

Instructions: Answer all questions.

TWO PAGES IN TOTAL

Time allowed: 55 minutes

Total marks: 50

1. (8 marks)

- (i) A plasma torch is an integral component of ICP-OES and ICP-MS instruments. Outline the purpose of the plasma for each technique (ICP-OES and ICP-MS).
- (ii) With reference to the ICP-MS technique, outline two mechanisms that can be used to break down molecular interferences (polyatomic and oxide/hydroxide interferences).

2. (18 marks) Answer THREE of the following, (a) – (d):

(a)

- (i) Explain why complexation of anions to a colloid at $\text{pH} < \text{pH}_{\text{pzc}}$ can lead to colloid coagulation.
- (ii) Is there a critical anion concentration for this reaction? Explain your answer. Your answer should make reference to Figure 14.12

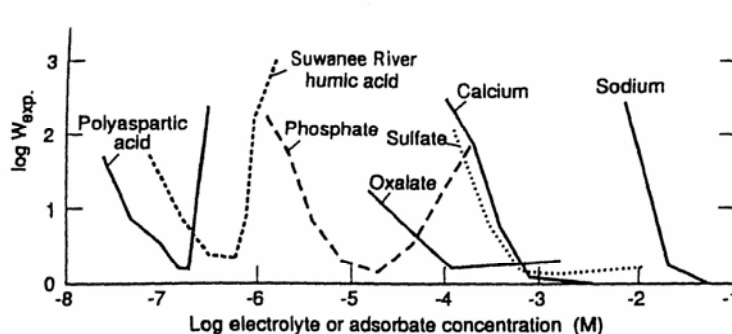


Figure 14.12. Summary plot of experimentally derived stability ratios, W_{exp} , of hematite suspensions, as a function of added electrolyte or adsorbate concentration (in case of polymers, monomer units) at pH around 6.5 ($\text{pH} = 10.5$ for Ca^{2+} and Na^+). Hematite concentration is about $10\text{--}20 \text{ mg liter}^{-1}$. The stability ratio, W_{exp} , was determined from measurements on the coagulation rate; it is the reciprocal of the experimentally determined collision efficiency factor, α_p . (From Liang and Morgan, 1990.)

- (iii) Is this concentration dependent on the colloid concentration? Explain your answer.

- (b) Explain why knowledge of trace metal speciation in aquatic environments is important. As part of your answer define the term speciation and list three key parameters that can influence trace metal speciation in waterways.
- (c) Cations are adsorbed to hydrated metal oxide surfaces more strongly at high pH. Explain the basis of this simple electrostatic model for adsorption. Indicate its limitations and provide an alternative mechanism.
- (d) (i) Explain how hydration of a metal oxide/hydroxide leads to a surface that can be described as $\equiv\text{S-OH}$.
- (ii) Write the two equations that indicate the amphoteric properties of an hydrated metal oxide surface

3. (20 marks)

Write descriptive notes on the sorption of organic contaminants in aquatic environments. Your answer should

- (i) explain how key physico-chemical properties (solubility, K_d , K_{oc} , K_{ow}) can be used to predict sorption;
- (ii) distinguish between adsorption and absorption;
- (iii) describe how K_d values can be calculated
- (iv) outline the key sorptive surfaces in aquatic environments for organic contaminants
- (vi) discuss the importance of sorption to the persistence and toxicity of organic contaminants in aquatic environments.

4. (4 marks)

Describe FOUR precautions you would take to avoid cross contamination when collecting water samples.