C18 Calculating with Faradays

A solution of $CuSO_4(aq)$ is electrolyzed for 20.0 min with 2.0 A of current. Calculate the mass of metal produced.

Cu^{2+}, SO_4^{2-}, H_2O

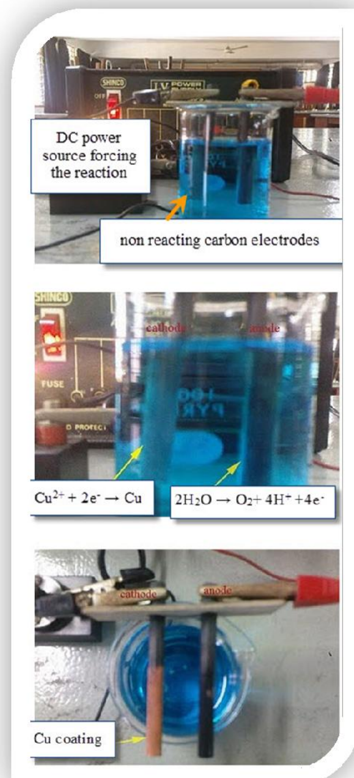
$4e^- + O_2(g) + 4H^+(aq) \leftarrow 2H_2O(l)$	oxidation	1.23 V
$Cu^{2+}(aq) + 2e^- \rightarrow Cu$	reduction	0.52 V

$E°_{rx} = E°_{red} - E°_{ox}$

$E°_{rx} = 0.52\text{ V} - 1.23\text{ V}$

$E°_{rx} = -0.71\text{ V}$

This is a nonspontaneous reaction. It will not occur unless energy is used to force it. This requires a power source to force the electrons to reduce the copper and simultaneously oxidize the water to generate acid and oxygen. Electrolysis only occurs with a power source forcing the reaction.



$Cu^{2+}(aq) + 2e^- \rightarrow Cu$

$I \times t$ = coulombs of electrons

$F = 9.65\times10^4$ C/mol e$^-$

$$n_{e^-} = \frac{I \times t}{F}$$

$$n_{e^-} = \frac{\left(2.0\ \frac{C}{s}\right) \times 20.\text{ min} \times \frac{60\ s}{\text{min}}}{96500\ \frac{C}{\text{mol } e^-}} = 0.02487 \text{ mol e}^-$$

$$0.02487 \text{ mol } e^- \times \frac{1 \text{ mol Cu}}{2 \text{ mol e}^-} \times \frac{63.55 \text{ g Cu}}{1 \text{ mol Cu}} = 0.79 \text{ g Cu}$$