Roll No. ☐☐☐☐☐☐☐☐

Q.P. Code 56/4/1

CHEMISTRY (THEORY)

CBSE Class XII Board Examination 2025

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

General Instructions:

1. The paper has 33 questions in five sections (A to E); all of them must be answered.
2. Section A: Q1–16, multiple choice (Q13–16 Assertion-Reason), 1 mark each.
3. Section B: Q17–21, very short answer, 2 marks each.
4. Section C: Q22–28, short answer, 3 marks each.
5. Section D: Q29–30, case-based, 4 marks each.
6. Section E: Q31–33, long answer, 5 marks each.
7. There is no overall choice, but some questions in Sections B to E offer an internal choice (OR). Calculators are not allowed.

SECTION A

Q1–16 are multiple choice questions of 1 mark each (Q13–16 are Assertion-Reason).

1. A cell works on the reaction $2Cu^{+}(aq) + Zn(s) \rightarrow 2Cu(s) + Zn^{2+}(aq)$, with $E°cell = 1.28$ V. What happens to the cell voltage as the reaction goes on? **1**

(A) It stays the same.
(B) It falls as $[Zn^{2+}]$ rises.
(C) It rises as $[Cu^{+}]$ rises.
(D) It rises as $[Zn^{2+}]$ rises.

2. Which of these ions is colourless in water: Fe^{3+}, Sc^{3+}, Cr^{3+}, Co^{3+}? (Atomic numbers: Fe 26, Sc 21, Cr 24, Co 27) **1**

(A) Sc^{3+}
(B) Fe^{3+}
(C) Cr^{3+}
(D) Co^{3+}

3. Which compound undergoes the Hoffmann bromamide degradation? **1**

(A) $ArNO_2$
(B) $ArNH_2$
(C) $ArCONH_2$
(D) $ArCH_2NH_2$

4. A Haworth (pyranose) ring of a sugar is drawn with its carbons numbered: C-5 carries the CH_2OH group and is bonded to the ring oxygen; C-1 is on the other side of the ring oxygen and carries an OH and an H; C-2, C-3 and C-4 carry H and OH groups. Which numbered carbon is the anomeric carbon? **1**

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

5. Henry's law constant K_H is: **1**

(A) larger for more soluble gases
(B) larger for less soluble gases
(C) the same for all gases
(D) unrelated to gas solubility

6. Pick the INCORRECT statement. **1**

(A) La is really an element of the transition series.
(B) Because of lanthanoid contraction, Zr and Hf have nearly the same atomic radii.
(C) Ionic radius decreases from La^{3+} to Lu^{3+}.
(D) Lanthanoids are radioactive.

7. Among 2-bromobutane, 1-bromobutane, 2-bromopropane and 1-bromopropane, which molecule is chiral? **1**

(A) 2-Bromobutane
(B) 1-Bromobutane
(C) 2-Bromopropane
(D) 1-Bromopropane

8. Aniline is treated with $NaNO_2/HCl$ at 0–5 °C to give X, and X is then treated with ethanol to give Y. What is Y? **1**

(A) Phenol (C_6H_5OH)

(B) Benzene (C_6H_6)

(C) Nitrobenzene ($C_6H_5NO_2$)

(D) Benzenediazonium chloride ($C_6H_5N_2^+Cl^-$)

9. When I^- is oxidised by MnO_4^- in alkaline medium, the product is: **1**

(A) IO_4^-

(B) I_2

(C) IO^-

(D) IO_3^-

10. DDT is an important polyhalogen compound. It is a: **1**

(A) greenhouse gas

(B) fertilizer

(C) biodegradable insecticide

(D) non-biodegradable insecticide

11. How much charge is needed to reduce 1 mol of MnO_4^- to Mn^{2+}? **1**

(A) 1 F

(B) 5 F

(C) 4 F

(D) 6 F

12. Alcohols give alkenes when heated with concentrated H_2SO_4. What is the first step of this reaction? **1**

(A) formation of a carbocation

(B) formation of an ester

(C) protonation of the alcohol

(D) loss of water

13. Assertion (A): Electrolysis of aqueous NaCl gives H_2 at the cathode and Cl_2 at the anode. **1**
Reason (R): Chlorine has a higher oxidation potential than water.

(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.

