Roll No. ☐☐☐☐☐☐☐☐

Q.P. Code 56/1/1

CHEMISTRY (THEORY)

CBSE Class XII Board Examination 2023

Time allowed: 3 hours **Maximum Marks: 70**

General Instructions:

1. The paper has 35 questions in five sections (A to E); all of them must be answered.
2. Section A: Q1–18, multiple choice and Assertion-Reason, 1 mark each.
3. Section B: Q19–25, very short answer, 2 marks each.
4. Section C: Q26–30, short answer, 3 marks each.
5. Section D: Q31–32, case-based, 4 marks each.
6. Section E: Q33–35, long answer, 5 marks each.
7. There is no overall choice, but two questions each in Sections B, C, D and E offer an internal choice (OR). Calculators are not allowed.

SECTION A

Q1–18 carry 1 mark each (MCQ; Q15–18 are Assertion-Reason).

1. Which colligative property is preferred for finding the molar mass of polymers and proteins? **1**

(A) Osmotic pressure
(B) Depression in freezing point
(C) Relative lowering of vapour pressure
(D) Elevation in boiling point

2. People who live at high altitudes have a low concentration of oxygen in their blood and tissues. This is because of: **1**

(A) high atmospheric pressure
(B) low temperature
(C) low atmospheric pressure
(D) both low temperature and high atmospheric pressure

3. Which cell notation correctly represents the reaction $Zn + 2Ag^+ \rightarrow Zn^{2+} + 2Ag$? **1**

(A) $2Ag \mid Ag^+ \parallel Zn \mid Zn^{2+}$
(B) $Ag^+ \mid Ag \parallel Zn^{2+} \mid Zn$
(C) $Ag \mid Ag^+ \parallel Zn \mid Zn^{2+}$
(D) $Zn \mid Zn^{2+} \parallel Ag^+ \mid Ag$

4. For a reaction that occurs spontaneously, the signs of ΔG and $E°_{cell}$ are respectively: **1**

(A) positive, negative
(B) negative, negative
(C) negative, positive
(D) positive, positive

5. Which one of the following quantities is changed by a catalyst? **1**

(A) ΔH
(B) ΔG
(C) Ea
(D) ΔS

6. What is the order of the photochemical reaction $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$ carried out in the presence of light (hν)? **1**

(A) 2
(B) 1
(C) 0
(D) 3

7. Which oxidation state is the most common and most stable for lanthanoids? **1**

(A) +2
(B) +3
(C) +4
(D) +6

8. $[Co(SO_4)(NH_3)_5]Br$ and $[Co(Br)(NH_3)_5]SO_4$ are examples of which type of isomerism? **1**

(A) optical isomerism
(B) linkage isomerism
(C) ionisation isomerism
(D) coordination isomerism

9. Alkyl fluorides are best prepared by: **1**

(A) Free radicals **(B)** Swarts reaction

(C) Sandmeyer reaction **(D)** Finkelstein reaction

10. In the reaction R–OH + HCl (anhydrous $ZnCl_2$) → R–Cl + H_2O, what is the correct order of reactivity of alcohols? **1**

(A) 1° < 2° < 3° **(B)** 1° > 3° > 2°

(C) 1° > 2° > 3° **(D)** 3° > 1° > 2°

11. When CH_3CONH_2 is treated with Br_2 and NaOH (alcoholic medium), the product is: **1**

(A) CH_3COONa **(B)** CH_3NH_2

(C) CH_3CH_2Br **(D)** $CH_3CH_2NH_2$

12. Which of these is the weakest base? **1**

(A) $(CH_3)_2NH$ **(B)** NH_3

(C) $C_6H_5NH_2$ (aniline) **(D)** $(CH_3)_3N$

13. Which glycosidic linkage joins the glucose units in the amylose part of starch? **1**

(A) C1–C6 α linkage **(B)** C1–C6 β linkage

(C) C1–C4 α linkage **(D)** C1–C4 β linkage

14. The α-helix is a structural feature found in: **1**

(A) Sucrose **(B)** Starch

(C) Polypeptides **(D)** Nucleotides

15. Assertion (A): In electrophilic substitution, the $–NH_2$ group directs incoming groups to ortho and para positions. **1**
Reason (R): Aniline does not undergo the Friedel–Crafts reaction.

