CH1011 Tutorial 7

Name:

1. Define the term the **entropy** of a substance.

State whether entropy increases of decreases in the following reactions.

$HgS(s) + O_2(g) \rightarrow Hg(g) + SO_2(g)$

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

2. Calculate the **Gibbs free energy** for the following reaction at 25^{o}C and from this the value of K.

$H_2O(l) \rightleftharpoons H_2O(g)$

3. Assign the **oxidation state** of sulphur in the following molecules: SO_2 H_2SO_4 S_8

4. The electrode Ag(s) AgCl(s) Cl^-(aq), for which the half-reaction is $AgCl(s) + e \rightarrow Ag(s) + Cl^-(aq)$ and $E^o = +0.223V$, can be used to measure chloride ion concentrations. The e.m.f. of the following cell is +1.059V at 298K.

- What is the cell reaction?
- What is the standard free energy change ΔG^o for the cell reaction?
- Calculate the concentration of chloride ion in the sea water sample.

Zn(s)	Zn^{2+}(aq) c = 0.01M	sea water (Cl^-)	AgCl(s)	Ag(s)

5. Using an example illustrate the chief features of a **gas-ion electrode**.

6. After a recent legal battle that Duracell® alkaline batteries it turned out that they really do last longer than their competitors.

- Why do alkaline batteries outperform standard dry cell batteries?
- Sketch the essential features of a **primary battery**.

Additional information:

$\Delta G^o_f(H_2O(l)$ -237.2 kJ/mol $\Delta G^o_f(H_2O(g)$ -228.6 kJ/mol - values of ΔG^o_f at 298 K

$\Delta G^o = -RT \ln K$ R = 8.31 J/mol K $T(K) = T(^oC) + 273$

$$E_{cell} = E^{o}_{cell} - \frac{RT}{nF}\ln\left(\frac{[C]^{c}[D]^{d}}{[A]^{a}[B]^{b}}\right)$$

$$E^{o}_{cell} = E^{o}_{Reduction} - E^{o}_{Oxidation}$$

$$\Delta G^{=} = - n F E$$