# Answer on Question #55705 - Chemistry - Physical chemistry

**Question:**

For the reaction H2+2AgCl+2H2O=2Ag(s)+2H3O++2Cl- at 250C. The slandered free energy of formation of AgCl (s), H2O(l), H3O+ and Cl- are -110,-237, -200-α, (-168+α)KJ/mol. Where α is not known. Calculate the cell voltage if this reaction is run at 250C and 0.8 atm in a cell in which [H3O+] and [Cl-] are 0.006M and 0.02M respectively

**Solution**

The corresponding half-reactions are

$2AgCl + 2e = 2Ag + 2Cl^-$ ; $\Delta G^0_1 = 2\Delta G(Ag) + 2\Delta G(Cl^-) - 2\Delta G(AgCl)$; $E^0_1 = - G^0_1/(nF)$

$H_2 + 2H_2O- 2e = 2H_3O^+$; ; $\Delta G^0_2 = 2\Delta G(H_3O^+) - 2\Delta G(H_2O) - \Delta G(H_2)$; $E^0_2= - \Delta G^0_2/(nF)$

For the overall process

$\Delta G^0 = 2\Delta G^0 (H_3O^+) + 2\Delta G^0 (Ag) + 2\Delta G^0 (Cl^-) - 2\Delta G^0 (AgCl) - 2\Delta G^0 (H_2O) - \Delta G^0 (H_2)$

The reference data for $\Delta G^0$ (Ag) =0 and $\Delta G^0$ ($H_2$) = 0 because these sunstances are simple.

The standard free energy change is $\Delta G^0 =2(-200 - \alpha) + 2(\alpha-168)+2(0) – 2(-110) – 2(-237) = -42$ kJ

The non-standard free energy change is $\Delta G = \Delta G^0 + RTln([Cl^-]^2[ H_3O^+]^2/p(H_2))$

$\Delta G = -42x10^3 + 8.31x298xln(0.02^2 0.006^2/0.8)= -8.611x10^4$ J

The cell voltage is

$E= - G/(nF) = 8.611x10^4/(2x96500) = -0.446$ V

**Answer: -0.446 V**