

## 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. Assertion (A):** Vitamin D cannot be stored in our body.

**Reason (R):** Vitamin D is fat soluble vitamin and is not excreted from the body in urine.

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|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| (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.                                                                 |

**2. Assertion (A):** Aromatic primary amines cannot be prepared by Gabriel Phthalimide synthesis.

**Reason (R):** Aryl halides do not undergo nucleophilic substitution reaction with the anion formed by phthalimide.

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|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| (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.                                                                 |

**3. Assertion (A):** Cu cannot liberate  $H_2$  on reaction with dilute mineral acids.

**Reason (R):** Cu has positive electrode potential.

- |                                                                                                                |                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| (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.                                                                 |

**4. Assertion (A):** In a first order reaction, if the concentration of the reactant is doubled, its half-life is also doubled.

**Reason (R):** The half-life of a reaction does not depend upon the initial concentration of the reactant in a first order reaction.

- |                                                                                                                |                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| (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.                                                                 |

**5.** Scurvy is caused due to deficiency of

- |                   |                   |
|-------------------|-------------------|
| (A) Vitamin B1    | (B) Vitamin B2    |
| (C) Ascorbic acid | (D) Glutamic acid |

**6.** Nucleotides are joined together by

- |                        |                            |
|------------------------|----------------------------|
| (A) Glycosidic linkage | (B) Peptide linkage        |
| (C) Hydrogen bonding   | (D) Phosphodiester linkage |

**7.** Which of the following is/are examples of denaturation of protein?

- |                              |                      |
|------------------------------|----------------------|
| (A) Coagulation of egg white | (B) Curdling of milk |
| (C) Clotting of blood        | (D) Both (A) and (B) |

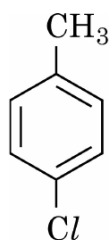
8. The conversion of phenol to salicylic acid can be accomplished by

- (A) Reimer-Tiemann reaction (B) Friedel-Crafts reaction  
(C) Kolbe reaction (D) Coupling reaction

9. What will be formed after oxidation reaction of secondary alcohol with chromic anhydride ( $\text{CrO}_3$ )?

- (A) Aldehyde (B) Ketone  
(C) Carboxylic acid (D) Ester

10. Which is the correct IUPAC name for the compound shown?



- (A) Methylchlorobenzene  
(B) Toluene  
(C) 1-Chloro-4-Methylbenzene  
(D) 1-Methyl-4-Chlorobenzene

11. The diamagnetic species is: [At. No. Co = 27, Fe = 26, Ni = 28]

- (A)  $[\text{Ni}(\text{CN})_4]^{2-}$  (B)  $[\text{NiCl}_4]^{2-}$   
(C)  $[\text{Fe}(\text{CN})_6]^{3-}$  (D)  $[\text{CoF}_6]^{3-}$

12. The complex ions  $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$  and  $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+}$  are called

- (A) Ionization isomers (B) Linkage isomers  
(C) Co-ordination isomers (D) Geometrical isomers

13. The element having  $[\text{Ar}]3d^{10}4s^1$  electronic configuration is

- (A) Cu (B) Zn  
(C) Cr (D) Mn

14. The number of molecules that react with each other in an elementary reaction is a measure of the:

- (A) activation energy of the reaction (B) stoichiometry of the reaction  
(C) molecularity of the reaction (D) order of the reaction

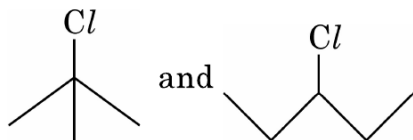
15. Which among the following is a false statement?

- (A) Rate of zero order reaction is independent of initial concentration of reactant. (B) Half-life of a zero order reaction is inversely proportional to the rate constant.  
(C) Molecularity of a reaction may be zero. (D) For a first order reaction,  $t_{1/2} = 0.693/k$ .

16. The charge required for the reduction of 1 mol of  $\text{MnO}_4^-$  to  $\text{MnO}_2$  is

- (A) 1F (B) 3F  
(C) 5F (D) 6F

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



(b) Arrange the following compounds in increasing order of their reactivity towards  $S_N2$  displacement:

2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane.

18. A reaction is of second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is (i) doubled (ii) reduced to half?

19. When  $\text{FeCr}_2\text{O}_4$  is fused with  $\text{Na}_2\text{CO}_3$  in the presence of air it gives a yellow solution of compound (A). Compound (A) on acidification gives compound (B). Compound (B) on reaction with  $\text{KCl}$  forms an orange coloured (C). An acidified solution of compound (C) oxidises  $\text{Na}_2\text{SO}_3$  to (D). Identify (A), (B), (C) and (D).

