ELECTROCHEMISTRY

ELECTROLYTIC CELLS AND ELECTROLYSIS

CHEMISTRY 165 // SPRING 2020

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PRACTICE PROBLEM 1

A current of 10.23 A is passed through a solution of silver nitrate for 1800. seconds. What mass of silver can be plated onto the cathode electrode?

– answer –

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The reaction we are interested in is the cathodic reaction: Ag^{+} (aq) + e^{-} → Ag (s).

We can determine the amount of Ag using the stoichiometry of the equation above where $n = 1$, $F = 96500 \frac{\mathrm{C}}{\mathrm{mol}\ e^{-}}$, and $1\ \mathrm{A} = 1 \frac{\mathrm{C}}{\mathrm{s}}$.

$$m_{\mathrm{Ag}} = 1800.\ \mathrm{s} \times \frac{10.23\ \mathrm{C}}{1\ \mathrm{s}} \times \frac{1\ \mathrm{mol\ e^{-}}}{96500\ \mathrm{C}} \times \frac{1\ \mathrm{mol\ Ag}}{1\ \mathrm{mol\ e^{-}}} \times \frac{107.9\ \mathrm{g\ Ag}}{1\ \mathrm{mol\ Ag}} = 20.59\ \mathrm{g\ Ag}$$

PRACTICE PROBLEM 2

$$O_2\,(g) + 4\,H^+\,(aq) + 4\,e^- \rightarrow 2\,H_2O\,(l) \qquad E^\circ = +1.229\ \text{V}$$

$$2\,H^+\,(aq) + 2\,e^- \rightarrow H_2\,(g) \qquad E^\circ = 0\ \text{V}$$

An electrolytic cell is constructed from the reactions above. How many moles of O_2 (g), at 25 °C and 1.00 atm, are produced if the electrolytic cell is operated at a current of 0.025 A for 1.0 hour?

— answer —

PRACTICE PROBLEM 2

$$O_2\ (g) + 4\ H^+\ (aq) + 4\ e^- \rightarrow 2\ H_2O\ (l) \qquad E^o = +1.229\ \text{V}$$

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First, write out the balanced net ionic equation for the nonspontaneous electrolytic cell reaction where $E^o_{\text{cell}} < 0\ \text{V}$ and $\Delta G^o > 0$.

Cathode (Reduction):	2 × [	$2\ H^+$ (aq)	+	$2\ e^-$	→	H_2 (g)	]				
Anode (Oxidation):				$2\ H_2O$ (l)	→	O_2 (g)		+	$4\ H^+$ (aq)	+	$4\ e^-$
Cell				$2\ H_2O$ (l)	→	$2\ H_2$ (g)		+	O_2 (g)		

We can determine the amount of O_2 using the stoichiometry of the equation above where $n = 4$, $F = 96500\ \frac{\text{C}}{\text{mol}\ e^-}$, and $1\ \text{A} = 1\ \frac{\text{C}}{\text{s}}$.

$$n_{O_2} = 1.0\ \text{hr} \times \frac{3600\ \text{s}}{1\ \text{hr}} \times \frac{0.025\ \text{C}}{1\ \text{s}} \times \frac{1\ \text{mol e}^-}{96500\ \text{C}} \times \frac{1\ \text{mol O}_2}{4\ \text{mol e}^-} = 2.3 \times 10^{-4}\ \text{mol O}_2$$