Fall 1998-1999	**Chem. 206**	**January 13. 1999**
⌛: 90 min.	**Lab. Final**	**Section:_____**

Name:_____

I.D # :_____

I) You are provided with the following:

i) A white powder mixture of Na_2CO_3 (s) + $ZnCO_3$ (s) + Sand
Total mass of the mixture = 10.0 g
ii) Pure water (1liter)
iii) Standardized Hydrochloric acid solution where [HCl]=0.1M (1liter)
iv) A buret (50ml ± 0.02ml)
v) A pipette (25ml ± 0.03ml)
vi) Volumetric flasks (250ml ± 0.2ml)
vii) A Glass funnel & filter papers
viii) A Graduated Cylinder (100ml)

* IMPORTANT REMARK*

You are free to choose at will, but please indicate, the glassware suitable for a particular experimental procedure and any relevant calculations that goes with it. If the space provided is not adequate, write at the back of the page.

ix) Molar Mass of: Na = 23gmol^{-1}, C = 12gmol^{-1}, O = 16gml^{-1}, Zn = 65gmol^{-1}

a) Describe briefly a method that can separate the white powder mixture into Na_2CO_3 (aq), Zn^{2+} (aq), and pure sand. (Max. 8 lines)

b) The Na_2CO_3 (aq) solution is titrated with the standard HCl 0.1M solution.

i) Name a primary standard that can be used to standardize the HCl solution.

ii) Write the stoichiometric reaction between HCl (aq) and Na_2CO_3 (aq).

c) Use the graph shown in Fig-1(& previous info.) to determine:

i) The mass of sodium in the mixture, hence the % Na in the mixture.

ii) The indicator suitable for this titration.

iii) Is this graph plotted using visual titration ?

iv) The pK at point 'e ' , with proof ? Hence, find the concentration of $[OH^-]$. If the anions present in this titration are Cl^- & CO_3^{2-} , explain how the OH^- ions are generated ?

d- According to part (a) Zn^{2+} ions are now present in solution, which can be quantified using complexometric titration, in this titration:

i) Titrant used is ..... Analyte is ..... Indicator is .....

ii) The change in the color of indicator depends on

1= .....
2= .....

e- Titration of Zn^{2+} with the chelating agent of $[H_2Y^{2-}]$= 0.0070M ± 0.0003M is a 1:1 ratio process. The following table of results is obtained:

2nd read	17.02	31.28	45.56	14.42
1st read	0.25	17.02	31.28	0.12
Vol. of titrant				

Use this table and your experimental skills to:

i) Show the uncertainties & the error propagated in measurements and in calculations up to the point where the amount (moles) of Zinc, in the analyte, is determined.

ii) To determine the % of Zinc in the white solid mixture.

II) A mixture of Cu^{2+} (aq) and Sn^{2+} (aq) solution whose volume is 35 ml is to be separated and quantified. Using a chelating agent such as dithiazone at pH<1 forces copper to chelate as $Cu(L)_2$ while Sn^{2+} does not where:

$$Cu^{2+}\ (aq) + 2L\ (aq) \rightleftharpoons Cu(L)_2\ (org)$$

a) Describe briefly how extraction methods can separate the Cu-complex from Sn^{2+} (aq) ions. (Max. 8 lines).

b) If K_{Cu} (water/organic) = 9.2, calculate the % of Cu extracted from the aqueous phase knowing that:

i) A volume of 40ml of the organic phase is used in one extraction.

ii) If the 40ml volume is divided into 10ml portions.

c)-i) What is the other benefit for extracting Cu as a complex.

ii) Name two factors that cause deviations from Beer`s Law.

d) Calculate the molar absorptivity coefficient 'ε' (L $mol^{-1}cm^{-1}$) using the graph shown in Fig-2 given that: path length of cuvette = 0.5cm.

The aqueous phase containing the Sn^{2+} (aq) ions is titrated against $KMnO_4$ (aq) using potentiometric titration.

e) What does the $KMnO_4$ do to Sn^{2+} ? (Write the two half reactions).

f) Draw the experimental set up labelling the electrodes, the analyte and the titrant ? *[Use a Calomel Electrode].

g) The graph shown in Fig-3 where E(mV) is plotted versus $V_{KMnO_4}(ml)\left[V_{KMnO_4}\right.$ is titrated against a 25ml aliquote of Sn^{2+} solution$\left.\right]$.

Use this graph to:

i) Determine the quantity of tin in ppm, given that:$[KMnO_4]= 10^{-3}$M; MM of Sn= 118.7gmol^{-1}.

ii) Determine the ratio of $\frac{Sn^{2+}}{Sn^{4+}}$ at point 'a' if $E_{calomel} = -0.246$V.

