AP Free Response Practice! (2015 #1)

Half-Reaction	$E°$ (V)
$2\,CO_2(g) + 12\,H^+(aq) + 12\,e^- \rightarrow C_2H_5OH(aq) + 3\,H_2O(l)$	-0.085
$O_2(g) + 4\,H^+(aq) + 4\,e^- \rightarrow 2\,H_2O(l)$	1.229

$\Rightarrow E°_{ox} = +0.085$ V

$\Rightarrow E°_{red} = 1.229$ V

2. A student used a galvanic cell to determine the concentration of ethanol, C_2H_5OH, in an aqueous solution. The cell is based on the half-cell reactions represented in the table above.

   a. Write a balanced equation for the overall reaction that occurs in the cell.

   b. Calculate $E°$ for the overall reaction that occurs in the cell.

   c. A 10.0 mL sample of $C_2H_5OH(aq)$ is put into the electrochemical cell. The cell produces an average current of 0.10 amp for 20. Seconds, at which point the $C_2H_5OH(aq)$ has been totally consumed.

      i. Calculate the charge, in coulombs, that passed through the cell.

      ii. Calculate the initial $[C_2H_5OH]$ in the solution.

#2.)

(a) $C_2H_5OH_{(aq)} + 3H_2O_{(l)} \rightarrow 2CO_{2(g)} + 12H^+_{(aq)} + 12e^-$

$3O_{2(g)} + 12H^+_{(aq)} + 12e^- \rightarrow 6H_2O_{(l)}$ +

$C_2H_5OH_{(aq)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$

(b) $E°_{cell} = E°_{ox} + E°_{red} = 0.085 + 1.229 = \boxed{+1.314\ V}$

(c)(i) $20.\ sec \times \frac{0.10\ C}{1\ s} = \boxed{2.0\ C}$

(ii) $2.0\ C \times \frac{1\ mol\ e^-}{96{,}485\ C} \times \frac{1\ mol\ C_2H_5OH}{12\ mol\ e^-} = 1.7E\text{-}6\ mol\ C_2H_5OH$

$[C_2H_5OH] = \frac{1.7E\text{-}6\ mol}{0.0100\ L} = \boxed{1.7 \times 10^{-4}\ M\ C_2H_5OH}$