SOME PREVIOUS YEAR SOLVED EXAMPLES

1. Find the solubility product of a saturated solution of Ag_2CrO_4 in water at 298 K if the emf of the cell $Ag|Ag^+$ (satd.Ag_2 CrO_4 soln.) || Ag^+(0.1 M) | Ag is 0.164 V at 298K. **[JEE 1998]**

1. Ans.(K_{sp} = 2.287 × 10^{-12})

Sol. $Ag|Ag^+$ sat. sol^n || Ag^+ (0.1 M)| Ag

$AgClO_4$)

$$0.164 = 0 - \frac{.059}{1}\log\frac{[Ag^+]A}{0.1}$$

$\therefore [Ag^+]_A = (1.66 \times 10^{-4}) \times (.83 \times 10^{-4})$

$= 2.287 \times 10^{-12}$

2. Calculate the equilibrium constant for the reaction, $2Fe^{3+} + 3I^- \rightleftharpoons 2Fe^{2+} + I_3^-$. The standard reduction potentials in acidic conditions are 0.77 and 0.54 V respectively for Fe^{3+} | Fe^{2+} and I_3^- | I^- couples. **[JEE 1998]**

2. Ans. (K_C = 6.26 × 10^7)

Sol. $2Fe^{+3} + 3I^- \rightleftharpoons 2Fe^{2+} + I_3^-$

$$E° = 0.77 + (-.54) = 0.23,\ \ Keq = 10^{\frac{2\times.23}{.059}}$$

$Keq = 6.26 \times 10^7$

3. A gas X at 1 atm is bubbled through a solution containing a mixture of 1 M Y and 1 M Z at 25°C. If the reduction potential of Z > Y > X, then **[JEE 1999]**

(A) Y will oxidise X and not Z
(B) Y will oxidise Z and X
(C) Y will oxidise both X and Z
(D) Y will reduce both X and Z.

3. Ans. (A)

4. The following electrochemical cell has been set up

$$Pt_{(I)} \mid Fe^{3+}, Fe^{2+}(a=1) \parallel Ce^{4+}, Ce^{3+}(a=1) \mid Pt_{(II)}$$

$$E^\circ_{Fe^{3+}/Fe^{2+}} = 0.77\ V \text{ and } E^\circ_{Ce^{4+}/Ce^{3+}} = 1.61\ V$$

If an ammetter is connected between the two platinum electrodes. predict the direction of flow of current. Will the current increase or decrease with time? **[JEE 2000]**

4. Ans. (decrease with time)

Sol. $E°_{cell}$ is (+) ve so cell will work and current will flow from cathode to anode. Current will decrease with time

5. Copper sulphate solution (250 mL) was electrolysed using a platinum anode and a copper cathode. A constant current of 2 mA was passed for 16 mintue. It was found that after electrolysis, the absorbance (concentration) of the solution was reduced to 50% of its original value. Calculate the concentration of copper sulphate in the solution to begin with. **[JEE 2000]**

5. Ans.(7.95 × 10^{-5}M)

Sol. $\left(n_{Cu^{+2}}\right)_{reduced} = \frac{2\times10^{-3}\times16\times60}{96500\times2} = \frac{.96}{96500}$

$(n_{Cu^{+2}})_{originally\,present} = \frac{1.92}{96500}$

$\therefore\ M = \frac{1.92}{96500}\times\frac{1000}{250} = 7.958\times10^{-5}$

$E°_{cell} = -.77 + 1.61 = 0.84$

6. For the electrochemical cell, $M \mid M^{+} \parallel X^{-} \mid X$, $E°(M^{+}|M) = 0.44$ V and $E°(X|X^{-}) = 0.33$V. From this data , one can deduce that **[JEE 2000]**

(A) $M + X \longrightarrow M^{+} + X^{-}$ is the spontaneous reaction

(B) $M^{+} + X^{-} \longrightarrow M + X$ is the spontaneous reaction

(C) $E_{cell} = 0.77$ V

(D) $E_{cell} = -0.77$ V

6. Ans.(B)

Sol. $E°_{cell} = E^{0}_{MM^{+}} + E°_{M/M^{+}} + E°_{X^{-}/X} = -.44 + -.33 = -0.77$ V

so (B)

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

$Pt \mid H_2(g) \mid HCl\,(aq) \mid AgCl(s) \mid Ag(s)$

(i) Write the cell reaction.

(ii) Calculate ΔH^0 ,ΔS^0 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 25°C. **[JEE 2001]**

7. Ans.$\Delta H^0 = -49987\ Jmol^{-1}$, $\Delta S^0 = -96.5\ J\ mol^{-1}\ K^{-1}$, $s = 1.47\times10^{-5}$ M

Sol. (i) Anode : $\frac{1}{2}H_2 \longrightarrow H^{+} + e^{-}$

Cathode : $\frac{AgCl + e^{-} \longrightarrow Ag + Cl^{-}}{\frac{1}{2}H_2 + AgCl \longrightarrow H^{+} + Cl^{-} + Ag}$

(ii) $\frac{\partial E}{\partial T} = \frac{.21-.23}{308-288} = \frac{.02}{10} = -2\times10^{-3}$

$\Delta G° = -nFE°$ so $(\Delta G°)_{288K} = -22195$ $(\Delta G°)_{308K} = -20265$ J

now using $\Delta G° = \Delta H° - T\Delta S° \Rightarrow \Delta H° = -49987$ J, $\Delta S° = -96.5$ J

(iii) $E°_{25°C} = 0.22V$ $E°_{cell} = E°_{Cl^{-}/AgCl/Ag} = 0.22$

so $-.8 + 0.22 = \frac{0.59}{1}\log Ksp$

$\therefore$ $Ksp = 1.47\times10^{-10} \Rightarrow S = 1.21\times10^{-5}$

8. Saturated solution of KNO_3 is used to make salt bridge because

(A) velocity of K^+ is greater than that of NO_3^-

(B) velocity of NO_3^- is greater than that of K^+

(C) velocities of both K^+ and NO_3^- are nearly the same

(D) KNO_3 is highly soluble in water **[JEE 2001]**

8. Ans.(C)

Sol. Fact

9. The correct order of equivalent conductance at infinite dilution of LiCl, NaCl and KCl is

(A) LiCl > NaCl > KCl
(B) KCl > NaCl > LiCl[JEE 2001]
(C) NaCl > KCl > LiCl
(D) LiCl > KCl > NaCl

9. Ans.(B)

Sol. Fact

10. The reaction, **[JEE 2001]**

$3ClO^-(aq) \longrightarrow ClO_3^-(aq) + 2Cl^-(aq)$

is an example of

(A) Oxidation reaction
(B) Reduction reaction
(C) Disproportionation reaction
(D) Decomposition reaction

10. Ans.(C)

Sol Fact

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

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

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

$$Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}(aq);\ E° = 0.77\ V$$

$$Cl_2(g) + 2e^- \longrightarrow 2Cl^-(aq);\ E° = 1.40\ V$$

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

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

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

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

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

11. Ans.(A)

Sol. MnO_4^- will oxidise Cl^- into Cl_2 so MnO_4^- can not be used in aqueous HCl

12. Two students use same stock solution of $ZnSO_4$ and a solution of $CuSO_4$. The e.m.f of one cell is 0.03 V higher than the other. The conc. of $CuSO_4$ in the cell with higher e.m.f value is 0.5 M. Find out the conc. of $CuSO_4$ in the other cell $\left(\frac{2.303\,RT}{F} = 0.06\right)$. **[JEE 2003]**

12. Ans.(0.05)

Sol. $E_1 = E^\circ - \log \frac{[Zn^{+2}]}{[Cu^{+2}]_1}$

$E_2 = E^\circ - \log \frac{[Zn^{+2}]}{[Cu^{+2}]_2}$

$E_2 - E_1 = -\,.03 \log \frac{[Cu^{+2}]_1}{[Cu^{+2}]_2} \Rightarrow 0.03 = -\frac{.059}{2} \log \frac{[Cu^{+2}]}{5}$

$\therefore\ 0.03 = -\,03 \log \frac{[Cu^{+2}]}{5} \Rightarrow [Cu^{+2}] = .05\ M$

13. In the electrolytic cell, flow of electrons is from:

(A) Cathode to anode in solution

(B) Cathode to anode through external supply

(C) Cathode to anode through internal supply

(D) Anode to cathode through internal supply. **[JEE 2003]**

13. Ans.(C)

14. Find the equilibrium constant at 298 K for the reaction,

$$Cu^{2+}(aq) + In^{2+}(aq) \rightleftharpoons Cu^{+}(aq) + In^{3+}(aq)$$

Given that $E^\circ_{Cu^{2+}|Cu^{+}} = 0.15V$, $E^\circ_{In^{3+}|In^{+}} = -0.42V$, $E^\circ_{In^{2+}|In^{+}} = -0.40V$ **[JEE 2004]**

14. Ans.(K_C = 10^{10})

Sol. $E^\circ_{Cell} = E^\circ_{In^{+2}/In^{+3}} + E^\circ_{Cu^{+2}/Cu^{+}}$

$= .44 + .15 = .59$

$E^\circ_{In^{+2}/In^{+3}} = \frac{1\alpha - 0.4 + 2\alpha 0.42}{1} = .44$

$K_{eq} = 10^{\frac{1\times .59}{.059}} = 10^{10}$

15. Zn | Zn^{2+} (a = 0.1M) || Fe^{2+} (a = 0.01M)|Fe. The emf of the above cell is 0.2905 V. Equilibrium constant for the cell reaction is

(A) $10^{0.32|0.0591}$ (B) $10^{0.32|0.0295}$ (C) $10^{0.26|0.0295}$ (D) $e^{0.32|0.295}$ **[JEE 2004]**

15. Ans.(B)

Sol. $0.2905 = E^\circ - \frac{.059}{2} \log \frac{.1}{0.01} \Rightarrow E^\circ = .32$

$\therefore\ K_{sp} = 10^{\frac{2\times .32}{0.0591}} = 10^{\frac{.32}{0.0295}} \Rightarrow B$

16. (a) Calculate ΔG_f^0 of the following rection

$$Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$$

Given : ΔG_f^0 (AgCl) =–109 kJ|mole, ΔG_f^0 (Cl^-) =–129 kJ|mole, ΔG_f^0 (Ag^+) = 77 kJ|mole

Represent the above reaction in form of a cell

Calculate E^0 of the cell. Find $\log_{10}K_{SP}$ of AgCl

(b) 6.539×10^{-2} g of metallic Zn (amu = 65.39) was added to 100 ml of saturated solution of AgCl.

Calculate $\log_{10}\frac{[Zn^{2+}]}{[Ag^+]^2}$, given that

$Ag^+ + e^- \longrightarrow Ag \quad E^0 = 0.80$ V ; $Zn^{2+} + 2e^- \longrightarrow Zn \quad E^0 = -0.76$V

Also find how many moles of Ag will be formed? **[JEE 2005]**

16. Ans. (a) E^0 = 0.59 V, $\log_{10}K_{SP}$ = –10 (b) 52.8, 10^{-6} moles

Sol. (a) $\Delta G° = (-109) - [-129 + 77] = -57$

$$E° = \frac{-57 \times 1000}{1 \times 96500} = 0.59$$

$$\Delta G° = -2.303RT \log K_{sp} \Rightarrow \log K_{sp} = \frac{-57 \times 1000}{-2.303 \times 8.314 \times 298}$$

$$\log K_{sp} = 9.989 \cong 10$$

(b) $Zn + 2Ag^+ \longrightarrow Zn^{+2} + 2Ag \quad E°_{cell} = 1.56$

$$\therefore \log_{10}\frac{[Zn^{+2}]}{[Ag^+]^2} = \frac{1.56 \times 2}{.059} = 52.8$$

$$[Ag^+] = \sqrt{Ksp} = \sqrt{10^{-10}} = 10^{-5}$$

$$\therefore n_{Ag^+} = 10^{-5} \times .1 = 10^{-6}$$

17. The half cell reactions for rusting of iron are: **[JEE 2005]**

$2H^+ + \frac{1}{2}O_2 + 2e^- \longrightarrow H_2O$; E^0 = + 1.23 V, $Fe^{2+} + 2e^- \longrightarrow Fe$; E^0 = –0.44 V

ΔG^0 (in kJ) for the reaction is:

(A) –76 (B) –322 (C) –122 (D) –176

17. Ans.(B)

Sol. $\Delta G° = -nFE°$

$$= \frac{-2 \times 96500 \times 1.67}{1000} - 322$$

18. We have taken a saturated solution of AgBr.K_{sp} of AgBr is 12×10^{-14}. If 10^{-7} mole 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 : $\lambda^0_{(Ag^+)} = 6 \times 10^{-3}$ **S m² mol⁻¹** ; $\lambda^0_{(Br^-)} = 8 \times 10^{-3}$ **S m² mol⁻¹** ; $\lambda^0_{(NO_3^-)} = 7 \times 10^{-3}$ **S m² mol⁻¹**

