2. Answer the following questions involving the stoichiometry and thermodynamics of reactions containing aluminum species.

$$2\ Al_2O_3(l)\ +\ 3\ C(s)\ \rightarrow\ 4\ Al(l)\ +\ 3\ CO_2(g)$$

An electrolytic cell produces 235 g of $Al(l)$ according to the equation above.

(a) Calculate the number of moles of electrons that must be transferred in the cell to produce the 235 g of $Al(l)$.

(b) A steady current of 152 amp was used during the process. Determine the amount of time, in seconds, that was needed to produce the $Al(l)$.

(c) Calculate the volume of $CO_2(g)$, measured at 301 K and 0.952 atm, that is produced in the process.

(d) For the electrolytic cell to operate, the Al_2O_3 must be in the liquid state rather than in the solid state. Explain.

When $Al(s)$ is placed in a concentrated solution of KOH at 25°C, the reaction represented below occurs.

$$2\ Al(s)\ +\ 2\ OH^-(aq)\ +\ 6\ H_2O(l)\ \rightarrow\ 2[Al(OH)_4]^-(aq)\ +\ 3\ H_2(g)$$

Half-reaction	$E°$ (V)
$[Al(OH)_4]^-(aq) + 3\ e^-\ \rightarrow\ Al(s)\ +\ 4\ OH^-(aq)$	−2.35
$2\ H_2O(l)\ +\ 2\ e^-\ \rightarrow\ H_2(g)\ +\ 2\ OH^-(aq)$	−0.83

(e) Using the table of standard reduction potentials shown above, calculate the following.

(i) $E°$, in volts, for the formation of $[Al(OH)_4]^-(aq)$ and $H_2(g)$ at 25°C

(ii) $\Delta G°$, in kJ/mol$_{rxn}$, for the formation of $[Al(OH)_4]^-(aq)$ and $H_2(g)$ at 25°C