Chemistry-4311
November 13, 2015

Quiz #7 **Name** Key

$R = 1.987 \text{ cal } K^{-1} mol^{-1} = 8.314 \text{ J } K^{-1} mol^{-1} = 0.08206 \text{ L atm } K^{-1} mol^{-1}$
$K = °C + 273.15$, $F = 96{,}500$ C/mole

1. Matching (Use a letter only once)

For an electrochemical cell operating spontaneously, the sign of the emf potential E is e.

The biological standard state reduction potentials are for a pH of a.

The membrane potential arising from different inner and outer concentrations of K^+ is c.

$\Delta G°$ for an electrochemical cell is i

The Nernst equation is g.

a. seven
b. -vFlnQ
c. $0.0257 \text{ V } \ln\{[K^+]_{outer}/[K^+]_{inner}\}$
d. $E = E° + RT\ln Q$
e. positive
f. zero
g. $E = E° - (RT/vF)\ln Q$
h. negative.
i. $-vFE°$
j. $vFE° \{[K^+]_{outer}/[K^+]_{inner}\}$

+3 2. Consider the following reduction potentials for an electrochemical cell:

$Al^{3+} + 3e^- \rightarrow Al \quad E° = -1.662 \text{ V}, \quad Pb^{2+} + 2e^- \rightarrow Pb \quad E° = -0.126 \text{ V}$

a. What is the chemical reaction for the cell?

$2Al \rightarrow 2Al^{3+} + 6e^-$

$3Pb^{2+} + 2Al \rightarrow 3Pb + 2Al^{3+}$ $\quad 3Pb^{2+} + 6e^- \rightarrow 3Pb$

b. Calculate E° for the cell

$$\begin{array}{r} 1.662 \text{ V} \\ - \ 0.126 \text{ V} \\ \hline 1.536 \text{ V} \end{array}$$

c. Calculate $\Delta G°$ for the cell

$$\Delta G° = -vFE° = -6 \times 96{,}500 \times 1.536$$
$$= -889344 \text{ J} = -889.3 \text{ kJ}$$

+2 3. $E° = 1.507$ V for the reduction reaction $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$. Show how to calculate the biological standard reduction potential E°′.

$$E°' = E° - \frac{RT}{vF} \ln \frac{1}{[10^{-7}]^8}$$

$$E = E° - \frac{RT}{vF} \ln Q$$

$$E°' = E° - \frac{RT}{vF} \ln \frac{1}{[H^+]}$$

$[H^+] = 1 \times 10^{-7}$ M