18. Ans.(55 S m⁻¹)

Sol. $AgBr \rightleftharpoons Ag^+ + Br^-$

$\qquad\qquad s \quad s$

$AgNO_3 \longrightarrow Ag^+ + NO_3^-$

$\qquad\qquad 10^{-7} \quad 10^{-7}$

$\therefore (K_{sp})_{AgBr} = [Ag^+][Br^-] \Rightarrow 12 \times 10^{-14} = (s + 10^{-7})\cdot(s)$

$s^2 + 10^{-7} s - 12 \times 10^{-14} = 0 \Rightarrow s = 3 \times 10^{-7}$

$\therefore [Ag^+] = 4 \times 10^{-7}$ $[Br] = 3 \times 10^{-7}$ $[NO_3] = 10^{-7}$

now $\Lambda_M^\infty = \dfrac{1000\,k}{M}$

for $Ag^+ \Rightarrow 6 \times 10^{-3} \times 10^4 = \dfrac{1000k}{4 \times 10^{-7}} \Rightarrow k_{Ag^+} = 24$

$Br^- \Rightarrow 8 \times 10^{-3} \times 10^4 = \dfrac{1000k}{3 \times 10^{-7}} \Rightarrow k_{Br^-} = 24$

$NO_3^- \Rightarrow 7 \times 10^{-3} \times 10^4 = \dfrac{1000\,k}{10^{-7}} \Rightarrow R_{NO_3^-} = 7$

Ans. 55

Question No. 19 to 21 (3 questions)

Tollen's reagent is used for the detection of aldehyde when a solution of $AgNO_3$ is added to glucose with NH_4OH then gluconic acid is formed

$Ag^+ + e^- \longrightarrow Ag$; $E^0_{red} = 0.8$ V

$C_6H_{12}O_6 + H_2O \longrightarrow C_6H_{12}O_7$ (Gluconic acid) $+ 2H^+ + 2e^-$; $E^0_{red} = -0.05$ V

$Ag(NH_3)_2^+ + e^- \longrightarrow Ag(s) + 2NH_3$; $E^0 = -0.337$ V

[Use $2.303 \times \dfrac{RT}{F} = 0.0592$ and $\dfrac{F}{RT} = 38.92$ at 298 K] **[JEE 2006]**

19. $2Ag^+ + C_6H_{12}O_6 + H_2O \longrightarrow 2Ag(s) + C_6H_{12}O_7 + 2H^+$

Find ln K of this reaction

(A) 66.13 (B) 58.38 (C) 28.30 (D) 46.29

19. Ans.(A)

Sol. $\log K = \dfrac{2.303 \times n \times E°}{.059} = \dfrac{2.303 \times 2 \times .85}{.059} = 66.13$

20. When ammonia is added to the solution, pH is raised to 11. Which half-cell reaction is affected by pH and by how much?

(A) E_{oxd} will increase by a factor of 0.65 from E^0_{oxd}

(B) E_{oxd} will decrease by a factor of 0.65 from E^0_{oxd}

(C) E_{red} will increase by a factor of 0.65 from E^0_{red}

(D) E_{red} will decrease by a factor of 0.65 from E^0_{red}

20. Ans.(A)

Sol. Since H^+ is involved in oxidation half reaction so E_{oxd} will be affected and it will increase

$$E_{oxd} = E°_{oxd} - \frac{.059}{2}\log\frac{[C_6H_{12}O_7][H^+]^2}{[C_2H_{12}O_6]}$$

21. Ammonia is always is added in this reaction. Which of the following must be incorrect?

(A) NH_3 combines with Ag^+ to form a complex.

(B) $Ag(NH_3)_2^+$ is a weaker oxidising reagent than Ag^+.

(C) In absence of NH_3 silver salt of gluconic acid is formed.

(D) NH_3 has affected the standard reduction potential of glucose|gluconic acid electrode.

21. Ans.(D)

Sol. **$E°_{Red}$ in a constant quantity**

Paragraph for Question Nos. 22 to 24 (3 questions)

Chemical reactions involve interaction of atoms and molecules. A large 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]**

22. The total number of moles of chlorine gas evolved is

(A) 0.5 (B) 1.0 (C) 2.0 (D) 3.0

22. Ans.(B)

Sol. At anode $2Cl^- \longrightarrow Cl_2 + 2e^-$

$$\begin{array}{cc} 2 & 1 \end{array}$$

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

(A) 200 (B) 225 (C) 400 (D) 446

23. Ans.(D)

Sol. At cathode $2Na^+ + 2e^- \longrightarrow 2Na(s)$

$$\begin{array}{cc} 2 & 2 \end{array}$$

$$2Na + 2Hg \longrightarrow 2Na\text{–}Hg$$

$$\begin{array}{ccc} 2 & 2 & \therefore W = 446 \end{array}$$

24. The total charge (coulombs) required for complete electrolysis is
(A) 24125 (B) 48250 (C) 96500 (D) 193000

24. Ans.(D)

Sol. 2 moles on e^- = 2F = 193000 C

Paragraph for Question Nos. 25 & 26 (2 questions)

Redox reactions play a pivoted role in chemistry and biology. The values of standard redox potential (E°) of two half-cell reactions decide which way the reaction is expected to proceed. A simple example is a Daniel cell in which zinc goes into solution and copper gets deposited. Given below are a set of half-cell reactions (acidic medium) along with their E° (V with respect to normal hydrogen electrode) values. Using this data obtain the correct explanations to Questions 14-16.

$I_2 + 2e^- \rightarrow 2I^-$ $E^\circ = 0.54$

$Cl_2 + 2e^- \rightarrow 2Cl^-$ $E^\circ = 1.36$

$Mn^{3+} + e^- \rightarrow Mn^{2+}$ $E^\circ = 1.50$

$Fe^{3+} + e^- \rightarrow Fe^{2+}$ $E^\circ = 0.77$

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ $E^\circ = 1.23$ **[JEE 2007]**

25. Among the following, identify the correct statement.

(A) Chloride ion is oxidised by O_2 (B) Fe^{2+} is oxidised by iodine

(C) Iodine ion is oxidised by chlorine (D) Mn^{2+} is oxidised by chlorine

25. Ans.(C)

Sol. as E° will be positive

26. While Fe^{3+} is stable, Mn^{3+} is not stable in acid solution because

(A) O_2 oxidises Mn^{2+} to Mn^{3+}

(B) O_2 oxidises both Mn^{2+} to Mn^{3+} and Fe^{2+} to Fe^{3+}

(C) Fe^{3+} oxidises H_2O to O_2

(D) Mn^{3+} oxidises H_2O to O_2

26. Ans.(D)

Sol. as E° will be positive

27. 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

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

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

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

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

The pair(s) of metal that is(are) oxidised by NO_3^- in aqueous solution is(are) **[JEE 2009]**

(A) V and Hg (B) Hg and Fe

(C) Fe and Au (D) Fe and V

27. Ans.(A,B,D)

Sol. (A,B,D) as E° will be positive

Paragraph for Questions 28 to 29

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 : **[JEE 2010]**

$M(s)|M^+(aq ; 0.05 \text{ molar}) || M^+(aq ; 1 \text{ molar})|M(s)$

For the above electrolytic cell the magnitude of the cell potential $|E_{cell}| = 70$ mV.

28. For the above cell :-

(A) $E_{cell} < 0 ; \Delta G > 0$ (B) $E_{cell} > 0 ; \Delta G < 0$

(C) $E_{cell} < 0 ; \Delta G^0 > 0$ (D) $E_{cell} > 0 ; \Delta G^0 < 0$

28. Ans.(B)

Sol. $E_1 = -\frac{.059}{1}\log\frac{.05}{1} = (+)\text{ve} \Rightarrow \text{so}$

29. If the 0.05 molar solution of M^+ is replaced by a 0.0025 molar M^+ solution, then the magnitude of the cell potential would be :-

(A) 35 mV (B) 70 mV (C) 140 mV (D) 700 mV

29. Ans.(C)

Sol. $E_2 = -\frac{.059}{1}\log\frac{0.0025}{1}$

$= 2 \times El = 140 \text{ mV} \Rightarrow \text{so}$

EXERCISE # (S-I)

Note : If not given in question Use : $\frac{2.303RT}{F} = 0.059$

Electrode potential cell emf.

1. Write cell reaction of the following cells :

(a) $Ag \mid Ag^+ (aq) \mid\mid Cu^{2+} (aq) \mid Cu$ (b) $Pt \mid Fe^{2+}, Fe^{3+} \mid\mid MnO_4^-, Mn^{2+}, H^+ \mid Pt$

(c) $Pt, Cl_2 \mid Cl^- (aq) \mid\mid Ag^+ (aq) \mid Ag$ (d) $Pt, H_2 \mid H^+ (aq) \mid\mid Cd^{2+} (aq) \mid Cd$

EC0001

2. Write cell representation for following cells.

(a) $Cd^{2+} (aq) + Zn (s) \longrightarrow Zn^{2+} (aq) + Cd (s)$

(b) $2Ag^+ (aq) + H_2 (g) \longrightarrow 2H^+ (aq) + 2Ag (s)$

(c) $Cr_2O_7^{2-} (a) + 14H^+ (aq) + 6Fe^{2+} (aq) \longrightarrow 6Fe^{3+} (aq) + 2Cr^{3+} (aq) + 7H_2O (l)$

EC0002

3. For the cell reaction $2Ce^{4+} + Co \longrightarrow 2Ce^{3+} + Co^{2+}$

E^o_{cell} is 1.89 V. If $E^o_{Co^{2+}|Co}$ is – 0.28 V, what is the value of $E^o_{Ce^{4+}|Ce^{3+}}$?

EC0003

4. Determine the standard reduction potential for the half reaction :

$Cl_2 + 2e^- \longrightarrow 2Cl^-$

Given $Pt^{2+} + 2Cl^- \longrightarrow Pt + Cl_2$, $E^o_{Cell} = -0.15$ V

$Pt^{2+} + 2e^- \longrightarrow Pt$ $E° = 1.20$ V

EC0193

5. If $E^o_{Fe^{2+}|Fe} = -0.44$ V, $E^o_{Fe^{3+}|Fe^{2+}} = 0.77$ V. Calculate $E^o_{Fe^{3+}|Fe}$.

EC0005

6. If for the half cell reactions

$Cu^{2+} + e^- \longrightarrow Cu^+$ $E° = 0.15$ V

$Cu^{2+} + 2e^- \longrightarrow Cu$ $E° = 0.34$ V

Calculate E° of the half cell reaction

$Cu^+ + e^- \longrightarrow Cu$

also predict whether Cu^+ undergoes disproportionation or not.

EC0004

7. The reduction potential of hydrogen electrode when placed in a buffer solution is found to be – 0.413V. The pH of the buffer is -

EC0014

8. Calculate the EMF of a Daniel cell when the concentration of $ZnSO_4$ and $CuSO_4$ are 0.001 M and 0.1M respectively. The standard potential of the cell is 1.1V.

EC0006

9. Calculate E^0 and E for the cell $Sn \mid Sn^{2+} (1M) \mid\mid Pb^{2+}(10^{-3}M) \mid Pb$, $E^0 (Sn^{2+}| Sn) = -0.14V$, $E^0 (Pb^{2+}| Pb) = -0.13V$. Is cell representation is correct?

