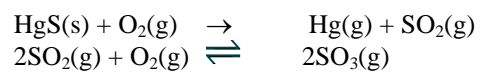


Name:

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

State whether entropy increases or decreases in the following reactions.

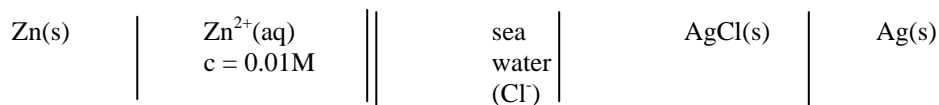


2. Calculate the **Gibbs free energy** for the following reaction at 25°C and from this the value of K.



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

4. The electrode $\text{Ag(s)} \mid \text{AgCl(s)} \mid \text{Cl}^-(\text{aq})$, for which the half-reaction is $\text{AgCl(s)} + \text{e}^- \rightarrow \text{Ag(s)} + \text{Cl}^-(\text{aq})$ and $E^\circ = +0.223\text{V}$, can be used to measure chloride ion concentrations. The e.m.f. of the following cell is $+1.059\text{V}$ at 298K .
- What is the cell reaction?
 - What is the standard free energy change ΔG° for the cell reaction?
 - Calculate the concentration of chloride ion in the sea water sample.



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:

$$\Delta G^\circ_f(\text{H}_2\text{O(l)}) -237.2 \text{ kJ/mol}$$

$$\Delta G^\circ = -RT \ln K$$

$$\Delta G^\circ_f(\text{H}_2\text{O(g)}) -228.6 \text{ kJ/mol}$$

$$R = 8.31 \text{ J/mol K}$$

- values of ΔG°_f at 298 K

$$T(\text{K}) = T(^{\circ}\text{C}) + 273$$

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

$$E^{\circ}_{\text{cell}} = E^{\circ}_{\text{Reduction}} - E^{\circ}_{\text{Oxidation}}$$

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