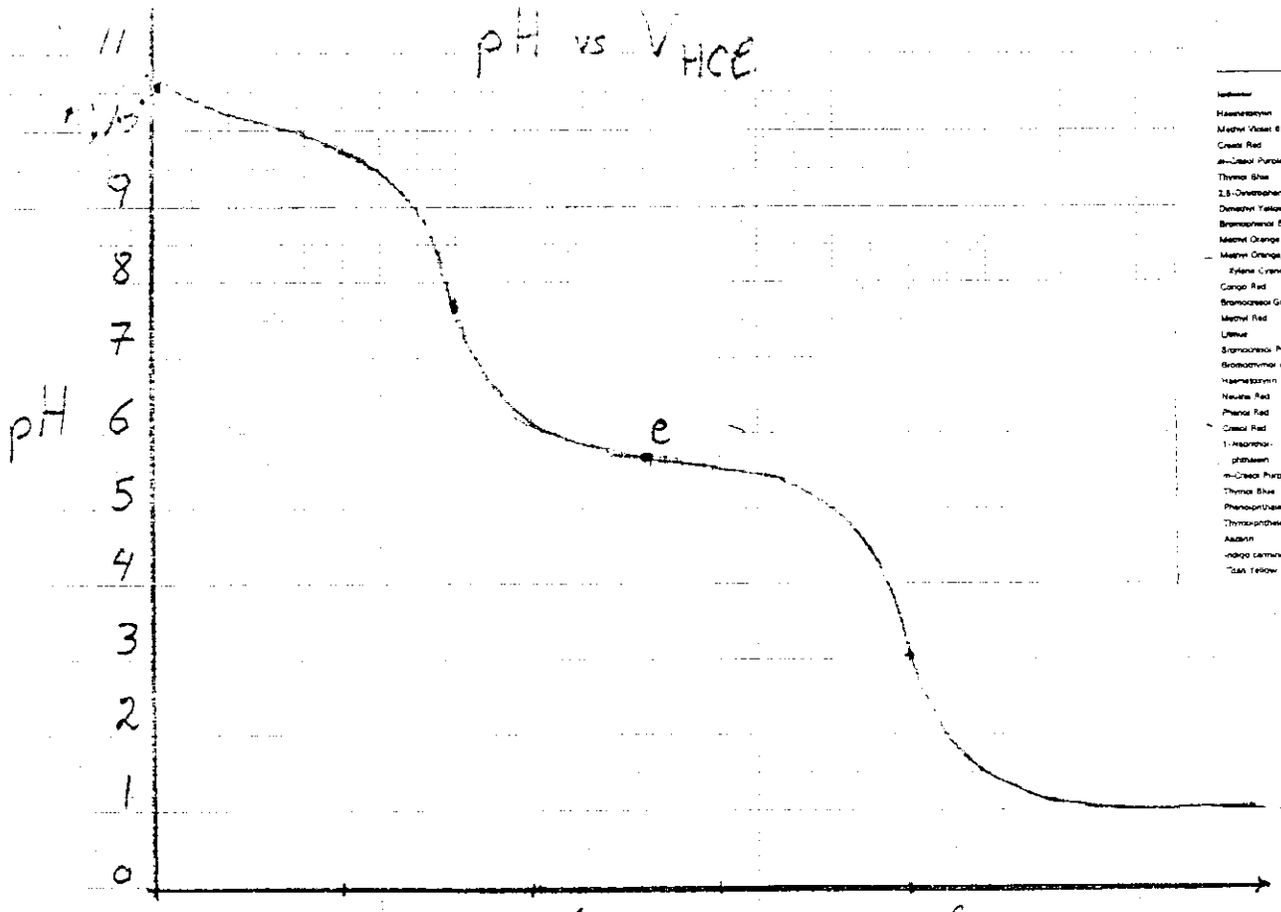

Fig-1

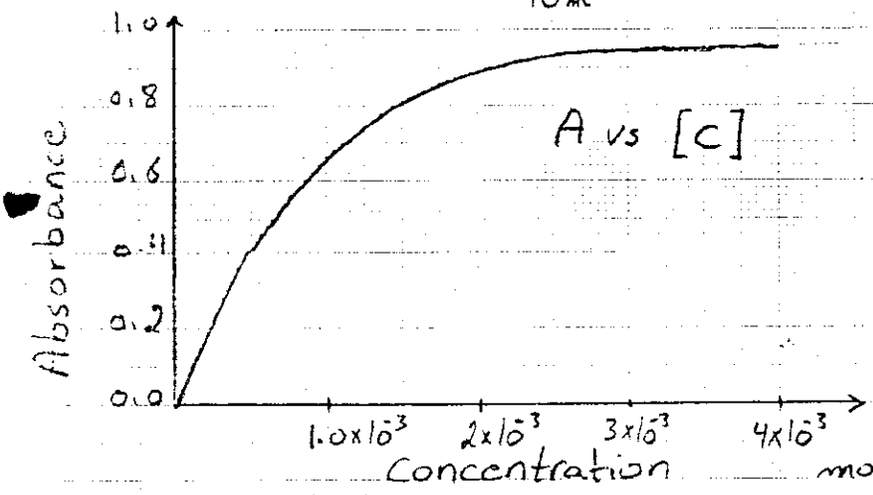

Fig-2

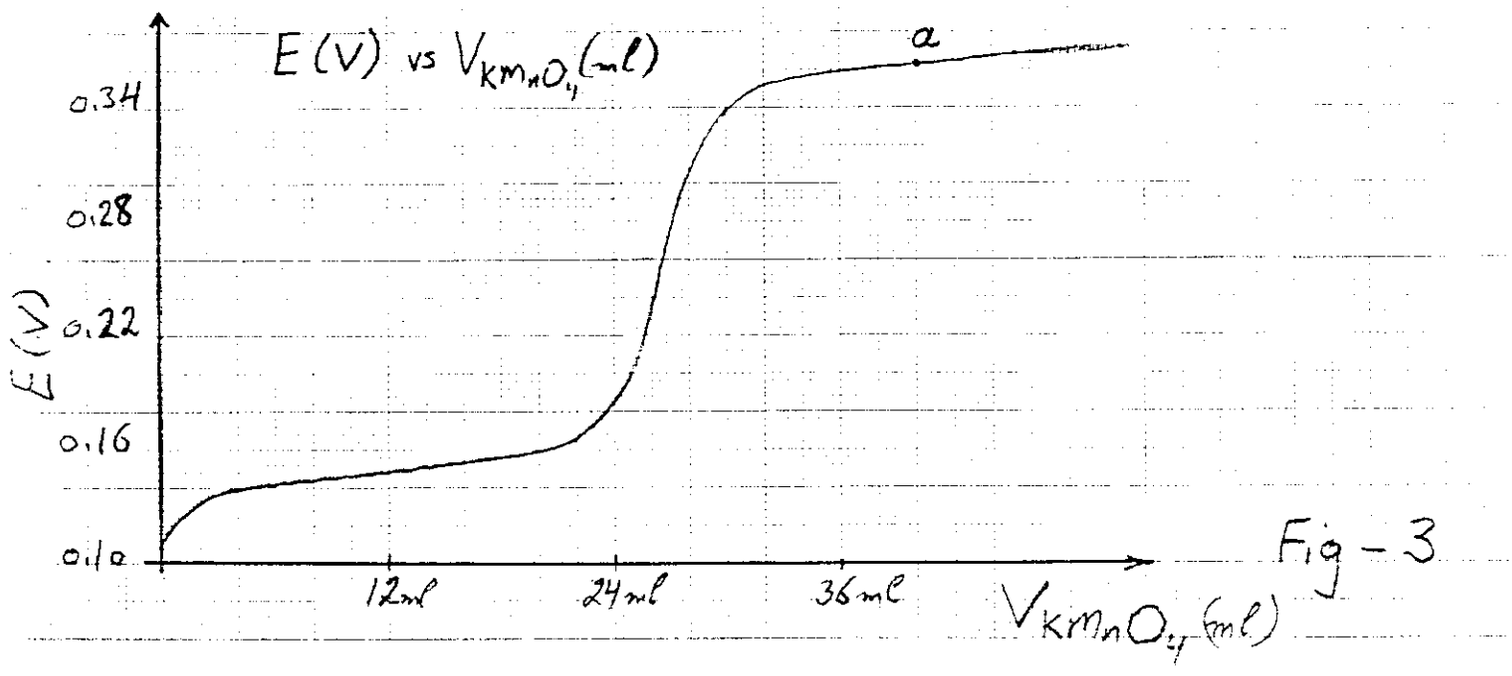

Fig-3

Indicators for acid-base titration and pH determination

Indicator	pH range		Colour change
Haematoxylon	0–1·0	Red	to Yellow
Methyl Violet 6B	0·1–2·0	Yellow	to Violet
Cresol Red	0·2–1·8	Red	to Yellow
m-Cresol Purple	1·2–2·8	Red	to Yellow
Thymol Blue	1·2–2·8	Red	to Yellow
2,6-Dinitrophenol	2·2–4·4	Colourless	to Yellow
Dimethyl Yellow	2·9–4·6	Red	to Yellow
Bromophenol Blue	2·8–4·6	Yellow	to Violet
Methyl Orange	2·9–4·6	Red	to Yellow
Methyl Orange/ Xylene Cyanol	2·9–4·6	Violet	to Green
Congo Red	3·0–6·0	Violet	to Red/Orange
Bromocresol Green	3·6–5·2	Yellow	to Blue
Methyl Red	4·2–6·3	Red	to Yellow
Litmus	5·0–8·0	Red	to Blue
Bromocresol Purple	5·2–6·8	Yellow	to Violet
Bromothymol blue	6·0–7·6	Yellow	to Blue
Haematoxylin	6·0–11·0	Orange	to Red/Violet
Neutral Red	6·8–8·0	Red	to Orange
Phenol Red	6·8–8·4	Yellow	to Red
Cresol Red	7·2–8·8	Yellow	to Violet/Red
1-Naphthol-phthalein	7·3–8·7	Yellow	to Blue
m-Cresol Purple	7·6–9·2	Yellow	to Violet
Thymol Blue	8·0–9·6	Yellow	to Violet/Blue
Phenolphthalein	8·3–10·0	Colourless	to Red
Thymolphthalein	9·3–10·5	Colourless	to Blue
Alizarin	11·0–13·0	Red	to Violet
Indigo Carmine	11·6–14·0	Blue	to Yellow
Titan Yellow	12·0–13·0	Yellow	to Red

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