Chapter 03 Electro Chemistry

JEE-FLASHBACK

JEE MAINS QUESTION

Q.1 Resistance of 0.2 M solution of an electrolyte is 50 Ω. The specific conductance of the solution is 1.3 S m^{-1}. If resistance of the 0.4 M solution of the same electrolyte is 260 Ω, its molar conductivity is :– **[AIEEE 2011]**

(1) 6250 m^2 mol^{-1}

(2) 6.25 × 10^{-4} S m^2 mol^{-1}

(3) 625 × 10^{-4} S m^2 mol^{-1}

(4) 62.5 S m^2 mol^{-1}

Q.2 The reduction potential of hydrogen half-cell will be negative if :- **[AIEEE 2011]**

(1) $p(H_2)$ = 2 atm and $[H^+]$ = 1.0 M

(2) $p(H_2)$ = 2 atm and $[H^+]$ = 2.0 M

(3) $p(H_2)$ = 1 atm and $[H^+]$ = 2.0 M

(4) $p(H_2)$ = 1 atm and $[H^+]$ = 1.0 M

Q.3 The standard reduction potentials for Zn^{2+} / Zn, Ni^{2+} / Ni and Fe^{2+} / Fe are – 0.76, – 0.23 and – 0.44 V respectively. The reaction $X + Y^{+2} \rightarrow X^{2+} + Y$ will be spontaneous when **[AIEEE 2012]**

(1) X = Zn, Y = Ni (2) X = Ni, Y = Fe

(3) X = Ni, Y = Zn (4) X = Fe, Y = Zn

Q.4 Given :

$E^0_{Cr^{3+}/Cr} = 0.74V; E^0_{MnO_4^-/Mn^{2+}} = 1.51V;$

$E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33V; E^0_{Cl/Cl^-} = 1.36V$

Based on the data given above, strongest oxidising agent will be : **[JEE-MAINS 2014]**

(1) Cl^- (2) Cr^{3+} (3) Mn^{2+} (4) MnO_4^-

Q.5 The equivalent conductance of NaCl at concentration C and at infinite dilution are λ_C and λ_∞, respectively. The correct relationship between λ_C and λ_∞ is given as : **[JEE-MAINS 2014]**

(1) $\lambda_C = \lambda_\infty - (b)\sqrt{C}$ (2) $\lambda_C = \lambda_\infty + (b)\sqrt{C}$

(3) $\lambda_C = \lambda_\infty + (b)C$ (4) $\lambda_C = \lambda_\infty - (b)(C)$

Q.6 Resistance of 0.2 M solution of an electrolyte is 50 Ω. The specific conductance of the solution is 1.4 S m^{-1}. The resistance of 0.5 M solution of the same electrolyte is 280 Ω. The molar conductivity of 0.5 M solution of the electrolyte in S m^2 mol^{-1} is : **[JEE-MAINS 2014]**

(1) 5 × 10^3 (2) 5 × 10^2

(3) 5 × 10^{-4} (4) 5 × 10^{-3}

Q.7 At 298 K, the standard reduction potentials are 1.51 V for $MnO^-_4|Mn^{2+}$, 1.36 V for $Cl_2|Cl^-$, 1.07 V for $Br_2|Br^-$, and 0.54 V for I2|I^-. At pH = 3, permanganate is expected to oxidize $\left(\frac{RT}{F} = 0.059V\right)$: **[JEE-Mains-2015]**

(1) Cl^- and Br^- (2) Cl^-, Br^- and l^-

(3) Br^- and l^- (4) l^- only

Q.8 A variable, opposite external potential (E_{ext}) is applied to the cell $Zn|Zn^{2+}$ (1 M) || Cu^{2+} (1 M) | Cu, of potential 1.1 V. When E_{ext} < 1.1 V and E_{ext} > 1.1 V, respectively electrons flow from : **[JEE-MAINS 2015]**

(1) anode to cathode in both cases

(2) anode to cathode and cathode to anode

(3) cathode to anode in both cases

(4) cathode to anode and anode to cathode

Q.9 Two Faraday of electricity is passed through a solution of $CuSO_4$. The mass of copper deposited at the cathode is : (at. mass of Cu = 63.5 amu) **[JEE-MAINS 2015]**

(1) 2 g (2) 127 g (3) 0 g (4) 63.5 g

Q.10 What will occur if a block of copper metal is dropped into a beaker containing a solution of 1M $ZnSO_4$ **[JEE-MAINS-2016]**

