Chemistry-4311
November 15, 2013

Quiz #9 **Name** Key

R = 8.314 J/mol-K = 0.08206 L-atm/mol-K = 1.987 cal/mol-K, $N_A = 6.02 \times 10^{23}$, F = 96,500 C

5 1. Matching (Use a letter only once)

ΔG_r for an electrochemical cell is i.

The equilibrium constant and standard emf E° are related by f.

Biological standard reduction potentials are for a pH of a.

The Nernst equation is h.

The membrane potential ΔE for K^+ ions is e.

a. seven
b. $E^\circ = RT\ln K$
c. $E = E^\circ - RT\ln Q$
d. $\Delta S - T\Delta H$
e. $0.257V\ln\{[K^+]_{ex}/[K^+]_{in}\}$
f. $E^\circ = RT\ln K/\nu F$
g. zero
h. $E = E^\circ - RT\ln Q/\nu F$
i. $-\nu FE$
j. $0.257V\ln[K^+]$

2 2. $E^\circ = 1.507$ V for the reduction reaction $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$. Show how to calculate the biological standard reduction potential $E^{\circ\prime}$.

$\Delta G_r = \Delta G_r^\circ + RT\ln Q$

$-\nu FE = -\nu FE^\circ + RT\ln Q$

$E = E^\circ - \frac{RT}{\nu F}\ln Q$

For biological standard state $[H^+] = 1.0 \times 10^{-7}$ M

$E^{\circ\prime} = E^\circ - \frac{RT}{5F}\ln\frac{1}{[1.0\times10^{-7}]^8}$

The concentration of everything else is [1.0].

3 3. An electrochemical cell consists of the half-cells

$Al^{3+} + 3e^- \rightarrow Al$ $\quad E^\circ = -1.662$ V

$Pb^{2+} + 2e^- \rightarrow Pb$ $\quad E^\circ = -0.126$ V

a. Give the cell reaction.

$2\times(Al \rightarrow Al^{3+} + 3e^-)$

$3\times(Pb^{2+} + 2e^- \rightarrow Pb)$

$2Al + 3Pb^{2+} \rightarrow 2Al^{3+} + 3Pb$

$E^\circ = 1.662$

$E^\circ = -0.126$

$E^\circ = 1.536$ V

b. What is E° for the cell?

$E^\circ = 1.536$