



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS – JULY 2005
ANALYTICAL CHEMISTRY III – SCH 4206
TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES

Answer **Four** questions. Each question carries 25 marks.

1. Copper (II) reacts with the chelating agent HL to give a complex CuL_2 that is readily soluble in CHCl_3 . A spectrophotometric study revealed that when 1.00×10^{-4} M aqueous solution of copper (II) was extracted with CHCl_3 that was 0.0100 M in H_2L , the analytical concentration of copper in the two phases was identical at pH 5.65.
 - (i) Write the equations describing the equilibria in the system, assuming that the dissociation of CuL_2 in the organic phase is negligible.
 - (ii) Calculate K_{ex} .
 - (iii) Calculate the distribution ratio for the system at pH 6.00.
 - (iv) If 50.0 mL of 5.00×10^{-5} M Cu^{2+} in a pH 6.00 buffer were to be extracted with 25.0 mL portions of 0.0100 M H_2L in CHCl_3 , how many extractions would be required to remove 99% of the copper from the aqueous phase?
 - (v) Repeat the calculations in part (iv) for 99.9% removal. [25 marks]

2.
 - (a) Derive the expression that relates the distribution ratio, D, to the distribution coefficient, K_d and the dissociation constant K_a . [10 marks]
 - (b) In a liquid-liquid extraction using organic chelating reagents the distribution ratio is dependent on pH and on the concentration of the chelating reagent. Using relevant equilibrium expressions and appropriate equations derive an expression, which support this statement. [15 marks]

3. Following the death of numerous deer near a pond in Hwange National Park, a park ranger consulted a chemist in the veterinary laboratory to help identify the cause of the problem so as to prevent further killings. A search carried out in the pond's surroundings (approx. 2 acres) revealed that the grass was wilted and discoloured. These observations lead to the speculation that a herbicide had been sprayed on the grass. A common ingredient of herbicides is arsenic. By employing the steps used in an analytical investigation, describe how the chemist would confirm the presence of arsenic and determine its concentrations in the sample. [25 marks]

4. (a) What is solid phase extraction? Discuss different types of stationary phases that can be employed in this technique. What advantages does SPE offer over liquid-liquid extraction. Give three examples of its application as a sample clean-up or pre-concentration technique. [25 marks]

5. (a) Write notes on the following

(i) Proficiency Testing [5 marks]

(ii) Collaborative Trials [5 marks]

(iii) Shewart Charts [5 marks]

(b) A prosecuting attorney in a criminal case presented as principal evidence small fragments of glass found imbedded in the coat of the accused. The attorney claimed that the fragments were identical in composition to a rare Belgian stained glass window broken during the crime. The average of triplicate analyses for five elements in the glass are shown below. On the basis of these data, does the defendant have grounds for claiming reasonable doubt as to guilt? Employ 99% confidence level as criterion for doubt.

Element	Concentration, ppm		Standard Deviation $s \rightarrow \sigma$
	From Clothes	From Window	
As	129	119	9.5
Co	0.53	0.60	0.025
La	3.92	3.52	0.20
Sb	2.75	2.71	0.25
Th	0.61	0.73	0.043

[10 marks]

End of question Paper!!!