NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CHEMISTRY
END OF SECOND SEMESTER EXAMINATIONS – DECEMBER 2002
GENERAL CHEMISTRY – SCH 1217
TIME – (3) THREE

INSTRUCTIONS TO CANDIDATES

Answer **ANY FOUR** questions. Each question carries 25 marks.

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1. (a) State the four laws of thermodynamics.

   (b) For an ideal gas, calculate the molar gas constant ***R***, for 1 mol of gas which occupies a volume of 22,414 dm^3 at S.T.P.

   (c) Classify Analytical Chemical Methods of Analysis.

2. Calculate the activities of sodium and sulphate ions in an aqueous solution containing 0,005 mol dm^{-3} sodium chloride and 0,001 mol dm^{-3} potassium sulphate at 298K.

3. Calcium oxalate is of interest to clinical Biochemist since it is only slightly soluble in water (7mg dm^{-3} @ room temperature) and can be deposited in Renal Calculi.

   Calculate values for the following terms at room temperature:

   (a) The concentration of oxalate ions in a saturated aqueous solution of calcium oxalate.

   (b) Solubility constant of calcium oxalate in water

   (c) The concentration of oxalate ions in a saturated solution of calcium oxalate in 10^{-3} mol dm^{-3} aqueous calcium chloride.

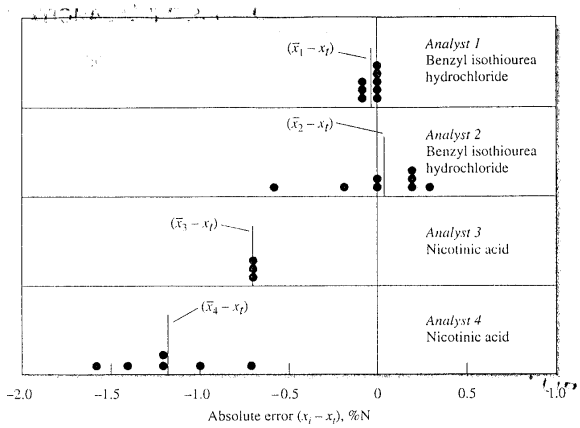
4. (a) To 10 cm^3 of 0,1 mol dm^{-3} HCl was added 9,6 cm^3 of 0.1 mol dm^{-3} NaOH.

   Calculate the pH of the final solution.

   (b) State Beers Law.

   (c) List four seperation methods that you know.

2. (c)



The diagram shows the Absolute Error in the determination of nitrogen in two pure compounds. The dots show the Absolute Errors of replicate results obtained by four analysts. Each vertical line labelled (x_i-x_t) is the Absolute Average Deviation from the true value.

Comment on the data presented by each analyst in terms of accuracy, precision, random and systematic errors. (8 marks)

3. (a) (i) What is a primary standard? (2 marks)
(ii) List the desirable properties of standard solutions. (4 marks)
(iii) Define molarity and normality. (4 marks)

(b) Calculate the molar concentration of ethanol in an aqueous solution that contains 2.30g of C_2H_5OH (FW = 46.07) in 3.50L of solution. (5 marks)

(c) Describe the preparation of:

(i) 500mL of 0.0750M $AgNO_3$ from the solid reagent.
(ii) 1.00L of 0.315M HCl, starting with a 6.00M solution of the reagent.
(iii) 2.00L of 0.120M $HClO_4$ from the commercial reagent [60% $HClO_4$ (w/w), sp gr 1.60].
(iv) 2.00L of 0.108M $BaCl_2$ from $BaCl_2.2H_2O$ (FW 244.3)
(v) 500mL 0.0740M Cl^- solution of solid $BaCl_2.2H_2O$ (FW 244.3g)
(10 marks)

4. (a) (i) State the Zeroth Law of thermodynamics. (4 marks)

(ii) Show that the work done during Isothermal Expansion for a perfect gas is:

$$W = nRT\ln\frac{P_1}{P_2}$$

(5 marks)

(b) State six factors that influence the rate of chemical reactions. (6 marks)

(c) For a zero order reaction, show that if x is the amount transformed into products after time t then $x = kt$. (10 marks)

5. (a) Define the following:
(i) chelate
(ii) tetradentate chelating agent
(iii) water hardness
(iv) ligand (8 marks)

(b) Describe three general methods for performing EDTA titrations. What are the advantages of each. (12 marks)

(d) Explain how step-wise and overall formation constants are related. (5 marks)

END OF QUESTION PAPER!!!