

Subject

Date

No.

"Practical Analytical Chemistry"

Name:

Reg. No.:

Locker No. : 163

Section No: 9

Instructor: Dr- Safwan Frehat. د. صفوان فريحات

Date : 17th - oct - 2023

Exp. No: Experiment "1"

Title of the experiment : Volumetric Glassware & Balances



Experiment 1

Data sheet and calculations

Name:
Reg. No.:

Section:
Date:

	Trial (1)	Trial (2)	Trial (3)
Initial burette reading	0,00 $\pm$ 0,05	5,10 $\pm$ 0,05	10,20 $\pm$ 0,05
Final burette reading	5,10 $\pm$ 0,05	10,20 $\pm$ 0,05	15,33 $\pm$ 0,05
Apparent volume, ml	5,10 $\pm$ 0,07	5,10 $\pm$ 0,07	5,13 $\pm$ 0,07
Weight of empty flask	6,6446 $\pm$ 0,0001	6,6446 $\pm$ 0,0001	6,6446 $\pm$ 0,0001
Weight of flask and water	11,6150 $\pm$ 0,0001	11,7062 $\pm$ 0,0001	11,7579 $\pm$ 0,0001
Weight of water, g	4,9704 $\pm$ 0,0001	5,2602 $\pm$ 0,0001	5,3119 $\pm$ 0,0001
Temperature, °C	17,0 $\pm$ 0,5	17,0 $\pm$ 0,5	17,0 $\pm$ 0,5
Actual (experimental) volume, ml	4,9818 ml	5,2723 ml	5,3241 ml
Correction (ml)	-0,1182	0,1723	0,2941

Calculate the volume of water contained in each 5 ml portion from the above data

Instructor's Signature:

Instructor's Name:



Calculations 8-

- 1) Apparent volume = final ~~pipette~~ burette reading - initial ~~pipette~~ burette reading
- 2) Weight of water = weight of flask and water - weight of empty flask
- 3) Correction = actual volume - apparent volume
- 4) actual volume from Table

* Calculating of the results:-

$$T = 17^{\circ}\text{C}$$

- Trial 1 :-

- Initial burette reading = $(0.00 \pm 0.05) \text{ ml}$
- final burette reading = $(5.10 \pm 0.05) \text{ ml}$
- Apparent volume = $5.10 - 0.00 = 5.10 \pm 0.07 \rightarrow \sqrt{(0.05)^2 + (0.05)^2} = 0.07$
- Weight of empty flask = $(6.6446 \pm 0.0001) \text{ g}$
- Weight of flask and water = $(11.6150 \pm 0.0001) \text{ g}$
- Weight of water = $(4.9704 \pm 0.0001) \text{ g}$
- Actual volume = $4.9704 \times 1.0023 = 4.9818 \text{ ml}$
- Correction = -0.1182 ml

Trial 2 :- $T = 17^{\circ}\text{C}$

- initial burette reading = $(5.10 \pm 0.05) \text{ ml}$
- final burette reading = $(10.20 \pm 0.05) \text{ ml}$
- Apparent volume = $10.20 - 5.10 = 5.10 \pm 0.07 \rightarrow$
- weight of empty flask = $(6.6446 \pm 0.0001) \text{ g}$
- weight of flask and water = $(11.7062 \pm 0.0001) \text{ g}$
- weight of water = $(5.2602 \pm 0.0001) \text{ g}$
- Actual volume = $5.2602 \times 1.0023 = (5.2723) \text{ ml}$
- Correction = 0.1723 ml

Trial 3 :- $T = 17^{\circ}\text{C}$

- initial burette reading = $(10.20 \pm 0.05) \text{ ml}$
- final burette reading = $(15.33 \pm 0.05) \text{ ml}$
- Apparent volume = $(5.13 \pm 0.07) \text{ ml}$
- weight of empty flask = 6.6446 ± 0.0001
- weight of flask and water = 11.7579 ± 0.0001
- weight of water = $(5.3119 \pm 0.0001) \text{ g}$
- Actual volume = 5.3241 ml
- correction = 0.1941 ml

* Sources of error :-

- 1- There was air bubbles in the burette
- 2- There was an error by recording the initial and final ~~no~~ burette reading
- 3- The weighting bottle was held by fingers
- 4- weighting the bottle wasn't professionally done because it wasn't cleaned very well.

Question

A 25.00 ml pipette was found to deliver 24.976 g of water when calibrated against stainless steel weight at 25°C. Use the data in Table 2 to calculate the volume delivered by the pipette at this temperature and at 20°C.

at 25°C :-

$$1 \text{ g} \rightarrow 1.0036 \text{ ml}$$

$$24.976 \rightarrow ?? \text{ ml}$$

$$\text{Actual volume} = 25.0659 \text{ ml}$$

at 20°C :-

$$1 \text{ g} \rightarrow 1.0028 \text{ ml}$$

$$24.976 \text{ g} \rightarrow ?? \text{ ml}$$

$$\text{Actual volume} = 25.0459 \text{ ml}$$



Name :-

Reg. No :-

Locker No :- " 553 "

~~CAF~~

Section :- 9

~~TKN/EXP~~

Instructor :- Dr. Safwan Al-Freihat

Date :- 20 ~ Mar ~ 2013

Exp. No :- 2

Title of the exp :- Sampling and Statistical Treatment of Data



Experiment 2

Data Sheet and Calculations

Name:

Section: 9

Reg. No.:

Date:

A. Homogenous sample

Result no.	V_S	V_B	$V_S - V_B$
1	$10,80 \pm 0,05$	$0,05 \pm 0,05$	$10,75 \pm 0,09$
2	$12,30 \pm 0,07$	$0,05 \pm 0,07$	$12,25 \pm 0,09$
3	$10,10 \pm 0,05$	$0,05 \pm 0,07$	$10,05 \pm 0,09$
4	$10,55 \pm 0,07$	$0,05 \pm 0,07$	$10,50 \pm 0,09$
5	$11,15 \pm 0,07$	$0,05 \pm 0,07$	$11,10 \pm 0,09$

B. Non-homogenous sample

Result no.	V_S	V_B	$V_S - V_B$
1	$6,50 \pm 0,07$	$0,05 \pm 0,07$	$6,45 \pm 0,09$
2	$7,10 \pm 0,07$	$0,05 \pm 0,07$	$7,05 \pm 0,09$
3	$6,10 \pm 0,07$	$0,05 \pm 0,07$	$6,05 \pm 0,09$
4	$7,85 \pm 0,07$	$0,05 \pm 0,07$	$7,80 \pm 0,09$
5	$6,85 \pm 0,07$	$0,05 \pm 0,07$	$6,80 \pm 0,09$

Instructor's Signature:

Instructor's Name:



Calculations :-

A Homogenous sample

① The results are (10,05, 10,50, 10,75, 11,10, 12,25)

② Q-test (The value of Q critical in confidence limit 90% = 0,64)

$\rightarrow 10,05$ $Q_{\text{calculated}} = \frac{|10,05 - 10,50|}{12,25 - 10,05} = 0,20$ $Q_{\text{calc}} < Q_{\text{critical}}$ so retained
 Keep the value 10,05

