

Questions with Answer Keys

MathonGo

Q1 (20 July 2021 Shift 2)

Potassium chlorate is prepared by electrolysis of KCl in basic solution as shown by following equation.



A current of xA has to be passed for 10 h to produce 10.0 g of potassium chlorate. the value of x is ____

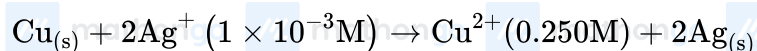
(Nearest integer)

(Molar mass of $\text{KClO}_3 = 122.6 \text{ g mol}^{-1}$)

$F = 96500\text{C}$)

Q2 (22 July 2021 Shift 1)

Assume a cell with the following reaction



$$E_{\text{cell}}^\ominus = 2.97 \text{ V}$$

E_{cell} for the above reaction is V.

(Nearest integer)

[Given : $\log 2.5 = 0.3979$, $T = 298 \text{ K}$]

Q3 (25 July 2021 Shift 1)

Consider the cell at 25°C $\text{Zn} | \text{Zn}^{2+}(\text{aq}), (1\text{M}) || \text{Fe}^{3+}(\text{aq}), \text{Fe}^{2+}(\text{aq}) | \text{Pt}(\text{s})$

The fraction of total iron present as Fe^{3+} ion at the cell potential of 1.500 V is $x \times 10^{-2}$. The value of x

(Nearest integer) (Given: $E_{\text{Fe}^{2+}/\text{Fe}^{3+}}^0 = 0.77 \text{ V}$, $E_{\text{Zn}^{2+}/\text{Zn}}^0 = -0.76 \text{ V}$)

Q4 (27 July 2021 Shift 1)

The conductivity of a weak acid HA of concentration 0.001 mol L^{-1} is $2.0 \times 10^{-5} \text{ S cm}^{-1}$. If

$\Lambda_m^\circ(\text{HA}) = 190 \text{ S cm}^2 \text{ mol}^{-1}$, the ionization

constant (K_a) of HA is equal to $\times 10^{-6}$

(Round off to the Nearest Integer)

Q5 (27 July 2021 Shift 2)

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For the cell



the cell potential $E_1 = 0.3095 \text{ V}$

For the cell



the cell potential = $\times 10^{-2} \text{ V}$. (Round off the Nearest Integer).

$$\left[\text{Use : } \frac{2.303RT}{F} = 0.059 \right]$$

Questions with Answer Keys

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Answer Key

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Q1 (1)

Q2 (3)

Q3 (24)

Q4 (12)

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Q5 (28)

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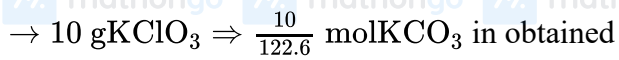
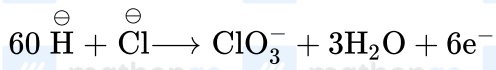
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Hints and Solutions

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Q1

Given balanced equation is



→ from the above reaction, it is concluded that by

6F charge 1 mol KClO₃ is obtained.

→ By the passage of 6 F charge = 1 mol KClO₃

∴ By the passage of $\frac{x \times 10 \times 60 \times 60}{96500}$ F charge

$$= \frac{1}{6} \times \frac{x \times 10 \times 60 \times 60}{96500}$$

$$\text{Now } \frac{x \times 10 \times 60 \times 60}{6 \times 96500} = \frac{10}{122.6}$$

$$\Rightarrow x = \frac{10 \times 965}{60 \times 122.6} = \frac{965}{735.6} = 1.311 \simeq 1$$

OR

$$W = \frac{E}{F} \times I \times t$$

$$10 = \frac{122.6}{96500 \times 6} \times x \times 10 \times 3600$$

$$X = 1.311$$

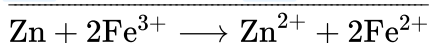
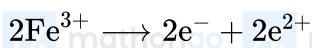
Ans.(1)

Q2

$$E = E^\circ - \frac{0.059}{2} \log \frac{[\text{Cu}^{2+}]}{[\text{Ag}^+]^2}$$

$$= 2.97 - \frac{0.059}{2} \log \frac{0.25}{(10^{-3})^2} = 2.81 \text{ V}$$

Q3



$$E_{\text{cell}}^0 = 0.77 - (0.76)$$

$$= 1.53 \text{ V}$$

Hints and Solutions

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$$1.50 = 1.53 - \frac{0.06}{2} \log \left(\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} \right)^2$$

$$\log \left(\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} \right) = \frac{0.03}{0.06} = \frac{1}{2}$$

$$\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} = 10^{1/2} = \sqrt{10}$$

$$\frac{[\text{Fe}^{3+}]}{[\text{Fe}^{2+}]} = \frac{1}{\sqrt{10}}$$

$$\frac{[\text{Fe}^{3+}]}{[\text{Fe}^{2+}] + [\text{Fe}^{3+}]} = \frac{1}{1 + \sqrt{10}} = \frac{1}{4.16}$$

$$= 0.2402$$

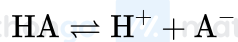
$$= 24 \times 10^{-2}$$

Q4

$$\Lambda_m = 1000 \times \frac{\text{K}}{\text{M}}$$

$$= 1000 \times \frac{2 \times 10^{-5}}{0.001} = 20 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Rightarrow \alpha = \frac{\Lambda_m}{\Lambda_m^\infty} = \frac{20}{190} = \left(\frac{2}{19} \right)$$



$$0.001(1 - \alpha) \quad 0.001\alpha \quad 0.001\alpha$$

$$\Rightarrow K_a = 0.001 \left(\frac{\alpha^2}{1 - \alpha} \right) = \frac{0.001 \times \left(\frac{2}{19} \right)^2}{1 - \left(\frac{2}{19} \right)}$$

$$= 12.3 \times 10^{-6}$$

Q5

Cell reaction is:



$$\text{Now, } E_{\text{cell}} = E_{\text{Cell}}^\circ - \frac{0.059}{2} \log \frac{[\text{Cu}^{2+}]}{[\text{Ag}^+]^2} \dots (1)$$

$$\therefore E_1 = 0.3095 = E_{\text{Cell}}^\circ - \frac{0.059}{2} \cdot \log \frac{0.01}{(0.001)^2} \dots (2)$$

$$\text{From (1) and (2), } E_2 = 0.28 \text{ V} = 28 \times 10^{-2} \text{ V}$$