CHEMISTRY (CODE – 043)

Chapter-wise Test: Electrochemistry

(NCERT Class XII Chemistry, Unit 2: Electrochemistry)

PRACTICE QUESTION PAPER

CLASS XII (2026-27)

Time: 1½ hours **Max. Marks: 35**

GENERAL INSTRUCTIONS: Read the following instructions carefully.

1. There are 17 questions in this question paper with internal choice. All questions are based on Unit 2: Electrochemistry.
2. SECTION A consists of 8 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 3 very short answer questions carrying 2 marks each.
4. SECTION C consists of 4 short answer questions carrying 3 marks each.
5. SECTION D consists of 1 case-based question carrying 4 marks.
6. SECTION E consists of 1 long answer question carrying 5 marks.
7. All questions are compulsory. Internal choice is provided in Questions 9 to 15, 16(iii) and 17.
8. Questions 2, 3, 9, 12, 13, 16 and 17 are based on figures, structures or data tables given in the paper.
9. Use of log tables and calculators is not allowed.

SECTION A

Questions 1 to 8 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions. Each question carries 1 mark.

1 The SI unit of molar conductivity (Λ_m) is: 1

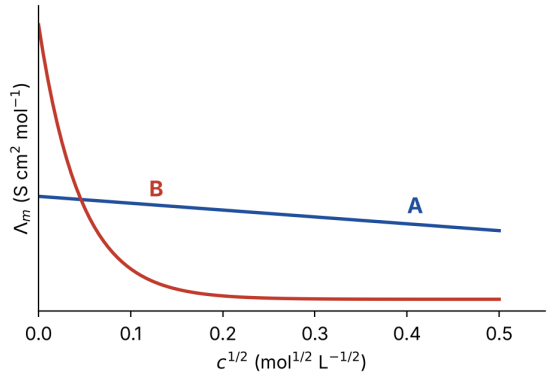
A. S m^{-1}
B. S m^2 mol^{-1}
C. Ω m
D. S cm^{-1}

2 The table gives the standard electrode potentials of some redox couples at 298 K. 1

Reduction half-reaction	E° (V)
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$	1.51
$Cl_2 + 2e^- \rightarrow 2Cl^-$	1.36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$	1.33
$Br_2 + 2e^- \rightarrow 2Br^-$	1.09
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.77
$I_2 + 2e^- \rightarrow 2I^-$	0.54

Which of the following will oxidise Br^- to Br_2 but will **not** oxidise Cl^- to Cl_2?

A. MnO_4^- (acidic)
B. Fe^{3+}
C. $Cr_2O_7^{2-}$ (acidic)
D. I_2

3	Fig. 1 shows the variation of molar conductivity (Λ_m) with the square root of concentration ($c^{1/2}$) for two electrolytes A and B.  **Fig. 1** Which of the following statements is correct? A. B is a strong electrolyte because its Λ_m rises on dilution. B. The limiting molar conductivity ($\Lambda°_m$) of both A and B can be obtained by extrapolation to $c^{1/2} = 0$. C. A is a weak electrolyte because its Λ_m changes slowly with concentration. D. A is a strong electrolyte whose $\Lambda°_m$ can be obtained by extrapolation to $c^{1/2} = 0$, whereas B is a weak electrolyte whose $\Lambda°_m$ cannot be obtained this way.	1
4	The quantity of electricity required to reduce one mole of $Cr_2O_7^{2-}$ to Cr^{3+} in acidic medium is: A. 6 F B. 3 F C. 2 F D. 7 F	1
5	Which of the following is a secondary cell (rechargeable)? A. Leclanché (dry) cell B. Lead storage battery C. Mercury cell D. H_2–O_2 fuel cell	1
6	The standard EMF of the Daniell cell is 1.1 V. The standard Gibbs energy change ($\Delta_r G°$) for the cell reaction ($n = 2$, $F = 96500$ C mol^{-1}) is: A. −212.3 kJ mol^{-1} B. −106.15 kJ mol^{-1} C. +212.3 kJ mol^{-1} D. −424.6 kJ mol^{-1}	1
7	The mass of silver deposited at the cathode when 96500 C of electricity is passed through silver nitrate solution is (molar mass of Ag = 108 g mol^{-1}): A. 54 g B. 216 g C. 108 g D. 27 g	1
8	**Assertion (A):** The conductivity of an electrolytic solution decreases on dilution. **Reason (R):** The molar conductivity of an electrolytic solution increases on dilution. Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true.	1

SECTION B

Question Nos. 9 to 11 are very short answer questions carrying 2 marks each.

