

Chemistry-4311  
November 13, 2015

Quiz #7

Name Key

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

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.

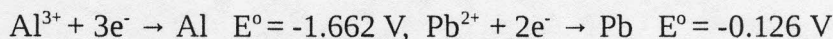
The membrane potential arising from different inner and outer concentrations of  $K^+$  is c.

$\Delta G^\circ$  for an electrochemical cell is i.

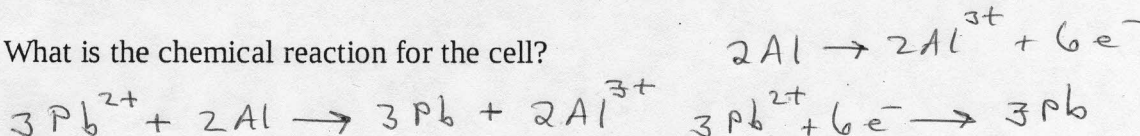
The Nernst equation is g.

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

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



a. What is the chemical reaction for the cell?



b. Calculate  $E^\circ$  for the cell

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

c. Calculate  $\Delta G^\circ$  for the cell

$$\Delta G^\circ = -\nu F E^\circ = -6 \times 96,500 \times 1.536$$

$$= -889,344 \text{ J} = -889.3 \text{ kJ}$$

+2 3.  $E^\circ = 1.507 \text{ V}$  for the reduction reaction  $\text{MnO}_4^- + 8\text{H}^+ + 5e^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$ . Show how to calculate the biological standard reduction potential  $E^\circ'$ .

$$E^\circ' = E^\circ - \frac{RT}{\nu F} \ln \frac{1}{[10^{-7}]^8}$$

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

$$E^\circ' = E^\circ - \frac{RT}{\nu F} \ln \frac{1}{[H^+]^8}$$

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