THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. Degree Programme / Stand alone course – Level 4

CHU 2125/CHE 4125 – Analytical Chemistry I - 2009/2010

Duration: One and half-hours 13th November 2009 from 4.00 p.m. to 5.30 p.m.

Reg. No. .....

Question No.	Marks
1	
2	
3	
Total	
Percentage	

Instructions to candidates

*** Answer all questions.**
*** Write down answers on this paper itself, attached sheets will not be graded.**

1.(a)(i) Write down two types of buffers and give examples of each type.

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(ii) Write down the expression for pH of a buffer solution in terms of pK_a of the weak acid and the concentrations of the weak acid and its conjugate base.

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(iii) Calculate the change in pH when 0.01 mol of solid NaOH is added to a solution (1.00 dm^3) which is 0.200 mol dm^{-3} with respect to HCOOH ($pK_a = 3.75$) and 0.100 mol dm^{-3} with respect to $HCOO^-$. (45 marks)

(b)(i) Write the conditions that must be satisfied by a reaction for it to be used in classical titrimetry methods. (15 marks)

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(ii) Briefly describe, with an example, indirect titration method. (15 marks)

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(c)(i) Draw the structure of the metal complex formed by calcium ions with EDTA.

(ii) The *pH* of drinking water sample (50.0 cm^3) is adjusted to 10. In a titration using Calmagite as an indicator, the solution required 22.00 cm^3 of 2.5×10^{-3} mol dm^{-3} EDTA solution to reach the end point. Calculate the hardness of this water sample in

terms of mg dm^{-3} of $CaCO_3$. Write any assumption you make. (C=12, O=16, Ca=40)
(25marks)

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2.(a)(i) What is meant by the solubility product of a sparingly soluble compound?

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(ii) The solubility product (K_{sp}) at 38°C of lead phosphate, $Pb_3(PO_4)_2$ is $3.0x10^{-44}$ mol^5 dm^{-15}. Calculate the molar solubility of lead phosphate at 38 °C.

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(iii) Predict whether or not a precipitate will be formed when 10.0 cm^3 of 0.03 mol dm^{-3} $Pb(NO_3)_2$ solution is mixed with 20.0 cm^3 of 0.006 mol dm^{-3} NaCl solution. K_{sp} for $PbCl_2$ is $1.6x10^{-5}$ mol^3 dm^{-9}. (50 marks)

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(b)(i) Write the factors that affect the solubility of a precipitate.

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(ii) Briefly describe the processes of contamination that can take place during precipitation. Outline methods that can be used to overcome them. (50 marks)

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3.(a) For the redox reaction:, $Fe^{2+} + Ce^{4+} == Fe^{3+} + Ce^{3+}$

(i) Write down equations for the half cell reactions and the overall chemical reaction.

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(ii) Write down the Nernst equation and the expression for the equilibrium constant.

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(iii) Consider the titration of 100.0 ml of 0.05 mol dm^{-3} Fe^{2+} against a solution of 0.10 mol dm^{-3} Ce^{4+} in 1 mol dm^{-3} $HClO_4$ which was monitored potentiometrically. The standard potentials for the half cells Fe^{3+}/Fe^{2+} and Ce^{4+}/Ce^{2+} are 0.767V and 1.70V respectively. The end point of the titration occurs when the volume of Ce^{4+} added was 50.00 ml.

(I) Calculate the strength of Ce^{4+} solution.

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(II) Calculate the cell potential when 25.00 ml, 50.00 ml and 62.50 ml of Ce^{4+} was added to the Fe^{2+} solution.

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