**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS – AUGUST 2014
ANALYTICAL CHEMISTRY I– SCH 1206
TIME: (3) THREE HOURS

MATERIAL
 Periodic Table

 INSTRUCTIONS TO CANDIDATES
 Answer <u>any FOUR</u> questions in this paper
 Each question carries 25 marks

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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   [10 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]

   (c)   Give a brief overview of two sysytematic errors.   [5 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:

$$2SO_2 + O_2 \rightleftharpoons 2SO_3 \qquad \text{(all gases)}$$
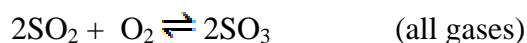
The total pressure is 10 atm. If the number of mols of O_2 at equilibrium is 1.5, calculate K_p at the same temperature. [7 marks]

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

(b) Explain the common ion effect in details (examples of reactions may be used for clarity) [5 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. [5 marks]

(d) If NaOH is added to the solution above, would the solubility of the solid increase? Explain briefly. [3 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 $Ba(IO_3)_2 = 1.57 \times 10^{-9}$ [5 marks]

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

(b) Define the terms a Bronsted-Lowry acid and the conjugate base of a Bronsted-Lowry acid [3 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 [5 marks]

(ii) In what respect will the two curves be indistinguishable. [5 marks]

(d) Name one of the following:
(i) Acid base indicator
(ii) Redox indicator
(iii)Complex Formation indicator
(iv)Precipitation indicator [8 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!!!!!!!!!!!!!!!!!