



IIT-JAM CHEMISTRY 2023
TEST : ELECTROCHEMISTRY

Time 00 : 60 Hour

Date : 25-08-2022
M.M. : 35

INSTRUCTION:

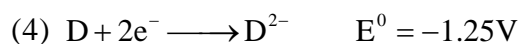
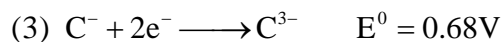
1. Attempt all the questions.
2. PART-A contains 10 Multiple Choice Questions (MCQ). Each question has 4 choices (a), (b), (c) and (d), for its answer, out of which ONLY ONE is correct. From Q.1 to Q.5 carries 1 Marks and Q.6 to Q.10 carries 2 Marks each.
3. PART-B contains 05 Multiple Select Questions (MSQ). Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which ONE or MORE than ONE is/are correct. For each correct answer you will be awarded 2 marks.
4. PART-C contains 06 Numerical Answer Type (NAT) questions. Q.16 to Q.17 carry 1 Mark and Q.18 to Q.21 carries 2 Marks each. The answer of each (NAT) is a real number.
5. In all sections, questions not attempted will result in zero mark. In PART-A (MCQ), wrong answer will result in negative marks. For all 1 mark questions, 1/3 marks will be deducted for each wrong answer. For all 2 marks questions, 2/3 marks will be deducted for each wrong answer. In PART-B (MSQ), there is no negative and no partial marking provisions. There is no negative marking in PART-C (NAT) as well.

PART-A

Q.1 to Q.05: Carry 1 Mark each.

1. One mole of metal can be deposited when one Faraday of electricity is passed through one litre solution containing one mole of
(a) BaCl_2 (b) CuSO_4 (c) NaCl (d) AlCl_3
2. When HCl is titrated conductometrically with KOH, the drastic decrease in conductance is observed due to
(a) increase in number of Cl^- (b) Replacement of H^+ by K^+
(c) Replacement of Cl^- by low conducting K^+ (d) Formation of weak electrolyte
3. The correct order of transport numbers of Cl^- in infinitely diluted aqueous solution of LiCl, NaCl and KCl are
(a) $t^-(\text{LiCl}) < t^-(\text{NaCl}) < t^-(\text{KCl})$ (b) $t^-(\text{LiCl}) < t^-(\text{KCl}) < t^-(\text{NaCl})$
(c) $t^-(\text{KCl}) < t^-(\text{NaCl}) < t^-(\text{LiCl})$ (d) $t^-(\text{KCl}) = t^-(\text{NaCl}) = t^-(\text{LiCl})$
4. Consider the following half-cells and their reduction potential
(1) $\text{A} + \text{e}^- \longrightarrow \text{A}^-$ $E^0 = -0.24\text{V}$
(2) $\text{B}^- + \text{e}^- \longrightarrow \text{B}^{2-}$ $E^0 = 1.25\text{V}$

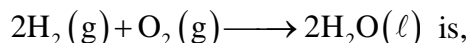




The correct combination of two half-cells that would result in a cell with the largest potential is

- (a) (1) and (2) (b) (2) and (3) (c) (1) and (4) (d) (2) and (4)

5. Standard Gibb's free energy change of the reaction



(Given: for $2H_2O \longrightarrow O_2 + 4H + 4e^-$, E^0 is $-1.23V$)

- (a) -475 kJ (b) 475 kJ (c) 237 kJ (d) -237 kJ

Q.6 to Q.10: Carry 2 Marks each.

6. Consider the following data of molar conductance at infinite dilution at $25^\circ C$

Electrolyte	KCl	KNO ₃	HCl	NaOAc	NaCl
$\Lambda_m^\infty (\text{Scm}^2\text{mol}^{-1})$	149.9	145.0	426.2	91.0	126.5

The limiting molar conductance of acetic acid (HOAc) is (in $\text{Scm}^2\text{mol}^{-1}$)

- (a) 517.2 (b) 390.7 (c) 552.7 (d) 227.5

7. When current of 2.0 A is passed for 5 hrs through a molten salt, it deposits $22g$ of metal (atomic weight 177). The oxidation state of the metal ion is

- (a) 1 (b) 2 (c) 3 (d) 4

8. The ionic strength of Na_2SO_4 and $Ca_3(PO_4)_2$ will be same when

- (a) Molality of Na_2SO_4 is 3 times of molality of $Ca_3(PO_4)_2$
 (b) Molality of Na_2SO_4 is 5 times of molality of $Ca_3(PO_4)_2$
 (c) Molality of $Ca_3(PO_4)_2$ is 3 times of molality of Na_2SO_4
 (d) Molality of $Ca_3(PO_4)_2$ is 5 times of molality of Na_2SO_4

9. The cell constant and resistance of the cell is 0.5 cm^{-1} and 50 ohm respectively. The equivalent conductance (in $\text{ohm}^{-1} \text{ cm}^2 \text{ eq}^{-1}$) containing $1N$ solution is

- (a) 10 (b) 20 (c) 0.1 (d) 0.01

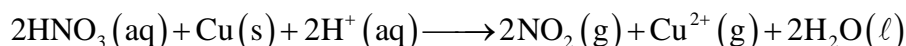
10. A potential of 5.6 V is applied to two electrodes placed 9.8 cm apart, the distance travelled by ammonium ion in one hour in a dilute solution of ammonium salt is (Given: $\lambda(\text{NH}_4^+) = 73.4 \text{ } \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$)

- (a) 1.56 cm (b) 15.6 cm (c) 156 cm (d) 186 cm

PART-B

Q.11 to Q.15: Carry 2 Marks each.

