



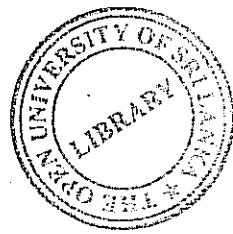
THE OPEN UNIVERSITY OF SRI LANKA  
B.Sc. Degree Programme / Stand alone course – Level 4

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

Duration: One and half-hours

13<sup>th</sup> 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 ( $1.00 \text{ dm}^3$ ) which is  $0.200 \text{ mol dm}^{-3}$  with respect to HCOOH ( $pK_a = 3.75$ ) and  $0.100 \text{ mol dm}^{-3}$  with respect to  $\text{HCOO}^-$ . (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 ( $50.0 \text{ cm}^3$ ) is adjusted to 10. In a titration using Calmagite as an indicator, the solution required  $22.00 \text{ cm}^3$  of  $2.5 \times 10^{-3} \text{ mol dm}^{-3}$  EDTA solution to reach the end point. Calculate the hardness of this water sample in

terms of  $\text{mg dm}^{-3}$  of  $\text{CaCO}_3$ . Write any assumption you make. ( $\text{C}=12$ ,  $\text{O}=16$ ,  $\text{Ca}=40$ )  
(25marks)

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

- (ii) The solubility product ( $K_{sp}$ ) at 38°C of lead phosphate,  $Pb_3(PO_4)_2$  is  $3.0 \times 10^{-44}$  mol<sup>5</sup> dm<sup>-15</sup>. Calculate the molar solubility of lead phosphate at 38 °C.

- (iii) Predict whether or not a precipitate will be formed when  $10.0 \text{ cm}^3$  of  $0.03 \text{ mol dm}^{-3}$   $\text{Pb}(\text{NO}_3)_2$  solution is mixed with  $20.0 \text{ cm}^3$  of  $0.006 \text{ mol dm}^{-3}$   $\text{NaCl}$  solution.  $K_{\text{sp}}$  for  $\text{PbCl}_2$  is  $1.6 \times 10^{-5} \text{ mol}^3 \text{ dm}^{-9}$ . (50 marks)





(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)

3.(a) For the redox reaction;  $\text{Fe}^{2+} + \text{Ce}^{4+} \rightarrow \text{Fe}^{3+} + \text{Ce}^{3+}$

(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  $0.05 \text{ mol dm}^{-3}$   $\text{Fe}^{2+}$  against a solution of  $0.10 \text{ mol dm}^{-3}$   $\text{Ce}^{4+}$  in  $1 \text{ mol dm}^{-3}$   $\text{HClO}_4$  which was monitored potentiometrically. The standard potentials for the half cells  $\text{Fe}^{3+}/\text{Fe}^{2+}$  and  $\text{Ce}^{4+}/\text{Ce}^{2+}$  are  $0.767\text{V}$  and  $1.70\text{V}$  respectively. The end point of the titration occurs when the volume of  $\text{Ce}^{4+}$  added was 50.00 ml.

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

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

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