DIRECTORATE OF EDUCATION GNCT OF DELHI

MID-TERM

(2026-27)

PRACTICE PAPER

Class-XII

Chemistry (043)

Time Allowed: 3 Hours **Maximum Marks:** 70

General Instructions:

Read the following instructions carefully:

- There are **33 questions** in this question paper with internal choice.
- **SECTION A** consists of 16 multiple-choice questions carrying 1 mark each.
- **SECTION B** consists of 5 short answer questions carrying 2 marks each.
- **SECTION C** consists of 7 short answer questions carrying 3 marks each.
- **SECTION D** consists of 2 case-based questions carrying 4 marks each.
- **SECTION E** consists of 3 long answer questions carrying 5 marks each.
- All questions are compulsory.
- Use of log tables and calculators is not allowed.

SECTION A

The following questions (Q. No. 1–16) are multiple-choice questions with one correct answer. Each question carries 1 mark.

1. According to Henry's law, the value of Henry's constant (K_H):
   (a) increases with an increase in temperature
   (b) decreases with an increase in temperature

(c) remains constant with temperature change

(d) is independent of the nature of the gas

2. The standard reduction potential for the half-cells are given below:

   $E°(Zn^{2+}/Zn) = –0.76$ V; $E°(Cu^{2+}/Cu) = +0.34$ V

   The standard Gibbs free energy change ($\Delta G°$) for the cell reaction: $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$ will be:

   (a) $–212.3$ kJ $mol^{–1}$

   (b) $+212.3$ kJ $mol^{–1}$

   (c) $–106.1$ kJ $mol^{–1}$

   (d) $+106.1$ kJ $mol^{–1}$

3. The unit of rate constant for a zero-order reaction is:

   (a) mol $L^{–1}$ $s^{–1}$

   (b) $s^{–1}$

   (c) L $mol^{–1}$ $s^{–1}$

   (d) $L^2 mol^{–2}$ $s^{–1}$

4. Which of the following first-row transition metal ions has the highest magnetic moment in its +2 oxidation state?

   (a) Ti^{2+} (Z = 22)

   (b) Cr^{2+} (Z = 24)

   (c) Fe^{2+} (Z = 26)

   (d) Ni^{2+} (Z = 28)

5. For a reaction $A + 2B \rightarrow$ Products, the rate law is given by Rate = $k[A]^{1/2}[B]^1$. The overall order of the reaction is:

   (a) 0.5

   (b) 1.5

   (c) 2.0

   (d) 2.5

6. The hybridization and magnetic character of the complex $[Ni(CO)_4]$ are respectively:
   (a) dsp^2 and diamagnetic
   (b) sp^3 and diamagnetic
   (c) sp^3 and paramagnetic
   (d) dsp^2 and paramagnetic

7. Which actinoid element exhibits a +7 oxidation state?
   (a) Thorium (Th)
   (b) Uranium (U)
   (c) Plutonium (Pu)
   (d) Neptunium (Np)

8. The major product obtained when 2-bromopentane is treated with ethanolic KOH solution under heating is:
   (a) Pent-1-ene
   (b) Pent-2-ene
   (c) Pentan-2-ol
   (d) 2-Ethoxypentane

9. Which of the following solution exhibits positive deviation from Raoult's law?
   (a) Ethanol + acetone
   (b) Phenol + aniline
   (c) Chloroform + acetone
   (d) HCl + water

10. Identify the compound, which has highest acidic strength:
    (a) Ethanol
    (b) p-Nitrophenol
    (c) p-Cresol
    (d) Phenol

11. The limiting molar conductivity (Λ°_m) of an electrolyte cannot be determined directly by extrapolation of a Λ_m vs. $\sqrt{c}$ plot for:
    (a) KCl
    (b) NaCl
    (c) CH_3COOH
    (d) $CaCl_2$

12. Which of the following alkyl halides undergoes S_N1 hydrolysis at the fastest rate?
    (a) CH_3CH_2Cl
    (b) $(CH_3)_2CHCl$
    (c) $(CH_3)_3CCl$
    (d) $C_6H_5CH_2Cl$

Directions for Q. Nos. 13–16: In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option:
(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.

13. **Assertion (A):** Haloarenes are much less reactive than haloalkanes towards nucleophilic substitution reactions.
    Reason (R): In haloarenes, the C–X bond acquires a partial double bond character due to resonance.

14. **Assertion (A):** Phenol reacts with bromine water to give a white precipitate of 2,4,6-tribromophenol.
    Reason (R): The –OH group attached to the benzene ring is strongly activating and ortho-/para-directing.

15. **Assertion (A):** $[Co(NH_3)_6]^{3+}$ is a diamagnetic and low-spin complex.
    Reason (R): NH_3 acts as a strong field ligand and causes pairing of electrons in the 3d orbitals of Co^{3+}.