14. Assertion (A): Cuprous salts are diamagnetic. **1**
Reason (R): The cuprous ion has completely filled 3d orbitals.

(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.

15. Assertion (A): n-Butyl chloride boils at a higher temperature than n-butyl bromide. **1**
Reason (R): The C–Cl bond is more polar than the C–Br bond.

(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): Acetanilide is a weaker base than aniline. **1**
Reason (R): Acetylation of aniline lowers the electron density on nitrogen.

(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

Q17–21 are very short answer questions of 2 marks each.

17. A reactant A decomposes. Its concentration was measured every hour: t = 0 h, [A] = 0.40 M; 1 h, 0.20 M; 2 h, 0.10 M; 3 h, 0.05 M. From these data predict the order of the reaction and write its rate law. **2**

OR

$H_2(g)$ and $I_2(g)$ react in a closed container kept at constant temperature, with rate law Rate = $k[H_2][I_2]$. If 1 mole more of $H_2(g)$ is added, what happens to (i) the rate of reaction and (ii) the rate constant?

18. A solution of $PtCl_4 \cdot 2KCl$ gives no AgCl precipitate with $AgNO_3$. Write the structural formula of the complex and its IUPAC name. **2**

19. What is a fuel cell? State two advantages of a fuel cell over an ordinary cell. **2**

20. Write the main products: **2**
(a) Cyclohexanone carrying a $–CH_2CH_2COOCH_3$ group on the carbon next to the C=O (methyl 3-(2-oxocyclohexyl)propanoate) is treated with $NaBH_4$.
(b) $6\ (CH_3)_3C–OH + 2Al \rightarrow$

21. What are essential amino acids? Why do amino acids behave as amphoteric compounds? **2**

SECTION C

Q22–28 are short answer questions of 3 marks each.

22. Explain: **3**

(i) Allyl chloride is hydrolysed faster than n-propyl chloride.

(ii) Alkyl halides give isocyanides with silver cyanide.

(iii) In an SN2 reaction with OH^-, methyl chloride reacts faster than t-butyl chloride.

OR

Give the structures of A and B:

(i) $CH_3CH{=}CH_2$ + HBr (peroxide) → A; A + aq. KOH → B

(ii) $CH_3CH_2CH(Cl)CH_3$ + alc. KOH → A; A + HBr → B

(iii) A + Mg (dry ether) → CH_3CH_2MgCl; $CH_3CH_2MgCl + H_2O/H^+$ → B (main product)

23. A voltaic cell is made at 25 °C from the half-cells Al/Al^{3+}(0.001 M) and Ni/Ni^{2+}(0.1 M). Given $E°(Ni^{2+}/Ni) = -0.25$ V and $E°(Al^{3+}/Al) = -1.66$ V, calculate the cell voltage. **3**

24. Explain: **3**

(a) Mn^{3+} and Cr^{2+} are both d^4 ions, yet Mn^{3+} is an oxidising agent while Cr^{2+} is a reducing agent.

(b) The contraction from one element to the next is greater among actinoids than among lanthanoids.

(c) Transition metals form many interstitial compounds with H, B, C and N.

25. For an aqueous NaOH solution, the molar mass found from osmotic pressure measurement at 27 °C was 25 g mol^{-1}. Calculate the percentage dissociation of NaOH. (Na = 23, O = 16, H = 1) **3**

26. Arrange as directed: **3**

(a) $C_2H_5NH_2$, $(C_2H_5)_2NH$, $C_6H_5NHCH_3$, $C_6H_5NH_2$ – decreasing pKb

(b) C_2H_5OH, $C_2H_5NH_2$, $(CH_3)_2NH$ – increasing boiling point

(c) $C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$ – increasing solubility in water

27. Aromatic compound A (C_8H_8O) gives a positive 2,4-DNP test and a yellow precipitate B with sodium hypoiodite. A does not react with Tollens' or Fehling's reagent. Strong oxidation of A with $KMnO_4$ gives a carboxylic acid C. Identify A, B and C and give their IUPAC names. **3**

28. (a) Can t-butyl ethyl ether be made from sodium ethoxide and t-butyl chloride? Explain, and suggest the right starting materials for making this ether. **3**

(b) Give the IUPAC name of this ether.

SECTION D

Q29–30 are case-based questions of 4 marks each. Read the case and answer the questions that follow.