$\rightarrow 12,25$ $Q_{\text{calculated}} = \frac{|12,25 - 11,10|}{12,25 - 10,05} = 0,52 < Q_{\text{critical}}$ so retained
 " " " " 12,25

③ Mean = $\frac{\sum x}{n} = 10,93$

④ Median = 10,75

⑤ Average deviation from the mean = $\frac{\sum |x_i - \bar{x}|}{N} = \frac{(0,88 + 0,43 + 0,18 + 0,17 + 1,32)}{5} = 0,596$

⑥ Relative average deviation from the mean = $(AD / \bar{x}) \times 100\% = 5,4\%$

⑦ Average deviation from the median = $(0,7 + 0,25 + 0,02 + 0,35 + 1,5) / 5 = 0,56$

⑧ Relative average deviation from the median = $\frac{0,56}{10,75} \times 100\% = 5,2\%$

⑨ standard deviation = $S = \sqrt{\frac{\sum (x_i - \bar{x})^2}{N-1}} = 0,83$

⑩ Relative standard deviation = $\frac{S}{\bar{x}} \times 100\% = 7,5\%$

B Non Homogenous Sample

① The results are (6,10, 6,45, 6,80, 7,10, 7,80)

$\rightarrow 6,05$ $Q_{\text{calculated}} = \frac{|6,10 - 6,45|}{7,80 - 6,05} = 0,22 < Q_{\text{critical}}$ so retained
 Keep the value 6,10

$\rightarrow 7,80$ $Q_{\text{calculated}} = \frac{|7,80 - 7,10|}{7,80 - 6,05} = 0,41 < Q_{\text{critical}}$ so retained
 " " " " 7,80

③ Mean = $\frac{\sum x_i}{N} = 6,85$

④ Median = 6,80

Average deviation from the mean = $\frac{\sum |x_i - \bar{x}|}{N} = \frac{(0.75 + 0.40 + 0.25 + 0.25 + 0.05)}{5}$
 $\boxed{= 0.48}$

⑥ Relative Average deviation from the mean = $\frac{AD}{\bar{x}} \times 100\% = 7.00\%$

⑦ Average deviation from the median = $(0.7 + 0.35 + 0.00 + 0.30 + 1.00)/5$
 $\boxed{= 0.47}$

⑧ Relative average deviation from the median = $\frac{AD}{0.47} \times 100\% = 6.9\%$

⑨ standard deviation = $s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{N-1}} = 0.65$

⑩ Relative standard deviation = $\frac{s}{\bar{x}} \times 100\% = 9.5\%$

Questions 1- compare the results of two groups in terms of -

① Mean homogenous $10.93 > 6.85$ Non Homogenous

② standard deviation Homogenous $0.83 \neq 0.65$ Non Homogenous

③ Relative standard deviation Homogenous $7.6\% < 9.5\%$ Non Homogenous

② Calculated the molar concentration of acetic acid for both group results

→ Homogenous $M(\text{NaOH}) \times V(\text{NaOH}) = M(\text{CH}_3\text{COOH}) V(\text{CH}_3\text{COOH})$
 $0.10 \times 10.93 = M(10.00)$
 $\boxed{M = 0.1093 \text{ M}}$

→ Non homogenous $M(\text{NaOH}) V(\text{NaOH}) = M(\text{CH}_3\text{COOH}) V(\text{CH}_3\text{COOH})$
 $(0.10)(6.85) = M(10.00)$
 $\boxed{M = 0.0685 \text{ M}}$

③ Assume the concentration of

acetic acid is 0.1 M ; Make comments on the results in terms of accuracy

and precision Accuracy → relative error

precision → RSD

for Homo → $\frac{0.1093 - 0.1}{0.1} \times 100\% = 9.3\%$
 for non Homo → $\frac{0.0685 - 0.1}{0.1} \times 100\% = -31.5\%$

NAME :

REG. NO :

Locker No : 163

Section No : 9

Instructor : Dr. Safwan Al-Freihat.

Date : 7 - 11 - 2023.

Exp No : 3

Title : Neutralization Titration in Aqueous Medium



Experiment 3 Date Sheet and Calculations

43

Name:

Section: 9

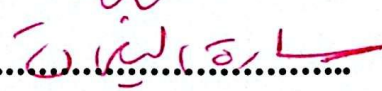
Reg. No.:

Date:

Mass of Na_2CO_3	0.5005 $\pm$ 0.0001	
(A) Vol. of Na_2CO_3	Vol. of HCl	
1. 10.00 $\pm$ 0.05	9.90 $\pm$ 0.07	$\pm$ 0.07
2. 10.00 $\pm$ 0.05	9.70 $\pm$ 0.07	
3. 10.00		
(B) Vol. of NaOH	Vol. of HCl	
1. 10.00 $\pm$ 0.05	9.30 $\pm$ 0.07	$\pm$ 0.07
2. 10.00 $\pm$ 0.05	8.90 $\pm$ 0.07	
3. 10.00		
(C) Vol. of H_3PO_4	Vol. of NaOH	Indicator
1. 10.00 $\pm$ 0.05	14.20 $\pm$ 0.07	green indicator
2. 10.00 $\pm$ 0.05	13.40 $\pm$ 0.07	Phenolphthalein

Calculate the molarity of Na_2CO_3 , HCl and NaOH solutions, and calculate the concentration of H_3PO_4 in the unknown solution in g/L.

Instructor's Signature: 

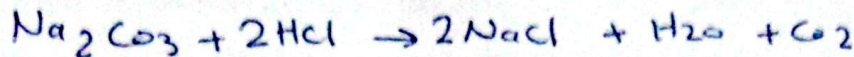
Instructor's name: 

31/10/2023



Part (A)

→ Calculation ←



- mass of $\text{Na}_2\text{CO}_3 = 0.5005 \text{ g} \pm 0.0001$

- Volume of $\text{Na}_2\text{CO}_3 = 10.00 \pm 0.05 \text{ mL}$

$$M = \frac{0.5005}{\text{molar mass of } (\text{Na}_2\text{CO}_3)} \times 10^3 \text{ (for volume)} = 0.047 \text{ M}$$

$$\frac{4.722 \times 10^{-3}}{0.01} = 0.47$$

→

$$\text{Volume of HCl} = (9.90 + 9.70) / 2 = 9.8 \text{ mL} \pm 0.1 \rightarrow \sqrt{(0.07)^2 + (0.07)^2}$$

* Stoichiometry → 1 mol of Na_2CO_3 : 2 mol HCl

$$2 M \bar{V}(\text{Na}_2\text{CO}_3) = M \bar{V}(\text{HCl}) \quad (\bar{V} \text{ NaOH} = (10.00 + 10.00) / 2 = 10.00 \text{ mL} \pm 0.07)$$

$$\frac{2 \times 0.047 \times 10.00}{9.8} = M(\text{HCl}) \Rightarrow \boxed{M(\text{HCl}) = 0.096 \text{ M}}$$

— The indicator that I have been used in this part: bromocresol green indicator → For changes from blue (base) → yellow (acid).