9 **Attempt either A or B.** 1+1

The table gives the limiting molar conductivities (λ°) of some ions in water at 298 K.

Cation	λ° (S cm^2 mol^{-1})	Anion	λ° (S cm^2 mol^{-1})
H^+	349.6	Cl^-	76.3
Na^+	50.1	CH_3COO^-	40.9
Ca^{2+}	119.0	SO_4^{2-}	160.0
Mg^{2+}	106.0		

(A) (i) State Kohlrausch's law of independent migration of ions.
(ii) Using the table, calculate Λ°_m of ethanoic acid (CH_3COOH).

OR

(B) Using the table, calculate Λ°_m of (i) $CaCl_2$ and (ii) $MgSO_4$.

10 **Attempt either A or B.** 1+1

(A) Write the anode and cathode reactions taking place in the lead storage battery when it is in use (discharging).

OR

(B) (i) Write the anode and cathode reactions of the mercury cell.
(ii) Why does the mercury cell give a constant potential throughout its life?

11 **Attempt either A or B.** 1+1

(A) A conductivity cell filled with 0.1 mol L^{-1} KCl solution (conductivity = 1.29 S m^{-1}) has a resistance of 100 Ω at 298 K. Calculate the cell constant. What will be the conductivity of a solution which shows a resistance of 200 Ω in the same cell?

OR

(B) The conductivity of a 0.01 mol L^{-1} solution of an electrolyte is 0.0015 S cm^{-1}. Calculate its molar conductivity.

SECTION C

Question Nos. 12 to 15 are short answer questions carrying 3 marks each.

12 **Attempt either A or B.** 1+1+1

(A) Fig. 2 shows a galvanic cell set up with zinc and copper electrodes. [$E°(Zn^{2+}/Zn) = -0.76$ V and $E°(Cu^{2+}/Cu) = +0.34$ V]

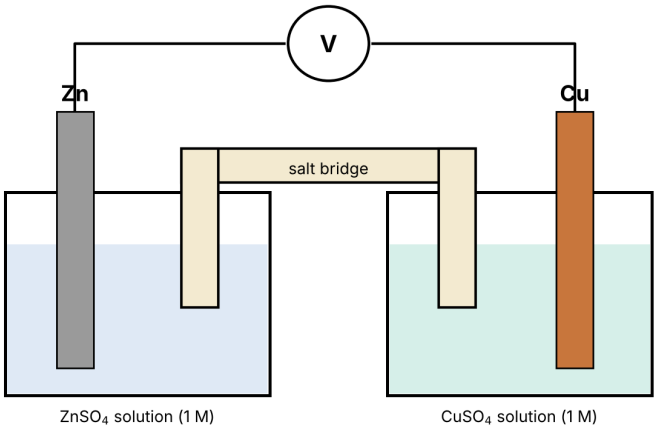


Fig. 2

(i) Identify the anode and the cathode, and give the direction of flow of electrons in the external circuit.
(ii) Represent the cell and calculate its standard EMF.
(iii) What is the function of the salt bridge?

OR

(B) (i) Write the Nernst equation for the cell reaction $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$.
(ii) Calculate the EMF of the cell $Zn \mid Zn^{2+}(0.1\ M) \parallel Cu^{2+}(0.01\ M) \mid Cu$ at 298 K. [$E°_{cell} = 1.10$ V; $2.303RT/F = 0.059$ V]

13 **Attempt either A or B.** 1+1+1

The table gives the standard electrode potentials of some metal ions at 298 K.

Electrode (M^{n+}/M)	**Ag^{+}/Ag**	**Cu^{2+}/Cu**	**Fe^{2+}/Fe**	**Zn^{2+}/Zn**	**Mg^{2+}/Mg**
$E°$ (V)	+0.80	+0.34	−0.44	−0.76	−2.36

(A) (i) Which metal in the table is the strongest reducing agent?
(ii) Calculate $E°_{cell}$ for the cell in which the reaction $Fe(s) + 2Ag^{+}(aq) \rightarrow Fe^{2+}(aq) + 2Ag(s)$ takes place.
(iii) Calculate $\Delta_r G°$ for this reaction. ($F = 96500$ C mol^{-1})

OR

(B) (i) Which of the metals in the table will liberate hydrogen from dilute acid?
(ii) Calculate $E°_{cell}$ for the cell $Mg \mid Mg^{2+} \parallel Cu^{2+} \mid Cu$.
(iii) Calculate $\Delta_r G°$ for this cell reaction. ($F = 96500$ C mol^{-1})