(1) The copper metal will dissolve and zinc metal will be deposited

(2) No reaction will occur

(3) The copper metal will dissolve with evolution of oxygen gas

(4) The copper metal will dissolve with evolution of hydrogen gas

Q.11 Oxidation of succinate ion produces ethylene and carbon dioxide gases. On passing 0.2 Faraday electricity through on aqueous solution of potassium succinate, the total volume of gases (at both cathode and anode) at STP (1 atm and 273 K) is : **[JEE-MAINS 2016]**

(1) 8.96 L (2) 2.24 L

(3) 4.48 L (4) 6.72 L

Q.12 Given **[JEE-MAINS 2017]**

$E^0_{Cl^2/Cl^-} = 1.36V, E^0_{Cl^{3+}/Cr} = -0.74V$

$E^0_{Cr_2O_7^{-2}/Cr^{+3}} = 1.33V,\ E^0_{MnO_4^-/Mn^{2+}} = 1.51V$

Among the following the strongest reducing agents is

(1) Cr (2) Mn^{2+} (3) Cr^{3+} (4) Cl^-

Q.13 How long (approximate) should water be electrolysed by passing through 100 amperes current so that the oxygen released can completely burn 27.66 g of diborane? **[JEE-MAINS 2018]**

(Atomic weight of B = 10.8 u)

(1) 1.6 hours (2) 6.4 hours

(3) 0.8 hours (4) 3.2 hours

Q.14 $\wedge_m^0$ for NaCl, HCl and NaA are 126.4, 425.9 and 100.5 S cm^2mol^{-1}, respectively. If the conductivity of 0.001 M HA is 5×10^{-5} S cm^{-1}, degree of dissociation of HA is: **[JEE Mains 2019]**

(1) 0.50 (2) 0.125 (3) 0.25 (4) 0.75

Q.15 The standard electrode potential $E^\ominus$ and its temperature coefficient $\left(\frac{dE^\ominus}{dT}\right)$ for a cell are 2V and -5×10^{-4} VK^{-1} at 300 K respectively. The cell reaction is $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$ The standard reaction enthalpy $\Delta_r H^\ominus$) at 300 K in kJ mol^{-1} is, **[JEE Mains 2019]**

(1) 192.0 (2) –384.0

(3) 206.4 (4) –412.8

Q.16 Given the equilibrium constant : **[JEE Mains 2019]**

K_C of the reaction :

$Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$ is

10×10^{15}, calculate the E^0_{Cell} of this reaction at 298K

$[2.303]\frac{RT}{F}$ at 298K is 0.059V]

(1) 0.4736 V (2) 0.04736 mV

(3) 0.4736 mV (4) 0.04736 V

Q.17 For the cell $Zn(s) \mid Zn^{2+}(aq) \parallel M^{x+}(aq) \mid M(s)$, different half cells and their standard electrode potentials are given below : **[JEE Mains 2019]**

$M^{x+}(aq/M(s))$	$Au^{3+}(aq)/Au(s)$	$Ag^+/Ag(s)$	$Fe^{3+}(aq)/Fe^{2+}(aq)$	$Fe^{2+}(aq)/Fe(s)$
$E^o_{M^{x+}/M^{(V)}}$	1.40	0.80	0.77	–0.44

If $E^0_{Zn^{2+}/Zn} = -0.76V$, which cathode will give a maximum value of E^0_{Cell} per electron transferred?

(1) Fe^{2+}/Fe (2) Au^{3+} / Au

(3) Fe^{3+} / Fe^{2+} (4) Ag^+ / Ag

Q.18 In the cell $Pt(s)|H_2(g,\ 1bar)|HCl(aq)|AgCl(s)|Ag(s)|Pt(s)$ the cell potential is 0.92 V when a 10^{-6} molal HCl solution is used. The standard electrode potential of $(AgCl/Ag,Cl^-)$ electrode is : $\left\{\text{Given, } \frac{2.303RT}{F} = 0.06V \text{ at } 298K\right\}$

[JEE mains 2019]

(1) 0.94 V (2) 0.40 V

(3) 0.20 V (4) 0.76 V

Q.19 Consider the following reduction processes :

[JEE Mains 2019]

$Zn^{2+} + 2e^- \rightarrow Zn(s)$; $E° = -0.76$ V

$Ca^{2+} + 2e^- \rightarrow Ca(s)$; $E° = -2.87$ V

$Mg^{2+} + 2e^- \rightarrow Mg(s)$; $E° = -2.36$ V

$Ni^{2+} + 2e^- \rightarrow Ni(s)$; $E° = -0.25$ V

The reducing power of the metals increases in the order :

(1) Ca < Mg < Zn < Ni

(2) Zn < Mg < Ni < Ca

(3) Ni < Zn < Mg < Ca

(4) Ca < Zn < Mg < Ni

Q.20 If the standard electrode potential for a cell is 2 V at 300 K, the equilibrium constant (K) for the reaction **[JEE Mains 2019]**

$Zn(s) + Cu^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Cu(s)$at 300 K is approximately.