Part (B)



$$\bar{V} \text{ HCl} = (9.30 + 8.90) / 2 = 9.1 \text{ mL} \pm 0.1 \rightarrow \text{(Same as } \bar{V} \text{ HCl in Experi. A, Part)}$$

$$\bar{V} \text{ NaOH} = (10.00 + 10.00) / 2 = 10.00 \text{ mL} \pm 0.07 \rightarrow \sqrt{(0.05)^2 + (0.05)^2} = 0.07$$

* Stoichiometry 1 mol NaOH = 1 mol HCl

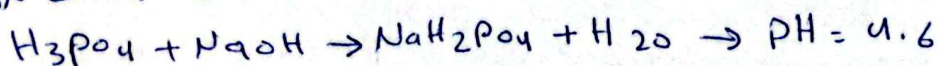
$$M \bar{V}(\text{NaOH}) = M \bar{V}(\text{HCl})$$

$$M(\text{NaOH}) = \frac{0.096 \times 9.1}{10.00} = 0.097 \text{ M}$$

* The indicator : phenolphthalein From pink → colorless (basic) (acidic)

Part C : unknown number : 43

(I) Neutralization of one proton:-



$$\bar{V} \text{ NaOH} = (14.2 + 13.4) / 2 \rightarrow 13.8 \text{ mL} \pm 0.1$$

$$\bar{V} \text{ H}_3\text{PO}_4 = (10.00 + 10.00) / 2 = 10.00 \text{ mL} \pm 0.07$$

$$M \bar{V}(\text{H}_3\text{PO}_4) = M \bar{V}(\text{NaOH})$$

Stoichiometry → 1 mol H_3PO_4 = 1 mol NaOH

$$\Rightarrow M(\text{H}_3\text{PO}_4) = \frac{0.097 \times 13.8}{10.000} = 0.131 \text{ M}$$

Molar mass of $H_3PO_4 = 97.994 \text{ g/mol}$

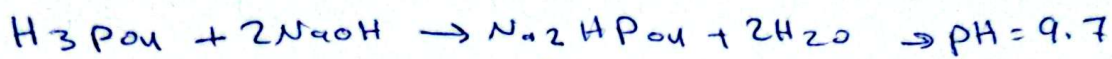
$$0.131 \frac{\text{mol}}{\text{L}} \times 97.994 \text{ g/mol} = 12.83 \text{ g/L}$$

- The indicator has been used : Bromocresol green indicator
(acidic) yellow $\rightarrow$ blue (basic)

For indicator : Phenolphthalin.

Change from colorless (acidic) $\rightarrow$ pink (basic)

For calculation same as above $\rightarrow$ the result $\rightarrow = 6.67 \text{ g/L}$



$$\bar{V}_{NaOH} = (13.8 \text{ mL} \pm 0.1)$$

$$\bar{V}_{H_3PO_4} = 10.00 \text{ mL} \pm 0.07$$

Stoichiometry $1 \text{ mol } H_3PO_4 = 2 \text{ mol } NaOH$

$$M \bar{V} (H_3PO_4) = \frac{1}{2} M \bar{V} (NaOH)$$

$$M(H_3PO_4) = \frac{0.07 \times 13.8}{2 \times 10.00} = 0.069 \text{ M}$$

$$\rightarrow 0.069 \frac{\text{Mol}}{\text{L}} \times 97.994 \text{ g/mol} = 6.67 \text{ g/L}$$

$\text{Avg} = \frac{6.67 + 6.67}{2} = 6.67 \text{ g/L}$
 9.75
 9.5
with of new

* Sources of error :-

- Error while detecting the color change of the indicator
- Determining the initial & final volume of the burette
- using the balance as a result of holding the weighing bottle.

Conclusion:

[1] we choose the indicator depending on the numerical value of pH which the indicator changes its color at a certain pH

[2] Titration is 3 types :
1) strong acid & strong base
2) weak " & weak "
3) strong " & weak base

[3] in this experiment Na_2CO_3 was a primary standard solution

[4] we can standardize an acid, then use it with other bases in titration & complete calculation

ask : believe & recieve

Questions:
1) How do you determine the solubility of Ca(OH)_2 by a simple acid-base?

(a) prepare a solution of Ca(OH)_2

(b) pipette a certain volume of the Ca(OH)_2 standard solution

(c) Titrate against a weak or strong acid with a known concentration

(E.g) HCl & put a appropriate indicator

(d) Find the solubility of Ca(OH)_2 by the equation of titration.



here ... 1 mole of $\text{Ca(OH)}_2 \rightarrow 2\text{mol}$ of HCl

(e) According to the above equation.

$$M(\text{Ca(OH)}_2) = \frac{M_{\text{HCl}} V_{\text{HCl}}}{2 V(\text{Ca(OH)}_2)} \Rightarrow M(\text{Ca(OH)}_2) = [\text{Ca}^{+2}] = \frac{1}{2} [\text{OH}^-]$$

2) How do you determine the water of crystallization of washing soda? you need x in $\rightarrow \text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ (percentage of water percent)

(A) prepare a solution by putting a known mass of hydrate Na_2CO_3 in a distilled water.

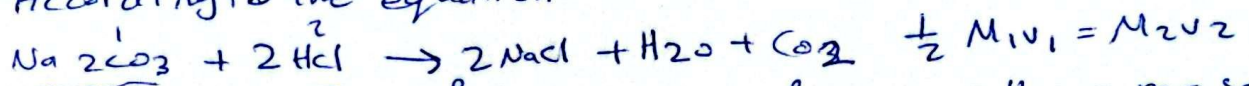
(B) mark the volume of the solution that has been prepared

(C) put Methyl orange indicator or any appropriate indicator

(D) Titrate with a known molarity with HCl (acid) at the end point

the color will change yellow $\rightarrow$ peach pink

(E) According to the equation.



(F) calculate the mass of $\text{H}_2\text{O} = \text{mass of } \text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} - \text{mass of } \text{Na}_2\text{CO}_3$

(G) calculate the mole of H_2O ($n = m/M_m$)

(H) x water of crystallization = moles of H_2O / moles of Na_2CO_3

3) why two indicators can be used for the determination of phosphoric acid?

Because phosphoric acid has 3 protons (H_3PO_4) and each proton gets titrated at a specific pH, and choosing indicators depend on the pH medium (color changes at certain pH)

4) No there is no titration between weak acid & weak base because there will not be a abrupt change in pH at the equivalence point. Also, we will need a large amount of titrate in order to get to the equivalence point) NH_3 : weak base $\rightarrow$ CH_3COOH : weak acid

Practical Analytical Chemistry

Name :

Reg No :

8
10

Laker No :

Course : experimental analytical chemistry (0303216)

Section No : 9

Instructor : Dr - Safwan Frehat

Date : 14-11-2023 ← وقت التسليم

Exp No : 4

Title : Precipitation Titration Argentometry

unknown No : 22



Section: 9
Date: 7-11-2023

Mass of NaCl: 0.6163 g

(A) Mohr's method	Trial (1)	Trial (2)
Vol. of NaCl solution	10.00 mL	10.00 mL
Vol. of AgNO ₃ solution	10.10 ± 0.07	10.10 ± 0.07
(B) Fajan's method		
Vol. of NaCl solution	10.00 mL	10.00 mL
Vol. of AgNO ₃ solution	10.30 ± 0.07	10.30 ± 0.07
(C) Volhard's method		
Vol. of AgNO ₃ solution	10.00 mL	10.00 mL
Vol. of KSCN solution	10.50 mL	10.30 mL

