Fall 1995-96
Time = 2 hours

Fri. January 12, 1996
Professor Ayssar Nahlé

Chemistry 206

Quantitative Analysis

Lab. Final

Student's name: ....
Family First name

I.D. no.: .... - ....

Section no.: 1 2 3 4
(Circle)

Grade

I	/ 16
II	/ 16
III	/ 15
IV	/ 18
V	/ 15
VI	/ 20
Total:	/ 100

Good Luck

I. A sample of P_2O_5 contains some H_3PO_4 impurity. A 0.405-g sample is reacted with water ($P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$), and the resulting solution is titrated with 0.250 M NaOH ($H_3PO_4 \rightarrow Na_2HPO_4$). If 42.5 mL is required for the titration, what is the percent H_3PO_4 impurity?
(For phosphoric acid; $K_{a1} = 7.5x10^{-3}$; $K_{a2} = 6.2x10^{-8}$; $K_{a3} = 1x10^{-12}$)

% H_3PO_4 = ...

II. Two colorless species, A and B, react to form a colored complex AB that absorbs at 550 nm with a molar absorptivity of 450. The dissociation constant for the complex is 6.00×10^{-4}. What would the absorbance of a solution, prepared by mixing equal volumes of 0.0100 M solutions of A and B in a 1.00-cm cell, be at 550 nm?

Absorbance = ...

III. You are required to prepare working standard solutions of $1.00x10^{-5}$, $2.00x10^{-5}$, $5.00x10^{-5}$ and $1.00x10^{-4}$ glucose from a 0.100 M stock solution. You have available 100-mL volumetric flasks and only four pipettes consisting of 1.00-, 2.00-, 5.00-, and 10.00-mL volume. Outline a procedure for preparing the working standards.

IV. The solutions listed below contain one or more of the following substances: NaOH, $NaHCO_3$, Na_2CO_3. Below are listed the volume of 0.1000 M HCl solution consumed in the titration of 25.00 mL of each of the five solutions in the presence of a) methyl orange, and b) phenolphthalein, as indicators. Which substance or substances, and in what quantities, in g, are present in each of the five solution?

(Cross the square(s) corresponding to the substance(s) which are not contained in each solution and fill the remaining square(s) with the appropriate quantity, in g, of the substance(s) existing in the solution)

(For carbonic acid; $K_{a1} = 4.2 \times 10^{-7}$; $K_{a2} = 4.8 \times 10^{-11}$)

sample	V_{HCl}, mL	V_{HCl}, mL	Quantity in g		
	(V_m) Methyl orange	(V_p) Phenol phthalein	NaOH	$NaHCO_3$	Na_2CO_3
a	19.76	19.76			
b	42.37	18.01			
c	32.23	0.00			
d	43.80	21.90			
e	38.24	23.72			

V. A 0.5697-g sample of iron ore is dissolved, reduced (Fe^{2+}) and titrated with potassium dichromate solution, each milliliter of which corresponds to 1.000 % Fe in the ore. What is the normality and the molarity or the potassium dichromate solution?

$N_{\text{potassium dichromate}}$ = ...

$M_{\text{potassium dichromate}}$ = ...

VI. a) Derive the titration curve of 45.00 mL of 0.120 M Na_2CO_3 solution titrated with 0.1000 M HCl solution. The pH of the resulting solution should be calculated according to the HCl volumes shown in the table below, and must be inserted in the appropriate column.

b) Plot the resulting titration curve on one of the graph papers provided and show graphically the volume of HCl at the end point(s).

c) Calculate the first derivative ($\Delta pH/\Delta V$) and the corresponding volume (V') (fill the values in the table).

d) Plot the resulting first derivative curve on the second provided graph paper and show graphically the volume of HCl at the end point(s).

(For carbonic acid; $K_{a1} = 4.2x10^{-7}$; $K_{a2} = 4.8x10^{-11}$)

Volume of HCl, mL	pH	$\Delta pH/\Delta V$	V'
0.00			
10.00			
20.00			
27.00			
35.00			
45.00			
54.00			
60.00			
70.00			
81.00			
85.00			
95.00			
108.00			
120.00			
130.00			