# CHEMISTRY 133

## Quiz 3 – Solutions

Calculate E° for the half-reaction $Pd(OH)_2(s) + 2e^- \leftrightarrow Pd(s) + 2OH^-$ given that $K_{sp}$ for $Pd(OH)_2$ is $3 \times 10^{-28}$ and E° = 0.915 V for the reaction $Pd^{2+} + 2e^- \leftrightarrow Pd(s)$. R = 8.314 J $mol^{-1}$ $K^{-1}$

Equations that might be useful:

$$E = E^o - \frac{RT}{nF}\ln Q = E^o - \frac{2.303RT}{nF}\log Q = E^o - \frac{0.05916}{n}\log Q \,(\mathrm{T} = 298\ \mathrm{K})$$

$\Delta G° = - nFE°$ and $\Delta G° = -RT\ln K$ F = 96,500 C/mol e

*If we look at the reaction associated with $K_{sp}$ and the reduction of $Pd^{2+}$ to Pd(s), we can see that these combined gives the half reaction for which we want to calculate E°:*

*1) $Pd(OH)_2(s) + 2e^- \leftrightarrow Pd^{2+} + 2OH^-$*

*2) $Pd^{2+} + 2e^- \leftrightarrow Pd(s)$*

*(1) + (2) = rxn3: $Pd(OH)_2(s) + 2e^- \leftrightarrow Pd(s) + 2OH^-$*

*Thus, $\Delta G°_{rxn1} + \Delta G°_{rxn2} = \Delta G°_{rxn3}$ and $\Delta G°_{rxn1} = -RT\ln K$ and $\Delta G°_{rxn2} = -nFE°_{rxn2}$*

*$\Delta G°_{rxn3} = -(8.314\ J\ mol^{-1}\ K^{-1})(298\ K)\ln K + -(2mol\ e)(96{,}500\ C/mol\ e)(0.915\ V)$*

*(note: standard conditions means T = 25C = 298K)*

*$\Delta G°_{rxn3} = -(8.314\ J\ mol^{-1}\ K^{-1})(298\ K)(-63.37) - 176{,}600\ J\ mol^{-1}$*

*$\Delta G°_{rxn3} = -19{,}590\ J\ mol^{-1} = -nFE°$ or $E° = -(-19{,}590\ J\ mol^{-1})/[(96{,}500\ C/mol\ e)(2\ mol\ e)]$*

***E° = 0.102 V***