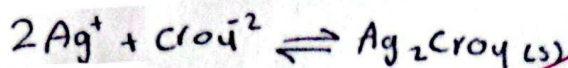
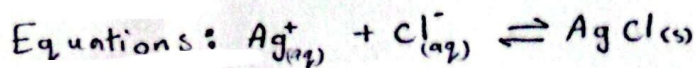
Unknown mixture ID: 22		
(I) According to Mohr's method	Trial 1	Trial 2
Vol. of unknown solution	10.00 ml	10.05
Vol. of AgNO ₃ solution	10.90 ml	10.07
(II) According to Volhard's method		
Volume of unknown solution	10.00 ml	
Vol. of KSCN solution		
Vol. of AgNO ₃ added in excess		

Instructor's Signature: *صالح العتيبي*

Instructor's Name:

Calculations:-

"PART A" standardization of AgNO_3 by Mohr's method



- indicators : trial $\rightarrow$ potassium chromal "colour $\rightarrow$ reddish-brown"

- Mass of $\text{NaCl}_{(s)} = 0.6163\text{g}$ Using Analytical balance.

- uncertainty = ± 0.0001

- volume of NaCl solution = $10.00\text{ mL} \pm 0.05$ $\nearrow \frac{1}{2} \times \text{least division} = \frac{1}{2} \times 0.1 = 0.05$

- volume of AgNO_3 solution = $10.10\text{ mL} \pm 0.07$ $\nearrow \sqrt{(0.05)^2 + (0.05)^2} = 0.07$

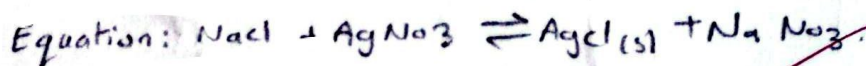
$$n = \frac{m}{M} = \frac{0.6163\text{g}}{58.44\text{g/mol}} = 0.0105\text{ mol} \rightarrow M = \frac{n}{V(L)} = \frac{0.0105}{100 \times 10^{-3}} = 0.105\text{ mol/L}$$

$$M V(\text{NaCl}) = M V(\text{AgNO}_3) \rightarrow 0.105 \times 10.00 = M \text{AgNO}_3 \times 10.10$$

$$M(\text{AgNO}_3) = 0.1039\text{ mol/L}$$

$$M(\text{AgNO}_3) = 0.1039\text{ mol/L} \times 169.9\text{g/mol} = 17.65\text{ g/L}$$

"PART B" standardization of AgNO_3 by Fajan's method.



Indicator : 5 drops of dichlorofluoresceine "colour $\rightarrow$ pink"

Mass $\text{NaCl} : 0.6163$, $M_m : 58.44\text{g/mol}$, $V_{\text{NaCl}} = 10.00\text{ mL} \pm 0.05$

$V_{\text{AgNO}_3} = 10.30\text{ mL} \pm 0.07$

$$M V_{\text{NaCl}} = M V_{\text{AgNO}_3}$$

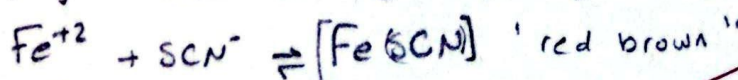
$$0.105 \times 10.00 = M \cdot 10.30 \Rightarrow M \text{AgNO}_3 = 0.1019\text{ mol/L}$$

molar mass of $\text{AgNO}_3 = 169.91\text{g/mol}$

$$0.1019\text{ mol/L} \times 169.91\text{g/mol} = 17.31\text{ g/L}$$

* The mean value : molarity = $(0.1039 + 0.1019)/2 = 0.1029\text{ mol/L}$

"PART C" standardization of potassium thiocyanate by Volhard's method.



indicator $\rightarrow$ Ferric indicator "1mL" $\rightarrow$ colour "red brown colour" $\rightarrow$ permanent for 1min

$\rightarrow 2.5\text{ mL}$ of M HNO_3

$V(\text{AgNO}_3) \rightarrow 10.00\text{ mL} \pm 0.05$ "using pipet"

uncertainty = $\frac{1}{2} \times \text{least division} = \frac{1}{2} \times 0.1 = 0.05$

Volume of $\text{KSCN} : 10.50 \pm 0.07$ $\nearrow \sqrt{(0.05)^2 + (0.05)^2} = 0.07$

From part A & B $\rightarrow M(\text{AgNO}_3) = 0.1039 \text{ M}$ & $V \text{ AgNO}_3 = 10.00 \text{ ml}$

$$\bar{V} \text{ KSCN} = 10.40 \text{ ml} \left[(10.50 + 10.30 / 2) = 10.40 \text{ ml} \pm 0.07 \right]$$

$$(M_1 V_1)_{\text{Ag}} = (M_2 V_2)_{\text{KSCN}} \rightarrow M_{\text{KSCN}} = \frac{M_1 V_1}{M_2} = \frac{10.00 \times 0.1039 \text{ M}}{10.40 \text{ ml}} = 0.0999 \text{ M}$$

$$M_{\text{KSCN}} = 97.0 \text{ g/mol}$$

$$97.0 \frac{\text{g}}{\text{mol}} \times \frac{0.0999 \text{ mol}}{\text{L}} = 9.69 \text{ g/L}$$

'PART D' I Determination of unknown mixture of Halides (NaCl + KCl)

- unknown number 22

I : According to Mohr's method :-

volume of unknown : $10.00 \text{ ml} \pm 0.05$

volume of AgNO_3 $\bar{V}$: 10.85 ± 0.07 $\left((10.80 + 10.90) / 2 = 10.85 \text{ ml} \right)$

indicator : Mixed indicators.

Calculations :

$$\text{mass of the unknown } x + y = 0.065$$

$$\text{Molarity } (\text{AgNO}_3) = 0.1029 \text{ M}$$

$$n(\text{AgNO}_3) = M \times \bar{V} = 0.1029 \frac{\text{mol}}{\text{L}} \times 10.85 \text{ ml} \times 10^{-3} = 0.00112 = 11.2 \times 10^{-4} \text{ mol}$$

$$(M_1 V_1)_{\text{unknown}} = (M_2 V_2)_{\text{AgNO}_3}$$

$$\text{moles of unknown} \Rightarrow \frac{x}{M_{\text{NaCl}}} + \frac{y}{M_{\text{KCl}}} \Rightarrow \frac{x}{58.5} + \frac{y}{74.5} = M_{\text{AgNO}_3} \bar{V} \quad \text{--- (2)}$$

$$x + y = 0.065 \rightarrow y = 0.065 - x \quad \text{--- (1)}$$

Substitute (1) in (2)

$$\frac{x}{58.5} + \frac{(0.065 - x)}{74.5} = 10.85 \times 10^{-3} \times 0.1039 \text{ M}$$

$$74.5x + 58.5x + 3.80 = 4.913 \times 10^{-3}$$

$$133x = 1.113 \Rightarrow x = 0.00836 \text{ g}$$

$$x = \frac{0.00836}{10 \times 10^{-3} \text{ L}} = 0.836 \text{ g/L}$$

$$y = 0.0046 \rightarrow 0.46 \text{ g/L}$$

Determining their weight per L volume 10 ml



Source of errors:

- ① errors in NaCl
- ② uncleaned glassware.
- ③ uncalibrated glass wares.
- ④ Not observing the end point in titration (adding more drops)
- ⑤ errors in preparing NaCl solution (adding more volume of distilled water, not cleaning the glass rod off funnel that may have particles of NaCl on its surface).
- ⑥ Air bubbles in Buret or pipet will make errors in volume.

