NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS– AUGUST 2013
ANALYTICAL CHEMISTRY I– SCH 1206
TIME: (3) THREE HOURS

MATERIAL
Periodic Table

INSTRUCTIONS TO CANDIDATES
Answer any FOUR questions in this paper
Each question carries 25 marks

---

1. (a) Explain the difference between:

   (i) Random and systematic error

   (ii) Homogeneous and inhomogeneous

   (iii) Mean and median

   (iv) Accuracy and precision

   (v) Sample and replicate [15 marks]

   (b) The following determinations were made of the atomic weight of carbon: 12,0080, 12,0095, 12,0097, 12,0101; 12,0102; 12,0106, 12,0111, 12,013, 12,0118, and 12,0120. Calculate:

   (i) the arithmetic mean,

   (ii) the standard deviation,

   (iii) the standard deviation of the mean,

   (iv) the 99 percent confidence limits of the mean. [10 marks]

2. (a) Define the following:

   (i) normality

   (ii) molarity

   (iii) equivalent weight

   (iv) ionic strength
   (iv) activity coefficient [10 marks]

(b) Calculate the volume of 10 M HCl acid which must be added to 300cm^3 of 0.15 M NH_3(aq) to give a buffer solution with a pH of 8.22. K_b for $NH_3 = 1.8 \times 10^{-5}$. [8 marks]

(c) 2 mols of O_2 and 2 mols of SO_2 are placed in a 1 dm^3 container and allowed to come to equilibrium:

$$2SO_2 + O_2 \rightleftharpoons 2SO_3 \quad \text{(all gases)}$$

The total pressure is 10 atm. If the number of mols of O_2 at equilibrium is 1.5, calculate K_p at the same temperature. [7 marks]

3. (a) Define solubility product. [2 marks]

(b) Explain the common ion effect in details (examples of reactions may be used for clarity) [6 marks]

(c) Calculate the solubility of $Fe(OH)_2$ at 25°C, given that K_{sp} for $Fe(OH)_2$ is 1.6×10^{-14} mol dm^{-3} at this temeperature. [6 marks]

(e) For the equilibrium $CaSO_4(s) + aq \rightleftharpoons Ca^{2+}(aq) + SO_4^{2-}(aq)$, $K_{sp} = 2.0 \times 10^{-5}$ mol^2 dm^{-6}

(i) What is the solubility of calcium sulphate in a saturated solution of the salt in g cm^{-3}? [5 marks]

(f) Calculate the solubility of $Ba(IO_3)_2$ in a solution prepared by mixing 200 mL of 0.0100 M $Ba(NO_3)_2$ with 100 mL of 0.100 M $NaIO_3$. K_{sp} of $Ba(IO_3)_2 = 1.57 \times 10^{-9}$ [6 marks]

4. (a) What is a buffer and what do you understand from the term buffer capacity. [6 marks]

(b) Define the terms a Bronsted-Lowry acid and the conjugate base of a Bronsted-Lowry acid [5 marks]

(c) Consider the curves for the titration of 0.1M NaOH and 0.01M NH_3 with 0.10M HCI

(i) Briefly account for the differences between the curves for the titrations [8 marks]

(ii) In what respect will the two curves be indistinguishable. [6 marks]

5. (a) From a weak acid/conjugate base buffer system, CH_3COOH/CH_3COONa in an aqueous solution show that:

$$pH = pK_{CH_3COOH} + \log\frac{[CH_3COO^-]}{[CH_3COOH]}$$

[7 marks]

(b) Which form of EDTA is used in preparing a titration solution? Why is a solution containing a metal ion buffered before titrating with EDTA? [5 marks]

(c) Calculate the volume of 0.0500 M EDTA needed to titrate:
(i) 26.37 mL of 0.0741 M in $Mg(NO_3)_2$.
(ii) the Ca and Mg in a 0.1557 g sample that is 92.5% dolomite, $CaCO_3$-$MgCO_3$(184.4g/mol) [6 marks]

(d) Calculate the hydronium ion concentration in 0.120M nitrous acid. The principal equilibrium is $HNO_2 + H_2O \rightleftharpoons H_3O + NO^-_2$ ($K_a = 7.1 \times 10^{-4}$) [7 marks]

End of paper!!!!!!!!!!!!!!!!