcohol with KCN (D) butyl alcohol with KCN

5. Which of the following is most acidic ?



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

6. $(\text{CH}_3)_2\text{CH}-\text{O}-\text{CH}_3$ reacts with HI to give :

- (A) $(\text{CH}_3)_2\text{CH}-\text{OH} + \text{CH}_3-\text{OH}$ (B) $(\text{CH}_3)_2\text{CH}-\text{OH} + \text{CH}_3-\text{I}$
 (C) $(\text{CH}_3)_2\text{CH}-\text{I} + \text{CH}_3-\text{OH}$ (D) $(\text{CH}_3)_2\text{CH}-\text{I} + \text{CH}_3-\text{I}$

7. A compound (X) with the molecular formula $\text{C}_3\text{H}_8\text{O}$ can be oxidized by strong oxidizing agents to another compound (Y) whose molecular formula is $\text{C}_3\text{H}_6\text{O}_2$. The compound (X) is :

- (A) $\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_3$
 (B) $\text{CH}_3-\text{CH}(\text{OH})-\text{CH}_3$
 (C) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{OH}$
 (D) None of the above

8. On mixing 10 mL of acetone with 50 mL of chloroform, the total volume of the solution will be :

- (A) $< 60 \text{ mL}$ (B) $> 60 \text{ mL}$
 (C) $= 60 \text{ mL}$ (D) $= 100 \text{ mL}$

9. The unit of cell constant is :

- (A) ohm cm (B) ohm^{-1}
 (C) cm^{-1} (D) $\text{ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$

10. For a certain reaction $R \rightarrow \text{products}$, a plot of $\log[R]$ vs. time gives a straight line with a slope of -1.25 s^{-1} . The order of the reaction is :

- (A) One (B) Zero
(C) Two (D) Fractional

11. For a zero order reaction $A \rightarrow \text{products}$, $t_{1/2}$ is :

where $[A]_0$ = initial concentration of the reactant, k = rate constant.

- (A) $\frac{[A]_0}{2k}$ (B) $\frac{2.303 \log 2}{k}$
(C) $\frac{1}{k[A]_0}$ (D) $\frac{[A]_0}{k}$

12. 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

13. Assertion (A): Aniline is a weaker base than cyclohexylamine ($\text{C}_6\text{H}_{11}-\text{NH}_2$).

Reason (R): Aniline is resonance stabilized.

- (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): Vitamin C cannot be stored in our body.

Reason (R): Vitamin C is water soluble and readily excreted in urine.

- (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): Ammonolysis of alkyl halides involves reaction between alkyl halide and ethanolic solution of ammonia.

Reason (R): Ammonolysis of alkyl halides mainly produces secondary amines.

- (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): Aniline does not undergo Friedel-Crafts reaction.

Reason (R): Friedel-Crafts reaction is a nucleophilic substitution reaction.

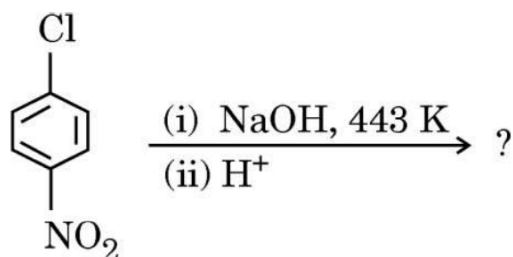
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(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Section B

17. (a) Which one of the following pairs of substances undergoes S_N1 reaction faster and why ?



(b) Write the major product in the following :



18. (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?

19. Define the following terms :

(a) Peptide linkage

(b) Essential amino acids

20. 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 ?

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

21. A 3% solution of glucose (molar mass = 180 g mol^{-1}) is isotonic with 2.5% solution of an unknown organic substance. Calculate the molecular weight of the unknown organic substance.

Section C

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

- (a) Phenol from chlorobenzene
- (b) Salicylaldehyde from phenol
- (c) 2-Methoxyacetophenone from anisole
- (d) Picric acid from phenol

23. Give reasons for the following :

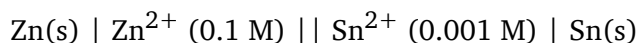
- (a) Chlorine is ortho/para directing in electrophilic aromatic substitution reactions, though chlorine is an electron withdrawing group.
- (b) Racemic mixture is optically inactive.
- (c) Allyl chloride is hydrolysed more readily than n-propyl chloride.

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

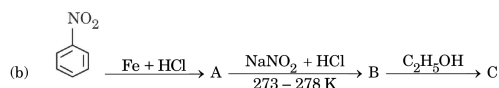
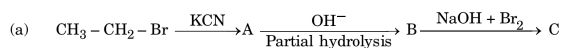
26. Calculate emf of the following cell :



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

[$\log 10 = 1$]

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



28. Write the reaction involved in the following :

- (a) Wolff-Kishner reduction
- (b) Decarboxylation reaction
- (c) Cannizzaro reaction

Section D

29(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 ?

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

29(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 ?

30(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)

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

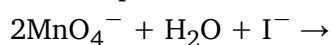
30(c). (c) (i) Why do $E_{M^{2+}/M}^0$ values show irregular trend from Vanadium to Zinc ?

(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 :



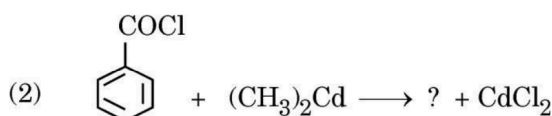
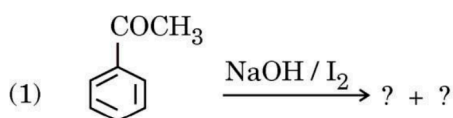
Section E

31. (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 : $\text{CH}_3-\text{CO}-\text{CH}_2-\text{COOC}_2\text{H}_5 \xrightarrow[\text{(ii) H}^+]{\text{(i) NaBH}_4} ?$

32. (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.

33. 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 $[\text{PtCl}_2(\text{en})_2]^{2+}$.

- End of Question Paper -