Answer on Question #60012 – Chemistry – General Chemistry

1. What is the emf when [Cr3+]=7.42M, [HSO4-]=6.13M, and the pH=1.05 at 298K?

Conditions:

$C(Cr^{3+})=7.42M$
$C(HSO_4^-)=6.13M$
pH=1.05
T=298K

Emf -?

Solution:

1. In condition of low pH part of HSO_4^- can be in form of sulfide
   $HSO_4^- \rightarrow SO_4^{2-} + H^+$ $Ka_2=1.2*10^{-2}$
2. $pH= -lg[H^+]=1.05$ => $[H^+]=0.89M$
3. $Ka_2 = [H^+]*[SO_4^{2-}]/[HSO_4^-]$, Hereof $[SO_4^{2-}]= Ka_2*[HSO_4^-]/[H^+]$
   $[SO_4^{2-}]=1.2*10^{-2}*6.13/0.89=0.0655M$
   The chromium sulfate is insoluble in water or acid then the $Cr_2(SO_4)_3$ precipitates
   The amount of Cr^{3+} in the deposit will be = (2/3)*0.0655=0.044M

4. The equilibrium concentration of chromium Cr^{3+} is 7.42-0.044=7.376M
5. Electromotive force
   E (Cr3+/Cr) = Eº (Cr3+/Cr) + 0,059 lg[Cr3+] /n = – 0,74 + 0,059 lg[Cr3+]/3 = – 0,74 + 0,0196 *0.868 = 0.723(V)

Answer: Emf=0.723(V)