EC0007

10. At what concentration of Cu^{2+} in a solution of $CuSO_4$ will the electrode potential be zero at 25°C? Given : $E^0 (Cu \mid Cu^{2+}) = -0.34$ V. $[10^{-11.525} = 2.99 \times 10^{-12}]$

EC0008

11. Is 1.0 M H^+ solution under H_2SO_4 at 1.0 atm capable of oxidising silver metal in the presence of 1.0 M Ag^+ ion? $E^o_{Ag^+|Ag} = 0.80$ V, $E^o_{H^+|H_2(Pt)} = 0.0$ V **EC0194**

12. For a cell Mg(s) | Mg^{2+}(aq) || Ag^+ (aq) | Ag,
(i) Calculate the equilibrium constant at 25°C.
(ii) Also find the maximum work per mole Mg that can be obtained by operating the cell in standard condition.
$E^0_{(Mg^{2+}|Mg)} = -2.3565$V, $E^0_{(Ag+|Ag)} = 0.8$ V.
EC0195

13. The pK_{sp} of AgI is 16.07 . If the E° value for Ag^+| Ag is 0.7991 V . Find the E° for the half cell reaction $AgI(s) + e^- \longrightarrow Ag + I^-$. [16.07 × 0.059 = 0.94813]
EC0009

14. A zinc electrode is placed in a 0.1M solution at 25°C. Assuming that the salt (ZnX) is 20% dissociated at this dilutions calculate the electrode reduction potential. E^0 (Zn^{2+}| Zn) = –0.76V.
EC0010

EQUILIBRIUM CONSTANT

15. Calculate the equilibrium constant for the reaction : [$10^{12.88} = 7.585 \times 10^{12}$]
$Fe^{2+} + Ce^{4+} \rightleftharpoons Fe^{3+} + Ce^{3+}$, [Given : $E^0_{Ce^{4+}|Ce^{3+}} = 1.44$ V; $E^0_{Fe^{3+}|Fe^{2+}} = 0.68$ V]
EC0011

16. Calculate the equilibrium constant for the reaction $Fe + CuSO_4 \rightleftharpoons FeSO_4 + Cu$ at 25°C.
Given E^0 (Fe|Fe^{2+}) = 0.44V, E^0 (Cu|Cu^{2+}) = –0.337V. [$10^{26.3389} = 2.18 \times 10^{26}$]
EC0196

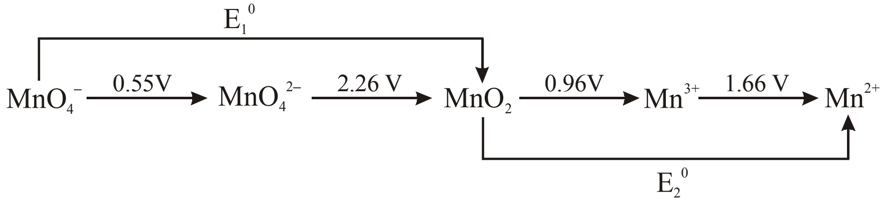
17. At 25^0C the value of K for the equilibrium $Fe^{3+} + Ag \rightleftharpoons Fe^{2+} + Ag^+$ is 0.531mol|litre. The standard electrode potential for $Ag^+ + e^- \rightleftharpoons Ag$ is 0.799V. What is the standard potential for $Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$? [log (0.531 = – 0.27)]
EC0197

18. The standard reduction potential at 25°C for the reduction of water
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$ is –0.8277 volt. Calculate the equilibrium constant for the reaction
$2H_2O \rightleftharpoons H_3O^+ + OH^-$ at 25°C. [193 × 0.8277 = 159.75] [2.303 RT = 5705.35 J/mol]
EC0198

19. For the reaction, $4Al(s) + 3O_2(g) + 6H_2O + 4\,OH^- \rightleftharpoons 4\,[Al(OH)_4^-]$; $E^\circ_{cell} = 2.73$ V.
If $\Delta G^\circ_f(OH^-) = -157$ kJ mol^{-1} and $\Delta G^\circ_f(H_2O) = -237.2$ kJ mol^{-1}, determine ΔG°_f [Al $(OH)_4^-$].
[96.5 × 2.73 = 263.445]
EC0199

20. For the cell reaction : $Hg_2Cl_2(s) + 2Ag(s) \rightarrow 2Hg\,(l) + 2AgCl(s)$
temperature coefficient of cell emf is found to be 0.02 VK^{-1}. Find Δ_rS^o for cell reaction in kJ mole^{-1}
EC0012

21. From the standard potential in acidic medium as shown in the following latimer diagram , the value of ($E_1^o + E_2^o$), in volts, is -



EC0013

CONCENTRATION CELLS :

22. Calculate the EMF of the following cell

$$Zn \mid Zn^{2+} (0.01M) \parallel Zn^{2+} (0.1\ M) \mid Zn$$

at 298 K.

EC0015

23. Calculate pH using the following cell :

$Pt (H_2) \mid H^+ (x\ M) \mid\mid H^+ (1\ M) \mid Pt (H_2)$ if $E_{cell} = 0.2364$ V.

1 atm 1 atm

EC0016

24. Equinormal Solutions of two weak acids, HA ($pK_a = 3$) and HB ($pK_a = 5$) are each placed in contact with equal pressure of hydrogen electrode at 25°C. When a cell is constructed by interconnecting them through a salt bridge, find the emf of the cell.

EC0200

25. In two vessels each containing 500ml water, 0.5m mol of aniline ($K_b = 10^{-9}$) and 50mmol of HCl are added separately. Two hydrogen electrodes are constructed using these solutions. Calculate the emf of cell made by connecting them appropriately.

EC0201

ELECTROLYTIC CELL :

26. Calculate the no. of electrons lost or gained during electrolysis of

(a) 3.55 gm of Cl^- ions (b) 1 gm Cu^{2+} ions (c) 2.7 gm of Al^{3+} ions

EC0017

27. How many faradays of electricity are involved in each of the case

(a) 0.25 mole Al^{3+} is converted to Al.

(b) 27.6 gm of SO_3 is convered to SO_3^{2-}

(c) The Cu^{2+} in 1100 ml of 0.5 M Cu^{2+} is converted to Cu.

EC0018

28. 0.5 mole of electron is passed through two electrolytic cells in series. One contains silver ions, and the other zinc ions. Assume that only cathode reaction in each cell is the reduction of the ion to the metal. How many gm of each metals will be deposited. **[At weight Zn = 65, Ag = 108]**

EC0019

29. If 0.224 litre of H_2 gas is formed at the cathode, how much O_2 gas is formed at the anode under identical conditions?

EC0022

30. Chromium metal can be plated out from an acidic solution containing CrO_3 according to following equation :

$CrO_3(aq) + 6H^+ (aq) + 6e^- \rightarrow Cr(s) + 3H_2O$

Calculate :

(i) How many grams of chromium will be plated out by 24125 coulombs and

(ii) How long will it take to plate out 1.5 gm of chromium by using 12.5 ampere current

EC0202

31. The electrosynthesis of MnO_2 is carried out from a solution of $MnSO_4$ in H_2SO_4 (aq). If a current of 25.5 ampere is used with a current efficiency of 85%, how long would it take to produce 1 kg of MnO_2?

$$\left[\frac{965}{87 \times 25.5 \times 85} = 5.12 \times 10^{-3}\right]$$

EC0020

32. Calculate the quantity of electricity that would be required to reduce 12.3 g of nitrobenzene to aniline, if the current efficiency for the process is 50 percent. If the potential drop across the cell is 3.0 volts, how much energy will be consumed? **EC0203**

33. A constant current of 30 A is passed through an aqueous solution of NaCl for a time of 1.0 hr. How many grams of NaOH are produced? What is volume of Cl_2 gas at 1atm,273K produced (in litre) ?
EC0021

34. Assume 96500 C as one unit of electricity. If cost of electricity of producing x gm Al is Rs x, what is the cost of electricity of producing x gm Mg?
EC0023

35. A metal is known to form fluoride MF_2. When 10A of electricity is passed through a molten salt for 330 sec., 1.95g of metal is deposited. Find the atomic weight of M. What will be the quantity of electricity required to deposit the same mass of Cu from $CuSO_4$?
$$\left[\frac{1.95\times 965}{63.5}=29.63, \frac{1.95\times 965}{33}=57\right]$$
EC0024

36. After electrolysis of NaCl solution with inert electrodes for a certain period of time. 600 mL of the solution was left. Which was found to be 1N in NaOH. During the same time, 31.75 g of Cu was deposited in the copper voltameter in series with the NaCl electrolytic cell. Calculate the percentage yield of NaOH obtained.
EC0204

37. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using a current of 5 ampere for 20 mintue. What mass of Ni is deposited at the cathode?
EC0025

38. A current of 3.7A is passed for 6hrs. between Ni electrodes in 0.5L of 2M solution of $Ni(NO_3)_2$. What will be the molarity of $Ni(NO_3)_2$ solution at the end of electrolysis?
EC0026

CONDUCTANCE

39. A solution containing 2.08 g of anhydrous barium chloride is 500 CC of water has a specific conductivity 0.005 $ohm^{-1}cm^{-1}$. What are molar and equivalent conductivities of this solution.
EC0031

Application of Kohlrausch's law

40. The resistance of a conductivity cell filled with 0.01N solution of NaCl is 200 ohm at18°C.Calculate the equivalent conductivity of the solution. The cell constant of the conductivity cell is 0.88 cm^{-1}.
EC0027

41. The molar conductivity of 0.1 M CH_3COOH solution is 4 S cm^2 $mole^{-1}$. What is the specific conductivity and resistivity of the solution ?
EC0028

42. The conductivity of pure water in a conductivity cell with electrodes of cross sectional area 4 cm^2 and 2 cm apart is 8×10^{-7} S cm^{-1}.
(i) What is resistance of conductivity cell ?
(ii) What current would flow through the cell under an applied potential difference of 1 volt?
EC0029

43. For 0.01N KCl, the resistivity 800 ohm cm. Calculate the conductivity and equivalent conductance.
EC0030

44. Specific conductance of a saturated solution of AgBr is 8.075×10^{-7} $ohm^{-1}cm^{-1}$ at 25^0C. Specific conductance of pure water at 25°C is 0.75×10^{-7} ohm^{-1} cm^{-2}. Λ_m^{∞} for KBr , $AgNO_3$ and KNO_3 are 140 , 130 , 110 (S cm^2 mol^{-1}) respectively. Calculate the solubility of AgBr in gm|litre.
EC0032

45. Equivalent conductance of 0.01 N Na_2SO_4 solution is 120 $ohm^{-1}\ cm^2\ eq^{-1}$. The equivalent conductance at infinite dilution is 150 $ohm^{-1}\ cm^2 eq^{-1}$. What is the degree of dissociation in 0.01 N Na_2SO_4 solution?
EC0205

46. Saturated solution of AgCl at 25°C has specific conductance of $1.12\times10^{-6}\ ohm^{-1}\ cm^{-1}$. The $\lambda_\infty(Ag^+)$ and $\lambda_\infty(Cl^-)$ are 54 and 58 $ohm^{-1}\ cm^2$ | equi. respectively. Calculate the solubility product of AgCl at 25°C.
EC0206

47. The value of Λ_m^∞ for HCl, NaCl and CH_3CO_2Na are 425, 125 and 100 S $cm^2\ mol^{-1}$ respectively. Calculate the value of Λ_m^∞ for acetic acid. If the equivalent conductivity of the given acetic acid is 48 at 25° C, calculate its degree of dissociation.
EC0034

48. For the strong electroytes NaOH, NaCl and $BaCl_2$ the molar ionic conductivities at infinite dilution are 240×10^{-4}, 125×10^{-4} and 280.0×10^{-4} mho $cm^2\ mol^{-1}$ respectively. Calculate the molar conductivity of $Ba(OH)_2$ at infinite dilution.
EC0035

49. Hydrofluoric acid is weak acid. At 25°C, the molar conductivity of 0.002M HF is 200 $ohm^{-1}\ cm^2\ mole^{-1}$. If its $\Lambda_m^\infty = 400\ ohm^{-1}\ cm^2\ mole^{-1}$, calculate its degree of dissociation and equilibrium constant at the given concentration.
EC0033

50. At 25°C, $\lambda_\infty(H^+) = 3.5\times10^{-2}\ S\ m^2\ mol^{-1}$ and $\lambda_\infty(OH^-) = 2\times10^{-2}\ S\ m^2 mol^{-1}$.
Given: Sp. conductnace = $5.5\times10^{-6}\ S\ m^{-1}$ for H_2O, determine pH and K_w.
EC0207

EXERCISE # S-II

1. Calculate the emf of the cell : [log (1.8) = 0.26]
   Pt, H_2(1.0 atm) | CH_3COOH (0.1M) || NH_3(aq, 0.01M) | H_2 (1.0 atm),
   Pt $K_a(CH_3COOH) = 1.8 \times 10^{-5}$, $K_b(NH_3) = 1.8 \times 10^{-5}$.

   EC0036

2. The Edison storage cell is represented as Fe(s) | FeO(s) | KOH(aq) | Ni_2O_3 (s) | NiO(s) The half–cell reaction are
   $Ni_2O_3(s) + H_2O(i) + 2e^- \rightleftharpoons 2NiO(s) + 2OH^-$, $E^0 = +0.40V$
   $FeO(s) + H_2O(l) + 2e^- \rightleftharpoons Fe(s) + 2OH^-$, $E^0 = -0.87V$
   (i) What is the cell reaction?
   (ii) What is the cell e.m.f.? How does it depend on the concentration of KOH?
   (iii) What is the maximum amount of electrical energy that can be obtained from one mole of Ni_2O_3?

   EC0037

3. The standard reduction potential for Cu^{2+} | Cu is 0.34 V. Calculate the reduction potential at pH = 14 for the above couple. K_{sp} of $Cu(OH)_2$ is 1×10^{-19}.

   EC0038

4. The emf of the cell Ag|AgI|KI(0.05M) || $AgNO_3$(0.05M) |Ag is 0.788V. Calculate the solubility product of AgI. [$10^{-0.788/0.059} = 4.4 \times 10^{-14}$]

   EC0039

5. Consider the cell Ag|AgBr(s)|Br^-||Cl^- | AgCl(s)| Ag at 25° C . The solubility product constants of AgBr & AgCl are respectively 5×10^{-13} & 1×10^{-10} . For what ratio of the concentrations of Br^- & Cl^- ions would the emf of the cell be zero ?

