

### Problem 11-14 Thermodynamics of the cell – solubility product

Calculate the solubility product of AgSCN at the temperature of 25 °C. For your calculation select appropriate data:

$$E^{\ominus}(\text{Ag}^+|\text{Ag}) = 0.799 \text{ V}$$

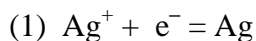
$$E^{\ominus}(\text{AgSCN}|\text{Ag}, \text{SCN}^-) = 0.095 \text{ V}$$

$$E^{\ominus}(\text{AgCN}|\text{Ag}, \text{CN}^-) = -0.017 \text{ V}$$

$$E^{\ominus}(\text{AgCl}|\text{Ag}, \text{Cl}^-) = +0.222 \text{ V}$$

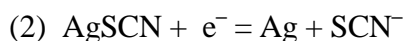
$$[K_{\text{AgSCN}} = 1.257 \cdot 10^{-12}]$$

Solution:



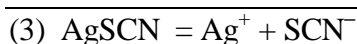
$$E^{\ominus}(\text{Ag}^+|\text{Ag}) = 0.799 \text{ V}$$

$$\Delta G^{\ominus}(1) = -FE^{\ominus}(\text{Ag}^+|\text{Ag})$$



$$E^{\ominus}(\text{AgSCN}|\text{Ag}, \text{SCN}^-) = 0.095 \text{ V}$$

$$\Delta G_2^{\ominus}(2) = -FE^{\ominus}(\text{AgSCN}|\text{Ag}, \text{SCN}^-)$$



$$\Delta G_3^{\ominus}(3) = -RT \ln K_S$$

$$\begin{aligned} \Delta G^{\ominus}(3) &= \Delta G^{\ominus}(2) - \Delta G^{\ominus}(1) \\ -RT \ln K_S &= -FE^{\ominus}(\text{AgSCN}|\text{Ag}, \text{SCN}^-) - (-FE^{\ominus}(\text{Ag}^+|\text{Ag})) \\ \ln K_S &= \frac{F}{RT} [E^{\ominus}(\text{AgSCN}|\text{Ag}, \text{SCN}^-) - FE^{\ominus}(\text{Ag}^+|\text{Ag})] \\ &= \frac{96485.3}{8.314 \cdot 298.15} \cdot (0.095 - 0.799) \\ &= -27.402424 \end{aligned}$$

$$K_S = 1.257 \cdot 10^{-12}$$