($R = 8$ JK^{-1} mol^{-1}, $F = 96000$ C mol^{-1})

(1) e^{-80} (2) e^{-160} (3) e^{160} (4) e^{320}

Q.21 Given that the standard potentials (E°) of Cu^{2+} /Cu and Cu^{+} /Cu are 0.34 V and 0.522 V respectively, the E° of Cu^{2+} /Cu^{+} is: **[JEE MAIN 2020]**

(1) –0.182 V (2) –0.158 V

(3) 0.182 V (4) +0.158 V

Q.22 For an electrochemical cell

$Sn(s)Sn^{2+}(aq,1M)||Pb^{2+}(aq,1m)|Pb(s)$

$\text{Theratio}\ \frac{[Sn^{2+}]}{[Pb^{2+}]}$

When this cell attains equilibrium is_____.

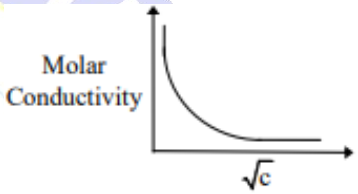
$(\text{Given}: E^0_{Sn^{2+}|Sn} = -0.14V, E^0_{Pb^{2+}|Pb} = -0.13V, \frac{2.303RT}{F} = 0.06)$ **[JEE MAIN 2020]**

Q.23 The internal energy change (in J) when 90 g of water undergoes complete evaporation at 100ºC is _____. (Given: ΔH_{vap} for water at 373 K = 41 kJ/ mol, R = 8.314 JK^{-1} mol^{-1})

[JEE MAIN 2020]

Q.24 The variation of molar conductivity with concentration of an electrolyte (X) in aqueous solution is shown in the given figure.

[JEE MAIN 2020]



The electrolyte X is:

(1) NaCl (2) KNO_3

(3) CH_3COOH (4) HCl

Q.25 The electrode potential of M^{2+}/M of 3d-series elements shows positive value of :

[JEE MAIN 2021]

(1) Zn (2) Fe (3) Co (4) Cu

Q.26 For the reaction $A_{(g)} \rightarrow (B)_{(g)}$, the value of the equilibrium constant at 300 K and 1 atm is equal to 100.0. The value of $\Delta_r G$ for the reaction at 300 K and 1 atm in J mol^{-1} is – xR, where x is _____ (Rounded of to the nearest integer) (R = 8.31 J mol^{-1} K^{-1} and ln 10 = 2.3)

[JEE MAIN 2021]

Q.27 Emf of the following cell at 298 K in V is $x \times 10^{-2}$. $Zn|Zn^{2+}$ (0.1 M)$||Ag^{+}$ (0.01 M)|Ag. The value of x is _____. (Rounded off to the nearest integer)

$[\text{Given}; E^0_{Zn^{2+}/Zn} = -0.76V; E^0_{Ag^{+}/Ag} = +0.80V; \frac{2.303RT}{F} = 0.059]$

[JEE MAIN 2021]

Q.28 The cell potential for the following cell $Pt|H_2(g)|H^+(aq)||Cu^{2+}(0.01M)|Cu(s)$ is 0.576 V at 298K. The pH of the solution is ____. (Nearest integer) **[JEE MAIN (June shift-1) 2022]**

Q.29 The resistance of conductivity cell containing 0.01M KCl solution at 298 K is 1750Ω. If the conductivity of 0.01 M KCl solution at 298K is 0.152×10^{-3}S cm^{-1}, then the cell constant of the conductivity cell is _____ $\times 10^{-3}$ cm^{-1}.

[JEE MAIN (June shift-2) 2022]

Q.30 In a cell, the following reactions take place

$Fe^{2+} \rightarrow Fe^{3+} + e^-$ $E^0_{Fe^{3+}/Fe^{2+}} = 0.77V$

$2I^- \rightarrow I_2 + 2e^-$ $E^0_{I_2/I^-} = 0.54V$

The standard electrode potential for the spontaneous reaction in the cell is $x \times 10^{-2}$V 298K. The value of x is _____ (nearest integer)

[JEE MAIN (June shift-1) 2022]

Q.31 The correct order of reduction potential of the following pairs is

(A) Cl_2/Cl^-

(B) I_2/I^-

(C) Ag^+/Ag

(D) Na^+/Na

(E) Li^+/Li

Chose the correct answer from the options given below. **[JEE MAIN (June shift-2) 2022]**

(1) A > C > B > D > E

(2) A > B < C > D > E

(3) A > C > B > E > D

(4) A > B > C > E > D

Q.32 A solutions of $Fe_2(SO_4)_3$ is electrolyzed for 'x' min with a current of 1.5A to deposit 0.3482g of Fe. The value of x is _____.