— conclusion

in precipitation titration we use AgNO_3 as titrant, and this kind of titration is used to titrate halides, cyanide and also isocyanate and to a less extent for phosphate sulfide.

There are 3 general methods:-

- ① Mohr's method ② Fajans's method ③ Volhard's method
 direct "indirect"

in the 1st part and second one we calculate the molarity of AgNO_3 used it in the following parts → so each part of this experiment depends on its previous parts.

we used several types of indicators & determine the mass of the component of the known.

→ Purpose

Determine the concentration of Cl^- by forming a precipitate in the three different methods.



Question 11

(1) Because if we use a basic solution $\text{Ag}^+ \xrightarrow{\text{OH}^-} \text{AgOH}$, which will change to Ag_2O so we will need more volume of AgNO_3 and there will be a large positive error. On the other hand if we use an acidic solution $\text{CrO}_4^{2-} \xrightarrow{\text{H}^+} \text{Cr}_2\text{O}_7^{2-}$ and there will be $\text{Ag}_2\text{Cr}_2\text{O}_7$. ($K_{\text{sp}}(\text{Ag}_2\text{Cr}_2\text{O}_7) > K_{\text{sp}}(\text{Ag}_2\text{CrO}_4)$) so we will need an extra AgNO_3 to have the end point (there will be positive error)

(2) In an acidic solution your indicator (Fluoresceine) will react with H^+ , so our indicator will be the anion of weak acid, it forms protonated species that will not function as an indicator, so there will be extra volume of AgNO_3 (positive determination error)

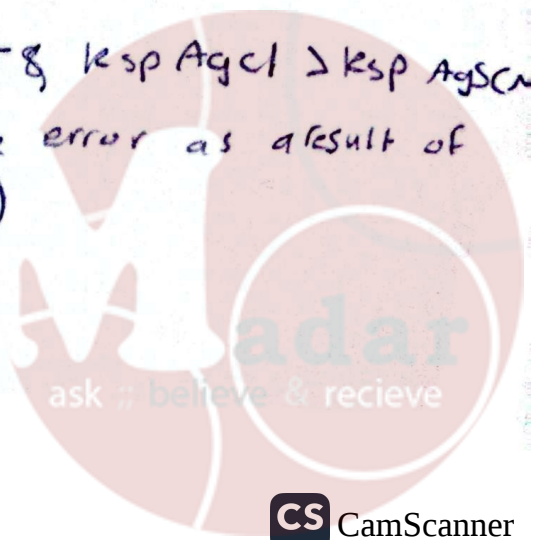
(3) $K_{\text{sp}} \text{Ag}_2\text{Cr}_2\text{O}_7 > K_{\text{sp}} \text{Ag}_2\text{CrO}_4$ so we need extra volume of AgNO_3 to reach the end point (positive error)

(4) Mohr's & Fajan's method, as we said above $\text{Ag}^+ \xrightarrow{\text{OH}^-} \text{Ag}(\text{OH})_2$, there will be Ag_2O ppt $\rightarrow$ large positive error.

$\rightarrow$ Volhard's method $\text{Fe}^{+3} \xrightarrow{\text{OH}^-} \text{Fe}(\text{OH})_3(\text{s})$ --- there will be Fe_2O_3 (it will be more volume of $\text{AgNO}_3 \rightarrow$ positive error)

(5) Nitro benzene will cover the surface of AgCl ppt also it will prevent the below reaction from occurring (the reaction is between AgCl and the titrant SCN^- to form AgSCN)

$\text{AgCl} + \text{SCN}^- \rightleftharpoons \text{AgSCN} + \text{Cl}^-$ & $K_{\text{sp}} \text{AgCl} > K_{\text{sp}} \text{AgSCN}$
(in order to prevent the negative error as a result of less volume of the titrant SCN^-)



Name:-

Reg. Nos:-

Lokar No:- 553

Instructor:- Dr. Safwan Al-Frehat

Date:- 10 - April - 2023

Section:- 9

Exp. No:- 5

Title of the Experiment:- Redox Titrations (Dichromate titrations)

q.s



Experiment 5

Data Sheet and Calculations

Name:
Reg. No.:

Section:
Date:

Unknown ID No.: 49	
(A) Determination of Fe^{2+} in a mixture	
Vol. of unknown solution	Vol. of $\text{K}_2\text{Cr}_2\text{O}_7$
1) 10.00 ± 0.05	3.60 ± 0.07
2) 10.00 ± 0.05	3.30 ± 0.07
3)	
(B) Determination of Fe^{3+} after reduction	
Vol. of unknown solution	Vol. of $\text{K}_2\text{Cr}_2\text{O}_7$
1) 10.00 ± 0.05	4.60 ± 0.07
2)	

Wt. of Fe^{2+} per liter =
Wt. of Fe^{3+} per liter =

Instructor's signature: [Signature]

Instructor's Name: [Name]



• calculation of the results and their precision:

Part A: Determination of Fe^{+2} in the mixture (unknown No. 49)

- average volume of $\text{K}_2\text{Cr}_2\text{O}_7 = \frac{3,60 + 3,30}{2} = 3,45 \pm 0,09$

$$6(M \cdot V)_{\text{K}_2\text{Cr}_2\text{O}_7} = (M \cdot V)_{\text{Fe}^{+2}}$$

$$6 \times 0,02 \times 3,45 = 10,00 \times M$$

$$\boxed{M_{\text{Fe}^{+2}} = 0,0414 \text{ M}}$$

- molar mass for Fe = $55,845 \frac{\text{g}}{\text{mol}}$

$$0,0414 \frac{\text{mol}}{\text{L}} \times 55,845 \frac{\text{g}}{\text{mol}} = 2,311 \frac{\text{g}}{\text{mol}} \text{Fe}^{+2} \text{ (before reduction)}$$

Part B: Determination of Fe^{+2} after reduction



- volume of $\text{K}_2\text{Cr}_2\text{O}_7 = 4,60 \pm 0,07$

$$6(M \cdot V)_{\text{K}_2\text{Cr}_2\text{O}_7} = (M \cdot V)_{\text{Fe}^{+2}} \rightarrow 6 \times 0,02 \times 4,60 = M (10,00)$$

$$M_{\text{Fe}^{+2}} = 0,0552 \text{ M}$$

$$0,0552 \frac{\text{mol}}{\text{L}} \times 55,845 \frac{\text{g}}{\text{mol}} = 3,082 \frac{\text{g}}{\text{mol}} \text{Fe}^{+2}$$

$$\text{Fe}^{+3} (\text{g/L}) = 3,082 - 2,311 = 0,7716 \frac{\text{g}}{\text{L}} \text{Fe}^{+3}$$



What is the role of H_3PO_4 in determination of Fe^{+2} by titration with $\text{K}_2\text{Cr}_2\text{O}_7$

H_3PO_4 reacts with yellow Fe^{+3} (resulting for titration) to form $[\text{Fe}(\text{HPO}_4)]$ which is colorless so that the end point of reduction is more clearly visible. Moreover, H_3PO_4 lowers the reduction potential of $\text{Fe}^{+3} - \text{Fe}^{+2}$ couple by complexation (Fe^{+3} is reduced) and hence tends to increase the reducing power of Fe^{+2} .