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, but R is not the correct explanation of A.

(C) A is true, but R is false.

(D) A is false, but R is true.

16. Assertion (A): Acetylating aniline (and then brominating) gives a monosubstituted product. **1**
Reason (R): The $–NHCOCH_3$ group is a stronger activating group than the $–NH_2$ group.

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, but R is not the correct explanation of A.

(C) A is true, but R is false.

(D) A is false, but R is true.

17. Assertion (A): The molecularity of the reaction $H_2 + Br_2 \rightarrow 2HBr$ appears to be 2. **1**
Reason (R): Two molecules of reactants take part in this given elementary reaction.

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, but R is not the correct explanation of A.

(C) A is true, but R is false.

(D) A is false, but R is true.

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18. Assertion (A): Tetrahedral complexes that are low spin are seldom seen. **1**
Reason (R): For tetrahedral complexes, the crystal field splitting energy is smaller than the pairing energy.

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, but R is not the correct explanation of A.

(C) A is true, but R is false.

(D) A is false, but R is true.

SECTION B

Q19–25 carry 2 marks each.

19. State Henry's law and give one of its applications. **2**

20. Two electrolytes A and B are diluted. On dilution, the molar conductivity Λm of A increases 25 times, while that of B increases only 1.5 times. Which electrolyte is strong? Support your answer with a graph. **2**

OR

A column of 0.05 mol L^{-1} NaOH solution has diameter 1 cm and length 50 cm, and its resistance is $5.55 \times 10^3\ \Omega$. Find its conductivity.

21. Complete these ionic equations: **2**

(a) $2MnO_4^- + 5NO_2^- + 6H^+ \rightarrow$

(b) $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow$

22. Identify A and B: **2**

(a) $CH_3–CH(OH)–CH_3 \xrightarrow{PCl_5} A \xrightarrow{AgCN} B$

(b) $CH_3CH_2CH_2Cl + KOH\ (ethanol) \rightarrow A \xrightarrow{HBr} B$

23. Give reasons: **2**

(i) Phenol is more acidic than an alcohol.

(ii) Among isomeric alcohols, the boiling point falls as the alkyl chain becomes more branched.

OR

(i) Give the mechanism of: $CH_3CH_2OH \xrightarrow[443\ K]{H^+} CH_2=CH_2 + H_2O$.

(ii) Write the equation for the Reimer–Tiemann reaction.

24. Explain briefly, writing the chemical equation in each case: **2**

(a) Carbylamine reaction

(b) Gabriel phthalimide synthesis

25. (a) Give a chemical reaction showing that the open-chain form of D-glucose has a straight (unbranched) chain of carbon atoms. **2**

(b) Which type of linkage holds amino acids together in a protein?

SECTION C

Q26–30 carry 3 marks each.

26. (a) Distinguish between an ideal solution and a non-ideal solution. **3**

(b) 30 g urea (M = 60 g mol^{-1}) is dissolved in 846 g water. If pure water has vapour pressure 23.8 mm Hg at 298 K, find the vapour pressure of water over this solution.

27. Give the main product in each case: **3**

(a) Methyl chloride is treated with NaI in acetone.

(b) 2,4,6-Trinitrochlorobenzene is hydrolysed.

(c) n-Butyl chloride is heated with alcoholic KOH.

28. How will you carry out any three of these conversions? **3**

(a) Phenol → picric acid

(b) Propanone → 2-methylpropan-2-ol

(c) Phenol → anisole

(d) Propene → propan-1-ol

29. Explain why: **3**

(i) The –COOH group of benzoic acid directs incoming electrophiles to the meta position.

(ii) Sodium bisulphite is used to purify aldehydes and ketones.

(iii) Carboxylic acids do not show the typical reactions of the carbonyl group.

OR

Compound A (C_3H_8O) is heated with Cu at 573 K to give B. B does not reduce Fehling's solution but forms a yellow precipitate C with I_2/NaOH. Find the structures of A, B and C.

30. (a) Name the products obtained on hydrolysis of (i) lactose and (ii) maltose. **3**

(b) What is the basic structural difference between starch and cellulose?