16. **Assertion (A):** Zinc, cadmium, and mercury are not regarded as typical transition elements.
    Reason (R): They have completely filled d-subshells (d^{10}) in their ground state as well as in their common oxidation states.

SECTION B

The following questions (Q. Nos. 17–21) are very short answer type carrying 2 marks each.

17. (a) Define molar conductivity and write its SI unit.
    (b) Why does the molar conductivity of strong and weak electrolytes increase with dilution?

18. Identify the type of isomerism exhibited by each of the following pair of coordination compounds:
    (a) $[Pt(NH_3)_4Cl_2]Br_2$ and $[Pt(NH_3)_4Br_2]Cl_2$
    (b) $[Co(NH_3)_5(NO_2)]Cl_2$ and $[Co(NH_3)_5(ONO)]Cl_2$

19. Write the cell reactions taking place at the anode and cathode in a dry cell (Leclanché cell). What is the function of MnO_2 in this cell?

20. (a) How does an increase in temperature affect the rate constant of a chemical reaction?
    (b) If the activation energy (E_a) of a reaction is zero, what is the value of the rate constant (k) in terms of the Arrhenius factor (A)?

21. **Answer either (A) or (B):**
    (A) (a) Out of $[Fe(CN)_6]^{4-}$ and $[FeF_6]^{3-}$, which complex is inner orbital and which is outer orbital?
    (b) Explain why transition metal complexes are generally brightly coloured.
    OR
    (B) Draw the geometrical isomers of $[Pt(NH_3)_2Cl_2]$ and state which of the isomers is used as an anti-cancer drug.

SECTION C

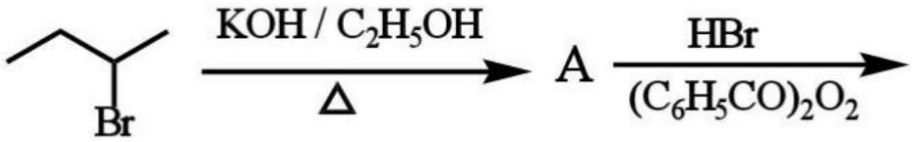
The following questions (Q. Nos. 22–28) are short answer type carrying 3 marks each.

22. Account for the following observations:
    (a) Transition metals exhibit high enthalpies of atomization.
    (b) 4d and 5d series have almost identical atomic and ionic radii.
    (c) Mn^{3+} is a strong oxidizing agent, whereas Cr^{2+} is a reducing agent, although both have d^4 configurations.

23. A first-order reaction has a rate constant of $1.15 \times 10^{-3}\ s^{-1}$. How long will 5.0 g of this reactant take to reduce to 3.0 g?
    (Given: log 5 = 0.6990, log 3 = 0.4771, log 1.667 = 0.2219)

24. (a) Write balanced ionic equations for the oxidation of:
    (i) I^- to IO_3^- by $KMnO_4$ in neutral/faintly alkaline medium.
    (ii) SO_3^{2-} to SO_4^{2-} by acidic $K_2Cr_2O_7$ solution.
    (b) Why do the d-block elements form interstitial compounds?

25. (a) Write the structure of the A and B formed in following reactions:



    (b) Why is sulfuric acid not used during the reaction of alcohols with KI?

26. The rate constants of a reaction are $1.0 \times 10^{-3}\ s^{-1}$ and $2.0 \times 10^{-3}\ s^{-1}$ at 293 K and 303 K respectively. Calculate the activation energy (E_a) of the reaction.
    (Given: R = 8.314 J $K^{-1}mol^{-1}$, log 2 = 0.3010)

27. 19.5 g of CH_2FCOOH is dissolved in 500 g of water. The depression in the freezing point of water observed is 1.0°C. Calculate the van't Hoff factor and dissociation constant of fluoroacetic acid.

(Given: K_f for water = 1.86 K kg mol^{-1}, Molar mass of fluoroacetic acid = 78 g mol^{-1})

28. **Answer either (A) or (B):**

(A) Calculate the EMF of the following cell at 298 K:

Cr(s) | Cr^{3+} (0.1 M) || Fe^{2+} (0.01 M) | Fe(s)

[Given: $E°(Cr^{3+}/Cr) = –0.74$ V; $E°(Fe^{2+}/Fe) = –0.44$ V; log 10 = 1]

OR

(B) The electrical resistance of a column of 0.05 M NaOH solution of diameter 1 cm and length 50 cm is 5.55×10^3 ohm. Calculate its resistivity, conductivity, and molar conductivity.

SECTION D

The following questions (Q. Nos. 29–30) are case-based questions carrying 4(1+1+2) marks each.