Given: 1F = 96500 $Cmol^{-1}$

Atomic mass of Fe = 56 g mol^{-1}

[JEE MAIN (June shift-2) 2022]

Q.33 The $\left(\frac{\partial E}{\partial T}\right)_p$ of different types of half cells are as follows:

A	B	C	D
1×10^{-4}	2×10^{-4}	0.1×10^{-4}	0.2×10^{-4}

(Where E is the electromotive force)

Which of the above half cells would be preferred to be used as reference electrode?

[JEE MAIN (June shift-1) 2022]

(1) A (2) B (3) C (4) D

Q.34 $Cu(s) + Sn^{2+}(0.001M) \rightarrow Cu^{2+}(0.01M) + Sn(s)$

The Gibbs free energy change for the above reaction at 298 K is $x \times 10^{-1}$ kJ mol^{-1};

The value of x is _____ . (nearest integer)

[Given : $E^{\ominus}_{Cu^{2+}/Cu} = 0.34V$; $E^{\ominus}_{Sn^{2+}/Sn} = -0.14V$ F = 96500 $Cmol^{-1}$]

[JEE MAIN (June shift-2) 2022]

Q.35 The limiting molar conductivities of NaI, $NaNO_3$ and $AgNO_3$ are 12.7, 12.0 and 13.3 mS m^2 mol^{-1}, respectively (all at 25°C). The limiting molar conductivity of AgI at this temperature is _____

[JEE MAIN (June shift-2) 2022]

Q.36 The standard reduction potentials at for the following half cells are given below:

$NO_3^- + 4H^+ + 3e^- \rightarrow NO(g)+2H_2O$	E^o = 0. 97 V
$V^{2+}(aq)+2e^- \rightarrow V(s)$	E^o = −1. 19 V
$Fe^{3+}(aq) + 3e^- \rightarrow Fe(s)$	E^o = −0. 04 V
$Ag^+(aq)+ e^- \rightarrow Ag(s)$	E^o = 0. 80 V
$Au^{3+}(aq) + 3e^- \rightarrow Au(s)$	E^o = 1. 40 V

The number of metal(s) which will be oxidised by NO_3^- in aqueous solution is _____.

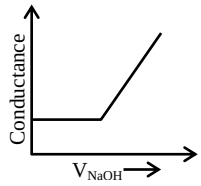
[JEE MAIN (June shift-2) 2023]

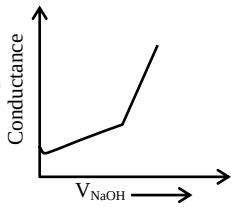
37. The specific conductance of **0.0025M** acetic acid id 5×10^{-5} S cm^{-1} at a certain temperature. The dissociation constant of acetic acid is _____$\times 10^{-7}$. **(Nearest integer)**

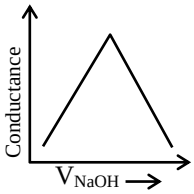
Consider limiting molar conductivity of CH_3COOH as 400 S cm^2 mol^{-1}

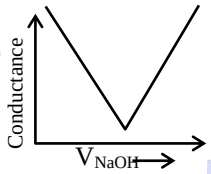
[JEE MAIN (Apr shift-2) 2023]

Q.38 Choose the correct representation of conductometric of benzoic acid vs sodium hydroxide. **[JEE MAIN (Jan shift-2) 2023]**

(1) 

(2) 

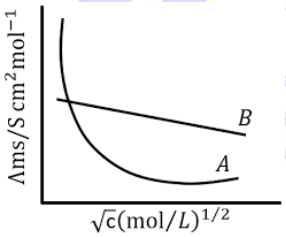
(3) 

(4) 

Q.39 Following figure shows dependence of molar conductance of two electrolytes on concentration.

$\Lambda°m$ is the limiting molar conductivity.

[JEE MAIN (Jan shift-1) 2023]



The number of **Incorrect** statements(s) from the following is _____

(1) $\Lambda°m$ for electrolyte A is obtained by extrapolation

(2) For electrolyte B, vx Λm vs $\sqrt{c}$ graph is a straight line with intercept equal to $\Lambda°m$

(3) At infinite dilute, the value of degree of dissociation approach zero for electrolyte B.