SECTION D

Q31–32 are case-based, 4 marks each (choice in part (iii)).

31. *The rate of a reaction is the change in concentration of a reactant or product per unit time. It may be reported as an instantaneous rate at a given moment or an average rate over an interval; a rate law expresses it mathematically, and the rate constant and order can be found from the rate law or its integrated form.* **4**

(i) What is meant by the average rate of a reaction? (1)

(ii) State two factors that affect reaction rate. (1)

(iii) (1) How does the rate of a zero-order reaction change as the reaction proceeds? (2) Give the unit of k for a zero-order reaction. (2)

OR

(iii) (1) For P + 2Q → products, the rate law is rate = k[P]^(1/2)[Q]¹. What is the overall order?

(2) Define a pseudo-first-order reaction and give one example.

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32. *In coordination compounds a metal shows two kinds of valency (Werner). Primary valencies are ionisable, non-directional and satisfied by anions; secondary valencies are non-ionisable, satisfied by neutral molecules or anions with lone pairs, and they decide the shape of the complex.* **4**

(i) $PtCl_2 \cdot 2NH_3$ gives no precipitate with $AgNO_3$. Write its formula. (1)

(ii) What is the secondary valency of the metal in $[Co(en)_3]^{3+}$? (1)

(iii) (1) Write the formula of iron(III) hexacyanidoferrate(II). (2) Give the IUPAC name of $[Co(NH_3)_5Cl]Cl_2$. (2)

OR

(iii) State the hybridisation and magnetic nature of $[Ni(CN)_4]^{2-}$. (Atomic number of Ni = 28)

SECTION E

Q33–35 carry 5 marks each.

33. (i) State Kohlrausch's law of independent migration of ions and use it to write an expression for the limiting molar conductivity of acetic acid. **5**

(ii) For the reaction $Ni(s) + 2Ag^+(aq) \rightleftharpoons Ni^{2+}(aq) + 2Ag(s)$ at 298 K, find the maximum work obtainable and log Kc.

Given: $E°(Ni^{2+}/Ni) = -0.25$ V, $E°(Ag^+/Ag) = +0.80$ V, 1 F = 96500 C mol^{-1}.

OR

(i) State Faraday's first law of electrolysis. How many faradays of charge are needed to reduce 1 mol of Cu^{2+} to Cu?

(ii) Find the emf at 298 K of the cell $Mg(s) \mid Mg^{2+}(0.1\ M) \parallel Cu^{2+}(0.01\ M) \mid Cu(s)$.

Given: E°cell = +2.71 V, 1 F = 96500 C mol^{-1}, log 10 = 1.

34. Give a reason for each: **5**

(i) Among 3d transition elements, manganese shows the highest oxidation state, +7.

(ii) Transition metals and their compounds are usually good catalysts.

(iii) Cr^{2+} acts as a reducing agent, but Mn^{3+}, which has the same d^4 configuration, acts as an oxidising agent.

(iv) Zinc has the lowest enthalpy of atomisation in the series.

(v) Cu^+ is not stable in aqueous solution.

35. (i) Carry out these conversions: **5**

(1) Ethanal → but-2-en-1-al

(2) Propanoic acid → 2-chloropropanoic acid

(ii) An alkene A (C_5H_{10}) on ozonolysis gives two compounds B and C. B gives a positive Fehling's test and also reacts with I_2/NaOH. C does not respond to Fehling's solution but gives iodoform. Identify A, B and C.

OR

(i) Give one chemical test to distinguish:

(1) $CH_3COCH_2CH_3$ and $CH_3CH_2CH_2CHO$

(2) Ethanal and ethanoic acid

(ii) Draw the structure of the oxime of acetone.

(iii) Identify A, B, C and D: $CH_3COOH \xrightarrow{PCl_5} A \xrightarrow{H_2/Pd–BaSO_4} B$; $B \xrightarrow{(i)\ CH_3MgBr,\ (ii)\ H_3O^+} C$; $B \xrightarrow{LiAlH_4} D$.

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Questions restated from the CBSE Class XII Board Examination 2023 (set 56/1/1) for practice. Reading passages and map items are described, not reproduced.