2] Can you determine Iron in ores using $\text{K}_2\text{Cr}_2\text{O}_7$?

Yes, I can, Because the iron ores contain Fe_2O_3 and Fe_3O_4 which can be dissolved in an acidic solution in order to have Fe^{+3} and reduced it as the equation $\text{Fe}^{+3} + e^- \rightarrow \text{Fe}^{+2}$ then titrate it ~~with~~ with titrant $\text{Cr}_2\text{O}_7^{2-}$ with the use of H_3PO_4 and diphenylamine sulfuric acid indicator.

3] How ~~can~~ could you check that Fe^{+3} has been completely reduced to Fe^{+2} ?

When the yellow color has disappeared entirely; this confirms that all Fe^{+3} has been reduced to Fe^{+2} . Also, to check the complete reduction of Fe^{+3} , one drop of the solution is added to a drop of NH_4SCN on a porcelain tile, if no blood-red color formation appears, this means that there is a complete reduction of Fe^{+3} to Fe^{+2} .



Name :

- Reg No :

- Exp No : 7

The title of Experiment : complexometric Titration
Using EDTA .

Instructor: Dr - safwan Freihab.

Locker No: 163

Course : Experimental Analytical lab .

Date: 7th oct .



Experiment 7

Data Sheet and Calculations

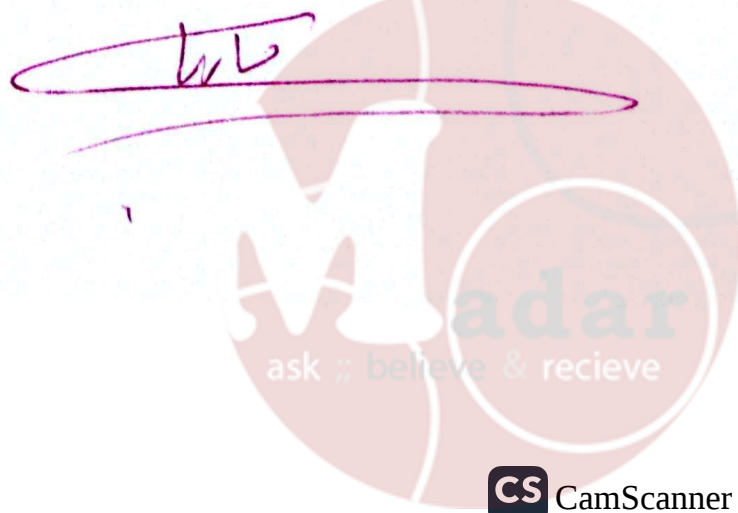
Name:

Section: 9

Reg. No.:

Date: 5-Dec

(A) Standardization of EDTA				
Mass of $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$	0.3358			
Data	Trial 1	Trial 2	Trial 3	Average
Volume of $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ Solution	10.00 +0.05			
Volume of EDTA solution	12.40 +0.07			
Molarity of EDTA solution	0.0094 mol/L			
(B) Determination of Water Hardness				
Data	Trial 1	Trial 2	Trial 3	Average
1- Vol. of tap water	50.00 +0.05			
2- Vol. of EDTA solution (V_1) (corresponding to Ca and Mg)	15.80 +0.07			
3- Vol. of tap water	50.00 +0.05			
4- Vol. of EDTA (V_2) (corresponding to Ca)	6.60 +0.07			



Calculations.

(A) standardization of EDTA with standard zinc sulfate.

• wt of $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O} = 0.3358 \text{ g} \pm 0.0001$

• Molar mass of $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O} = 287.36 \text{ g/mol}$

• V of EDTA = $12.40 \pm 0.07 \text{ mL}$ one Trial

$$n_{\text{for ZnSO}_4 \cdot 7\text{H}_2\text{O}} = 0.3358 \text{ g} \times \frac{1 \text{ mol}}{287.36 \text{ g}} = 1.168 \times 10^{-3}$$

$$M \text{ of } \text{ZnSO}_4 \cdot 7\text{H}_2\text{O} = \frac{1.168 \times 10^{-3}}{100 \times 10^{-3}} = \boxed{0.012 \text{ M}}$$

number of mol of $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O} = M \times V$

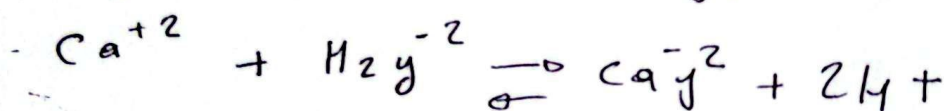
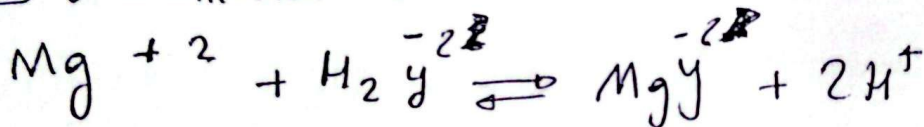
$$0.012 \times 100 \times 10^{-3} = 1.168 \times 10^{-3}$$

$$n_{\text{for EDTA}} = 1.168 \times 10^{-4}$$

$$M \text{ of EDTA} = \frac{\text{moles}}{V \text{ in L}} = \frac{1.168 \times 10^{-4}}{12.40 \times 10^{-3}} = \boxed{0.0094 \text{ M}}$$

or 9.42×10^{-3}

(B) determination of water hardness.



$$\textcircled{2} V_1 \text{ of EDTA} = 15.80 \pm 0.07 \text{ mL (one Trial)}$$

$$V_2 \text{ of EDTA} = 6.60 \pm 0.07 \text{ mL (one Trial)}$$

$$\text{mwt Ca} = 40 \text{ g/mol}$$

$$\text{mwt Mg} = 24.3 \text{ g/mol}$$

number of moles EDTA = $M \times V_1$

$$0.0094 \times 15.80 \times 10^{-3} = \boxed{1.48 \times 10^{-4} \text{ mol}}$$

follow

ask // believe & recieve

$$\text{mole of EDTA} = n_{\text{Ca}^{+2}} + n_{\text{Mg}^{+2}} = 1.48 \times 10^{-4} \text{ mol}$$

$$M_{\text{Ca}^{+2} + \text{Mg}^{+2}} = \frac{1.48 \times 10^{-4}}{50.000 \times 10^{-3}} = \boxed{2.97 \times 10^{-3} \text{ M}}$$

$$\text{number of mole of EDTA} = M \times V_2 = 0.0094 \times 6.60 \times 10^{-3} \\ = \boxed{6.204 \times 10^{-5} \text{ mol}}$$

$$M_{\text{Ca}^{+2}} = \frac{n = n_{\text{EDTA}}}{V} = \frac{6.204 \times 10^{-5}}{50.00 \times 10^{-3}} = \boxed{1.241 \times 10^{-3} \text{ M}}$$