   EC0208

6. For the galvanic cell : Ag|AgCl(s)| KCl (0.2M) || K Br (0.001 M)| AgBr(s) | Ag,
   Calculate the EMF generated and assign correct polarity to each electrode for a spontaneous process after taking into account the cell reaction at 25^{0}C. [log (4.24) = 0.627]

   $$[K_{sp(AgCl)} = 2.8\times10^{-10}; K_{sp(AgBr)} = 3.3\times10^{-13}]$$

   EC0209

7. Given, E° = –0.268 V for the Cl^- | $PbCl_2$ | Pb couple and – 0.126 V for the Pb^{2+} | Pb couple, determine K_{sp} for $PbCl_2$ at 25°C ? [$10^{-0.284/0.059} = 1.54 \times 10^{-5}$]

   EC0210

8. Calculate the equilibrium constant for the reaction:
   $3Sn(s) + 2Cr_2O_7^{2-} + 28H^+ \longrightarrow 3Sn^{4+} + 4Cr^{3+} + 14H_2O$
   E^0 for Sn|Sn^{2+}=0.136 V E^0 for Sn^{2+}|Sn^{4+} = – 0.154 V
   E^0 for $Cr_2O_7^{2-}$|Cr^{3+} = 1.33 V

   $$\left[\frac{15.852}{0.059} \approx 268\right]$$

   EC0211

9. One of the methods of preparation of per disulphuric acid, $H_2S_2O_8$, involve electrolytic oxidation of H_2SO_4 at anode ($2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^+ + 2e^-$) with oxygen and hydrogen as by–products. In such an electrolysis, 2.27 L of H_2 and 0.5675 L of O_2 were generated at STP. What is the weight of $H_2S_2O_8$ formed?

   EC0040

10. A current of 3 amp was passed for 2 hour through a solution of $CuSO_4$,3 g of Cu^{2+} ions were deposited as Cu at cathode. Calculate percentage current efficiency of the process.

    EC0041

11. Dal lake has water 8.2×10^{12} litre approximately. A power reactor produces electricity at the rate of 1.5×10^6 coulomb per second at an appropriate voltage. How many years would it take to electrolyse the lake?

EC0212

12. The equivalent conductance of 0.10 N solution of $MgCl_2$ is 97.1 mho cm^2 equi^{-1} at 25°C. a cell with electrode that are 1.5 cm^2 in surface area and 0.5 cm apart is filled with 0.1 N $MgCl_2$ solution. How much current will flow when potential difference between the electrodes is 5 volt.

EC0042

13. When a solution of specific conductance 1.342 ohm^{-1} metre^{-1} was placed in a conductivity cell with parallel electrodes, the resistance was found to be 170.5 ohm. Area of electrodes is 1.86×10^{-4} m^2. Calculate separation of electrodes.

EC0043

14. The specific conductance at 25°C of a saturated solution of $SrSO_4$ is 1.482×10^{-4} ohm^{-1} cm^{-1}while that of water used is 1.5×10^{-6} mho cm^{-1}. Determine at 25°C the solubility in gm per litre of $SrSO_4$ in water. Molar ionic conductance of Sr^{2+} and SO_4^{2-} ions at infinite dilution are 59.46 and 79.8 ohm^{-1} cm^2 mole^{-1} respectively. **[Sr = 87.6 , S = 32 , O = 16]**

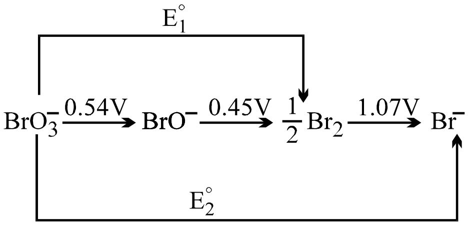
$$\left[\frac{1.467}{139.26} = 1.05 \times 10^{-2}\right]$$

EC0213

15. The EMF of the cell M | M^{n+} (0.02M) || H$^+$ (1M) | H_2(g) (1 atm), Pt at 25°C is 0.81V. Calculate the valency of the metal if the standard oxidation of the metal is 0.76V.

EC0214

16. From the standard potentials shown in the following diagram, calculate the potentials E_1° and E_2°.



EC0215

17. Calculate the EMF of the cell,

$$Zn - Hg(c_1M) \mid Zn^{2+}(aq) \mid Hg - Zn(c_2M)$$

at 25°C, if the concentrations of the zinc amalgam are: c_1 = 10g per 100g of mercury and c_2 = 1g per100 g of mercury.

EC0044

18. How long a current of 2A has to be passed through a solution of $AgNO_3$ to coat a metal surface of 80cm^2 with 5μm thick layer? Density of silver = 10.8g|cm^3.

EC0045

19. 10g solution of $CuSO_4$ is electrolyzed using 0.01F of electricity. Calculate:
(a) The weight of resulting solution
(b) Equivalents of acid or alkali in the solution.

EC0216

20. Cadmium amalgam is prepared by electrolysis of a solution of $CdCl_2$ using a mercury cathode. How long should a current of 5A be passed in order to prepare 12% Cd – Hg amalgam on a cathode of 2 gm Hg (Cd = 112.4)

EC0217

EXERCISE # O-I

NOTE : If not given in question use : $\frac{2.303RT}{F} = 0.059$

GALVANIC CELL

1. A standard hydrogen electrode has zero electrode potential because

(A) hydrogen is easier to oxidise
(B) electrode potential is assumed to be zero
(C) hydrogen atom has only one electron
(D) hydrogen is the lighest element.

EC0047

2. The thermodynamic efficiency of cell is given by-

(A) $\frac{\Delta H}{\Delta G}$
(B) $\frac{nFE_{cell}}{\Delta G}$
(C) $-\frac{nFE_{cell}}{\Delta H}$
(D) Zero

EC0050

3. From the following E° values of half cells,

(i) $A + e \rightarrow A^-$; $E° = -0.24$ V
(ii) $B^- + e \rightarrow B^{2-}$; $E° = +1.25$ V
(iii) $C^- + 2e \rightarrow C^{3-}$; $E° = -1.25$ V
(iv) $D + 2e \rightarrow D^{2-}$; $E° = +0.68$ V

What combination of two half cells would result in a cell with the largest potential ?

(A) (ii) and (iii)
(B) (ii) and (iv)
(C) (i) and (iii)
(D) (i) and (iv)

EC0055

4. Which of the following will increase the voltage of the cell with following cell reaction

$Sn_{(s)} + 2Ag^+_{(aq)} \rightarrow Sn^{+2}_{(aq)} + 2Ag_{(s)}$

(A) Decrease in the concentration of Ag^+ ions
(B) Increase in the concentration of Sn^{+2} ions
(C) Increase in the concentration of Ag^+ ions
(D) (A) & (B) both

EC0059

5. The standard electrode potentials for the reactions

$Ag^+ (a) + e^- \longrightarrow Ag(s)$ $\quad$ $Sn^{2+} (a) + 2e^- \longrightarrow Sn (s)$

at 25 °C are 0.80 volt and –0.14 volt, respectively. The standard emf of the cell.

$Sn_{(s)}|Sn^{2+}_{(aq)}(1M)||Ag^+_{(aq)}(1M)|Ag_{(s)}$ is :

(A) 0.66 volt
(B) 0.80 volt
(C) 1.08 volt
(D) 0.94 volt

EC0049

6. $E°(Ni^{2+}|Ni) = -0.25$ volt, $E° (Au^{3+} | Au) = 1.50$ volt. The standard emf of the voltaic cell.

$Ni_{(s)} | Ni^{2+}_{(aq)}$ (1.0 M) || $Au^{3+}_{(aq)}$ (1.0 M) | $Au_{(s)}$ is :

(A) 1.25 volt
(B) –1.75 volt
(C) 1.75 volt
(D) 4.0 volt

EC0053

7. E° for $F_2 + 2e^- = 2F^-$ is 2.8 V, E° for $\frac{1}{2}F_2 + e^- = F^-$ is ?

(A) 2.8 V
(B) 1.4 V
(C) –2.8 V
(D) –1.4 V

EC0054

8. If Δ G° of the cell reaction,

$AgCl(s) + \frac{1}{2}H_2(g) \rightarrow Ag(s) + H^+ + Cl^-$ is –21.52 KJ then

ΔG° of $2AgCl(s) + H_2(g) \rightarrow 2Ag(s) + 2H^+ + 2Cl^-$ is :

(A) –21.52 KJ
(B) –10.76 KJ
(C) –43.04 KJ
(D) 43.04 KJ

EC0056

9. The standard emf for the cell reaction,

$Zn_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$ is 1.10 volt at 25 °C. The emf for the cell reaction when 0.1 M Cu^{2+} and 0.1 M Zn^{2+} solution are used at 25°C is :

(A) 1.10 volt (B) 0.110 volt (C) –1.10 volt (D) –0.110 volt

EC0064

10. Given : $E^0_{Cr^{3+}/Cr} = -0.72$ V, $E^0_{Fe^{2+}/Fe} = -0.42$V. The potential for the cell

$Cr_{(s)} \mid Cr^{3+}_{(aq)}$ (0.1 M) || $Fe^{2+}_{(aq)}$ (0.01 M)|$Fe_{(s)}$ is

(A) 0.26 V (B) 0.339 V (C) – 0.339 V (D) – 0.26 V

EC0218

11. What is the potential of the cell containing two hydrogen electrodes as represented below

Pt | H_2(g) | $H^+_{(aq)}$(10^{-8} M) || $H^+_{(aq)}$(0.001 M) | H_2(g)|Pt

(A) – 0.295 V (B) – 0.0591 V (C) 0.295 V (D) 0.0591 V

EC0065

12. Consider the cell, Cu|Cu^{+2}||Ag^+|Ag. If the concentration of Cu^{+2} and Ag^+ ions becomes ten times the emf of the cell :–

(A) Becomes 10 times (B) Remains same

(C) Increase by 0.0295 V (D) Decrease by 0.0295 V

EC0066

13. The standard emf of a galvanic cell involving cell reaction with n = 4 is found to be 0.295 V at 25°C. The equilibrium constant of the reaction would be,

(A) 1.0×10^{20} (B) 2.0×10^{11} (C) 4.0×10^{12} (D) 1.0×10^{2}

EC0068

14. The cell Zn | $Zn^{+2}_{(aq)}$(1M) || $Cu^{+2}_{(aq)}{}^{(1M)}$ | Cu ($E°_{cell}$ = 1.10 V) was allowed to be completely discharged at 298 K. The relative concentration of Zn^{+2} to Cu^{+2}, $\left\{\frac{\left[Zn^{+2}\right]}{\left[Cu^{+2}\right]}\right\}$ is :

(A) 9.65×10^4 (B) Antilog (24.08) (C) 37.3 (D) $10^{37.3}$

EC0219

15. Given the data at 25°C,

$Ag_{(s)} + I^-_{(aq)} \rightarrow AgI_{(s)} + e^-$, E° = 0.152V

$Ag_{(s)} \rightarrow Ag^+_{(aq)} + e^-$, E° = – 0.800 V

What is the value of log K_{sp} for AgI ? (Where K_{sp}= solubility product)

$\left(2.303\frac{RT}{F} = 0.059V\right)$

(A) –8.12 (B) +8.612 (C) –37.83 (D) –16.13

EC0220

16. In a cell that utilises the reaction,

$Zn(s) + 2H^+(A) \longrightarrow Zn^{2+}(aq) + H_2(g)$ addition of H_2SO_4 to cathode compartment, will :

(A) increase the E_{cell} and shift equilibrium to the right

(B) lower the E_{cell} and shift equilibrium to the right

(C) lower the E_{cell} and shift equilibrium to the left

(D) increase the E_{cell} and shift equilibrium to the left

EC0221

17. By how much times will potential of half cell $Cu^{+2}|Cu$ change if, the solution is diluted to 100 times at 298 K :–

(A) Increases by 59 mV (B) Decrease by 59 mV

(C) Increases by 29.5 mV (D) Decreases by 29.5 mV

EC0071

ELECTROLYTIC CELL

18. When an electric current is passed through a cell containing an electrolyte, positive ions move towards the cathode and negative ions towards the anode. What will happen if the cathode is pulled out of the solution?

(A) The positive ions will start moving towards the anode and negative ions will stop moving.

(B) The negative ions will continue to move towards the anode and the positive ions will stop moving

(C) Both positive and negative ions will move towards the anode.

(D) None of these movements will take place.

EC0072

19. The products formed when an aqueous solution of NaBr is electrolyzed in a cell having inert electrodes are :

(A) Na and Br_2 (B) Na and O_2

(C) H_2, Br_2 and NaOH (D) H_2 and O_2

EC0074

20. A solution of sodium sulphate in water is electrolysed using inert electrodes. The products at the cathode and anode are respectively.

