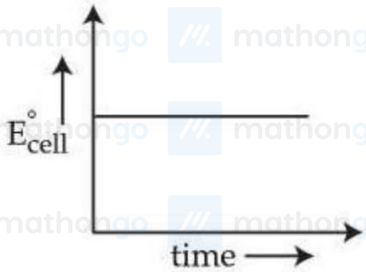
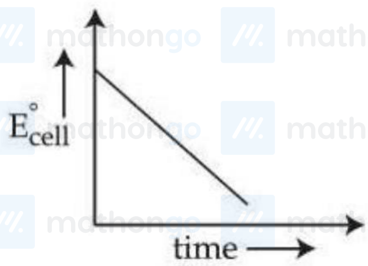
Q1. 21 January Shift 1

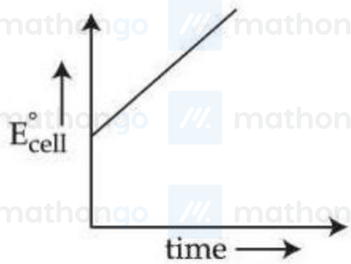
The pH and conductance of a weak acid (HX) was found to be 5 and 4×10^{-5} S, respectively. The conductance was measured under standard condition using a cell where the electrode plates having a surface area of 1 cm^2 were at a distance of 15 cm apart. The value of the limiting molar conductivity is ____ $Sm^2\ mol^{-1}$. (nearest integer) (Given : degree of dissociation of the weak acid $(\alpha) \ll 1$)

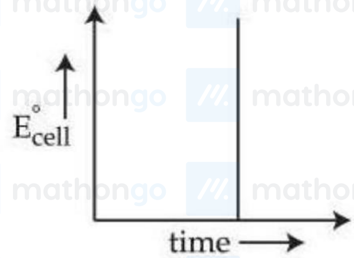
Q2. 21 January Shift 2

For a closed circuit Daniell cell, which of the following plots is the accurate one at a given temperature?

(1)


(2)


(3)


(4)


Q3. 21 January Shift 2

MX is a sparingly soluble salt that follows the given solubility equilibrium at 298 K.

$MX(s) \rightleftharpoons M^+(aq) + X^-(aq); K_{sp} = 10^{-10}$

If the standard reduction potential for $M^+(aq) \xrightarrow{+e^-} M(s)$ is $\left(E^\ominus_{M^+/M}\right) = 0.79$ V, then the value of the standard reduction potential for the metal/metal insoluble salt electrode $E^\ominus_{X^-/MX(s)/M}$ is ____ mV. (nearest integer)

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

Q4. 22 January Shift 1

Consider the following electrochemical cell at 298 K

$Pt\,|HSnO_2^-(aq)|Sn(OH)_6^{2-}(aq)\,|OH^-(aq)|Bi_2O_3(s)\,|\,Bi(s).$

If the reaction quotient at a given time is 10^6, then the cell EMF (E_{cell}) is ____ $\times 10^{-1}$ V (Nearest integer).

Given the standard half-cell reduction potential as

$E^\circ_{Bi_2O_3/Bi,OH^-} = -0.44$ V and $E^\circ_{Sn(OH)_6^{2-}/HSnO_2^-,OH^-} = -0.90$ V

Q5. 22 January Shift 2

Consider the following reduction processes :

$Al^{3+} + 3e^{-} \longrightarrow Al(s), E^{0} = -1.66\ V$

$Fe^{3+} + e^{-} \longrightarrow Fe^{2+}, E^{0} = +0.77\ V$

$Co^{3+} + e^{-} \longrightarrow Co^{2+}, E^{0} = +1.81\ V$

$Cr^{3+} + 3e^{-} \longrightarrow Cr(s), E^{\circ} = -0.74\ V$

The tendency to act as reducing agent decreases in the order :

(1) $Al > Cr > Fe^{2+} > Co^{2+}$
(2) $Cr > Fe^{2+} > Al > Co^{2+}$
(3) $Al > Fe^{2+} > Cr > Co^{2+}$
(4) $Al > Cr > Co^{2+} > Fe^{2+}$

Q6. 22 January Shift 2

Consider the following electrochemical cell : $Pt\,|O_2(g)(1bar)|HCl(aq)||M^{2+}(aq, 1.0M)\,|\,M(s)$ The pH above which, oxygen gas would start to evolve at anode is ____ (nearest integer).

$$\left[\text{Given: } \left.\begin{array}{l} E^{o}{}_{M^{2+}/M} = 0.994\ V \\ E^{o}{}_{O_2/H_2O} = 1.23\ V \end{array}\right\} \text{standard reduction potential} \right]$$

Q7. 23 January Shift 1

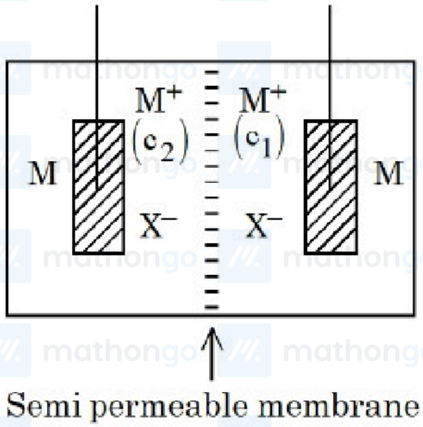
In the given electrochemical cell, $Ag(s)|AgCl(s)|FeCl_2(aq), FeCl_3(aq)\,|\,Pt(s)$ at 298 K, the cell potential (E_{cell}) will increase when :

A. Concentration of Fe^{2+} is increased.
B. Concentration of Fe^{3+} is decreased.
C. Concentration of Fe^{2+} is decreased.
D. Concentration of Fe^{3+} is increased.
E. Concentration of Cl^{-} is increased.

