

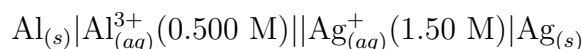
Chemistry 192

Recitation Session Questions

April 2, 2018

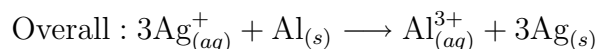
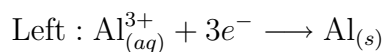
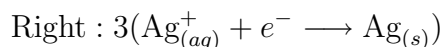
Solutions

1. Calculate the electromotive force of the cell at 298K



given $E_{\text{Ag}^{+}/\text{Ag}}^{\circ} = 0.7996\text{ V}$ and $E_{\text{Al}^{3+}/\text{Al}}^{\circ} = -1.662\text{ V}$. Give the direction of the flow of electrons when the two electrodes are connected by a wire.

Answer:



$$Q_P = \frac{[\text{Al}^{3+}]}{[\text{Ag}^{+}]^3}$$

$$E^{\circ} = E_R^{\circ} - E_L^{\circ} = 2.4616\text{ V}$$

$$E = E^{\circ} - \frac{RT}{nF} \ln Q_p$$

$$= 2.4616\text{ V} - \frac{(8.3144\text{ J mol}^{-1}\text{K}^{-1})(298\text{ K})}{3(96485\text{ C mol}^{-1})} \ln \frac{0.500}{1.50^3} = 2.478\text{ V}$$

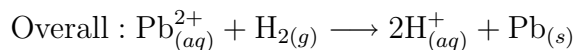
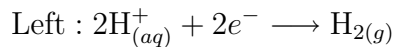
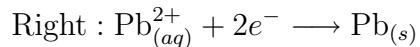
Electrons flow from Al to Ag.

2. At 298 K the EMF of the cell



is $E = 1.377\text{ V}$. Given $E_{\text{Pb}^{2+}/\text{Pb}}^{\circ} = 1.401\text{ V}$, calculate the pressure of hydrogen gas in the half-cell on the left-hand side.

Answer:



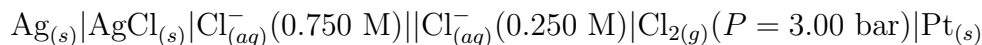
$$Q_P = \frac{[\text{H}^{+}]^2}{[\text{Pb}^{2+}]P_{\text{H}_2}}$$

$$E^{\circ} = E_R^{\circ} - E_L^{\circ} = 1.401 \text{ V}$$

$$E = E^{\circ} - \frac{RT}{nF} \ln Q_p$$

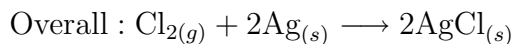
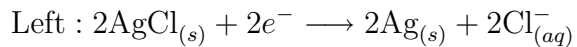
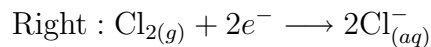
$$1.377 \text{ V} = 1.401 \text{ V} - \frac{(8.3144 \text{ J mol}^{-1}\text{K}^{-1})(298 \text{ K})}{2(96485 \text{ C mol}^{-1})} \ln \frac{2.50^2}{0.500P} \quad P = 1.93 \text{ bar}$$

3. Calculate the EMF of the cell at 298 K



given $E_{\text{Cl}^{-}/\text{AgCl}/\text{Ag}}^{\circ} = 0.22233 \text{ V}$ and $E_{\text{Cl}^{-}/\text{Cl}_2}^{\circ} = 1.35827 \text{ V}$.

Answer:



$$Q_P = \frac{1}{P_{\text{Cl}_2}}$$

$$E^{\circ} = E_R^{\circ} - E_L^{\circ} = 1.13594 \text{ V}$$

$$E = E^{\circ} - \frac{RT}{nF} \ln Q_p$$

$$= 1.13594 \text{ V} - \frac{(8.3144 \text{ J mol}^{-1}\text{K}^{-1})(298 \text{ K})}{2(96485 \text{ C mol}^{-1})} \ln \frac{1}{3.00} = 1.150 \text{ V}$$