14	**Attempt either A or B.** **(A)** A current of 2 A is passed for 80 minutes 25 seconds through $CuSO_4$ solution using inert electrodes. (Molar mass of Cu = 63.5 g mol^{-1}; F = 96500 C mol^{-1}) (i) Calculate the quantity of charge passed. (ii) Calculate the mass of copper deposited at the cathode. (iii) Calculate the volume of oxygen liberated at the anode at STP. (Molar volume at STP = 22.4 L mol^{-1}) **OR** **(B)** Predict the products of electrolysis of aqueous sodium chloride solution using inert electrodes. (i) Which species is reduced at the cathode? Give the reaction. (ii) Why is Cl_2 and not O_2 liberated at the anode, although $E°$ of water oxidation (1.23 V) is lower than that of Cl^- oxidation (1.36 V)? (iii) Write the net cell reaction.	1+1+1
15	**Attempt either A or B.** **(A)** (i) Why does the conductivity of a solution decrease on dilution? (ii) Explain why the molar conductivity of a strong electrolyte increases slowly on dilution, while that of a weak electrolyte increases very rapidly at low concentration. **OR** **(B)** (i) Write the Nernst equation for the electrode reaction $2H^+(aq) + 2e^- \rightarrow H_2(g)$ (1 bar). (ii) Calculate the electrode potential of a hydrogen electrode in contact with a solution of pH = 10 at 298 K. ($2.303RT/F$ = 0.059 V)	1+2

SECTION D

Question No. 16 is a case-based/data-based question carrying 4 marks.

16 **Corrosion and its prevention** — 1+1+2

Corrosion of iron (rusting) is an electrochemical process which causes huge economic loss every year. In a school laboratory, iron nails were each placed in contact with a strip of a different metal and kept in salt water for 10 days. The observations are given in the table. [$E°(Fe^{2+}/Fe) = -0.44$ V]

Metal in contact with the iron nail	$E°$ (M^{n+}/M) (V)	Observation after 10 days
Zinc	−0.76	No rust on iron; zinc strip corroded
Magnesium	−2.36	No rust on iron; magnesium strip corroded
Tin	−0.14	Rust formed on iron wherever the nail was exposed
Copper	+0.34	Heavy rusting of the iron nail

Answer the following questions:

(i) Explain, with reference to the table, why zinc and magnesium protect iron from rusting.
(ii) Why did the iron nail rust when in contact with tin and copper?
(iii) **Attempt either A or B.**
(A) Write the anode and cathode reactions for the rusting of iron.
OR
(B) What is meant by sacrificial protection? Write the formula of rust.

SECTION E

Question No. 17 is a long answer question carrying 5 marks.

17 **Attempt either A or B.** 5

(A) For the cell Zn(s) | Zn^{2+}(0.01 M) || Ag^{+}(0.01 M) | Ag(s) at 298 K, [$E°(Zn^{2+}/Zn) = -0.76$ V; $E°(Ag^{+}/Ag) = +0.80$ V; $F = 96500$ C mol^{-1}; $2.303RT/F = 0.059$ V]

(i) Write the cell reaction.

(ii) Calculate the standard EMF of the cell.

(iii) Calculate the EMF of the cell using the Nernst equation.

(iv) Calculate the standard Gibbs energy change of the cell reaction.

(v) How will the EMF change if the concentration of Ag^{+} is increased? Give a reason.

OR

(B) The tables give the conductivity of ethanoic acid (CH_3COOH) solutions and the limiting molar conductivities of some ions at 298 K.

Solution	Conductivity κ (S m^{-1})	Ion	λ° (S cm^2 mol^{-1})
0.1 M CH_3COOH	0.047	H^{+}	349.6
0.01 M CH_3COOH	0.016	CH_3COO^{-}	40.9

(i) Calculate the molar conductivity (Λ_m) of 0.01 M CH_3COOH in S cm^2 mol^{-1}.

(ii) Calculate the limiting molar conductivity ($\Lambda°_m$) of CH_3COOH.

(iii) Calculate the degree of dissociation (α) of the acid at this concentration.

(iv) Calculate the dissociation constant (K_a) of the acid. (Assume $1 - \alpha \approx 1$)

(v) Why can $\Lambda°_m$ of ethanoic acid not be obtained by extrapolating the Λ_m versus $c^{1/2}$ graph?

— End of Question Paper —