Chemistry 3
Set of exercises-4
Electrolysis- Faraday's law

Exercice1: Identical amount of electricity flows through these four following solutions **:**
a/ zinc sulfate $ZnSO_4$ b/ silver nitrate $AgNO_3$
c/ cobalt chloride $CoCl_2$ d/ chromic iodide CrI_3

In the first solution, 0.9807g of Zn were deposited. Calculate :

- The amount of electricity flowing the solutions.
- The respective masses of Ag, Co deposited on the cathodes by the solutions b and c.
- The masses of chromium and iodine (I_2) formed in the electrodes for the solution d.

Data : M(Zn)=65.39 ; M(Ag)=107.87 ; M(Co)=58.93 ; M(Cr)=52, M(I)=126.9 g/mol

Exercice2: Two cells connected in series. The first is used to deposit zinc, from a solution of $Zn(CN)_2$, over an electrode with a surface area of $1.4x10^{-2}$ m^2. The second is a copper coulometer (unit efficiency). After 20 min electrolysis, the deposited mass of zinc on the cathode of the first cell is 1.82g, while the mass of copper deposited on the cathode of the second cell is 2.1 g. Calculate for the first cell :

- The current efficiency.
- The thickness of the deposited layer.
- The cathodic current density.
  Data : $\rho_{Zn} = 7.14g/cm^3$. M(Cu) = 63.55 g/mol

Exercice3: In a electrolytic cell of production of soda and chlorine from brine, the reaction is as follows :

$$NaCl + H_2O \rightarrow NaOH + ½\ H_2 + 1/2\ Cl_2$$

A current intensity of 22000 A is applied during 24h. The volume of NaOH solution electrically obtained is 5.45 m^3 with a concentration of 138 kg/m^3. What is the current efficiency of this process ?

Exercice4: The products of electrolysis of a solution of $NaNO_3$ acidified with HNO_3 are as follows :

- A volume of hydrogen gas of 1876 ml in normal conditions.
- A mass of 0.1336g of $NaNO_2$ in solution.
- A mass of 0.0326g of NH_3 in solution.

-Write the reactions corresponding to the production of H_2, $NaNO_2$ and NH_3.

-Calculate the current efficiency relative to each obtained product.

Exercice5: The oxidation of potassium chloride into potassium perchlorate takes place in aqueous acidic solution by electrolysis in a cell with two platinium electrodes, using current intensity of 2500 A and a voltage of 3.5 V.
After 8h electrolysis, a volume of 1.82 m^3 of oxygen is obtained in the conditions (101.3 kPa, 67°C), calculate :

- The current efficiency.
- The energy efficiency.
- The consumed energy.
- The cost in terms of energy of one ton of produced potassium perchlorate ($KClO_4$).

Data : the minimum electrolysis voltage Uth = 1.25V,

Le price of one kWh = 2.5 AD and the molar mass of $KClO_4$ = 138.5g.