(4) $\Lambda°m$ for any electrolyte A or B can be calculated using $\lambda°$ for individual ions.

Q.40 The equilibrium constant for the reaction $Zn(s) + Sn^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Sn(s)$ is 1×10^{20} at 298 K. The magnitude of standard electrode potential of Sn/Sn^{2+} if $E^{o}_{Zn^{2+}/Zn}$ = – 0.76 V is _____$\times 10^{-2}$ V. (Nearest integer)

Given: $\frac{2.303RT}{F} = 0.059V$

[JEE MAIN (Jan shift-2) 2023]

JEE ADVANCED QUESTION

Q.1 The standard potential of the following cell is 0.23 V at 15°C & 0.21 V at 35°C

$Pt|H_2(g)|HCl(aq)|AgCl(s)|Ag(s)$

(i) Write the cell reaction.

(ii) Calculate $\Delta H°$, $\Delta S°$ for the cell reaction by assuming that these quantities remain unchanged in the range 15°C to 35°C.

(iii) Calculate the solubility of AgCl in water at 25°C.

Given standard reduction potential of the $Ag^+|Ag$ couple is 0.80 V at 25ºC. **[JEE-2001]**

Q.2 Standard electrode potential data is useful for understanding the suitablity of an oxidant in a redox titration. Some half cell reactions and their standard potentials are given below. **[JEE-2002]**

$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$; $E^o = 1.51$ V

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$; $E^o = 1.38$ V

$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$; $E^o = 0.77$ V $Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq)$; $E^o = 1.40$ V

Identify the only incorrect statement regarding quantitative estimation of aqueous $Fe(NO_3)_2$

(1) MnO_4^- can be used in aqueous HCl

(2) $Cr_2O_7^{2-}$ can be used in aqueous HCl

(3) MnO_4^- can be used in aqueous H_2SO_4

(4) $Cr_2O_7^{2-}$ can be used in aqueous H_2SO_4

Q.3 In the electrolytic cell, flow of electrons is from **[JEE-2003]**

(1) Cathode to anode in solution

(2) Cathode to anode through external supply

(3) Cathode to anode through internal supply

(4) Anode to cathode through internal supply

Q.4 Zn $|Zn^{2+}(a = 0.1\ M)|$ $|Fe^{2+}(a = 0.01\ M)|$ Fe the emf of the above cell is 0.2905 V. Equilibrium constant for the cell reaction is **[JEE-2004]**

(1) $10^{0.32/0.0591}$ (2) $10^{0.32/0.0295}$

(3) $10^{0.26/0.0295}$ (4) $e^{0.32/0.295}$

Q.5 The half cell reactions for rusting of iron are:

$2H^+ + \frac{1}{2}O_2 + 2e^- \rightarrow H_2O$; E° = +1.23 V,

$Fe^{2+} + 2e^- \rightarrow Fe$; E° = 0.44 V

ΔG° (in kJ) for the reaction is: **[JEE-2005]**

(1) –76 (2) –322 (3) –122 (4) –176

Q.6 We have taken a saturated solution of AgBr.K_{sp} of AgBr is 12×10^{-14}. If 10^{-7} moles of $AgNO_3$ are added to 1 litre of this solution, find conductivity (specific conductance) of this solution in terms of 10^{-7} S m^{-1}. **[JEE-2006]**

[Given: $\lambda^{\circ}_{(Ag^+)} = 6 \times 10^{-3}$ S m^2 mol^{-1}; $\lambda^{\circ}_{(Br^-)} = 8 \times 10^{-3}$ S m^2 mol^{-1}], $\lambda^{0}_{(NO_3^-)} = 7 \times 10^{-3} Sm^2 mol^{-1}$

Question No. 7 to 9(3 Questions)

Chemical reactions involve interaction of atoms and molecules. A larger number of atoms/molecules (approximately 6.023×10^{23}) are present in a few grams of any chemical compound varying with their atomic/molecular masses. To handle such large numbers conveniently, the mole concept was introduced. This concept has implications in diverse areas such as analytical chemistry, biochemistry, electrochemistry and radiochemistry. The following example illustrates a typical case, involving chemical/electrochemical reaction, which requires a clear understanding of the mole concept.