$$\text{ppm}_{\text{Ca}^{+2}} = 1.241 \times 10^{-3} \frac{\text{mol}}{\text{L}} \times \frac{40 \text{ g}}{\text{mol}} \times \frac{10^3 \text{ mg}}{1 \text{ g}} \\ = \boxed{49.64 \text{ ppm}} \text{ g}$$

$$\text{number of mole of } \text{Mg}^{+2} = (1.48 \times 10^{-4}) - (6.204 \times 10^{-5}) \\ = 8.596 \times 10^{-5} \\ \boxed{8.6 \times 10^{-5} \text{ mol}}$$

$$M_{\text{Mg}^{+2}} = \frac{8.6 \times 10^{-5}}{50.00 \times 10^{-3}} = \boxed{1.72 \times 10^{-3} \text{ M}}$$

$$\text{ppm} = 1.72 \times 10^{-3} \frac{\text{mol}}{\text{L}} \times \frac{100 \text{ g}}{1 \text{ mol}} \times \frac{10^3}{1 \text{ g}} = \boxed{172 \text{ ppm}} \\ \text{molar mass of } \text{CaCO}_3 = 100 \text{ g/mol}, \quad (\text{CaH}_2\text{O Hardness})$$

$$\text{Volume of EDTA} = V_1 - V_2 = 9.20 \\ 15.80 - 6.60 = 9.20 \\ \pm 0.07 \quad \pm 0.07$$



Practical Analytical Chemistry

- Name : -
- Reg No : -
- Locker No : -
- course : - Experimental Analytical chemistry "lab" (2303216)
- Section No : - "9"
- Instructor : - Dr. Safwan Freihab.
- Date : - 9-12-2023
- Exp No : - Exp 8
- Title of the experiment : Determination of calcium by quantitative precipitation & titration.



Experiment 8 Data Sheet and Calculations

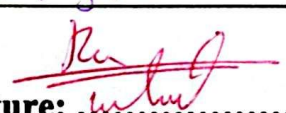
Name:

Section: 9

Reg. No.:

Date: 4-12-2023

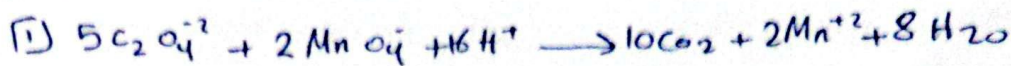
Unknown ID No.: 31	
(A) Standardization of KMnO_4	
Mass of Sodium oxalate 0.1512 g ± 0.0001 per 100 mL	
Molarity of sodium oxalate	
Vol. of $\text{Na}_2\text{C}_2\text{O}_4$ solution	Vol. of KMnO_4
1) 10.00 ± 0.05	① 9.20 ± 0.07
2) 10.00 ± 0.05	② 9.40 ± 0.07
3)	
Molarity of KMnO_4 solution 0.021 M	
Concentration of KMnO_4 in g/L: 3.32 g/L	
(B) Precipitation and Titration of Ca^{2+}	
Vol. of Ca^{2+} solution	Vol. of KMnO_4
1) 10.00	14.60 ± 0.07
2) 10.00 ± 0.05	
3)	
Concentration of Ca^{2+} solution in g/L 3.09 g/L	

Instructor's Signature: 

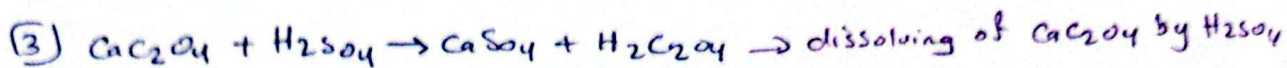
Instructor's Name: Dr. Ali Al-Sayid



- The equation for the principle reaction in the analysis :-



standardization of KMnO_4



- Equations that show the calculation employed in computing the results :-

$$n = M \times V(\text{L}) \quad , \quad n = \frac{m}{\text{molar mass}}$$

- calculation of the results & their precision :-

* [A] Standardization of 0.1 M KMnO_4 :-

$$- m_{\text{Na}_2\text{C}_2\text{O}_4} = 0.6106 \text{ g} \pm 0.0001 \rightarrow \text{Digital balance error.}$$

$$- M_{\text{Na}_2\text{C}_2\text{O}_4} = 133.998 \text{ g/mol}$$

$$- n_{\text{Na}_2\text{C}_2\text{O}_4} = \frac{0.6106}{133.998} = 4.490 \times 10^{-3} \text{ mole Na}_2\text{C}_2\text{O}_4$$

$$- M_{\text{Na}_2\text{C}_2\text{O}_4} = n / V = 4.490 \times 10^{-3} / 0.100 = 0.04490 \text{ M}$$

$$- \bar{V}_{\text{Na}_2\text{C}_2\text{O}_4} = (10.00 + 10.00) / 2 = 10.00 \text{ ml} \pm 0.07$$

$$\bar{V}_{\text{KMnO}_4} = (9.20 \pm 0.07 + 9.40 \pm 0.02) / 2 = 9.30 \pm 0.10$$

$$2 \frac{n_{\text{C}_2\text{O}_4^{2-}}}{\bar{M} \times \bar{V}} = 5 \frac{n_{\text{MnO}_4^-}}{\bar{M} \times \bar{V}}$$

$$2 \times 0.04490 \times 10 \times 10^{-3} = 5 M_{\text{KMnO}_4} \times 9.30 \times 10^{-3}$$

$$\Rightarrow M_{\text{KMnO}_4} = 0.021 \text{ M}$$

- Concentration of MnO_4^- in (g/L)

$$M.m = 158.032 \text{ g/mol (KMnO}_4)$$

$$0.021 \frac{\text{mol}}{\text{L}} \times 158.032 \frac{\text{g}}{\text{mol}} = 3.32 \text{ g/L}$$

* [B] precipitation of calcium as calcium oxalate & titration with standard KMnO_4 solution :- Unknown No. :-

$$n_{\text{Ca}^{2+}} = n_{\text{C}_2\text{O}_4^{2-}} = \frac{5}{2} n_{\text{MnO}_4^-} \Rightarrow 2 M_V \text{Ca}^{2+} = 5 M_V \text{MnO}_4^-$$

$$\Rightarrow 2 \times 10.00 \times 10^{-3} \times M_{\text{Ca}^{2+}} = 5 \times 14.6 \times 0.021 \times 10^{-3} \Rightarrow M_{\text{Ca}^{2+}} = 0.077 \text{ M}$$

$$M.m = 40.078 \text{ g/mol}$$

Concentration of Ca^{2+} in (g/L)

$$0.077 \frac{\text{mol}}{\text{L}} \times 40.078 \frac{\text{g}}{\text{mol}} = 3.09 \text{ g/L}$$

ask : believe & receive

* Sources of error :-

1. Error while detecting the initial & final volume of the burette as a reason of the wrong position of eye.
2. Error while detecting the color change as the end point of titration.
3. The precipitate wasn't dissolved completely with hot water & H_2SO_4 .
4. Error when weighing on balance

* Conclusion :-

Metal ions such as Ca^{2+} , Cu^{2+} , Pb^{2+} & Zn^{2+} give sparingly soluble oxalates & could be quantitatively determined by dissolving the washed precipitate in dilute sulfuric acid and titrate the liberated oxalic acid with standard $KMnO_4$ solution. This method is widely used for determination of calcium.