20. Explain  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is an inner orbital complex whereas  $[\text{Ni}(\text{NH}_3)_6]^{2+}$  is an outer orbital complex. [At. No. Co = 27, Ni = 28]

21. (A) The rate constant for a zero order reaction  $\text{A} \rightarrow \text{P}$  is  $0.0030 \text{ mol L}^{-1}\text{s}^{-1}$ . How long will it take for the initial concentration of A to fall from 0.10 M to 0.075 M?

OR

21. (B) The decomposition of  $\text{NH}_3$  on platinum surface is zero order reaction. What are the rates of production of  $\text{N}_2$  and  $\text{H}_2$  if  $k = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$ ?

## Section C

**22.** A solution containing 15 g urea (molar mass =  $60 \text{ g mol}^{-1}$ ) per litre of solution in water has the same osmotic pressure (isotonic) as a solution of glucose (molar mass =  $180 \text{ g mol}^{-1}$ ) in water. Calculate the mass of glucose present in one litre of its solution.

**23.** Calculate  $\Lambda_m^\circ$  for acetic acid and its degree of dissociation ( $\alpha$ ) if its molar conductivity is  $48.1 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$ .

Given that:

$$\Lambda_m^\circ (\text{HCl}) = 426 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$$

$$\Lambda_m^\circ (\text{NaCl}) = 126 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$$

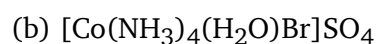
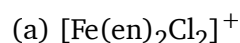
$$\Lambda_m^\circ (\text{CH}_3\text{COONa}) = 91 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$$

**24.** (a) Of the 3d species,  $\text{Cr}^{2+}$  is strongly reducing while  $\text{Mn}^{3+}$  is strongly oxidising. Why?

(b) Write two consequences of lanthanoid contraction.

(c) Which element of 3d series has lowest enthalpy of atomisation and why?

**25.** Write IUPAC names of the following coordination entities:



**26.** (A) Explain the following reactions and write chemical equation involved:

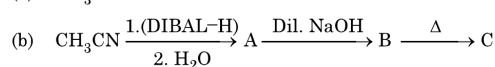
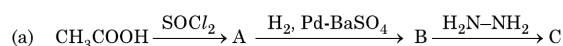
(a) Wolff-Kishner reduction

(b) Etard reaction

(c) Cannizzaro reaction

OR

**26.** (B) Write the structures of A, B and C in the following sequence of reactions:



**27.** (a) Define the following:

(i) Enantiomers

(ii) Racemic mixture

(b) Why is chlorobenzene resistant to nucleophilic substitution reaction?

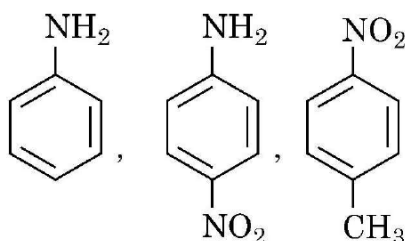
**28.** (a) Write the product obtained when D-glucose reacts with  $\text{H}_2\text{N-OH}$ .

(b) Amino acids show amphoteric behaviour, why?

(c) Why vitamin C cannot be stored in our body?

**29(a).** Read the passage and answer: Amines have a lone pair of electrons on nitrogen atom due to which they behave as Lewis base. Greater the value of  $K_b$  or smaller the value of  $pK_b$ , stronger is the base. Amines are more basic than alcohols, ethers, esters, etc. The basic character of aliphatic amines should increase with the increase of alkyl substitution. But it does not occur in a regular manner as a secondary aliphatic amine is unexpectedly more basic than a tertiary amine in aqueous solutions. Aromatic amines are weaker bases than ammonia and aliphatic amines. Electron releasing groups such as  $-CH_3$ ,  $-OCH_3$ ,  $-NH_2$ , etc., increase the basicity while electron-withdrawing substituents such as  $-NO_2$ ,  $-CN$ , halogens etc., decrease the basicity of amines. The effect of these substitute is more at p- than at m- position.

(a) Arrange the following in the increasing order of their basic character. Give reason:



**29(b).** (b) Why  $pK_b$  of aniline is more than that of methylamine?

**29(c)(i).** (c)(i) Arrange the following in the increasing order of their basic character in an aqueous solution. Give reason:

$(CH_3)_3N$ ,  $(CH_3)_2NH$ ,  $NH_3$ ,  $CH_3NH_2$

**29(c)(ii).** (c)(ii) Why ammonolysis of alkyl halides is not a good method to prepare pure amines?

**30(a).** Read the passage and answer: The spontaneous flow of the solvent through a semipermeable membrane from a pure solvent to a solution or from a dilute solution to a concentrated solution is called osmosis. The phenomenon of osmosis can be demonstrated by taking two eggs of the same size. In an egg, the membrane below the shell and around the egg material is semipermeable. The outer hard shell can be removed by putting the egg in dilute hydrochloric acid. After removing the hard shell, one egg is placed in distilled water and the other in a saturated salt solution. After some time, the egg placed in distilled water swells-up while the egg placed in salt solution shrinks. The external pressure applied to stop the osmosis is termed as osmotic pressure (a colligative property). Reverse osmosis takes place when the applied external pressure becomes larger than the osmotic pressure.

