THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME /STAND ALONE COURSES - LEVEL 4

CHU 2125/CHE 4125 – ANALYTICAL CHEMISTRY I
ASSIGNMENT TEST I – NO BOOK TEST (2006/2007)
TIME : ONE AND HALF HOURS

Date: 27-07-2006 **Time.** 4.00 – 5.30 p.m.

Registration Number : .....

Question No.	Marks
1	
2	
Percentage	

Instructions to candidates:

This question paper contains 6 pages and two questions.
Answer all questions. Please use a pen (not a pencil) in answering. Write down the answers in the spaces provided. Attached sheets will not be graded.

01. Molarity of a solution is determined titrimetrically by doing six titrations, taking 15.00 cm^3 of sample at a time. Results in units of mol dm^{-3} are given below.

0.2014, 0.2049, 0.2039, 0.2043, 0.2016, 0.2035

i. How do you report the molarity of this solution? Show all your calculation in detail

(30 marks)

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ii. Calculate the coefficient of variation (as a percentage) using this data.
(10 marks)

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iii. If there is an impurity (other than the analyte) in your sample solution which consumes certain amount of standard solution, while titrating, there will be a <u>proportional systematic error</u> involved in the six results given in this question.

Clearly explain what experimental procedure you can use to prove the presence or absence of such an impurity?

(30 marks)

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iv. If you don't detect the presence of proportional systematic error involved in these six results, what is the reason for the variation of results?

(10 marks)

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02. For the titration of a strong acid with ammonia.

$H_3O^+ + NH_3 \rightleftharpoons NH_4^+ + H_2O \quad K_{eq}=1.8 \times 10^9$

The reaction of Cu^{2+} with ammonia proceeds stepwise as shown below.

$$Cu^{2+} + NH_3 \rightleftharpoons CuNH_3^{2+} \quad K_1=1.9 \times 10^4$$
$$Cu(NH_3)^{2+} + NH_3 \rightleftharpoons Cu(NH_3)_2^{2+} \quad K_2=3.6 \times 10^3$$
$$Cu(NH_3)_2^{2+} + NH_3 \rightleftharpoons Cu(NH_3)_3^{2+} \quad K_3=7.9 \times 10^2$$
$$Cu(NH_3)_3^{2+} + NH_3 \rightleftharpoons Cu(NH_3)_4^{2+} \quad K_4=1.5 \times 10^2$$

For the overall reaction.

$$Cu^{2+} + 4\,NH_3 \rightleftharpoons Cu(NH_3)_4^{2+}$$

$$K_{eq}=\frac{[Cu(NH_3)_4^{2+}]}{[Cu^{2+}][NH_3]^4} = K_1K_2K_3K_4 = 8.1 \times 10^{12}$$

The titration of a strong acid with NH_3 is feasible ($K_{eq}= 1.8 \times 10^9$).

However, the titration of a solution of Cu^{2+}, with ammonia is not feasible even though $K_{eq}=8.1 \times 10^{12}$. Clearly explain why? <u>It is not necessary to give calculations.</u>

Hint. For a quantitative titration, there should be a large vertical portion in the titration curve i.e. p^H versus volume of ammonia or p^{Cu} versus volume of ammonia.

(20 marks)