11. Consider the following reaction and choose the correct options



- (a) H^+ is the oxidising agent (b) Cu is the reducing agent
 (c) HNO_3 is the oxidising agent (d) H^+ is the reducing agent.



12. The emf of the following cell is 0.22V, $\text{Ag(s)} | \text{AgCl(s)} | \text{KCl(1M)} || \text{H}^+(1\text{M}) | \text{H}_2(\text{g})(1\text{ atm}) | \text{Pt}$ which of the following will decrease the emf of the cell
- (a) Increasing pressure of $\text{H}_2(\text{g})$ from 1 atm to 2 atm
 - (b) Increasing H^+ concentration in cathodic compartment
 - (c) Decreasing KCl concentration in anodic compartment
 - (d) Increasing Cl^- concentration in anodic compartment
13. Choose the correct option.
- (a) Ionic mobility of Na^+ is greater than that of K^+
 - (b) Molar conductance increases on dilution
 - (c) Specific conductance decreases on dilution
 - (d) Transport number of Na^+ in NaOH is less than that of in NaCl
14. For 0.01 molal aqueous solution of ZnSO_4 at 25°C , the correct statements is/are
- (a) $\log \gamma_{\pm} = -0.407$
 - (b) The mean activity coefficients increases when concentration increases to 0.1 molal.
 - (c) The mean activity coefficient increases by replacing ZnSO_4 to $\text{Al}_2(\text{SO}_4)_3$.
 - (d) For very dilute solution of ZnSO_4 γ_{\pm} approaches to unity
15. Choose the correct option(s).
- (a) Cathode has negative polarity in electrolytic cell
 - (b) Anode has negative polarity in galvanic cell
 - (c) Oxidation occurs at negative electrode in electrolytic cell
 - (d) Oxidation occurs at positive electrode in galvanic cell

PART-C

Q.16 to Q.17: Carry 1 Mark each.

16. The standard potential of a cell is 2.0 V at 298K. The equilibrium constant of the following net cell reaction at 298K is 10^x .



The value of x is _____ (Round off to nearest integer)

$$\left(\text{Given : } \frac{2.303RT}{F} = 0.059 \text{ at } 298\text{K} \right)$$

17. The mean molality (m_{\pm}) of 0.01021 molal aqueous solution of ZnCl_2 is _____ mol/kg. (Round off to three decimal places).

Q.18 to Q.21: Carry 2 Marks each.

18. Ionic strength of 0.25 m $\text{Ca}_3(\text{PO}_4)_2$ is _____ (Round off to two decimal places)
19. The molar conductance at infinite dilution of Ag^+ is $61.92 \times 10^{-4} \text{ S.mol}^{-1}\text{m}^2$ at 25°C . The ionic mobility of Ag^+ ion will be _____ $\times 10^{-8} \text{ m}^2 \text{V}^{-1}\text{sec}^{-1}$. (Given: $1\text{F} = 96485 \text{ C}$) (Round off to two decimal places)
20. At 25°C , the specific conductance of a 0.01 M aqueous solution of acetic acid is 0.163 mS.m^{-1} . The molar conductance at infinite dilution is $390 \times 10^{-4} \text{ S.m}^2\text{mol}^{-1}$. The degree of dissociation of acid is _____ % (Round off to three decimal places)
21. If $E_{\text{Au}^{3+}|\text{Au}}^0 = -0.29 \text{ V}$ and $E_{\text{Fe}^{3+}|\text{Fe}^{2+}}^0 = 0.77 \text{ V}$, then E^0 for the reaction
- $$2\text{Fe}^{2+}(\text{aq}) + \text{Au}^{3+}(\text{aq}) \longrightarrow 2\text{Fe}^{3+}(\text{aq}) + \text{Au}^+(\text{aq})$$
- is _____ V. (Round off to two decimal places)





CAREER ENDEAVOUR

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PART - A

- | | | | | | | |
|--------|--------|---------|--------|--------|--------|--------|
| 1. (c) | 2. (b) | 3. (c) | 4. (d) | 5. (a) | 6. (b) | 7. (c) |
| 8. (b) | 9. (a) | 10. (a) | | | | |

PART - B

- | | | | | |
|-----------|-----------|-------------|------------|-----------|
| 11. (b,c) | 12. (a,c) | 13. (b,c,d) | 14. (a, d) | 15. (a,b) |
|-----------|-----------|-------------|------------|-----------|

PART - C

- | | | |
|--------------------|----------------------|----------------------|
| 16. (339) | 17. (0.015 to 0.017) | 18. (3.74 to 3.76) |
| 19. (6.40 to 6.43) | 20. (0.039 to 0.044) | 21. (-1.07 to -1.05) |