(a) Define reverse osmosis. Name one SPM which can be used in the process of reverse osmosis.

**30(b)(i).** (b)(i) What do you expect to happen when red blood corpuscles (RBC's) are placed in 0.5% NaCl solution?

**30(b)(ii).** (b)(ii) Which one of the following will have higher osmotic pressure in 1M KCl or 1M urea solution. Justify your answer.

**30(c).** (c) Why osmotic pressure is a colligative property?

## Section E

**31.** (A) An organic compound 'A', molecular formula  $C_2H_6O$  oxidises with  $CrO_3$  to form a compound 'B'. Compound 'B' on warming with iodine and aqueous solution of  $NaOH$  gives a yellow precipitate of compound 'C'. When compound 'A' is heated with conc.  $H_2SO_4$  at 413 K gives a compound 'D', which on reaction with excess  $HI$  gives compound 'E'. Identify compounds 'A', 'B', 'C', 'D' and 'E' and write chemical equations involved.

OR

**31.** (B) (a) Write chemical equations of the following reactions:

- (i) Phenol is treated with conc.  $HNO_3$
  - (ii) Propene is treated with  $B_2H_6$  followed by oxidation by  $H_2O_2/OH^-$ .
  - (iii) Sodium t-butoxide is treated with  $CH_3Cl$ .
- (b) Give a simple chemical test to distinguish between butan-1-ol and butan-2-ol.
- (c) Arrange the following in increasing order of acid strength:  
phenol, ethanol, water

**32.** (A) (a) Give IUPAC name of  $CH_3-CH=CH-CHO$ .

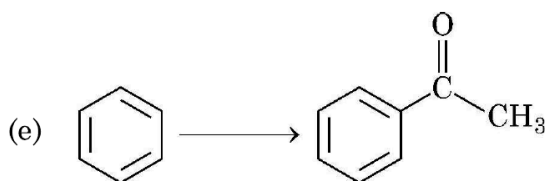
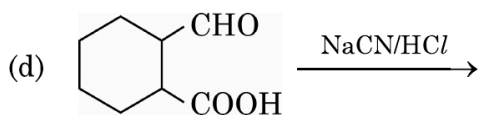
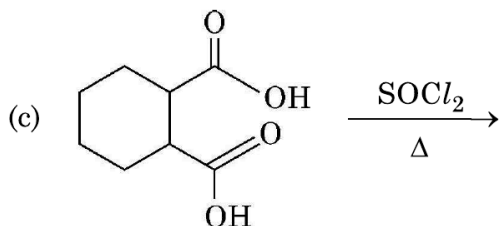
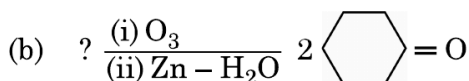
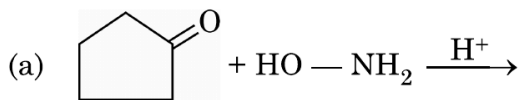
(b) Give a simple chemical test to distinguish between propanal and propanone.

(c) How will you convert the following:

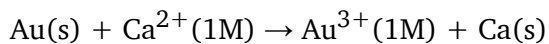
- (i) Toluene to benzoic acid
- (ii) Ethanol to propan-2-ol
- (iii) Propanal to 2-hydroxy propanoic acid

OR

32. (B) Complete each synthesis by giving missing starting material, reagent or products:



33. (A) (a) Calculate the standard Gibbs energy ( $\Delta_r G^\circ$ ) of the following reaction at 25 °C:

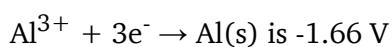
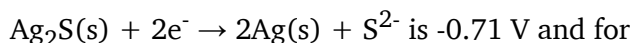


$$E^\circ_{\text{Au}^{3+}/\text{Au}} = +1.5 \text{ V}, E^\circ_{\text{Ca}^{2+}/\text{Ca}} = -2.87 \text{ V}$$

Predict whether the reaction will be spontaneous or not at 25 °C.

$$[1 \text{ F} = 96500 \text{ C mol}^{-1}]$$

(b) Tarnished silver contains Ag<sub>2</sub>S. Can this tarnish be removed by placing tarnished silverware in an aluminium pan containing an inert electrolytic solution such as NaCl? The standard electrode potential for half reaction:



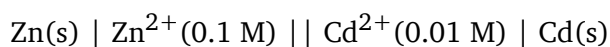
OR

33. (B) (a) Define the following:

(i) Cell potential

(ii) Fuel cell

(b) Calculate emf of the following cell at 25 °C:



$$\text{Given: } E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.40 \text{ V}, E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$$

$$[\log 10 = 1]$$

- End of Question Paper -