Answer on the question #62724, Chemistry / Physical Chemistry

Question:

1 dm3 of a solution of 2.0 M CuSO4 is electrolysed using platinum electrodes by passing 4.50 A current for 9000 s. Calculate
i) the mass of Cu deposited, and
ii) the amount of Cu2+ in the solution at the end of electrolysis.

Solution:

i) According to Faraday laws, the mass of the substance, deposited on the electrode is:

$$m = \frac{Q}{F} \cdot \frac{M}{z},$$

where $Q = At$ is the total electric charge passed through the substance in coulombs, F= 96485 C/mol is the Faraday constant; *M* is the molar mass of the substance in grams per mol; *z* is the valency number of ions of the substance (electrons transferred per ion).

Then, taking the total electric charge as the product of current and time, we get the mass of Cu deposited:

$$m = \frac{At}{F} \cdot \frac{M}{z} = \frac{4.5(A) \cdot 9000(s)}{96485(C \cdot mol^{-1})} \cdot \frac{63.546\ (g \cdot mol^{-1})}{2} = 13.34\ (g),$$

ii) Let's calculate the total mass of Cu in the solution before the electrolysis:

$$m_{tot} = nM = cVM = 2.0\ (mol\ \cdot L^{-1}) \cdot 1(L) \cdot 63.546\ (g \cdot mol^{-1}) = 127.09\ (g)$$

Then, the mass of copper left in the solution is:

$$m_{left} = m_{tot} - m_{deposited} = 127.09 - 13.34 = 113.76\ (g)$$

Answer: i) 13.34 g; ii) 113.76 g.