29. *The case discusses ideal solutions: in an ideal mixture the attractions between like and unlike molecules are equal. Truly ideal mixtures are rare, but very dilute solutions behave ideally towards the solvent, which is why Raoult's law describes them.* **4**

(a) Give one example of a pair of miscible liquids showing negative deviation from Raoult's law. Why does such deviation occur? (2)

(b) (i) State Raoult's law for a solution of volatile components. (1)

(c) Write two characteristics of an ideal solution. (1)

OR

(b) Raoult's law is a special case of Henry's law. Comment.

(ii)

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30. *The case describes ribose and 2-deoxyribose, sugars of great biological importance, whose phosphate derivatives at the 5′ position matter a lot; purine and pyrimidine bases joined to these sugars form nucleosides.* **4**

(a) What products are formed when DNA is hydrolysed? Give one structural difference between DNA and RNA. (2)

(b) Distinguish between a nucleotide and a nucleoside. (1)

(c) (i) Mention two important functions of nucleic acids. (1)

OR

(c) Name the linkage that joins two nucleotides. Name the base present in RNA nucleotides

(ii) but not in DNA.

SECTION E

Q31–33 are long answer questions of 5 marks each.

31. (i) Write the main products: **5**

(I) Cyclohexanone + $H_2NCONHNH_2$ (semicarbazide) →

(II) $(CH_3)_2Cd + 2CH_3COCl$ →

(III) Benzoyl chloride (C_6H_5COCl) + H_2 / Pd–$BaSO_4$ →

(ii) Give a simple chemical test to distinguish:

(I) ethyl benzoate and benzoic acid

(II) propanal and propanone

OR

(i) Complete each synthesis by giving the missing starting material, reagent or product:

(I) Ethylbenzene → (i) $KMnO_4$, KOH (ii) H_3O^+ → ?

(II) Methylenecyclohexane ($C_6H_{10}=CH_2$) → ? → cyclohexanecarbaldehyde ($C_6H_{11}CHO$)

(III) 4-Oxocyclohexane-1-carbaldehyde (ring with C=O at C-4 and –CHO at C-1) + $[Ag(NH_3)_2]^+$ → ?

(ii) Carry out the conversions:

(I) benzaldehyde to benzophenone

(II) benzaldehyde to 3-phenylpropanol

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32. (i) Give reasons: **5**

(I) $[Ni(CO)_4]$ is diamagnetic but $[NiCl_4]^{2-}$ is paramagnetic. (Ni = 28)

(II) CO is a stronger complexing agent than NH_3.

(III) The trans isomer of $[Co(en)_2Cl_2]^+$ is optically inactive.

(ii) Using crystal field theory, give the number of unpaired electrons in an octahedral Fe^{3+} complex with (I) a strong field ligand, (II) a weak field ligand. (Fe = 26)

OR

(i) Name the type of isomerism shown by each, and draw/write the corresponding isomers:

(I) $[Co(NH_3)_6][Cr(CN)_6]$

(II) $[Co(en)_3]^{3+}$

(III) $[Co(NH_3)_3(NO_2)_3]$

(ii) Differentiate between weak field and strong field ligands. How does ligand strength affect the spin of a complex?

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33. (i) For the first-order reaction $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ at 318 K, $[N_2O_5]$ fell from 1.2×10^{-2} mol L^{-1} to 0.2×10^{-2} mol L^{-1} in 60 minutes. Calculate the rate constant. (log 6 = 0.778) **5**

(ii) Explain:

(I) The order of a reaction cannot be found from its balanced equation.

(II) A bimolecular reaction can behave as first order under a certain condition.

OR

(i) The rate of a reaction doubles when the temperature is raised by 10 K from 298 K. Calculate the activation energy Ea. ($2.303R = 19.15$ J K^{-1} mol^{-1}, log 2 = 0.3)

(ii) For $2H_2O_2 \rightarrow 2H_2O + O_2$ (catalysed by I^-), the proposed mechanism is:

(I) $H_2O_2 + I^- \rightarrow H_2O + IO^-$ (slow)

(II) $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$ (fast)

(1) Write the rate law. (2) Give the overall order and the molecularity.

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Questions restated from the CBSE Class XII Board Examination 2025 (set 56/4/1) for practice. Reading passages and map items are described, not reproduced.