Name:

1. Define the terms **sensible heat** and **latent heat** as they are applied to a parcel of air.

2. A sample of lake water is analysed and contains the following concentrations of ions (mg / L) : Na⁺ Cl⁻ Ca²⁺ CO₃²⁻ Mg²⁺ SO₄²⁻ 46 71 401 600 243 961

The activity coefficients for Mg²⁺ and SO₄²⁻ at 25°C are both $\gamma = 0.630$.

Calculate the ion product, Q, for magnesium sulphate.

- Calculate the ion activity product, IAP, for magnesium sulphate and predict whether this compound is likely to precipitate from the bore water when it is left to stand at 25°C. (K_{SP} (M_{gSO4}) = 5.9 x 10⁻³ at 25°C)
- Calculate the ionic strength, *I*, of the water sample.

3. Calculate the pE of a swamp water which has a considerable amount of dissolved organic matter and which upon chemical analysis indicates that the following redox couple is dominant:

$$CO_{2(aq)} + 8H^{+}_{(aq)} + 8e^{-} \rightarrow CH_{4} + 2H_{2}O_{(l)} \qquad E^{o}_{1/2} \quad 0.170 \text{ V}$$

The pH of the water is 4.00 and the aqueous concentrations of carbon dioxide and methane are 1.00 mmol/L and 2.00 µmol/L, respectively.

- 4. A variety of bacteria have evolved to use the biomass that is floating around in natural waters as a carbon source.
 - Using a stratified lake with a reasonably high [SO₄] as an example explain which bacteria you would expect to find around the oxic-anoxic boundary.
 - Explain how these bacteria may alter the electron activity of the water body.