

University of Canterbury

Mid Year Examination and Test Period 2009

Prescription Number(s):	CHEM 224
Paper Title:	Analytical & Environmental Chemistry

Time Allowed: 75 MINUTES

Number of pages: FOUR

Answer **ALL** questions.

Total marks = 75.

(You should allocate about 1 minute per mark.)

1. (16 marks)
 - (a) Describe the essential components of a glass electrode for pH measurement (note: it is not necessary to describe the external reference electrode).
 - (b) Explain, in detail, how the glass electrode, in conjunction with an external reference electrode, enables the pH of a sample to be determined.

2. (12 marks)
 - (a) What problems can arise when measuring the pH of rainwater?
 - (b) What are the causes of these problems?
 - (c) Explain one approach to countering these problems.

3. (9 marks)

For an ion-selective electrode, $E_{\text{cell}} = E^{\circ} + S \log(a_i + K_{ij}a_j^{n/z})$

A lithium ion-selective electrode was equilibrated in a solution of 1.0×10^{-4} M LiCl. The equilibrium potential was 95 mV. The electrode was then equilibrated in a separate solution of 1.0×10^{-3} M NaCl. The equilibrium potential was 50.0 mV.

Calculate $K_{\text{Li}^+, \text{Na}^+}$ for the lithium ion-selective electrode, assuming that the slope of the calibration curve is 59 mV.

4. (10 marks)
 - (a) Describe the components of an ion-selective electrode for the measurement of dissolved CO_2 concentration in water.
 - (b) Describe how the CO_2 ion-selective electrode functions for the measurement of dissolved CO_2 concentration.

5. (12 marks)
- (a) In natural waters, the concentration of dissolved oxygen is determined by a dynamic equilibrium. Briefly outline the processes that consume and replenish dissolved oxygen in unpolluted natural waters.
 - (b) Briefly explain why monitoring of dissolved oxygen is essential for optimal wastewater and sewage treatment.
 - (c)
 - (i) Explain the acronym **BOD5** (i.e. what does **BOD5** stand for?).
 - (ii) What does BOD5 measure and why is this measurement important?
 - (iii) In two sentences, describe how a BOD5 measurement is made.
6. (16 marks)
- (a) Describe the essential steps of an anodic stripping voltammetric (ASV) measurement.
 - (b) Zinc, cadmium, lead and copper can be determined using ASV but not cobalt and nickel. Outline the factors which determine whether a metal can be determined by ASV.
 - (c) Explain why ground water and surface water samples are usually pre-treated with a UV digestion using hydrogen peroxide, prior to analysis by ASV.
 - (d) ASV can suffer from the problem of overlapping stripping peaks. Briefly describe one approach to solving the problem of overlapping peaks so that both metal concentrations can be determined.

END OF PAPER