A 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one of the electrodes (atomic mass: Na = 23, Hg = 200, 1 Faraday = 96500 Coulombs) **[JEE-2007]**

Q.7 The total number of moles of chlorine gas evolved is

(1) 0.5 (2) 1.0 (3) 2.0 (4) 3.0

Q.8 If the cathode is Hg electrode, the maximum weight (g) of amalgam formed from this solution is

(1) 200 (2) 225 (3) 400 (4) 446

Q.9 The total charge (coulombs) required for complete electrolysis is

(1) 24125 (2) 48250 (3) 96500 (4) 193000

Q.10 Electrolysis of dilute aqueous NaCl solution was carried out by passing 10 milliampere current. The time required to liberate 0.01 mol of H_2 gas at the cathode is (1 Faraday = 96500 C mol^{-1}) **[JEE-2008]**

(1) 9.65×10^4 s (2) 19.3×10^4 s

(3) 28.95×10^4 s (4) 38.6×10^4 s

Q.11 For the reaction of NO_3^- ion in an aqueous solution, E° is +0.96 V. Values of E° for some metal ions are given below **[JEE-2009]**

$V^{2+}(aq) + 2e^- \rightarrow V$ E° = –1.19 V

$Fe^{3+}(aq) + 3e^- \rightarrow Fe$ E° = –0.04 V

$Au^{3+}(aq) + 3e^- \rightarrow Au$ E° = +1.40 V

$Hg^{2+}(aq) + 2e^- \rightarrow Hg$ E° = +0.86 V

The pair(s) of metal that is(are) oxidized by NO_3^- in aqueous solution is(are):

(1) V and Hg (2) Hg and Fe

(3) Fe and Au (4) Fe and V

Q.12 Among the following the intensive property is (properties are) **[JEE-2009]**

(1) Molar conductivity

(2) Electromotive Force

(3) Resistance

(4) Heat capacity

Paragraph For Questions 13 to 14

The concentration of potassium ions inside a biological cell is at least twenty times higher than the outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simple model for such a concentration cell involving a metal M is:

$M(s)M^+$ (aq; 0.05 molar)|| M^+(aq; 1 molar) | M(s)

For the above electrolytic cell the magnitude of the cell potential $|E_{cell}| = 70$ mV. **[JEE-2010]**

Q.13 For the above cell

(1) $E_{cell} < 0; \Delta G > 0$ (2) $E_{cell} > 0; \Delta G < 0$

(3) $E_{cell} < 0; \Delta G^\circ > 0$ (4) $E_{cell} > 0; \Delta G^\circ < 0$

Q.14 If the 0.05 molar solution of M+ is replaced by a 0.0025 molar M^+ solution, the magnitude of the cell potential would be

(1) 35 mV (2) 70 mV

(3) 140 mV (4) 700 mV

Q.15 Consider the following cell reaction. **[JEE-2011]**

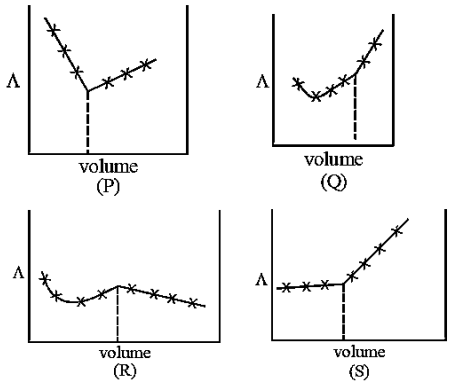
$2Fe(s) + O_2(g) + 4H^+(aq) \rightarrow 2Fe^{2+}(aq) + 2H_2O(l)$

$E^\circ = 1.67$ V

At $[Fe^{2+}] = 10^{-3}$ M, $P(O_2) = 0.1$ atm and pH = 3, the cell potential at 25°C is:

(1) 1.47 V (2) 1.77 V (3) 1.87 V (4) 1.57 V

Q.16 $AgNO_3$(aq.) was added to an aqueous KCl solution gradually and the conductivity of the solution was measured. The plot of conductance (Λ) versus the volume of $AgNO_3$ is: **[JEE-2011]**



(1) P (2) Q (3) R (4) S

Paragraph for Question No. 17 and 18

The electrochemical cell shown below is a concentration cell.

$M|M^{2+}$ (saturated solution of a sparingly soluble salt, MX_2) || M^{2+} (0.01 mol dm^{-3})| M.

