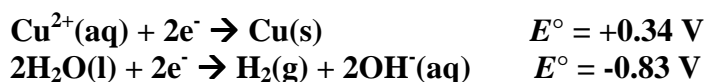


- An aqueous solution of CuSO_4 is electrolysed with a current of 1.00 A for 60 minutes. Calculate the mass of the products that are formed at the two electrodes.

If a current of 1.00 A is passed for 60 minutes, the number of electrons delivered is,

$$\text{moles of } e^- = \frac{It}{F} = \frac{(1.00 \text{ A}) \times (60 \times 60 \text{ s})}{(96485 \text{ C mol}^{-1})} = 0.037 \text{ mol}$$

At the cathode, the two possible reduction reactions are:



The reduction of $\text{Cu}^{2+}(\text{aq})$ is much easier (E is less negative) so $\text{Cu}(\text{s})$ is formed on the cathode.

[This potential for the reduction of water corresponds to $[\text{H}^+(\text{aq})] = 1 \text{ M}$. Using the Nernst equation gives $E = -0.42 \text{ V}$ for a pH 7 solution. An overpotential of 0.4 to 0.6 V must be added so that the reduction potential is actually $\sim 1 \text{ V}$. Thus it is even more difficult to reduce water than the E° value suggests.]

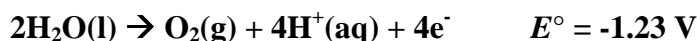
Each mole of $\text{Cu}(\text{s})$ requires 2 moles of electrons so,

$$\text{number of moles of Cu(s)} = \frac{1}{2} \times 0.037 \text{ mol} = 0.019 \text{ mol}$$

The atomic mass of Cu is 63.55 g mol^{-1} so the mass of copper deposited is,

$$\begin{aligned} \text{mass of Cu(s)} &= \text{number of moles} \times \text{molar mass} \\ &= 0.019 \text{ mol} \times 63.55 \text{ g mol}^{-1} = 1.2 \text{ g} \end{aligned}$$

At the anode, oxidation of H_2O occurs to produce $\text{O}_2(\text{g})$.



As SO_4^{2-} contains S(VI), further oxidation is very difficult.

Production of each mole of $\text{O}_2(\text{g})$ requires 4 moles of electrons so,

$$\text{number of moles of O}_2(\text{g}) = \frac{1}{4} \times 0.037 \text{ mol} = 0.0093 \text{ mol}$$

The molar mass of O_2 is $(2 \times 16.00) = 32.00 \text{ g mol}^{-1}$ so the mass of $\text{O}_2(\text{g})$ formed is,

$$\begin{aligned} \text{mass of O}_2(\text{g}) &= \text{number of moles} \times \text{molar mass} \\ &= 0.0093 \text{ mol} \times 32.00 \text{ g mol}^{-1} = 0.30 \text{ g} \end{aligned}$$