

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SECOND SEMESTER EXAMINATIONS – APRIL/MAY 1999
ANALYTICAL CHEMISTRY I - SCH 1206
TIME: THREE HOURS

INSTRUCTIONS TO CANDIDATES

Answer *All* questions from Section A and *Any Three* questions from Section B. Total marks = 100.

SECTION A

1. Calculate the ionic strength of a solution of equal volumes of 1M HCl and 0,5M NaOH.
(5 marks)
2. Calculate the concentration of all the species present in the dissociation of 0,5M H₂C₂O₄.
 $K_1 = 5,6 \times 10^{-2}$ $K_2 = 5,4 \times 10^{-5}$ (10 marks)
3. Which substances are acids or bases in aqueous solution according to the Bronsted and Lowry Theory.
HClO₄; NH₃; CO₃²⁻; HCO₃⁻ S²⁻; HS⁻ (6 marks)
4. Calculate the concentration of H⁺ and OH⁻ ions in a solution containing 25ml 0,2M CH₃COOH and 15ml 0,1M CH₃COONa
(9 marks)
5. In the analysis of a lead ore the following results were obtained (%) 14,50; 14,43, 14,54; 14,45; 14,44; 14,52; 14,58; 14,40; 14,25 14,19.
Given that $Q_2 = 0,42$ for $n=10$ at 95% confidence level, show that 14,25 and 14,58 must be either rejected or retained. Calculate the mean and the Standard deviation.
(10 marks)

SECTION B

Answer **any three** questions from Section B. Each question in Section B carries 20 marks.

1. (a) Draw a titration curve, when 100.00ml 0,10M Na₂CO₃ is titrated with 0,10MHCl, Calculate the pH when the following volumes of acid have been added:
- (i) 50.00ml
 - (ii) 91.00ml
 - (iii) 98.00ml
 - (iv) 109.00ml
 - (v) 150.00ml
 - (vi) 191.00ml
 - (vii) 199.00ml
- (b) A base of mass 0,534.1g containing 92% NaOH and 8% impurities was dissolved in a volumetric flask of volume 100,00ml. Calculate the molar concentration of the solution if 15,00ml of the solution was titrated with 19,50ml acid HCl.
2. (i) Why is the complexometric titration of CO²⁺ ; Zn²⁺ ; Ni²⁺ and Cd²⁺ done in an ammonium buffer solution.
- (ii) Why is the determination of cations with a charge of +3 and +4 with EDTA carried out in acidic media.
- (iii) 1,703g of Al(NO₃)₃.nH₂O was dissolved in 200,0ml to a 20,0ml aliquot was added Na₂Mg EDTA. In the titration of Mg²⁺ 17,45ml 0,02507M EDTA was used. Calculate the percentage (%) concentration of Al(NO₃)₃ in the sample.
3. (i) Derive the formulae for calculating pCl when titrating 0.1M NaCl with :
- (a) Ag NO₃
 - (b) Hg₂ (NO₃)₂
- At the end point
- (ii) From a Chrome-fluorine concentrate of mass 2,500g, a 100,00ml solution of fluorine was prepared and 25,00ml was titrated with 12,25ml 0,001667M KAl(SO₄)₂
- According to the reaction;
- $6\text{NaF} + \text{KAl}(\text{SO}_4)_2 + \text{NaCl} = \text{Na}_3\text{AlF}_6 \downarrow + \text{KCl} + 2\text{Na}_2 \text{SO}_4$. Calculate the percentage of fluorine in the ore.

4. (i) Which reagents and why are they added to the solution containing Fe^{2+} and Cl^- before titrating with KMnO_4 ?
- (ii) Uranium was reduced to U^{3+} and then oxidized to U^{4+} . Calculate the concentration of uranium in the solution if 25,00ML was titrated with 18,35ml of 0,08520N KMnO_4 (eqv. = $1/5$)?

END OF QUESTION PAPER!!!!