Summer 1996

Friday, August 30, 1996

Time: 2 hours

Prof. Ayssar Nahlé

Chemistry 206

Quantitative Analysis

Final Exam

Name: .....
Family First name

I.D. number: ....

Grade

I	/ 14
II	/ 14
III	/ 18
IV	/ 16
V	/ 18
VI	/ 20
total	/100

Good luck

I. X mg of $Na_2SO_4.nH_2O$ is dissolved in water and the solution is diluted to 1000 mL (solution A). 2X mg of anhydrous Na_2SO_4 is dissolved and diluted to 1000 mL of solution B. The potential of a sodium-selective electrode against a suitable reference electrode is +0.1286 V in solution A and +0.1675 V in solution B. Calculate the number of water molecules *n*, in the salt $Na_2SO_4.nH_2O$ (assume activity equals concentration).

n = ...

II. Calculate the minimum value for the formation constant K_{ML} (K_f) of the complex ML, so that the reaction of ML formation from solutions having $[M^{n+}] = [L^{n-}] = 0.010$ M can be used for the complexometric titration of M^{n+} with L^{n-}, that is, so that the titration is completed by 99.9% at the equivalence point.

K_{ML} = ...

III. How many milliliters from each of the following solutions, 0.50 M H_3PO_4, 0.50 M NaOH, and 2.00 M $NaClO_4$, are required to prepare one liter of a buffer having pH 7.00, total phosphate concentration 0.1000 M, and ionic strength 0.500?

mL H_3PO_4= .....

mL NaOH = ...

mL $NaClO_4$ = ...

mL H_2O = ...

IV. A 0.2142-g sample of the salt MCl_2 is dissolved in water and titrated with 36.00 mL of 0.1250 M $AgNO_3$ solution. Calculate the atomic weight of the metal M; and identify the metal M.

Atomic weight of M = ...

M is identified to be .....

V. The following cell was found to have a voltage of +0.2150 V when the solution in the left compartment was a buffer of pH 4.00:

$$\text{glass electrode} \mid H^+ (a_{H+} = x\ \underline{M}) \mid\mid KCl\ (satur.), Hg_2Cl_2 \mid Hg$$

a) Calculate the pH of the unknown solution for which the following voltage reading was obtained : + 0.0810 V

pH = ...

b) What voltage would be measured in a 0.100 $\underline{M}$ acetic acid solution?

Voltage = ... V

VI. The dissociation constant of the indicator HX is 2.50×10^{-6}. The following absorbance data are for 2.50×10^{-4} M solutions of the indicator in strongly acidic and strongly alkaline solutions, measured in 1.00-cm cells.

	Absorbance, A			Absorbance, A	
λ, nm	pH = 1.00	pH = 13.00	λ, nm	pH = 1.00	pH = 13.00
460	0.210	0.025	560	0.177	0.250
470	0.217	0.025	580	0.140	0.320
480	0.220	0.026	600	0.110	0.350
490	0.225	0.026	610	0.099	0.355
495	0.227	0.028	620	0.088	0.349
500	0.223	0.029	630	0.076	0.340
510	0.221	0.036	650	0.066	0.312
530	0.210	0.096	680	0.060	0.260
550	0.192	0.192			

a) Plot the curves on the provided graph paper.

b) What wavelength will be appropriate for the spectrophotometric determination of the indicator 1) in strongly acidic solutions, 2) in strongly alkaline solutions?

λ (acidic) = ...

λ (alkaline) = ...

c) What would the absorbance be for an 8.00×10^{-5} M solution of the indicator in the alkaline form (X^-), at 570 nm in a 5.00-cm cell?

A = ...

d) At what wavelength would the absorbance of an indicator solution be independent of pH?

λ = ...

e) Calculate the absorbance of a solution 0.010 M in Na_2HPO_4, 0.050 M in NaH_2PO_4, and 2.50×10^{-4} M in the indicator at 460 nm, in a 1.00-cm cell.

A = ...