

1 Determination of the electron charge

1.1 Theory

We start from the definition of electric current

$$I = \frac{dQ}{dt} \quad (1)$$

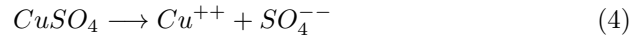
Integrating from a time $t = 0$ to a time t , we found that the charge is

$$Q = \int_0^t I dt \quad (2)$$

If we keep the current constant we will have that

$$Q = It \quad (3)$$

Now, let us to consider an electrolytic reaction of a copper sulphate. In the presence of an electric field, a solution containing this sulphate will experience a chemical reaction



Let us to put two copper plates as in Figure 1. For two electrons arriving to the cathode, we will get an atom of copper. Thus, when we have deposited N copper atoms, the charge in circulation will be

$$Q = 2Ne \quad (5)$$

with e the charge of the electron.

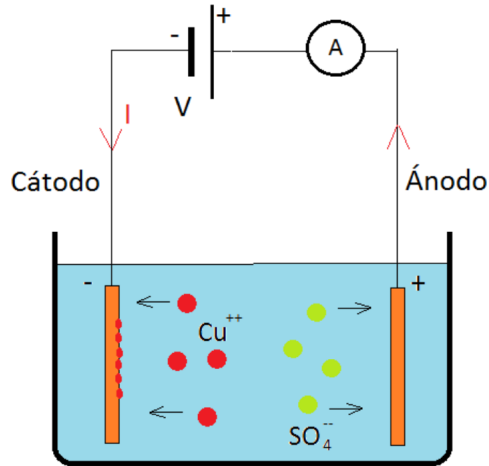


Figure 1: Copper plates in a solution of copper sulphate.

Combining equations (3) and (5) we will have:

$$e = \frac{It}{2N} \quad (6)$$

To determine the number of atoms deposited in the cathode we can use the mass of the copper plate where these atoms are deposited. Thus,

$$N = \frac{\Delta m}{PM(Cu)} N_{Av} \quad (7)$$

where N_{av} is the Avogadro number $N_{av} = 6.02 \cdot 10^{23}$, $PM(Cu) = 653.546 \text{ gr/mol}$ is the atomic weight of the copper. Also $\Delta m = m - m_0$ is the difference between the mass of the plate after the process denoted by m and m_0 corresponds to the initial mass.

1.2 Experiment and result

We used a continuous current of 1 A in three glass containers with their respective cathodes and anodes. They were kept during 1803.46 s. For these three cases, the number of deposited atoms were around $5.69 \cdot 10^{21}$. In consequence, the experimental value for the charge of the electron was

$$e = 1.6 \cdot 10^{-19} \text{ C} \quad (8)$$

The accepted value is approximately $e = 1.602 \cdot 10^{-19} \text{ C}$, Therefore, we got a difference of 0.125%.