



3.8. Suggest a way to determine the value of water.

Ans:

By using Kohlrausch's law,  $\Lambda_m^\circ$  for  $H_2O$  can be calculated, we can write,

$$\Lambda_m^\circ = \Lambda_m^\circ (HCl) + \Lambda_m^\circ (NaOH) - \Lambda_m^\circ (NaCl)$$

Being strong electrolytes,  $\Lambda_m^\circ$  values of HCl, NaOH and NaCl are known. By substituting their values, we can obtain  $\Lambda_m^\circ$  for  $H_2O$ .

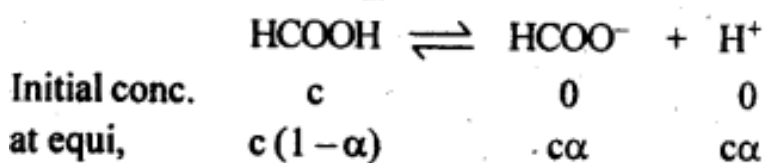
3.9. The molar conductivity of  $0.025 \text{ mol L}^{-1}$  methanoic acid is  $46.1 \text{ S cm}^2 \text{ mol}^{-1}$ . Calculate its degree of dissociation and dissociation constant Given  $\lambda^\circ(H^+) = 349.6 \text{ S cm}^2 \text{ mol}^{-1}$  and  $\lambda^\circ(HCOO^-) = 54.6 \text{ S cm}^2 \text{ mol}^{-1}$ .

Ans:

$$\begin{aligned}\Lambda_m^\circ(HCOOH) &= \lambda^\circ(H^+) + \lambda^\circ(HCOO^-) \\ &= 349.6 + 54.6 \\ &= 404.2 \text{ S cm}^2 \text{ mol}^{-1}\end{aligned}$$

$$\Lambda_m^C = 46.1 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\therefore \alpha = \frac{\Lambda_m^C}{\Lambda_m^\circ} = \frac{46.1}{404.2} = 0.114$$



$$\begin{aligned}\therefore K_a &= \frac{c\alpha \cdot c\alpha}{c(1-\alpha)} = \frac{c\alpha^2}{1-\alpha} \\ &= \frac{0.025 \times (0.114)^2}{1-0.114} = 3.67 \times 10^{-4}\end{aligned}$$

3.10. If a current of 0.5 ampere flows through a metallic wire for 2 hours, then how many electrons would flow through the wire?

Ans:

We know,  $Q = It$   
 $= 0.5 \times (2 \times 60 \times 60)$   
 $= 3600 \text{ C}$

$1 \text{ F} \Rightarrow 96500 \text{ C} \Rightarrow 1 \text{ mole of } e^{-1} \text{ s}$

$\Rightarrow 6.02 \times 10^{23} e^{-1} \text{ s}$

$\therefore 3600 \text{ C}$  is equivalent to the flow of  $e^{-1} \text{ s}$

$$= \frac{6.02 \times 10^{23}}{96500} \times 3600$$

$$= 2.246 \times 10^{22} e^{-1} \text{ s}$$

3.11. Suggest a list of metals that are extracted electrolytically.

Ans: Na, Ca, Mg and Al

3.12. Consider the reaction:  $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6e^- \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$

What is the quantity of electricity in coulombs needed to reduce 1 mol of  $\text{Cr}_2\text{O}_7^{2-}$  ?

Ans:

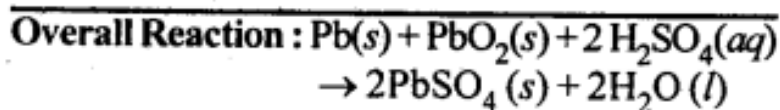
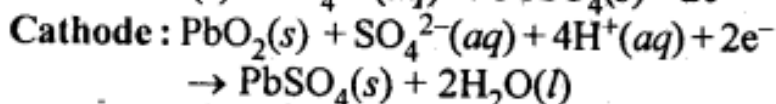
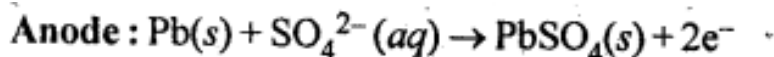
From the reaction, 1 mol of  $\text{Cr}_2\text{O}_7^{2-}$  require  $6\text{F}$   
 $= 6 \times 96500 = 579000 \text{ C}$

$\therefore 579000 \text{ C}$  of electricity are required for reduction of  $\text{Cr}_2\text{O}_7^{2-}$  to  $\text{Cr}^{3+}$

3.13. Write the chemistry of recharging the lead storage battery, highlighting all the materials that are involved during recharging.

Ans: A lead storage battery consists of anode of lead, cathode of a grid of lead packed with lead dioxide ( $\text{PbO}_2$ ) and 38%

$\text{H}_2\text{SO}_4$  solution as electrolyte. When the battery is in use, the reaction taking place are:



On charging the battery, the reverse reaction takes place, i.e.,  $\text{PbSO}_4$  deposited on electrodes is converted back to Pb and  $\text{PbO}_2$  and  $\text{H}_2\text{SO}_4$  is regenerated.

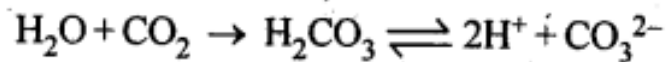
3.14. Suggest two materials other than hydrogen that can be used as fuels in fuel cells.

Ans: Methane and Methanol.

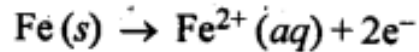
3.15. Explain how rusting of iron is envisaged as setting up of an electrochemical cell.

Ans: The water present on the surface of iron dissolves acidic oxides of air like  $\text{CO}_2$ ,  $\text{SO}_2$ , etc. to form acids which dissociate to give

$\text{H}^+$  ions :

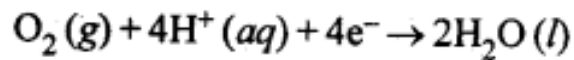


In the presence of  $\text{H}^+$ , iron loses  $e^-$ s to form  $\text{Fe}^{3+}$ . Hence, this spot acts as anode:

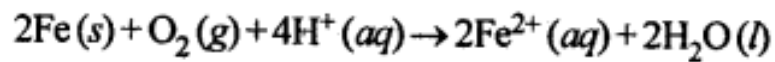


The  $e^-$ s released move through the metal to reach another spot where  $\text{H}^+$  ions and dissolved oxygen take up these  $e^-$ s and reduction occurs.

This spot, thus, acts as cathode :



The overall reaction is :



Thus, an electrochemical cell is set up on the surface.

Ferrous ions are further oxidised by atmospheric oxygen to ferric ions which combine with water to form hydrated ferric oxide,  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ , which is rust.

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