(A) H_2, O_2 (B) O_2, H_2 (C) O_2, Na (D) none

EC0076

21. When an aqueous solution of lithium chloride is electrolysed using graphite electrodes

(A) Cl_2 is liberated at the anode.

(B) Li is deposited at the cathode

(C) as the current flows, pH of the solution remains constant

(D) as the current flows, pH of the solution decreases.

EC0077

22. The Gibbs energy for the decomposition of Al_2O_3 at 500 °C is as follows

$$\frac{2}{3}Al_2O_3 \longrightarrow \frac{4}{3}Al + O_2,\ \Delta_rG = +966\ \text{KJ mol}^{-1}$$

The potential difference needed for electrolytic reduction of Al_2O_3 at 500 °C is at least :-

(A) 5.0 V (B) 4.5 V (C) 3.0 V (D) 2.5 V

EC0222

23. Electrolysis of a $CuSO_4$ produces :–

(A) An increase in pH (B) A decrease in pH

(C) Either decrease or increase (D) None

EC0075

24. The amount of an ion discharged during electrolysis is not directly proportional to :

(A) resistance

(B) time

(C) current strength

(D) electrochemical equivalent of the element

EC0078

25. Number of electrons involved in the electrodeposition of 63.5 g of Cu from a solution of $CuSO_4$ is : **($N_A = 6 \times 10^{23}$)**

(A) 6×10^{23} (B) 3×10^{23} (C) 12×10^{23} (D) 6×10^{22}

EC0079

26. When one coulomb of electricity is passed through an electrolytic solution the mass deposited on the electrode is equal to :

(A) equivalent weight (B) molecular weight

(C) electrochemical equivalent (D) one gram

EC0080

27. Electro chemical equivalent of a substance is 0.0006; its equivalent weight. is :

(A) 57.9 (B) 28.95

(C) 115.8 (D) cannot be calculated

EC0081

28. The same amount of electricity was passed through two separate electrolytic cells containing solutions of nickel nitrate [$Ni(NO_3)_2$]and chromium nitrate [$Cr(NO_3)_3$] respectively. If 0.3 g of nickel was deposited in the first cell, the amount of chromium deposited is : **(at. wt. of Ni = 59, at. wt. of Cr = 52)**

(A) 0.1 g (B) 0.17 g (C) 0.3 g (D) 0.6 g

EC0087

29. W g of copper deposited in a copper voltameter when an electric current of 2 ampere is passed for 2 hours. If one ampere of electric current is passed for 4 hours in the same voltameter, copper doposited will be :

(A) W (B) W|2 (C) W|4 (D) 2W

EC0082

30. When the same electric current is passed through the solution of different electrolytes in series the amounts of elements deposited on the electrodes are in the ratio of their:

(A) atomic number (B) atomic masses (C) specific gravities (D) equivalent masses

EC0083

31. The amount of electricity that can deposit 108 g. of silver from silver nitrate solution is:

(A) 1 ampere (B) 1 coulomb

(C) 1 Faraday (D) 2 ampere

EC0084

32. The ratio of weights of hydrogen and magnesium deposited by the same amount of electricity from aqueous H_2SO_4 and fused $MgSO_4$ are :

(A) 1 : 8 (B) 1 : 12 (C) 1 : 16 (D) None of these

EC0085

33. A current of 9.65 amp. flowing for 10 minute deposits 3.0 g of a metal. The equivalent wt. of the metal is :

(A) 10 (B) 30 (C) 50 (D) 96.5

EC0086

34. 1 mole of Al is deposited by X coulomb of electricity passing through aluminium nitrate solution. The number of moles of silver deposited by X coulomb of electricity from silver nitrate solution is

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

EC0092

35. The electric charge for electro deposition of 1 equivalent of a substance is :

(A) one ampere per second (B) 4 faraday

(C) one ampere for one hour (D) charge on one mole of electrons

EC0088

36. 3.17 g., of a substance was deposited by the flow of 0.1 mole of electrons. The equivalent weight of the substance is :

(A) 3.17 (B) 0.317 (C) 317 (D) 31.7

EC0089

37. A current of 9.65 amp. passing for 16 min. 40 sec. through a molten tin salt deposits 5.95 g. of tin The oxidation state of the tin in the salt is : (at. wt of Sn = 119)

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

EC0090

38. The time required for a current of 3 amp. to decompose electrolytically 18 g of H_2O is:

(A) 18 hour (B) 36 hour (C) 9 hour (D) 18 seconds

EC0091

39. An ion is reduced to the element when it absorbs 6×10^{20} electrons. The number of gm equivalents of the ion is :

(A) 0.10 (B) 0.01 (C) 0.001 (D) 0.0001

EC0093

40. How many coulombs of electric charge are required for the oxidation of 1 mole of H_2O to O_2 ?

(A) 9.65×10^4 C (B) 4.825×10^5 C

(C) 1.93×10^5 C (D) 1.93×10^4 C

EC0095

41. The time required to coat ameter surface of 80 cm^2 with 5×10^{-3} cm thick layer of silver (density 1.08 g cm^{-3}) with the passage of 9.65A current through a silver nitrate solution is :

(A) 10 sec. (B) 40 sec. (C) 30 sec. (D) 20 sec.

EC0099

42. One gm metal M^{+2} was discharged by the passage of 1.2×10^{22} electrons. What is the atomic weight of metal?

(A) 25 (B) 50 (C) 100 (D) 75

EC0100

43. One mole of electron passes through each of the solution of $AgNO_3$, $CuSO_4$ and $AlCl_3$ when Ag, Cu and Al are deposited at cathode. The molar ratio of Ag, Cu and Al deposited are

(A) 1 : 1 : 1 (B) 6 : 3 : 2 (C) 6 : 3 : 1 (D) 1 : 3 : 6

EC0101

44. During electrolysis of an aqueous solution of sodium sulphate, 2.4 L of oxygen at STP was liberated at anode. The volume of hydrogen at STP, liberated at cathode would be

(A) 1.2 L (B) 2.4 L (C) 2.6 L (D) 4.8 L

EC0102

45. The charge required for the oxidation of one mole Mn_3O_4 into MnO_4^{2-} in presence of alkaline medium is

(A) 5 × 96500 C (B) 96500 C (C) 10 × 96500 C (D) 2 × 96500 C

EC0103

CONDUCTANCE

46. Equivalent conductances of Ba^{+2} and Cl^- ions are 127 & 76 ohm^{-1} cm^2 eq^{-1} respectively. Equivalent conductance of $BaCl_2$ at infinite dilution is -

(A) 379 (B) 139.5 (C) 203 (D) 330

EC0114

47. If x is specific resistance of the electrolyte solution and y is the molarity of the solution, then $\wedge_m$ is given by

(A) $\frac{1000x}{y}$ (B) $1000\,\frac{y}{x}$ (C) $\frac{1000}{xy}$ (D) $\frac{xy}{1000}$

EC0115

48. The conductivity of a saturated solution of $BaSO_4$ is 3.06×10^{-6} ohm^{-1} cm^{-1}and its molar conductance is 1.53 ohm^{-1} cm^2 mol^{-1}. The K_{sp} of $BaSO_4$ will be :

(A) 2×10^{-4} (B) 4×10^{-4} (C) 4×10^{-3} (D) 4×10^{-6}

EC0113

49. The limiting molar conductivities Λ^0 for NaCl, KBr and KCl are 126,152 and 150Scm^2 mol^{-1} respectively. The Λ^0_m for NaBr is :

(A) 278 S cm^2 mol^{-1} (B) 176 S cm^2 mol^{-1}

(C) 128 S cm^2 mol^{-1} (D) 302 S cm^2 mol^{-1}

EC0223

50.

Electrolyte	**Λ^∞ (S cm^2 mol^{-1})**
KCl	149.9
KNO_3	145.0
HCl	426.2
NaOAC	91.0
NaCl	126.5

Calculate Λ^∞_{HOAc} using appropriate molar conductances of the electrolytes listed above at infinite dilution in H_2O at 25°C

(A) 390.7 (B) 217.5 (C) 517.2 (D) 552.7

EC0224

51. The highest electrical conducitivity of the following aqueous solution is of

(A) 0.1 M fluoroacetic acid (B) 0.1 M difluoroacetic acid

(C) 0.1 M acetic acid (D) 0.1 M chloroacetic acid

EC0225

52. The molar conductivities, Λ^0_{NaOAc} and Λ^0_{HCl} at infinite dilution in water at 25°C are 91.0 and 426.2 S cm^2|mol respectively. To calculate Λ^0_{HOAc} the additional value required is :

(A) KCl (B) NaOH (C) NaCl (D) H_2O

EC0226

53. Resistance of a conductivity cell filled with a solution of an electrolyte of concentration 0.1M is 100Ω. The conductivity of this solution is 1.29 Sm^{-1}. Resistance of the same cell when filled with 0.02M of the same solution is 520Ω. The molar conductivity of 0.02M solution of the electrolyte will be.

(A) 124×10^{-4} Sm^2 mol^{-1} (B) 1240×10^{-4} Sm^2 mol^{-1}

(C) 1.24×10^{4} Sm^2 mol^{-1} (D) 12.4×10^{-4} Sm^2 mol^{-1}

EC0227

EXERCISE # O-II

Single correct :

1. Consider the reaction, $Cl_{2(g)} + 2Br^-_{(aq)} \longrightarrow 2Cl^-_{(aq)} + Br_{2(g)}$
The emf of the cell when $[Cl^-]=[Br^-]=0.01M$ and Cl_2 gas at 1 atm pressure while $Br_2(g)$ at 0.01 atm will be (E° for the above reaction is = 0.29 volt) :
(A) 0.54 volt (B) 0.35 volt (C) 0.24 volt (D) –0.29 volt
EC0116

2. How much will the reduction potential of a hydrogen electrode change when its solution initially at pH = 0 is neutralised to pH = 7 ?
(A) increase by 0.059V (B) decrease by 0.059V
(C) increase by 0.413V (D) decrease by 0.413V
EC0117

3. If the pressure of H_2 gas is increased from 1 atm to 100 atm keeping H^+ concentration constant at 1 M, the change in reduction potential of hydrogen half cell at 25°C will be
(A) 0.059 V (B) 0.59 V (C) 0.0295 V (D) 0.118 V
EC0228

4. A silver wire dipped in 0.1 M HCl solution saturated with AgCl develops oxidation potential of –0.209 V. If $E^\circ_{Ag/Ag^+} = -0.799$ V, the K_{sp} of AgCl in pure water will be
(A) 3×10^{-11} (B) 10^{-11} (C) 4×10^{-11} (D) 3×10^{-11}
EC0229

5. Salts of A (atomic weight = 7), B (atomic weight =27) and C (atomic weight = 48) were electrolysed under identical conditions using the same quantity of electricity. It was found that when 2.1 g of A was deposited, the weights of B and C deposited were 2.7 and 7.2 g. The valencies of A, B and C respectively are
(A) 3, 1 and 2 (B) 1, 3 and 2 (C) 3, 1 and 3 (D) 2, 3 and 2
EC0230

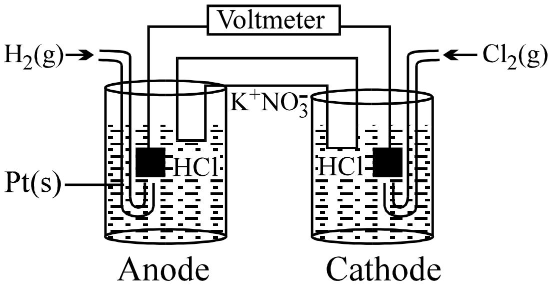
6. During electro refining of Cu by electrolysis of an aqueous solution of $CuSO_4$ using copper electrodes, if 2.5 g of Cu is deposited at cathode, then at anode
(A) decrease of more than 2.5 g of mass takes place (B) 450 ml of O_2 at STP is liberated
(C) 2.5 g of copper is deposited (D) a decrease of 2.5 g of mass takes place
EC0118

7. The conductivity of a saturated solution of Ag_3PO_4 is 9×10^{-6} S m^{-1} and its equivalent conductivity is 1.50×10^{-4} S m^2 equivalent^{-1}. The K_{sp} of Ag_3PO_4 is
(A) 4.32×10^{-18} (B) 1.8×10^{-9} (C) 8.64×10^{-13} (D) None of these
EC0119

8. Equal volumes of 0.015 M CH_3COOH & 0.015 M NaOH are mixed together. What would be molar conductivity of mixture if conductivity of CH_3COONa is 6.3×10^{-4} S cm^{-1}
(A) 8.4 S cm^2 mol^{-1} (B) 84 S cm^2 mol^{-1} (C) 4.2 S cm^2 mol^{-1} (D) 42 S cm^2 mol^{-1}
EC0120

9. For the fuel cell reaction $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$; $\Delta_f H^o_{298}(H_2O, l) = -285.5$ kJ|mol
What is ΔS^o_{298} for the given fuel cell reaction?
Given: $O_2(g) + 4H^+(aq) + 4e^- \longrightarrow 2H_2O(l)$; E° = 1.23 V
(A) – 0.322 J|K (B) – 0.635 kJ|K (C) 3.51 kJ|K (D) – 0.322 kJ|K
EC0231

10. Consider the following Galvanic cell.



By what value the cell voltage change when concentration of ions in anodic and cathodic compartments both increased by factor of 10 at 298 K

(A) +0.0590 (B) –0.0590 (C) –0.1180 (D) 0

EC0121

11. The standard reduction potentials at 25°C for the following half reactions are :

$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s),\ E^\circ_{RP} = -0.762V$

$Cr^{3+}(aq) + 3e^- \rightleftharpoons Cr(s),\ E^\circ_{RP} = -0.740V$

$2H^+_{(aq)} + 2e^- \rightleftharpoons H_2(g),\ E^\circ_{RP} = 0.00\ V$

$Fe^{3+}_{(aq)} + 2e^- \rightleftharpoons Fe^{2+}_{(aq)},\ E^\circ_{RP} = 0.77V$

Which is the strongest reducing agent ?