29. Colligative properties depend only on the total number of solute particles present in a given amount of solvent, rather than on their chemical identity. For solutions containing electrolytes that dissociate or associate in solution, the observed colligative properties deviate from theoretical values. To account for this anomaly, Jacobus Henricus van 't Hoff introduced the factor 'i'.

Sample Solution (0.1 M at 298 K)	Observed Osmotic Pressure	Van 't Hoff Factor (i)
Solution P (Glucose)	2.44 atm	1.0
Solution Q (Potassium Chloride)	4.68 atm	1.92
Solution R (Magnesium Chloride)	6.59 atm	2.70

Answer the following questions:

i. Why does 0.1 M $MgCl_2$ exhibit a higher osmotic pressure than 0.1 M KCl?

ii. Calculate the degree of dissociation (α) of potassium chloride in Solution Q.

iii. **Answer either (a) or (b):**

(a) What will happen to red blood cells when placed in a 0.5% (w/v) NaCl solution? Justify based on osmosis.

OR

(b) Calculate the osmotic pressure of a solution containing 17.1 g of sucrose (molar mass = 342 g mol^{-1}) dissolved in 500 mL of water at 300 K. [R = 0.0821 L atm $K^{-1}mol^{-1}$]

30. Alkyl halides undergo substitution and elimination reactions depending upon the structure of the halide, the nature of the attacking nucleophile/base, and the reaction conditions. Primary alkyl halides typically favor bimolecular nucleophilic substitution (S_N2) reactions with complete inversion of configuration (Walden inversion), whereas tertiary halides favorunimolecular substitution (S_N1) with racemization. When treated with strong, bulky bases at elevated temperatures, elimination competes effectively with substitution, yielding alkenes governed by Zaitsev's rule.

Answer the following questions:

i. Why is benzyl chloride ($C_6H_5CH_2Cl$) highly reactive towards S_N1 hydrolysis?

ii. Draw the optical isomers (enantiomeric pair) of 2-bromobutane.

iii. **Answer either (a) or (b):**

(a) Predict the major organic elimination product formed when 2-chloro-2-methylbutane is heated with alcoholic KOH. State the rule applied.

OR

(b) Explain why haloarenes are extremely resistant to nucleophilic aromatic substitution compared to chloroethane under normal laboratory conditions.

SECTION E

The following questions (Q. Nos. 31–33) are long answer type carrying 5 marks each. All questions have internal choice.

31. **Answer either (A) or (B):**

(A) (a) Write the IUPAC name, hybridization, geometry, and magnetic behaviour of $[Co(NH_3)_5Cl]Cl_2$.

(b) Define crystal field splitting energy. How does the crystal field splitting energy (Δ_o) decide whether a d^4 coordination complex will be high-spin or low-spin in an octahedral field?

OR

(B) (a) Explain: $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic while $[Fe(CN)_6]^{3-}$ is weakly paramagnetic.

(b) Explain the following terms with appropriate examples:

(i) coordination number

(ii) double salt

(iii) didentate ligand

32. **Answer either (A) or (B):**

(A) (a) An organic compound (A) with molecular formula $C_4H_{10}O$ reacts with PCl_5 to give compound (B). Compound (B) on treatment with alcoholic KOH gives an alkene (C). Alkene (C) on ozonolysis gives two moles of ethanal. Identify (A), (B), and (C), and write the chemical reactions involved.

(b) Phenol is more acidic than cyclohexanol. Give a valid reason.

OR

(B) (a) Explain the chemical equations to represent following::

(i) Kolbe's reaction

(ii) Hydroboration-oxidation of propene

(iii) Acid-catalyzed dehydration of ethanol to diethyl ether

(b) Write one chemical test each to distinguish between:

(i) Ethanol and Phenol

(ii) Propan-1-ol and Propan-2-ol

33. **Answer either (A) or (B):**

(A) (a) State Faraday's First and Second Laws of Electrolysis.

(b) A steady current of 2.0 A is passed through a solution of $Cu(NO_3)_2$ for 30 minutes using platinum electrodes. Calculate the mass of copper deposited at the cathode.

(Atomic mass of Cu = 63.5 g mol^{-1}, 1 F = 96500 C mol^{-1})

(c) What are fuel cells? Write the reactions occurring at both electrodes in a Hydrogen-Oxygen fuel cell.

OR

(B) (a) The molar conductivity at infinite dilution (Λ°_m) of NH_4Cl, NaOH, and NaCl are 129.8, 248.0, and 126.4 S cm^2mol^{-1} respectively. Calculate Λ°_m for ammonium hydroxide (NH_4OH).

(b) Explain the working of a lead-acid storage battery during the recharging process, writing the chemical reactions at both the anode and the cathode.