The emf of the cell depends on the difference in concentrations of M^{2+} ions at the two electrodes. The emf of the cell at 298 K is 0.059 V. **[JEE Advance-2012]**

Q.17 The solubility product (K_{sp}; $mol^3\ dm^{-9}$) of MX_2 at 298 K based on the information available for the given concentration cell is (take $2.303 \times R \times 298/F = 0.059$ V)

(1) 1×10^{-15} (2) 4×10^{-15}

(3) 1×10^{-12} (4) 4×10^{-12}

Q.18 The value of ΔG (kJ mol^{-1}) for the given cell is

(Take 1 F = 96500 C mol^{-1})

(1) –5.7 (2) 5.7 (3) 11.4 (4) –11.4

Q.19 An aqueous solution of X is added slowly to an aqueous solutions of Y as in List I. The variation in conductivity of these reactions is given in List II. Match List I with List II and select the correct answer using code given below the lists: **[JEE Advance-2013]**

	List-I		List-II
P.	$\underset{X}{(C_2H_5)_3N} + \underset{Y}{CH_3COOH}$	1.	Conductivity decreases and then increases
Q.	$\underset{X}{KI(0.1M)} + \underset{Y}{AgNO_3(0.01M)}$	2.	Conductivity decreases and then does not change Much
R.	$\underset{X}{CH_3COOH} + \underset{Y}{KOH}$	3.	Conductivity increases and then does not change Much
S.	$\underset{X}{NaOH} + \underset{Y}{HI}$	4.	Conductivity does not change much and then increases

	P	Q	R	S		P	Q	R	S
(1)	3	4	2	1	(2)	4	3	1	2
(3)	4	3	2	1	(4)	2	1	3	4

Q.20 In a galvanic cell, the salt bridge

[JEE Advance 2014]

(1) Does not participate chemically in the cell reaction.

(2) Stops the diffusion of ions from one electrode to another.

(3) Is necessary for the occurrence of the cell reaction.

(4) Ensures mixing of the two electrolytic solutions.

Q.21 All the energy released from the reaction $X \rightarrow Y$, $\Delta_r G^\circ = -193$ kJ mol^{-1} is used for oxidizing M^+ as $M^+ \rightarrow M^{3+} + 2e^-$, $E^\circ = -0.25$ V.

Under standard conditions, the number of moles of M^+ oxidized when one mole of X is converted to Y is [F = 96500 C mol^{-1}]

[JEE Advance 2015]

Q.22 For the following electrochemical cell at 298 K,

$Pt(s)|H_2(g, 1 bar)|H^+(aq, 1 M)||M^{4+}(aq), M^{2+}(aq)|Pt(s)$

$E_{cell} = 0.092$ V when $\frac{[M^{2+}(aq)]}{[M^{4+}(aq)]} = 10^x$

Given: $E^\circ_{M^{4+}/M^{2+}} = 0.151$ V; $2.303\frac{RT}{F} = 0.059$ V

the value of x is **[JEE Advance 2016]**

(1) –2 (2) –1 (3) 1 (4) 2

Q.23 The conductance of a 0.0015 M aqueous solution of a weak monobasic acid was determined by using a conductivity cell consisting of platinized Pt electrodes. The distance between the electrodes is 120 cm with an area of cross section of 1 cm^2. The conductance of this solution was found to be 5×10^{-7} S. The pH of the solution is 4. The value of limiting molar conductivity $\left(\Lambda_m^\circ\right)$ of this weak monobasic acid is aqueous solution is Z × 10^2 S cm^{-1}. The value of Z is:

[JEE Advance 2017]

Q.24 The correct option(s) to distinguish nitrate salts of Mn^{2+} and Cu^{2+} taken Separately is (are): –

[JEE Advance 2018]

(1) Mn^{2+} shows the characteristics green colour in the flame test

(2) Only Cu^{2+} show the formation of precipitate by passing H_2S in acidic medium

(3) Only Mn^{2+} shows the formation of precipitate by passing H_2S in faintly basic medium

(4) $Cu^{2+}|Cu$ has higher reduction potential than $Mn^{2+}|Mn$ (measured under similar conditions)

Q.25 Consider an electrochemical cell: $A(s)|A^{n+}(aq, 2 M)||B^{2n+}(aq, 1 M)|B(s)$. The value of ΔH° for the cell reaction is twice that of ΔG° at 300 K. If the emf of the cell is zero, the ΔS° (in JK^{-1} mol^{-1}) of the cell reaction per mole of B formed at 300 K is _____.

(Given: ln (2) = 0.7, R (Universal gas constant) = 8.3 J K^{-1}. H, S and G are enthalpy, entropy and Gibbs energy, respectively).

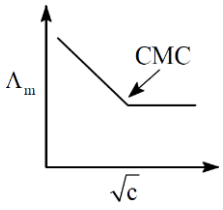
[JEE Advance 2018]

Q.26 Molar conductivity $\left(\Lambda_m\right)$ of aqueous solution of sodium stearate, which behaves as a electrolyte, is recorded at varying concentrations (c) of sodium stearate. Which one of the following plots provides the correct representation of micelle formation in the solution?

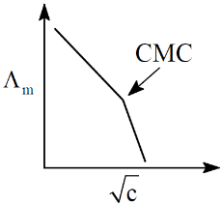
(Critical micelle concentration (CMC) is marked with an arrow in the figure)

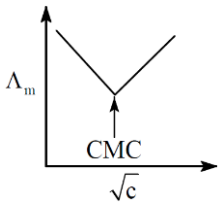
[JEE Advance 2019]

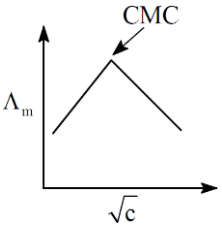
(1)



(2)



(3) 

(4) 

Q.27 Consider a 70% efficient hydrogen-oxygen fuel cell working under standard conditions at 1 bar and 298 K. Its cell reaction is

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$$

The work derived from the cell on the consumption of 1.0×10^{-3} mol of $H_2(g)$ is used to compress 1.00 mol of a monoatomic ideal gas in a thermally insulted container. What is the change in the temperature (in K) of the ideal gas?

The standard reduction potentials for the two half-cell are given below.

$O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O(l)$, $E° = 1.23$ V,

$2H^+(aq) + 2e^- \rightarrow H_2(g)$, $E° = 0.00$ V

Use $F = 96500$ C mol^{-1}, $R = 8.314$ J mol^{-1} K^{-1}.

[JEE Advance 2020]

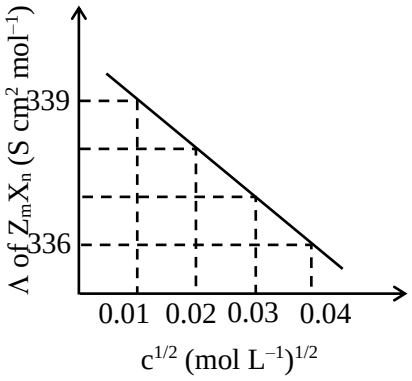
Q.28 Consider the strong electrolytes Z_m, X_n, U_mY_p and V_mX_n. Limiting molar conductivity $(\Lambda°)$ of U_mY_p and V_mX_n are 250 and 440 S cm^2 mol^{-1}, respectively. The value of (m + n + p) is _____.

Given:

Ion	Z^{n+1}	U^{p+}	V^{n+}	X^{m-}	Y^{m-}
$\lambda°$ (S cm^2 mol^{-1})	50.0	25.0	100.0	80.0	100.0

$\lambda°$ is the limiting molar conductivity of ions.

The plot of molar conductivity (Λ) of Z_mX_n vs $c^{1/2}$ is given below. **[JEE Advance 2022]**



Q.29 The reduction potential (E°, in V) of MnO_4^-(aq)/Mn(s) is **[JEE Advance 2022]**

[Given: $E°_{(MnO_4^-(aq)/MnO_2(s))} = 1.687$;

$E°_{(MnO_2(s)/Mn^{2+}(aq))} = 1.21$ V; $E°_{(Mn^{2+}(aq)/Mn(s))} = 1.03$ V]

Q.30 Plotting $1/\Lambda_m$ against $c\Lambda_m$ for aqueous solutions of a monobasic weak acid (HX) resulted in a straight line with y-axis intercept of P and slope of S. The ratio P/S is

[Λ_m = molar conductivity, Λ^o_m = limiting molar conductivity, c = molar concentration, K_a = dissociation constant of HX]

[JEE Advance 2023]

(1) $K_a\Lambda^o_m$ (2) $K_a\Lambda^o_m/2$

(3) $2K_a\Lambda^o_m$ (4) $1/(K_a\Lambda^o_m)$

ANSWER KEY

JEE-FLASHBACK

JEE-MAIN QUESTIONS

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	2	1	1	4	1	3	3	2	4	2	1	1	4	2	4
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	1	2	3	3	3	4	2.15	189494	3	4	1380	147	5	266	23
Que.	31	32	33	34	35	36	37	38	39	40					
Ans.	1	20	3	983	14	3	66	2	2	17					

JEE-ADVANCE QUESTIONS

Que.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ans.	1	3	2	2	55	2	4	4	2	1,2,4	1,2	2	3	4	4
Que.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Ans.	2	4	1	1	4	4	6	2,4	11.62	2	13.32	7	0.77	1	

Q.1 1.47×10^{-5}