(A) Zn (B) Cr (C) $H_2(g)$ (D) Fe^{2+} (aq)

EC0122

12. Using the standard electrode potential values given below, decide which of the statements, I, II, III and IV are correct. Choose the right answer from (A), (B), (C) and (D).

$Fe^{2+}_{(aq)} + 2e^- \rightleftharpoons Fe_{(s)}\ ;\quad E^\circ = -0.44\ V$

$Cu^{2+}_{(aq)} + 2e^- \rightleftharpoons Cu_{(s)}\ ;\quad E^\circ = +0.34\ V$

$Ag^{+}_{(aq)} + e^- \rightleftharpoons Ag_{(s)}\ ;\quad E^\circ = +0.80\ V$

I. Copper can displace iron from $FeSO_4$ solution.
II. Iron can displace copper from $CuSO_4$ solution.
III. Silver can displace copper from $CuSO_4$ solution.
IV. Iron can displace silver from $AgNO_3$ solution.

(A) I and II (B) II and III (C) II and IV (D) I and IV

EC0232

13. The following facts are available :–

$2X^- + Y_2 \rightarrow 2Y^- + X_2$

$2W^- + Y_2 \rightarrow$ NO reaction

$2Z^- + X_2 \rightarrow 2X^- + Z_2$

Which of the following statements is correct :–

(A) $E^\circ_{W^-/W_2} > E^\circ_{Y^-/Y_2} > E^\circ_{X^-/X_2} > E^\circ_{Z^-/Z_2}$

(B) $E^\circ_{W^-/W_2} < E^\circ_{Y^-/Y_2} < E^\circ_{X^-/X_2} < E^\circ_{Z^-/Z_2}$

(C) $E^\circ_{W^-/W_2} < E^\circ_{Y^-/Y_2} > E^\circ_{X^-/X_2} > E^\circ_{Z^-/Z_2}$

(D) $E^\circ_{W^-/W_2} > E^\circ_{Y^-/Y_2} < E^\circ_{X^-/X_2} < E^\circ_{Z^-/Z_2}$

EC0233

14. The cost of electricity required to deposit 1 g of Mg is Rs. 5.00. How much would it cost to deposit 9 g of Al (At wt. Al = 27, Mg = 24)

(A) Rs. 10 (B) Rs. 27 (C) Rs. 40 (D) Rs. 60

EC0234

15. 4.5g of aluminium (at. mass 27 amu) is deposited at cathode from Al^{3+} solution by a certain quantity of electric charge. The volume of hydrogen produced at STP from H^+ ions in solution by the same quantity of electric charge will be –

(A) 45.4L (B) 11.35L (C) 22.7L (D) 5.675 L

EC0123

16. The density of A is 10 g cm^{-3}. The quantity of electricity needed to plate an area 10 cm × 10 cm to a thickness of 10^{-2} cm using ASO_4 solution would be (Atomic mass of A = 193)

(A) 5000 C (B) 10000 C (C) 40000 C (D) 20000 C

EC0124

17. The resistance of 0.5 M solution of an electrolyte in a cell was found to be 50 Ω. If the electrodes in the cell are 2.2 cm apart and have an area of 4.4 cm^2 then the molar conductivity (in S m^2 mol^{-1}) of the solution is

(A) 0.2 (B) 0.02 (C) 0.002 (D) None of these

EC0125

18. Equivalent conductance of 0.1 M HA(weak acid) solution is 10 $Scm^2equivalent^{-1}$ and that at infinite dilution is 200 $Scm^2equivalent^{-1}$ Hence pH of HA solution is

(A) 1.3 (B) 1.7 (C) 2.3 (D) 3.7

EC0126

19. The dissociation constant of n-butyric acid is 1.6×10^{-5} and the molar conductivity at infinite dilution is 380×10^{-4} Sm^2mol^{-1}. The specific conductance of the 0.01 M acid solution is

(A) 1.52×10^{-5} Sm^{-1} (B) 1.52×10^{-2} Sm^{-1}

(C) 1.52×10^{-3} Sm^{-1} (D) None

EC0127

Multiple correct :

20. During discharging of lead storage battery, which of the following is|are true ?

(A) H_2SO_4 is produced (B) H_2O is consumed

(C) $PbSO_4$ is formed at both electrodes (D) Density of electrolytic solution decreases

EC0128

21. Which of the following arrangement will produce oxygen at anode during electrolysis ?

(A) Dilute H_2SO_4 solution with Cu electrodes.

(B) Dilute H_2SO_4 solution with inert electrodes.

(C) Fused NaOH with inert electrodes.

(D) Dilute NaCl solution with inert electrodes.

EC0235

22. If 270.0 g of water is electrolysed during an experiment performed by miss Abhilasha with 75% current efficiency then

(A) 168 L of O_2 (g) will be evolved at anode at 1 atm & 273 K

(B) Total 504 L gases will be produced at 1 atm & 273 K.

(C) 336 L of H_2 (g) will be evolved at anode at 1 atm & 273 K

(D) 45 F electricity will be consumed

EC0129

23. Pick out the correct statements among the following from inspection of standard reduction potentials (Assume standard state conditions).

$Cl_2\ (a) + 2e \rightleftharpoons 2Cl^-(a) \qquad E^o_{Cl_2/Cl^-} = +1.36$ volt

$Br_2\ (a) + 2e \rightleftharpoons 2Br^-(a) \qquad E^o_{Br_2/Br^-} = +1.09$ volt

$I_2(s) + 2e \rightleftharpoons 2I^-\ (a) \qquad E^o_{I_2/I^-} = +0.54$ volt

$S_2O_8^{2-}\ (a) + 2e \rightleftharpoons 2SO_4^{2-}\ (a) \qquad E^o_{S_2O_8^{2-}/SO_4^{2-}} = +2.00$ volt

(A) Cl_2 can oxidise SO_4^{2-} from solution

(B) Cl_2 can oxidise Br^- and I^- from aqueous solution

(C) $S_2O_8^{2-}$ can oxidise Cl^-, Br^- and I^- from aqueous solution

(D) $S_2O_8{}^{2-}$ is added slowly, Br^- can be reduce in presence of Cl^-

EC0236

24. The EMF of the following cell is 0.22 volt.
$Ag(s)\ |\ AgCl(s)\ |\ KCl\ (1M)\ |\ H^+(1M)\ |\ H_2(g)\ (1atm)\ ;\ Pt(s)$.
Which of the following will decrease the EMF of cell.
(A) increasing pressure of $H_2(g)$ from 1 atm to 2 atm
(B) increasing Cl^- concentration in Anodic compartment
(C) increasing H^+ concentration in cathodic compartment
(D) decreasing KCl concentration in Anodic compartment.

EC0130

Assertion & Reasoning type questions :

25. Statement -1 : The voltage of mercury cell remains constant for long period of time.
Statement -2 : It is because net cell reaction does not involve active species.
(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(C) Statement-1 is true, statement-2 is false.
(D) Statement-1 is false, statement-2 is true.

EC0237

26. Statement -1 : The SRP of three metallic ions A^+,B^{2+}, C^{3+} are –0.3, –0.5, 0.8 volt respectively, so oxidising power of ions is $C^{3+} > A^+ > B^{2+}$.
Statement -2 : Higher the SRP, higher the oxidising power.
(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(C) Statement-1 is true, statement-2 is false.
(D) Statement-1 is false, statement-2 is true.

EC0131

27. Statement -1 : We can add the electrode potential in order to get electrode potential of net reaction.
Statement -2 : Electrode potential is an intensive property.
(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(C) Statement-1 is true, statement-2 is false.
(D) Statement-1 is false, statement-2 is true. **EC0132**

Table type :

1 TABLE (3Q)

	Column-I		Column-II		Column-III
(P)	Zn(s) | $ZnSO_4$(0.1M) | | $Zn(NO_3)$ (0.01M)Zn(s)	(A)	Has metal -insoluble salt - anion electrode.	(I)	$E_{cell} < 0$
(Q)	Pt,Cl_2(0.1bar) | KCl(1M) | | NaCl(1M) Cl_2(1bar),Pt	(B)	Electrolytic concentration cell	(II)	$E^0_{cell} = 0$
(R)	Ag(s) | AgCl(s) | KCl (0.1M) | | Ag^+(0.1M) | Ag(s) Ksp[AgCl] = 10^{-10}.	(C)	Electrode concentration cell	(III)	$E_{cell} > 0$
(S)	Pt,H_2(1bar) | H_2SO_4 (0.05M) | | HNO_3(0.1M) | H_2 (1bar), Pt	(D)	Has gas-ion electrode	(IV)	$E_{cell} = 0$

(1) Use : $\frac{2.303RT}{F} = 0.06$

(2) Assume constant P,T condition of operation.

28. Which option is incorrectly matched ?

(A) P - B - II (B) Q - C - II
(C) R - A - I (D) S - D - IV

EC0133

29. For galvanic cell in option 'Q' on increasing concentration of KCl, cell potential will -

(A) Increase (B) decrease
(C) remains constant (D) cannot predict

EC0134

30. On increasing Ag^+ concentration in anodic compartment in option (R) cell potential will

(A) Remain same (B) increase
(C) decrease (D) can't predict

EC0135

Match the column

31.

	Column I		Column II (Electrolysis product using inert electrode)
(A)	Dilute solution of HCl	(P)	O_2 evolved at anode
(B)	Dilute solution of NaCl	(Q)	H_2 evolved at cathode
(C)	Concentrated solution of NaCl	(R)	Cl_2 evolved at anode
(D)	$AgNO_3$ solution	(S)	Ag deposition at cathode

EC0136

32. **Column-I** **Column-II**

Cell notation : E_{cell}

(P) $\mathrm{Mn}\Big\vert\begin{smallmatrix}\mathrm{Mn}^{2+}\\(0.1\mathrm{M})\end{smallmatrix}\Big\Vert\begin{smallmatrix}\mathrm{Cu}^{2+}\\(0.01\mathrm{M})\end{smallmatrix}\Big\vert\mathrm{Cu}$	(1)	0.33
(Q) $\mathrm{Ag}\Big\vert\mathrm{AgBr}\Big\vert\begin{smallmatrix}\mathrm{Br}^{-}\\(0.1\mathrm{M})\end{smallmatrix}\Big\Vert\begin{smallmatrix}\mathrm{Ag}^{+}\\(0.01\mathrm{M})\end{smallmatrix}\Big\vert\mathrm{Ag}$	(2)	0.6
(R) $\mathrm{Pt},\mathrm{H}_2(4\mathrm{atm})\Big\vert\begin{smallmatrix}\mathrm{H}^{+}\\(0.01\mathrm{M})\end{smallmatrix}\Big\Vert\begin{smallmatrix}\mathrm{Cl}^{-}\\(0.2\mathrm{M})\end{smallmatrix}\Big\vert\begin{smallmatrix}\mathrm{Cl}_2\\(1\mathrm{atm})\end{smallmatrix}\Big\vert\mathrm{Pt}$	(3)	1.49
(S) $\mathrm{Pt},\Big\vert\begin{smallmatrix}\mathrm{Fe}^{2+} & \mathrm{Fe}^{+3}\\(0.2\mathrm{M}) & (0.02\mathrm{M})\end{smallmatrix}\Big\Vert\begin{smallmatrix}\mathrm{MnO}_4^{-} & \mathrm{Mn}^{+2} & \mathrm{H}^{+}\\(0.1\mathrm{M}), & (0.1\mathrm{M}) & ,\mathrm{pH}=5\end{smallmatrix}\Big\vert\mathrm{Pt}$	(4)	1.54

Given :

$E^0_{Cu^{2+}/Cu} = 0.34V$ $K_{sp}(AgBr) = 10^{-13}$

$E^0_{Mn^{2+}/Mn} = -1.18V$ $\dfrac{2.303RT}{F} = 0.06$

$E^0_{Ag^{+}/Ag} = 0.8V$

$E^0_{Fe^{3+}/Fe^{2+}} = 0.77V$

$E^0_{MnO_4^{-}/Mn^{2+}} = 1.52V$

$E^0_{Cl_2/Cl^{-}} = 1.36V$

Code:

	P	Q	R	S
(A)	4	3	4	4
(B)	2	3	1	4
(C)	3	2	4	1
(D)	4	3	2	1

EC0238

EXERCISE # J-MAINS

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 0.4M solution of the same electrolyte is 260 Ω, its molar conductivity is :- **[AIEEE 2011]**

(1) 6250 S 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}

EC0137

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

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

EC0138

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

EC0139

4. Given : **[JEE-MAINS 2013]**

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

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

Based on the data given above, strongest oxidising agent will be :

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

EC0140

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]**

(where the constant B is postive)

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

(3) $\lambda_C = \lambda_\infty + (2)\,C$ (4) $\lambda_C = \lambda_\infty - (2)C$

EC0141

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}

EC0142

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 $I_2|I^-$. At pH = 3, permanganate is expected to oxidize $\left(\frac{RT}{F} = 0.059\,V\right)$:-

[JEE-MAINS (ONLINE) 2015]

(1) Cl^- and Br^- (2) Cl^-, Br^- and I^- (3) Br^- and I^- (4) I^- only

EC0143

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 (ONLINE) 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

EC0144

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

EC0145

10. What will occur if a block of copper metal is dropped into a beaker containing a solution of 1M $ZnSO_4$

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

(2) No reaction will occur **[JEE-MAINS (ONLINE) 2016]**

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

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

EC0146

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 (ONLINE) 2016]**

(1) 8.96 L (2) 2.24 L (3) 4.48 L (4) 6.72 L

EC0147

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

$E^o_{Cl_2/Cl^-} = 1.36\,V, E^o_{Cr^{3+}/Cr} = -0.74\,V$; $E^o_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V, E^o_{MnO_4^-/Mn^{2+}} = 1.51\,V$.

Among the following, the strongest reducing agent is

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

EC0148

13. What is the standard reduction potential (E°) for $Fe^{3+} \rightarrow Fe$? **[JEE-MAINS (ONLINE) 2017]**

Given that :

$Fe^{2+} + 2e^- \rightarrow Fe$; $E^o_{Fe^{2+}/Fe} = -0.47$ V

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

(1) +0.30 V (2) +0.057 V (3) –0.057 V (4) –0.30 V

EC0149

14. To find the standard potential of $M^{3+}|M$ electrode, the following cell is constituted: $Pt|M|M^{3+}$ (0.001 mol L^{-1})$|Ag^+$(0.01 mol L^{-1})$|Ag$ **[JEE-MAINS (ONLINE) 2017]**

The emf of the cell is found to be 0.421 volt at 298 K. The standard potential of half reaction $M^{3+} + 3e^- \rightarrow M$ at 298 K will be : **(Given $E^{\ominus}_{Ag^+/Ag}$ at 298 K = 0.80 Volt)**

(1) +0.30 V (2) +0.057 V (3) –0.057 V (4) –0.30 V

EC0150

15. 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 (OFFLINE) 2017]**

(Atomic weight of B = 10.8 u)

(1) 0.8 hours (2) 3.2 hours (3) 1.6 hours (4) 6.4 hours

EC0151

16. When an electric current is passed through acidified water, 112 mL of hydrogen gas at N.T.P. was collected at the catode in 965 seconds. The current passed, in ampere, is :

[JEE-MAINS (ONLINE) 2018]

(1) 2.0 (2) 1.0 (3) 0.1 (4) 0.5

EC0152

17. When 9.65 ampere current was passed for 1.0 hour into nitrobenzene in acidic medium, the amount of p-aminophenol produced is :- **[JEE-MAINS (ONLINE) 2018]**

(1) 10.9 g (2) 98.1 g (3) 109.0 g (4) 9.81 g

EC0153

18. For the cell Zn(s) | Zn^{2+}(aq) || M^{x+} (aq) | M(s), different half cells and their standard electrode potentials are given below : **[JEE-MAINS (ONLINE) 2019]**

M^{x+}(aq/M(s)	Au^{3+}(aq)/ Au(s)	Ag^{+}(aq)/ 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 $E^{o}_{Zn^{2+}/Zn} = -0.76\,V$, which cathode will give a mximum value of E^{o}_{cell} per electron transferred ?

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

EC0154

19. If the standard electrode potential for a cell is 2 V at 300 K, the equilibrium constant (K) for the reaction

$Zn(s) + Cu^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Cu(s)$ **[JEE-MAINS (ONLINE) 2019]**

at 300 K is approximately. **(R = 8 JK^{-1} mol^{-1} , F = 96000 C mol^{-1})**

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

EC0155

20. Given the equilibrium constant : **[JEE-MAINS (ONLINE) 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 298 K.

$$\left[2.303\frac{RT}{F}\text{at}\,298\,K = 0.059\,V\right]$$

(1) 0.04736 V (2) 0.4736 V (3) 0.4736 mV (4) 0.04736 mV

EC0156

21. The standard electrode potential $E^{\ominus}$ and its temeprature 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 **[JEE-MAINS (ONLINE) 2019]**

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

The standard reaction enthalpy $\left(\Delta_r H^{\ominus}\right)$ at 300 K in kJ mol^{-1} is,

[Use : R = 8JK^{-1} mol^{-1} and F = 96,000 Cmol^{-1}]

(1) –412.8 (2) –384.0 (3) 206.4 (4) 192.0

EC0157

22. $\wedge_m^{\circ}$ for NaCl, HCl and NaA are 126.4, 425.9 and 100.5 S cm^{2}mol^{-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 (ONLINE) 2019]**

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

EC0158

23. Consider the following reduction processes : **[JEE-MAINS (ONLINE) 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 : **[JEE-MAINS (ONLINE) 2019]**

(1) Ca < Zn < Mg < Ni (2) Ni < Zn < Mg < Ca

(3) Zn < Mg < Ni < Ca (4) Ca < Mg < Zn < Ni

EC0159

24. In the cell : **[JEE-MAINS (ONLINE) 2019]**

Pt(s) | H_2(g , 1 bar | HCl (aq) | AgCl(s) | Ag(s) | Pt(s)

the cell potential is 0.92V when a 10^{-6} molal HCl solution is used. The standard electrode potential of (AgCl/Ag,Cl$^-$) electrode is :

$$\left\{\text{given}, \frac{2.303RT}{F} = 0.06\text{Vat}298\text{K}\right\}$$

(1) 0.20 V (2) 0.76 V (3) 0.40 V (4) 0.94 V

EC0160

25. The anodic half-cell of lead-acid battery is recharged unsing electricity of 0.05 Faraday. The amount of $PbSO_4$ electrolyzed in g during the process in : **(Molar mass of $PbSO_4$ = 303 g mol^{-1})**

(1) 22.8 (2) 15.2 **[JEE-MAINS (ONLINE) 2019]**

(3) 7.6 (4) 11.4

EC0161

26. 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-MAINS (ONLINE) 2020]**

(1) +0.158 V (2) 0.182 V (3) –0.182 V (4) –0.158 V

EC0162

27. The equation that is incorrect is - **[JEE-MAINS (ONLINE) 2020]**

(1) $\left(\Lambda_m^0\right)_{NaBr}-\left(\Lambda_m^0\right)_{NaI}=\left(\Lambda_m^0\right)_{KBr}-\left(\Lambda_m^0\right)_{NaBr}$

(2) $\left(\Lambda_m^0\right)_{H_2O}=\left(\Lambda_m^0\right)_{HCl}+\left(\Lambda_m^0\right)_{NaOH}-\left(\Lambda_m^0\right)_{NaCl}$

(3) $\left(\Lambda_m^0\right)_{KCl}-\left(\Lambda_m^0\right)_{NaCl}=\left(\Lambda_m^0\right)_{KBr}-\left(\Lambda_m^0\right)_{NaBr}$

(4) $\left(\Lambda_m^0\right)_{NaBr}-\left(\Lambda_m^0\right)_{NaCl}=\left(\Lambda_m^0\right)_{KBr}-\left(\Lambda_m^0\right)_{KCl}$

EC0163

28. What would be the electrode potential for the given half cell reaction at pH = 5 ?______

$$2H_2O \rightarrow O_2 + 4H^{\oplus} + 4e^- \text{ ; } E^0_{red} = 1.23 \text{ V}$$

(R = 8.314 J mol^{-1} K^{-1} ; Temp = 298 K; oxygen under std. atm. pressure of 1 bar)

EC0164

29. For an electrochemical cell **[JEE-MAINS (ONLINE) 2020]**

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

the ratio $\frac{[Sn^{2+}]}{[Pb^{2+}]}$ when this cell attains equilibrium is _________.

(Given $E^0_{Sn^{2+}|Sn} = -0.14V$, $E^0_{Pb^{2+}|Pb} = -0.13V, \frac{2.303RT}{F} = 0.06$)

EC0165

30. 108 g of silver (molar mass 108 g mol^{-1}) is deposited at cathode from $AgNO_3$(aq) solution by a certain quantity of electricity. The volume (in L) of oxygen gas produced at 273 K and 1 bar pressure from water by the same quantity of electricity is _______. **[JEE-MAINS (ONLINE) 2020]**

EC0166

31. Amongst the following, the form of water with the lowest ionic conductance at 298 K is:

(1) distilled water

(2) water from a well **[JEE-MAINS (ONLINE) 2020]**

(3) saline water used for intravenous injection

(4) sea water

EC0167

EXERCISE # J-ADVANCED

1. Consider the following cell reaction : **[JEE 2011]**

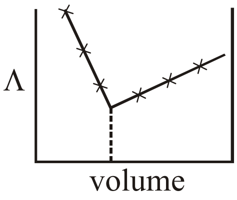
$2Fe_{(s)}+O_{2(g)}+4H^{+}_{(aq)} \rightarrow 2Fe^{2+}_{(a)}+2H_2O(\ell)$; $E° = 1.67$ V

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

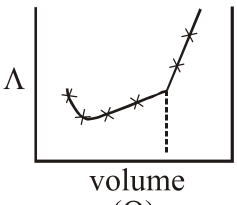
(A) 1.47 V (B) 1.77 V (C) 1.87 V (D) 1.57 V

EC0178

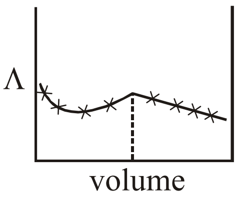
2. $AgNO_3$ (a) was added to an aqueous KCl solution gradually and the conductivity of the solution was measured. the plot of conductance (Λ) versus the volume of $AgNO_3$ is - **[JEE 2011]**



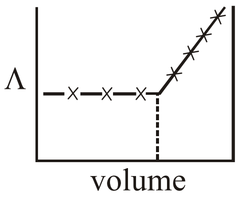
(P)



(Q)



(R)



(S)

(A) (P) (B) (Q) (C) (R) (D) (S)

EC0179

Paragraph for Question 3 and 4

The electrochemical cell shown below is a concentration cell. **[JEE 2012]**

M | M^{2+} (saturated solution of a sparingly soluble salt, MX_2) || M^{2+} (0.001 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 0.059V.

3. The value of ΔG (kJ mol^{-1}) for the given cell is (take If = 96500 C mol^{-1})

(A) –5.7 (B) 5.7 (C) 11.4 (D) –11.4

EC0180

4. 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 × R × 298|F = 0.059 V)

(A) 1×10^{-15} (B) 4×10^{-15} (C) 1×10^{-12} (D) 1×10^{-12}

EC0181

5. The standard reduction potential data at 25ºC is given below **[JEE-Adv. 2013]**

$E^o (Fe^{3+}, Fe^{2+}) = +0.77$ V ;

$E^o (Fe^{2+}, Fe) = -0.44$ V ;

$E^o (Cu^{2+}, Cu) = +0.34$ V ;

$E^o (Cu^{+}, Cu) = +0.52$ V ;

$E^o (O_2(g) + 4H^{+} + 4e^{-} \rightarrow 2H_2O] = +1.23$ V ;

$E^o [(O_2(g) + 2H_2O + 4e^{-} \rightarrow 4OH^{-})] = +0.40$ V ;

E^o (Cr^{3+}, Cr) = –0.74 V ;

E^o (Cr^{2+}, Cr) = –0.91 V ;

Match E^o of the redox pair in List-I with the values given in List-II and select the correct answer using the code given below the lists :

	List-I		**List-II**
(P)	$E^o(Fe^{3+}, Fe)$	(1)	–0.18 V
(Q)	$E^o(4H_2O \rightleftharpoons 4H^+ + 4OH^+)$	(2)	–0.4 V
(R)	$E^o(Cu^{2+} + Cu \rightarrow 2Cu^+)$	(3)	–0.04 V
(S)	$E^o(Cr^{3+}, Cr^{2+})$	(4)	–0.83 V

Codes :

	P	Q	R	S		P	Q	R	S
(A)	4	1	2	3	(B)	2	3	4	1
(C)	1	2	3	4	(D)	3	4	1	2

EC0182

6. An aqueous solution of X is added slowly to an aqueous solution of Y as shown 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 the code given below the lists : **[JEE-Adv. 2013]**

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

Codes :

	P	Q	R	S		P	Q	R	S
(A)	3	4	2	1	(B)	4	3	2	1
(C)	2	3	4	1	(D)	1	4	3	2

EC0183

7. In a galvanic cell , the salt bridge - **[JEE-Adv. 2014]**

(A) Does not participate chemically in the cell reaction

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

(C) Is necessary for the occurence of the cell reaction

(D) Ensures mixing of the two electrolytic solutions

EC0184

8. The molar conductivity of a solution of a weak acid HX (0.01 M) is 10 times smaller than the molar conductivity of a solution of a weak acid HY (0.1 M). If $\lambda^0_{X^-} \approx \lambda^0_{Y^-}$, the difference in their pK_a values , $pK_a(HX) - pK_a(HY)$, is (consider degree of ionization of both acids to be <<1).

[JEE-Adv. 2015]
EC0185

9. All the energy released from the reaction $X \rightarrow Y$, $\Delta_r G^o = -193$ kJ mol^{-1} is used for the oxidizing M^+ and $M^+ \rightarrow M^{3+} + 2e^-$, $E^o = -0.25$ V. **[JEE-Adv. 2015]**

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}]

EC0186

10. For the following electrochemical cell at 298K, **[JEE-Adv. 2016]**

$$Pt(s) \mid H_2(g, 1bar) \mid H^+(aq, 1M) \parallel M^{4+}(a), M^{2+}(a) \mid Pt(s)$$

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

$$\text{Given : } E^0_{M^{4+}/M^{2+}} = 0.151V \text{ ; } 2.303\frac{RT}{F} = 0.059V$$

The value of x is -

(A) –2 (B) –1 (C) 1 (D) 2

EC0187

11. 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 $\left(\Lambda^0_m\right)$ of this weak monobasic acid in aqueous solution is $Z \times 10^2$ S cm^{-1}mol^{-1}. The value of Z is.

EC0188

12. For the following cell : **[JEE-Adv. 2017]**

$Zn(s) \mid ZnSO_4$ (aq.) $\| CuSO_4$ (aq.) $\mid Cu(s)$

when the concentration of Zn^{2+} is 10 times the concentration of Cu^{2+} , the expression for ΔG (in J mol^{-1}) is

[F is Faraday constant , R is gas constant, T is temperature , E^o(cell) = 1.1V]

(A) 2.303 RT + 1.1F (B) 2.303 RT – 2.2F (C) 1.1 F (D) –2.2 F

EC0189

13. Consider an electrochemical cell: $A(s) \mid A^{n+}$ (aq, 2M) $\| B^{2n+}$ (aq, 1M) $\mid B(s)$. The value of ΔH^θ for the cell reaction is twice that of ΔG^θ at 300 K. If the emf of the cell is zero, the ΔS^θ (in JK^{-1} mol^{-1}) of the cell reaction per mole of B formed at 300 K is___. **[JEE-Adv. 2018]**

(Given : ln (2) = 0.7, R (universal gas constant) = 8.3 J K^{-1} mol^{-1}. H, S and G are enthalpy, entropy and Gibbs energy, respectively.) **EC0190**

14. For the electrochemical cell,

$Mg(s) \mid Mg^{2+}$(aq, 1 M) $\mid \mid Cu^{2+}$ (aq, 1M) $\mid Cu(s)$

the standard emf of the cell is 2.70 V at 300 K. When the concentration of Mg^{2+} is changed to x M, the cell potential changes to 2.67 V at 300 K. The value of x is____. **[JEE-Adv. 2018]**

(Given, $\frac{F}{R} = 11500\ KV^{-1}$, where F is the Faraday constant and R is the gas constant, ln(10) = 2.30)

EC0191

ANSWER KEY

EXERCISE # S-I

1. Ans. (a) $2Ag + Cu^{2+} \longrightarrow 2Ag^+ + Cu$,

(b) $MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

(c) $2Cl^- + 2Ag^+ \longrightarrow 2Ag + Cl_2$, (d) $H_2 + Cd^{2+} \longrightarrow Cd + 2H^+$

2. Ans. (a) $Zn \mid Zn^{2+} \mid\mid Cd^{2+} \mid Cd$, (b) $Pt, H_2 \mid H^+ \mid\mid Ag^+ \mid Ag$,

(c) $Pt \mid Fe^{2+}, Fe^{3+} \mid\mid Cr_2O_7^{2-}, H^+, Cr^{3+} \mid Pt$

3. Ans. 1.61 V

4. Ans. 1.35 V

5. Ans. – 0.0367 V

6. Ans. 0.53 V, disproportionation

7. Ans. (7)

8. Ans. E =1.159V

9. Ans. $E^0_{cell} = +0.01V$, $E_{cell} = -0.0785V$, correct representation is $Pb|Pb^{2+}\ (10^{-3}M)||Sn^{2+}(1M)|Sn$

10. Ans. $[Cu^{2+}] = 2.97 \times 10^{-12}M$ for E =0

11. Ans. – 0.80 V, No

12. Ans. (i) $K_c = 10^{107}$ (ii) 609.20 kJ

13. Ans. $E^0 = -0.15$ volt

14. Ans. E = –0.81 V

15. Ans. $K_c = 7.6 \times 10^{12}$

16. Ans. $K_c = 2.18 \times 10^{26}$

17. $E^0 = 0.7826$ V

18. Ans. $K_w \approx 10^{-14}$

19. –1303.14 kJ/mol

20. Ans 3.86

21. Ans. (3)

22. Ans. 0.0295 V

23. Ans. pH = 4

24. Ans. E = 0.059

25. Ans. E = 0.41 Volt

26. Ans. (a) 6.02×10^{22} electrons lost, (b) 1.89×10^{22} electrons gained,

(c) (b) 1.80×10^{23} electrons gained

27. Ans. (a) 0.75 F, (b) 0.69 F, (c)1.1 F

28. Ans. (i) 54 gm, (ii) 16.35 gm

29. Ans. 0.112 litre

30. Ans. (i) 2.17 gm ; (ii) 1336. 15 sec

31. Ans. 1.023×10^5 sec

32. Ans. 115800C, 347.40 kJ

33. Ans. 44.77 gm , 12.54 litre

34. Ans. Rs. 0.75 x

35. Ans. A = 114, Q = 5926C

36. Ans. 60 %

37. Ans. 1.83g

38. Ans. 2M

39. Ans. (i) 250 mho $cm^2\ mol^{-1}$, (ii) 125 mho cm^2 equivalent^{-1}

40. Ans. 440 S cm^2 equivalent^{-1}

41. Ans. 0.00040 S cm^{-1} ; 2500 ohm cm

42. Ans. (i) 6.25×10^5 ohm, (ii) 1.6×10^{-6} amp

43. Ans. 0.0125 mho g equiv^{-1} m^2, 1.25×10^{-3} mho cm^{-1}

44. Ans. 8.60×10^{-4} gm|litre

45. Ans. 0.8

46. Ans. 10^{-10} mole^2 |litre^2

47. Ans. (i) 400 S $cm^2\ mol^{-1}$ (ii) 12 %

48. Ans. 510×10^{-4} mho $cm^2\ mol^{-1}$

49. Ans. $\alpha = 0.5$, $k = 10^{-3}$

50. Ans. (i) 7 (ii) 1×10^{-14}

EXERCISE # S-II

1. **Ans. – 0.46 V**
2. **Ans. (ii). 1.27 V, (iii) 245.1 kJ**
3. **Ans. $E^0 = -0.22$ V**
4. **Ans. $K_{sp} = 1.10 \times 10^{-16}$**
5. **Ans. $[Br^-] : [Cl^-] = 1 : 200$**
6. **Ans. –0.037 V**
7. **Ans. 1.54×10^{-5}**
8. **Ans. $K = 10^{268}$**
9. **Ans. 9.70gm**
10. **Ans. 42.20 %**
11. **Ans. 1.86×10^{6} year**
12. **Ans. 0.145**
13. **Ans. 0.04 metre**
14. **Ans. 0.19 gm|litre**
15. **Ans. n = 2**
16. **Ans. 0.52 V, 0.61 V**
17. **Ans. 0.0295 V**
18. **Ans. t = 193 sec**
19. **Ans. Final weight = 9.60g, 0.01 Eq of acid**
20. **Ans. t = 93.65 sec.**

EXERCISE # O-I

1. Ans.(B)
2. Ans.(C)
3. Ans.(A)
4. Ans.(C)
5. Ans.(D)
6. Ans.(C)
7. Ans.(A)
8. Ans.(C)
9. Ans.(A)
10. Ans.(A)
11. Ans.(C)
12. Ans.(C)
13. Ans.(A)
14. Ans.(D)
15. Ans.(D)
16 Ans.(A)
17. Ans.(B)
18. Ans.(D)
19. Ans.(C)
20. Ans.(A)
21. Ans.(A)
22 Ans.(D)
23. Ans.(B)
24. Ans.(A)
25. Ans.(C)
26. Ans.(C)
27. Ans.(A)
28. Ans.(B)
29. Ans.(A)
30. Ans.(D)
31. Ans.(C)
32. Ans.(B)
33. Ans.(C)
34. Ans.(A)
35. Ans.(D)
36. Ans.(D)
37. Ans.(C)
38. Ans.(A)
39. Ans.C)
40. Ans.(C)
41. Ans.(B)
42. Ans.(C)
43. Ans.(B)
44. Ans.(D)
45. Ans.(C)
46. Ans.(C)
47. Ans.(C)
48. Ans.(D)
49 Ans.(C)
50 Ans.(A)
51 Ans.(B)
52 Ans.(C)
53. Ans.(A)

EXERCISE # O-II

1. Ans. B
2. Ans. D
3. Ans. A
4. Ans. B
5. Ans. B
6. Ans. A
7. Ans. A
8. Ans. B
9. Ans. D
10. Ans. C
11. Ans. A
12. Ans. C
13. Ans. B
14. Ans. D
15. Ans. D
16. Ans. B
17. Ans. C
18. Ans. C
19. Ans. B
20. Ans. C,D
21. Ans. B,C,D
22. Ans. A,B
23. Ans. B,C
24. Ans. A,D
25. Ans. A
26. Ans. A
27. Ans. D
28. Ans. C
29. Ans. A
30. Ans. C
31. Ans. (A) P, Q (B) P, Q (C) Q, R, (D) P,S
32. Ans.(C)

EXERCISE # J-MAINS

1.	**Ans.(2)**	**2.**	**Ans.(1)**	**3.**	**Ans.(1)**	**4.**	**Ans.(4)**
5.	**Ans. (1)**	**6.**	**Ans.(3)**	**7.**	**Ans. (3)**	**8.**	**Ans. (2)**
9.	**Ans.(4)**	**10.**	**Ans.(2)**	**11**	**Ans. (1)**	**12.**	**Ans. (1)**
13.	**Ans.(3)**	**14.**	**Ans.(1)**	**15.**	**Ans.(2)**	**16.**	**Ans.(2)**
17.	**Ans.(4)**	**18.**	**Ans.(2)**	**19.**	**Ans.(1)**	**20.**	**Ans.(2)**
21.	**Ans.(1)**	**22.**	**Ans.(2)**	**23.**	**Ans.(2)**	**24.**	**Ans.(1)**
25.	**Ans.(3)**	**26.**	**Ans.(1)**	**27.**	**Ans.(1)**	**28.**	**Ans.(–0.93 to –0.94)**
29.	**Ans.(2.13 to 2.17)**	**30.**	**Ans.(5.66 to 5.68)**			**31.**	**Ans.(1)**

EXERCISE # J-ADVANCED

1.	**Ans.(D)**	**2.**	**Ans.(D)**	**3.**	**Ans.(D)**	**4.**	**Ans.(B)**
5.	**Ans.(D)**	**6.**	**Ans.(A)**	**7.**	**Ans.(A,B)**	**8.**	**Ans. (3)**
9.	**Ans. (4)**	**10.**	**Ans.(D)**	**11.**	**Ans.(6)**	**12.**	**Ans.(B)**
13.	**Ans.(–11.62)**	**14.**	**Ans.(10)**				