Choose the correct answer from the options given below :

(1) B Only
(2) A and E Only
(3) C, D and E Only
(4) A and B Only

Q8. 23 January Shift 2



Consider the above electrochemical cell where a metal electrode (M) is undergoing redox reaction by forming M^+ ($M \rightarrow M^+ + e^-$). The cation M^+ is present in two different concentrations c_1 and c_2 as shown above. Which of the following statement is correct for generating a positive cell potential?

(1) If c_1 is present at cathode, then $c_1 < c_2$.
(2) If c_1 is present at anode, then $c_1 > c_2$.
(3) If c_1 is present at cathode, then $c_1 > c_2$.
(4) If c_1 is present at anode, then $c_1 = c_2$.

Q9. 24 January Shift 1

Electricity is passed through an acidic solution of Cu^{2+} till all the Cu^{2+} was exhausted, leading to the deposition of 300 mg of Cu metal. However, a current of 600 mA was continued to pass through the same solution for another 28 minutes by keeping the total volume of the solution fixed at 200 mL. The total volume of oxygen evolved at STP during the entire process is ____ mL. (Nearest integer)

[Given: $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s) E^o_{red} = +0.34$ V
$O_2(g) + 4H^+ + 4e^- \rightarrow 2H_2O E^o_{red} = +1.23$ V
Molar mass of Cu $= 63.54$ g mol^{-1}
Molar mass of $O_2 = 32$ g mol^{-1}
Faraday Constant $= 96500$ C mol^{-1}
Molar volume at STP $= 22.4$ L]

Q10. 24 January Shift 2

Molar conductivity of a weak acid HQ of concentration 0.18 M was found to be 1/30 of the molar conductivity of another weak acid HZ with concentration of 0.02 M. If $\lambda^\circ Q^-$ happened to be equal with $\lambda^\circ Z^-$, then the difference of the pK_a values of the two weak acids ($pK_a(HQ) - pK_a(HZ)$) is ____ (Nearest integer).

[Given: degree of dissociation (α) $\ll 1$ for both weak acids, λ° : limiting molar conductivity of ions]

Q11. 28 January Shift 1

Consider the following redox reaction taking place in acidic medium

$BH_4^-(aq) + ClO_3^-(aq) \longrightarrow H_2BO_3^-(aq) + Cl^-(aq)$

If the Nernst equation for the above balanced reaction is

$E_{cell} = E^\circ_{cell} - \frac{RT}{nF} \ln Q,$

then the value of n is ____.

(Nearest integer)

Q12. 28 January Shift 2

For strong electrolyte Λ_m increases slowly with dilution and can be represented by the equation $\Lambda_m = \Lambda_m^\circ - Ac^{1/2}$

Molar conductivity values of the solutions of strong electrolyte AB at $18^\circ C$ are given below :

$c\ [mol\ L^{-1}]$	0.04	0.09	0.16	0.25
$\Lambda_m\ [S\ cm^2\ mol^{-1}]$	96.1	95.7	95.3	94.9

The value of constant A based on the above data $\left[\text{in } Scm^2\ mol^{-1}/(mol/L)^{1/2}\right]$ unit is ____.

Q13. 28 January Shift 2

A volume of x mL of $5M NaHCO_3$ solution was mixed with 10 mL of $2M H_2CO_3$ solution to make an electrolytic buffer. If the same buffer was used in the following electrochemical cell to record a cell potential of 235.3 mV, then the value of $x =$ ____ mL (nearest integer).

$Sn(s)\ |Sn(OH)_6{}^{2-}(0.5M)|HSnO_2{}^-(0.05M)\ |OH^-|Bi_2O_3(s)\ |\ Bi(s)$

Consider upto one place of decimal for intermediate calculations

$$\left[\begin{array}{ll} \text{Given :} & E^o_{HSnO_2{}^-|Sn(OH)_6{}^{2-}} = -0.9\ V \\ & E_{Bi_2O_3|Bi} = -0.44\ V \\ & pKa_{(H_2CO_3)} = 6.11 \\ & \frac{2.303RT}{F} = 0.059\ V \\ & \text{Antilog}\ (1.29) = 19.5 \end{array}\right]$$

ANSWER KEYS

1. 6	**2.** (1)	**3.** 200	**4.** 4	**5.** (1)	**6.** 4	**7.** (1)	**8.** (3)
9. 111	**10.** 2	**11.** 24	**12.** 4	**13.** 78			