Calcium is precipitated as the oxalate by addition of ammonium oxalate solution to a dilute HCl solution of Ca^{2+} followed by neutralization of acid with dilute ammonia solution. The precipitate is washed, dissolved in dilute H_2SO_4 & the oxalic acid obtained is titrated with standard $KMnO_4$ solution.



* Questions :-

① why methyle red is used?

- Because this indicator can detect the end point in our titration because methyl red indicator has a pH range from 4.4 to 6.3 and it is the same as pH when we reach the endpoint, the solution will be neutral slightly basic.

② why the precipitate must be washed?

- 1- to get rid of Cl^- because it reacts with KMnO_4 to give Cl_2 and it will cause to have an error (positive error)
- 2- to get rid of $\text{C}_2\text{O}_4^{2-}$ (Oxalate) because it reacts with H_2SO_4 to give $\text{H}_2\text{C}_2\text{O}_4$, which will consume more volume of the titrant (KMnO_4) and be the cause of having $\pm$ error

③ what are the possible sources of error in carrying out this experiment?

1. incomplete dissolving CaC_2O_4 by H_2SO_4 .
2. Incomplete washing
3. incomplete filtration
4. incomplete precipitation of the solution
5. There was free chloride (Cl^-) or free oxalate ($\text{C}_2\text{O}_4^{2-}$)



Name:

Reg No:

Locker No: 163

Course: Analytical Chemistry lab

Section No: 9

Date: 17-12-2023

exp No: 10

Title of experiment: Gravimetric Determination of Nickel
as Bis(Dimethylglyoximate) Nickel(II)

Instructor: Dr-Safwan Freihat

Unknown No: 30



9-5

Experiment 10 Data Sheet and Calculations

Name:

Section: 9

Reg. No.:

Date: 19-12-2023

Unknown ID No.: 30	
Volume of solution used	10.00 $\pm$ 0.05
Mass of empty crucible	42.7429 $\pm$ 0.0001
Mass of empty crucible + Ni(DMG) ₂	43.5848 $\pm$ 0.0001
Mass of Ni(DMG) ₂ precipitate	0.8419 $\pm$ 0.0001
Mass of Ni	0.1710
Mass of Ni per liter solution (mg/L)	17100 mg/L

12/12

Instructor's Signature: 

Instructor's Name: 

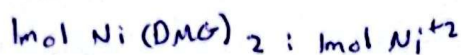
Calculation :-

- Equations:



- Equations that show the calculation employed in computing the results:

mass of crucible + Ni (DMG)₂ = mass of empty crucible + mass of Ni (DMG)₂



$$\text{no of moles} = \frac{\text{mass}}{\text{molar mass}}$$

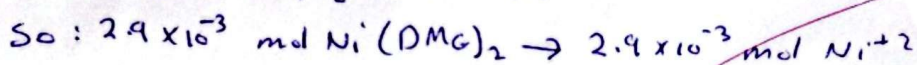
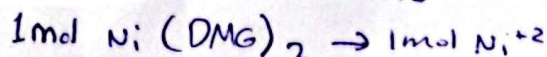
* Calculate of result and their precision:

$$\text{M.m of Ni(DMG)}_2 = 288.9146 \text{ g/mol}$$

$$\text{M.m of Ni}^{+2} = 58.6934 \text{ g/mol}$$

$$m \text{ Ni(DMG)}_2 = 0.8419 \pm 0.0001$$

$$n \text{ Ni(DMG)}_2 = \frac{0.8419}{288.9146} = 2.9 \times 10^{-3} \text{ mol}$$



$$\begin{aligned} \text{mass of Ni}^{+2} &= 2.9 \times 10^{-3} \times 58.6934 \text{ (g/mol) Ni}^{+2} \\ &= 0.1710 \text{ g Ni}^{+2} \end{aligned}$$

$$\text{- Concentration: Ni}^{+2} \text{ (mg/L)} = \frac{0.171 \times 10^3 \text{ mg}}{10.00 \times 10^3 \text{ L}} = 17100 \text{ mg/L of Ni}^{+2}$$

- Source of Error:

① not completely filtration.

② error in balance perhaps it wasn't calibrated well

③ the precipitate wasn't washed well.

④ the precipitate wasn't heated for enough time.

- conclusion:

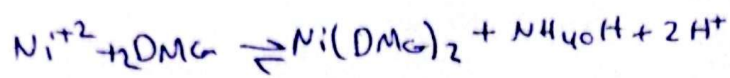
The gravimetric determination of a substance, the precipitating agent, should be as specific as possible for that substance: DMG has to specify to precipitate only palladium from acidic solution & only Ni from weakly basic soln.

In ammoniacal soln, Ni is precipitated quantitatively by DMG as bright strawberry colored complex (Ni(DMG)₂)

Problems:-

① Why precipitation is carried out in an ammoniacal solution?

Because in ammoniacal solution Ni^{2+} will be precipitated by DMG



The slow addition of aqueous ammonia increases the pH to have a basic solution & slowly decreases in solubility of the complex & the precipitate is formed.

② Why a large excess of DMG should be not added?

Because $\text{Ni}(\text{DMG})_2$ is bulky & tends to creep up the walls of the container, if we add an extra amount of DMG we will need an excess amount of ethanol in order to remove it, this will be the reason to stabilize the precipitate & decrease the yield.

③ suggest a way for transferring traces of $\text{Ni}(\text{DMG})_2$ that stick to the sides of the beaker into the sintered glass crucible.
- Use warm water & then use 30% ethanol.

- ④ why 30% ethanol is used for washing?

- ① In order not to have precipitation when washing the precipitate & ethanol is a volatile substance which is good for washing

- ② to get rid of an excess DMG from the precipitate,



Experiment 11

Data Sheet and Calculations

Name:
Reg. No.:

Section:
Date:

Unknown ID No.: 42		
Trial	Volume of 0.02 M NaOH	Volume of unknown
1	19.10 mL 19.10 to 0.09	10.00 mL 70.05 mL
2	mL	mL
3	mL	mL
Average:		mL

- Number of mmols of H^+ : $0.02 \times 19.10 = 3.82 \times 10^{-4}$
- Number of mmols of displaced (exchanged) Ca^{2+} per liter of the unknown: 1.91×10^{-4}
- Concentration of Ca^{2+} : $\frac{1.91 \times 10^{-4} \times 40.078}{0.010} \text{ ppm} = 0.77 \times 10^3 \frac{\text{mg}}{\text{L}}$

Instructor's Signature:

Instructor's Name:



Experiment 12

Data Sheet and Calculations

Name:
Reg. No.:

Section:
Date:

A. PURE COMPONENTS

Component	x_s	x_c	$x_c/x_s = R_f$
Cargo red	6.1	2.2	0.36
Phenyl red	6.1	2.0	0.33
Bromothymol blue	6.1	3.4	0.56
Methyl orange	6.1	3.0	0.49

x_s = Distance of the solvent front, x_c = Distance of the component

B. UNKNOWN SAMPLE

Distance of the solvent front

cm (x_s)

Spot Nr.	x_c	$R_f = x_c/x_s$	Spot Identification
1	3.3	0.54	Bromothymol blue
2			
3			
4			

Instructor's Signature:

Instructor's Name:

