



# Analytical lab

First semester 2025-2026 reports

Done by: **مجد الزعبي**

Madar Team

# practical Analytical Chemistry

10  
10

Name :- Majd emad Al-zoubi

Reg. No :- 0222387

Locker. No :- 163

Section No :- 9

Instructor :- Dr. Mohammad Rashid

course. No :- 0303216

Date of exp :- 14-10-25

Title of exp :- Volumetric Glassware and Balances

Date of delivery Reports :- 21-10-25

Exp. No : (1)

## Experiment 1

### Data sheet and calculations

0.05

Name: *Majid emad Al-zoubi*  
 Reg. No.: *0222387*

Section: *9*  
 Date: *14/10/2025*

	Trial (1)	Trial (2)	Trial (3)
Initial burette reading	$0.10 \pm 0.05$	$4.80 \pm 0.05$	$9.80 \pm 0.05$
Final burette reading	$4.80 \pm 0.05$	$9.80 \pm 0.05$	$14.90 \pm 0.05$
Apparent volume, ml	$4.70 \pm 0.07$	$5.00 \pm 0.07$	$5.1 \pm 0.07$
Weight of empty flask	$6.7476g$ $\pm 0.0001$	$6.6477g$ $\pm 0.0001$	$6.6477g$ $\pm 0.0001$
Weight of flask and water	$11.6600g$ $\pm 0.0001$	$11.6419g$ $\pm 0.0001$	$11.5986g$ $\pm 0.0001$
Weight of water, g	$4.3124g$ $\pm 0.0001$	$4.9942g$ $\pm 0.0001$	$4.9509g$ $\pm 0.0001$
Temperature, °C	$24.0 \pm 0.5$	$24.0 \pm 0.5$	$24.0 \pm 0.5$
Actual (experimental) volume, ml	$4.3279\text{ mL}$	$5.0122\text{ mL}$	$4.9687$
Correction (ml)	$-0.37\text{ mL}$	$0.01\text{ mL}$	$-0.13\text{ mL}$

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

Instructor's Signature:

*fatema abdull ah*

Instructor's Name:

*14/10/2025*

## Calculations :-

[1] Apparent volume [mL] = Final burette reading - Initial burette reading

→ Trial (1) :-

$$4.80 - 0.10^{+0.05} = 4.70 \text{ mL} \pm 0.07$$

→ Trial (2) :-

$$9.80 - 4.80 = 5.00 \text{ mL} \pm 0.07$$

→ Trial (3) :-

$$14.90 - 9.80 = 5.10 \text{ mL} \pm 0.07$$

$$\sqrt{(0.05)^2 + (0.05)^2}$$

\* [1] Uncertainty :- For the balance → ±0.0001

For the burette → 1/2 \* least division = 1/2 \* 0.1 = 0.05 → (±0.05) (initial & final read)

For the burette →  $\sqrt{(\text{uncertainty})^2 + (\text{uncertainty})^2} = \sqrt{(0.05)^2 + (0.05)^2} = \pm 0.07$

For the Thermometer → 1/2 \* least division = 1/2 \* 1 = ±0.5

For the weight of water →  $\sqrt{(0.0001)^2 + (0.0001)^2} = \pm 0.0001$

[2] weight of water [g] = weight of flask and water - weight of empty flask.

→ Trial (1) :-  $11.0600 - 6.7476 = 4.3124 \text{ g} \pm 0.0001$

→ Trial (2) :-  $11.6419 - 6.6477 = 4.9942 \text{ g} \pm 0.0001$

→ Trial (3) :-  $11.5986 - 6.6477 = 4.9509 \text{ g} \pm 0.0001$

[3] Actual volume [mL] in this experiment the temperature of water found equals.  $[24.0 \pm 0.5^\circ\text{C}]$  so for (1g) of water the volume is 1.0036 mL from table (2)

→ Trial (1) :-  
1g → 1.0036 mL  
4.3124g → ??

Actual volume = 4.3279

→ Trial (2) :-  
1g → 1.0036 mL  
4.9942 → ??

Actual volume = 5.0122

→ Trial (3) :-  
1g → 1.0036 mL  
4.9509 → ??

Actual volume = 4.9687

Correction :-

$$\text{Correction} = \text{Actual volume} - \text{apparent volume.}$$

→ Trial (1) :-

$$4.3279 - 4.70 = -0.37 \text{ mL}$$

→ Trial (2) :-

$$5.0122 - 5.00 = 0.01 \text{ mL}$$

→ Trial (3) :-

$$4.9687 - 5.10 = -0.13 \text{ mL}$$

Conclusion :-

I learned how to calibrate the Glassware & Clean the glassware by using a burette the quality of my data was not bad. I think I made some mistake.

seen

Sources of error :-

Personal errors

- errors on significant figures
- errors in reading burette
- errors in measurements.

Random errors

- environmental conditions
- the change of temperature.

Systemic errors

- the balance not at zero
- Burette or flask are not clean

Question 5:

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.

ans:

at 25°C

$$1 \text{ g} \rightarrow 1.0038 \text{ mL}$$
$$24.976 \text{ g} \rightarrow ?? \text{ mL}$$

Actual volume

at 20°C

$$1 \text{ g} \rightarrow 1.0028 \text{ mL}$$
$$24.976 \text{ g} \rightarrow ?? \text{ mL}$$

Actual volume

24.59 mL

Correction :-

$$\text{Correction} = \text{Actual volume} - \text{apparent volume.}$$

→ Trial (1) :-

$$4.3279 - 4.70 = -0.37 \text{ mL}$$

→ Trial (2) :-

$$5.0122 - 5.00 = 0.01 \text{ mL}$$

→ Trial (3) :-

$$4.9687 - 5.10 = -0.13 \text{ mL}$$

Conclusion :-

I learned how to calibrate the Glassware & Clean the glassware by using a burette the quality of my data was not bad. I think I made some mistake.

Sources of error :-

Personal errors → errors on significant figures

→ errors in reading burette

→ errors in measurements.

Random errors → environmental conditions

→ the change of temperature.

Systemic errors → the balance not at zero

→ Burette or flask are not clean

Question 5:

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.

ans:

at 25°C

$$1 \text{ g} \rightarrow 1.0038 \text{ mL}$$

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

Actual volume

$$= 25.0709 \text{ mL}$$

at 20°C

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

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

Actual volume

$$= 25.0459 \text{ mL}$$

# Analatical Chemistry;

9.5/10

Name :- Majd emad Al-zoubi

Reg No :- 0222 387

Locker No :- 163

Section No :- 9

Instructor :- Dr. Mohammad Rashed

Date of exp :- 21 - 10 - 25

Title of exp :- sampling and statistical Treatment (2)

**Experiment 2**  
**Data Sheet and Calculations**

Name: *Majd emad Al-zoubi*

Section: *9*

Reg. No.: *0222387*

Date: *21/10/2025*

**A. Homogenous sample**

Result no.	$V_s$	$V_B \pm 0.07$	$V_s - V_B \pm 0.1$
1	<del>0.10</del> 19.20 - 19.10 $\pm 0.07$	41.70 41.90 = 0.20 $\pm 0.07$	18.90 $\pm 0.09$
2	19.20 35.50 - 16.30 $\pm 0.07$	<del>41.70</del> 41.90 = 0.20 $\pm 0.07$	16.10 $\pm 0.09$
3	35.50 41.70 = 6.2 $\pm 0.07$	0.20 $\pm 0.05$	6.06 $\pm 0.09$
4			
5			

**B. Non-homogenous sample**

Result no.	$V_s$	$V_B \pm 0.07$	$V_s - V_B \pm 0.1$
1	7.10 17.60 = 10.50 $\pm 0.07$	39.30 39.60 = 0.30 $\pm 0.05$	10.20 $\pm 0.09$
2	17.60 28.30 = 10.70 $\pm 0.07$	0.30 $\pm 0.05$	10.40 $\pm 0.09$
3	28.30 39.30 = 11.00 $\pm 0.07$	0.30 $\pm 0.05$	10.70 $\pm 0.09$
4			
5			

Instructor's Signature: *deetee*

Instructor's Name: *21-10-2025*

# Calculations :-

## → Homogenous - sample :-

1. equation of the principle reaction in the analysis  $\Rightarrow$



2.  $(V_s - V_B) \rightarrow$  trial 1  $\rightarrow 19.10 - 0.20 = 18.90 \pm 0.09$

$\rightarrow$  trial 2  $\rightarrow 16.30 - 0.20 = 16.10 \pm 0.09$

$$\pm 0.1$$

$\rightarrow$  trial 3  $\rightarrow 6.2 - 0.20 = 6.00 \pm 0.09$

3. Uncertainty  $\Rightarrow$  for  $(V_s)$   $V_s = V_f - V_i \Rightarrow \sqrt{(0.05)^2 + (0.05)^2} = \pm 0.07$

for  $(V_B)$   $\frac{1}{2} * \text{least deviation} = \frac{1}{2} * 0.1 = \pm 0.05$

for  $(V_s - V_B)$   $\sqrt{(0.07)^2 + \frac{(0.05)^2}{(0.07)^2}} = 0.086 \approx \pm 0.09$

-0.5

4. Apply Q-test for homogenous sample &  $Q_{\text{critical}} (0.642)$

values  $\rightarrow (18.90, 16.10, 6.00)$

$$Q_{\text{exp}} = \left| \frac{\text{suggested data} - \text{closer data}}{\text{maximum value} - \text{minimum value}} \right| =$$

$Q_{\text{exp}} = \left| \frac{18.90 - 16.10}{18.90 - 6} \right| = 0.217 < 0.642$   $\rightarrow$  Accepted

$Q_{\text{exp}} = \left| \frac{6 - 16.10}{18.90 - 6} \right| = 0.782 > 0.642$   $\rightarrow$  rejected

\* Mean :-  $\frac{1}{n} \sum x = \frac{18.90 + 16.10 + 6}{3} = 13.66$

\* median :- (16.10)

\* Average deviation from the mean =  $\frac{\sum_{i=1}^N |x_i - \bar{x}|}{N} = \frac{7.6667 + 2.4333 + 5.2333}{3} = 5.11$

$$\text{relative average deviation} = \frac{\text{Average deviation}}{\bar{x}} \times 100\% = \frac{5.11}{13.66} \times 100\% = 37.4$$

$$\text{Average deviation from the median} = \frac{\sum |x_i - \bar{y}|}{N} \times 100\% = 4.3$$

$$\text{Relative average deviation from the median} = \frac{\text{Average deviation}}{\bar{y}} \times 100\% = \frac{4.3}{16.1} \times 100\% = 26.71\%$$

$$\text{Standard deviation} = \sqrt{\frac{\sum (x - \bar{x})^2}{N-1}} = 6.785$$

$$\text{Relative standard deviation} = \frac{s}{\bar{x}} \times 100\% = \frac{6.785}{13.66} = 49.67\%$$

\* Non homogeneous sample :-



$$(V_s - V_B) \rightarrow \text{trial 1} \rightsquigarrow 10.50 - 0.30 = 10.20 \pm 0.09$$

$$\text{trial 2} \rightsquigarrow 10.70 - 0.30 = 10.40 \pm 0.09$$

$$\text{trial 3} \rightsquigarrow 11.00 - 0.30 = 10.70 \pm 0.09$$

$\pm 0.1$

$$2- \text{uncertainty} \Rightarrow \text{for } (V_s) \quad V_s = V_f - V_i = \sqrt{(0.05)^2 + (0.05)^2} = \pm 0.07$$

$$\text{for } (V_B) \quad \frac{1}{2} \times \text{least deviation} = \frac{1}{2} \times 0.1 = \pm 0.05$$

$$\text{for } (V_s - V_B) \rightarrow \sqrt{(0.07)^2 + (0.05)^2} = \pm 0.09$$

3- Q test at 95, ( $Q_{\text{critical}} = 0.642$ )

$$Q_{\text{exp}} = \left| \frac{10.20 - 10.40}{10.70 - 10.20} \right| = 0.4 < 0.642 \rightarrow \text{accepted}$$

values  $\rightarrow 10.20, 10.40, 10.70$

$$Q_{\text{exp}} = \left| \frac{10.70 - 10.40}{10.70 - 10.20} \right| = 0.6 < 0.642 \rightarrow \text{accepted}$$

$$\text{mean} = \bar{x} = \frac{1}{N} \sum x_i = 10.43$$

$$\text{median} = \bar{y} = 10.40$$

$$\text{Average deviation from mean} = \frac{\sum |x - \bar{x}|}{N} = 0.176$$

$$\text{Relative deviation from mean} = \frac{\text{Average deviation}}{\bar{x}} \times 100\% = 1.69\%$$

$$\text{Average deviation from median} = \frac{\sum |x_i - \bar{y}|}{N} = 0.166$$

$$\text{Relative deviation from median} = \frac{\text{Average deviation}}{\bar{y}} \times 100\% = 1.60\%$$

$$\text{Standard deviation} = \sqrt{\frac{\sum (x - \bar{x})^2}{N-1}} = 0.251$$

$$\text{Relative standard deviation} = 2.406\%$$

Question:-

1. Compare the results of the two groups in terms of :-

	Homogeneous	Non-Homogeneous
mean	13.66	10.43
standard deviation	6.785	0.251
Relative standard deviation	49.67	2.406

2. Calculate the molar concentration of Acetic Acid for both groups of results

Homogeneous sample  $M \times V(\text{NaOH}) = M \times V(\text{CH}_3\text{COOH})$

$$0.1 \times (13.66) = M \times (10.0)$$

$$M = 0.1366 \text{ M}$$

Non-Homogeneous  $M V_{\text{NaOH}} = M V_{\text{CH}_3\text{COOH}}$

$$0.1 (10.43) = M (10.0)$$

$$M = 0.1043 \text{ M}$$

3. Relative errors (Accuracy)

Homogeneous  $\frac{x_i - x_t}{x_t} \times 100\% = \frac{0.1366 - 0.1}{0.1} \times 100\% = 36.6\%$

Non-Homogeneous  $\frac{x_i - x_t}{x_t} \times 100\% = \frac{0.1043 - 0.1}{0.1} \times 100\% = 4.3\%$  (more Accurate)

precision  $\rightarrow$  R.S.D  $\left\{ \begin{array}{l} \rightarrow \text{homo} \rightarrow 49.67 \\ \rightarrow \text{non homo} \rightarrow 2.406 \end{array} \right.$  ~~more precision~~

## Errors

\* most errors are personal like:

1  $\perp$  change the color of solution and there for exact point

2 Errors in measuring volume of NaOH in the buret

3 error on cleaning the buret, pipets, flask, Beaker.

Name:- Majd emad Al-zoubi

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Locker No :- 163

Section No :- 9

Instructor :- Dr Mohammed Rashed

Title of exp :- Neutralization Titration in Aqueous Medium

Date of Delivery Reports :- 4/11/2025

Exp No :- (3)

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## Experiment 3 Date Sheet and Calculations

Name: *Majd emad Al-zoubi*      Section: 9.  
Reg. No.: 0222387      Date:

Mass of $\text{Na}_2\text{CO}_3$			
		$0.5134 \pm 0.0001$	
(A) Vol. of $\text{Na}_2\text{CO}_3$		Vol. of HCl	
1.	$10.00 \pm 0.05$	$10.30 \pm 0.07$	
2.	$10.00 \pm 0.05$	$10.55 \pm 0.07$	
3.			
(B) Vol. of NaOH		Vol. of HCl	
1.	$10.00 \pm 0.05$	$12.90 \pm 0.07$	
2.	$10.00 \pm 0.05$	<del>12.90 ± 0.07</del>	
3.		$15.8 \pm 0.07$	
(C) Vol. of $\text{H}_3\text{PO}_4$	Vol. of NaOH	Indicator	
1.	$7.90 \pm 0.07$	Bromocresol	
2.	$13.70 \pm 0.07$	phenolphthalein	

$10.00 \pm 0.05$   
 $10.00 \pm 0.05$

Calculate the molarity of  $\text{Na}_2\text{CO}_3$ , HCl and NaOH solutions, and calculate the concentration of  $\text{H}_3\text{PO}_4$  in the unknown solution in g/L.

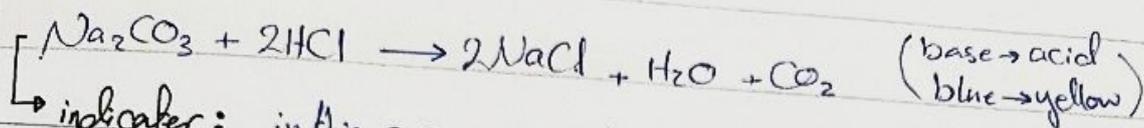
Instructor's Signature: *[Signature]*

Instructor's name: *Deema Ahmad*

28-10-2025

## Calculations :-

### part 'A' :-



indicator: in this case we will use Bromo-cresol - Green.

$$\bar{m} \text{ mass of Na}_2\text{CO}_3 = 0.5134 \pm 0.0001 \quad \text{uncertainty for balance (0.0001)}$$

$$\bar{M} \text{ molar mass of Na}_2\text{CO}_3 = 105.988 \text{ g/mol}$$

$$\bar{n} \text{ moles of Na}_2\text{CO}_3 = \frac{\text{mass}}{\text{molar mass}} = 4.843 \times 10^{-3} \text{ mol}$$

$$\bar{m} \text{ moles of Na}_2\text{CO}_3 = 4.843 \times 10^{-3} \text{ mol}$$

$$\bar{M} \text{ of Na}_2\text{CO}_3 = \frac{\text{moles}}{\text{Volume (L)}} = \frac{4.843 \times 10^{-3}}{100 \times 10^{-3} \text{ L}} = 0.0484 \text{ M}$$

$$\text{Volume of HCl} = \frac{10.30 + 10.65}{2} = 10.475 \text{ mL} \pm 0.1 \quad \text{uncertainty}$$

$$= \sqrt{(0.07)^2 + (0.07)^2} = \pm 0.1$$

Stoichiometry :- 1 mole  $\text{Na}_2\text{CO}_3$  : 2 mol HCl

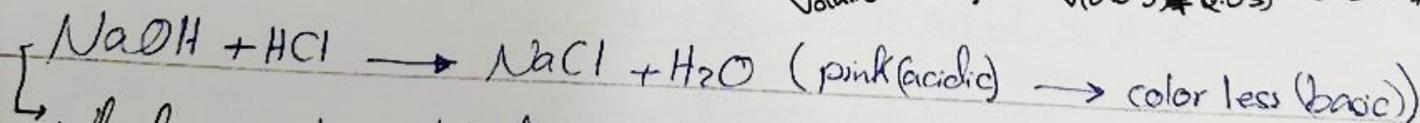
$$M \text{ of HCl} :- 2 M_{\text{Na}_2\text{CO}_3} = M_{\text{HCl}} \quad \rightarrow \rightarrow \rightarrow$$

$$2(0.0484)(10) = M * 10.475$$

$$M_{\text{HCl}} = 0.0924$$

### part 'B' :-

$$\text{uncertainty of Volume } 0.07 \rightarrow \sqrt{(0.05)^2 + (0.05)^2} = 0.07$$



indicator: phenolphthalein

$$\bar{V}_{\text{HCl}} = \frac{12.90 + 15.8}{2} = 14.35 \pm 0.1 \quad \text{uncertainty}$$

$$\sqrt{(0.07)^2 + (0.07)^2} = 0.1$$

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

Stoichiometry = 1 mole NaOH = 1 mole HCl

$$M \text{ of NaOH} \quad M \bar{V}_{\text{NaOH}} = M \bar{V}_{\text{HCl}}$$

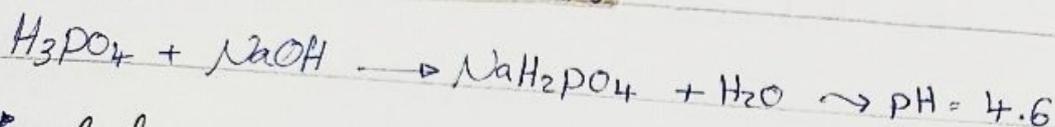
$$M(10.00) \text{ mL} = (0.0924)(14.35)$$

$$M_{\text{NaOH}} = 0.1325 \text{ M}$$

calculations 8-

→ unknown number → 9

1 Neutralization of one proton



indicator :- Bromocresol green. From yellow (acid) → blue (basic)

$$\bar{V} \text{ of NaOH} = \frac{(7.90 + 13.70) \pm 0.07}{2} = 10.8 \pm 0.1$$

→  $\sqrt{(0.07)^2 + (0.07)^2}$

$$\bar{V} \text{ of H}_3\text{PO}_4 = \frac{(0.00 + 10.00) \text{ mL} \pm 0.05}{2} = 10.00 \text{ mL} \pm 0.07$$

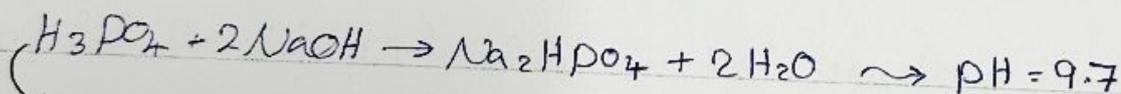
→  $\sqrt{(0.05)^2 + (0.05)^2}$

stoichiometry = 1 mole H<sub>3</sub>PO<sub>4</sub> = 1 mole NaOH

$$M \bar{V}_{\text{H}_3\text{PO}_4} = M \bar{V}_{\text{NaOH}} \rightarrow M_{\text{H}_3\text{PO}_4} = \frac{(0.1325)(10.8)}{10} = 0.1431 \text{ M}$$

molar mass of H<sub>3</sub>PO<sub>4</sub> = 97.994 g/mol \* 0.1431 mol/L = 7.94 g/L

2 Neutralization of two protons



Indicator = phenolphthalein colorless (acidic) → pink (basic)

$$\bar{V} \text{ of NaOH} = \frac{(11.00 + 24.6) \pm 0.07}{2} = 17.8 \text{ mL} \pm 0.1$$

→  $\sqrt{(0.07)^2 + (0.07)^2}$

$$\bar{V} \text{ of H}_3\text{PO}_4 = \frac{(0.00 + 10.00) \pm 0.05}{2} = 10.00 \text{ mL} \pm 0.07$$

→  $\sqrt{(0.05)^2 + (0.05)^2}$

stoichiometry = 1 mole H<sub>3</sub>PO<sub>4</sub> = 2 moles NaOH

$$M \text{ of H}_3\text{PO}_4 = 2 M \bar{V}_{\text{H}_3\text{PO}_4} = M \bar{V}_{\text{NaOH}}$$

$$M_{\text{H}_3\text{PO}_4} = \frac{(0.1325) * (17.8)}{2(10.00) \text{ mL}} = 0.1179 \text{ M}$$

molar mass of H<sub>3</sub>PO<sub>4</sub> = 97.994 g/mol \* 0.1179 mol/L = 11.555 g/L

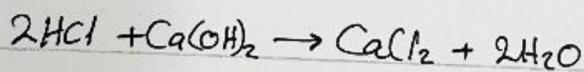
total concentration =  $\frac{11.555 + 7.94}{2} = 9.74 \frac{\text{g}}{\text{L}}$

Sources of errors :-

- ① errors in measurement
- ② errors in the balance if it isn't calibrated well
- ③ errors on buret and pipet.

Questions :-

- 1) How do you determine solubility of calcium hydroxide by a simple acid-base titration?
- a) prepare a saturated solution for  $\text{Ca}(\text{OH})_2$ .
- b) pipette certain volume of the  $\text{Ca}(\text{OH})_2$  standard solution.
- c) Titrate against a weak or strong acid with a known concentration (HCl) acid and put a appropriate indicator.
- d) find the solubility of  $\text{Ca}(\text{OH})_2$   $\rightarrow$  by the equation of titration



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

e) According to the above equation  $\therefore M_{\text{Ca}(\text{OH})_2} = \frac{M_{\text{HCl}} V_{\text{HCl}}}{2V_{\text{Ca}(\text{OH})_2}}$

$$M_{\text{Ca}(\text{OH})_2} = [\text{Ca}^{+2}]$$

$$\rightarrow \text{solubility of } \text{Ca}(\text{OH})_2 = [\text{Ca}^{+2}] = \frac{1}{2} [\text{OH}^-]$$

- ② How do you determine the water of crystallization of washing soda?
- a) prepare a solution putting a known mass of hydrate solution carbonate in a distilled water.
- b) make the volume of the solution that has been prepared.

Put Methyl orange indicator or any appropriate indicator

D) Titrate with a known molarity with HCl (strong acid), at the end point the color will change from yellow to pink.

E) According to this equation:  $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$   
 $\hookrightarrow \frac{1}{2} M_1 V_{\text{Na}_2\text{CO}_3} = M_2 V_2 \text{HCl}$

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

G) calculate the mole of  $\text{H}_2\text{O}$   $\rightarrow n = \text{mass} / \text{Molar mass}$

H) x water of crystallization =  $\frac{\text{moles of H}_2\text{O}}{\text{moles of Na}_2\text{CO}_3}$

## Questions

3) why two indicator can be used for determination of ~~phosphoric acid?~~

Because  $\text{H}_3\text{PO}_4$  has 3 protons in titration with NaOH and each end point occurs at a certain

4) could you make titration for  $\text{NH}_3$  solution with a standard solution of  $\text{CH}_3\text{COOH}$ ? why?

No, because  $\text{NH}_4\text{OH}$  is weak base and  $(\text{CH}_3\text{COOH})$  is a weak base acid and there is not weak acid-base titration  $\rightarrow$  indicator can't work because we have different (pH)

$\rightarrow$  Also, we will need a large amount of titrate to the equivalence point

- Name :- Majid emad Al-zoubi

8.5 / 10

- Reg No :- 0222387

- Locker No :- 163

- Instructor :- Dr - Mohammed Rasheed.

- Title of Experiment :- precipitation Titrations (Argentometry)

- Date of Delivery Reports :- 11/11/2025

- Exp. No :- "4"

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## Experiment 4 Data Sheet and Calculations

Name: *Majd emad A1-zoubi*  
Reg. No.: 0222387

Section: 9  
Date: 4/11/2025

Mass of NaCl: ...0.5502 ± 0.0001

	ind: potassium chromate Trial (1)	ind: Mixed indicator Trial (2)
<b>(A) Mohr's method</b>		
Vol. of NaCl solution	10.00 ± 0.05	10.00 ± 0.05 ml
Vol. of AgNO <sub>3</sub> solution	10.20 ± 0.07	10.40 ± 0.07 ml
<b>(B) Fajan's method</b>		
Vol. of NaCl solution	10.00 ± 0.05	10.00 ± 0.05 ml
Vol. of AgNO <sub>3</sub> solution	10.50 ± 0.07	<u>10.30</u> ± 0.07 ml
<b>(C) Volhard's method</b>		
Vol. of AgNO <sub>3</sub> solution	10.00 ± 0.05	10.00 ± 0.05 ml
Vol. of KSCN solution	9.9 ± 0.07	<u>10.15</u> ± 0.07 ml

?!  
?!

Unknown mixture ID: potassium chromate		
	Trial 1	Trial 2
<b>(I) According to Mohr's method</b>		
Vol. of unknown solution	10.00 ± 0.05	10.00 ± 0.05
Vol. of AgNO <sub>3</sub> solution	10.4 ± 0.07	9.60 ± 0.07
<b>(II) According to Volhard's method</b>		
Volume of unknown solution		
Vol. of KSCN solution		
Vol. of AgNO <sub>3</sub> added in excess		

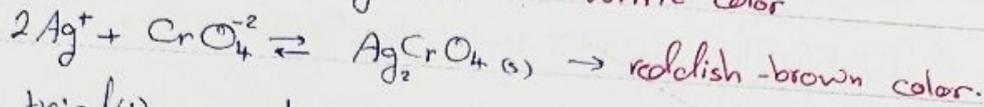
Instructor's Signature: *Latama abdulah*

Instructor's Name: *4/11/2025*

10.40  
9.80

calculations:-

part "A" → standardization of silver nitrate by Mohr's method



Indicators: trial (1) → potassium chromate

trial (2) → Mixed indicator (potassium chromate of potassium dichromate)  
color → reddish-brown

① mass of NaCl =  $0.5502 \text{ g} - 0.5$  → uncertainty for balance.  
 $0.6285 \pm 0.0001 \text{ g}$

② volume of NaCl solution (for trial (1)) =  $10.00 \text{ mL} \pm 0.05$  →  $\frac{1}{2} \times$  least division

③ volume of  $(\text{AgNO}_3)$  solution :- trial "1" →  $10.20 \pm 0.07 \text{ mL}$  →  $\sqrt{(0.05)^2 + (0.05)^2} = 0.07$   
trial "2" →  $10.40 \pm 0.07 \text{ mL}$  →  $\sqrt{(0.05)^2 + (0.05)^2} = 0.07$

$\bar{V}(\text{AgNO}_3) \rightarrow \frac{V_1 + V_2}{2} = \frac{(10.40 + 10.20) \text{ mL}}{2} = 10.30 \text{ mL} \pm 0.1$  →  $\sqrt{(0.07)^2 + (0.07)^2} = 0.1$

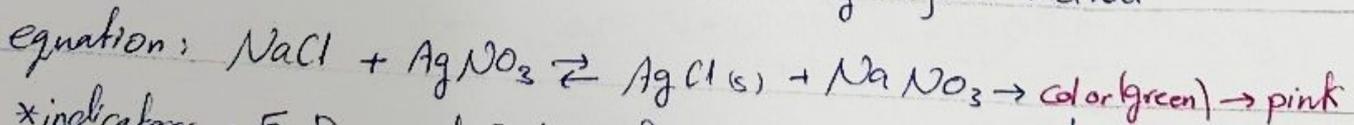
number of moles NaCl =  $\frac{\text{mass NaCl}}{\text{molar mass NaCl}} = \frac{0.5502 \text{ g}}{58.44 \text{ g/mol}} = 9.4148 \times 10^{-3} \text{ mol}$

molarity of NaCl =  $\frac{\text{number of moles}}{\text{volume in (L)}} = \frac{9.4148 \times 10^{-3} \text{ mol}}{100 \times 10^{-3} \text{ (L)}} = 0.0941 \text{ M}$

$(M\bar{V})_{\text{NaCl}} = (M\bar{V})_{\text{AgNO}_3} \rightarrow 0.0941 \times 10 \text{ mL} = M_{\text{AgNO}_3} (10.30) \text{ mL}$   
 $M_{\text{AgNO}_3} = 0.09140 \text{ M}$

(g/L) coefficient →  $0.09140 \frac{\text{mol}}{\text{L}} \times 169.872 \frac{\text{g}}{\text{mol}} = 15.52 \text{ g/L}$

part "B" → standardization of silver nitrate by Fajan's method



\* indicators = 5-Drops of Dichloro Fluorescein

① mass of NaCl =  $0.5502 \pm 0.0001 \text{ g}$  → uncertainty → for balance

② number of moles NaCl =  $9.4148 \times 10^{-3} \text{ mol}$  →  $\frac{1}{2} \times$  least division.

③ volume of NaCl =  $10.00 \text{ mL} \pm 0.05$

④ volume of  $(\text{AgNO}_3)$  → trial ①:  $10.50 \pm 0.07$  →  $\sqrt{(0.05)^2 + (0.05)^2} = 0.07$   
trial ②:  $10.36 \pm 0.07$

$$⑥ MV_1(\text{NaCl}) = MV_2(\text{AgNO}_3) \rightarrow (0.0941) \times (10 \text{ mL}) = M_{\text{AgNO}_3} \times 10.40 \text{ mL}$$

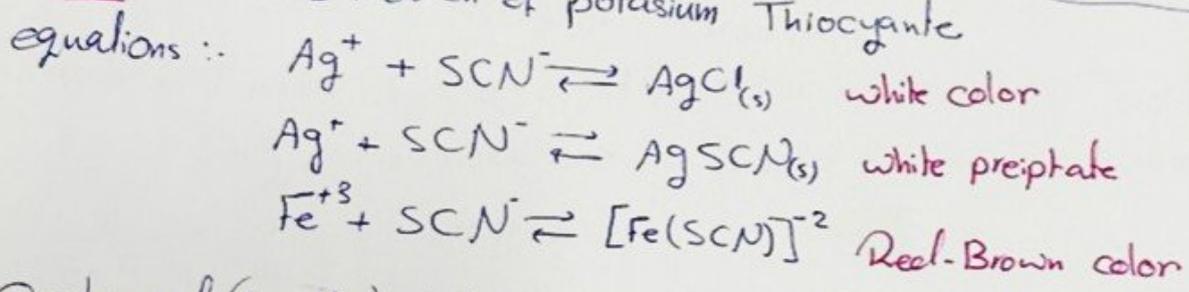
⑦ g/L  $\rightarrow$  coefficient of  $\text{AgNO}_3 \rightarrow 0.0904 \frac{\text{mol}}{\text{L}} \times 169.872 \frac{\text{g}}{\text{mol}} = 15.37 \text{ g/L}$

$\Rightarrow$  The average value for  $M$  (g/L) for  $\text{AgNO}_3$  from part (A+B)

$$\rightarrow M = \frac{M_1 + M_2}{2} = \frac{0.09140 + 0.0904}{2} = 0.0907 \text{ M}$$

$$\rightarrow \text{g/L} = \frac{(\text{g/L})_A + (\text{g/L})_B}{2} = \frac{15.52 + 15.37}{2} = 15.44 \text{ g/L}$$

part "C"  $\rightarrow$  standardization of potassium Thiocyanate



① volume of  $(\text{AgNO}_3)$  solution =  $10.00 \pm 0.05 \rightarrow \frac{1}{2} \times 0.1 = 0.05$  trial (1,2) using pipet.

② volume of  $(\text{KSCN})$  solution. trial ①  $\rightarrow 9.90 \pm 0.07$   
 trial ②  $\rightarrow 10.15 \pm 0.07 \rightarrow \sqrt{(0.05)^2 + (0.05)^2} = 0.07$

$$\bar{V}(\text{KSCN}) = \frac{V_1 + V_2}{2} = \frac{(9.90 + 10.15) \pm 0.07}{2} = 10.02 \text{ mL} \pm 0.1$$

$$M(\text{AgNO}_3) \text{ from A \& B part} = 0.0907 \text{ M}$$

$$(MV)_{\text{AgNO}_3} = (MV)_{\text{KSCN}} \rightarrow \frac{0.0907 \times (10.00)}{10.02 \text{ mL}} = 0.0905 \text{ M (KSCN)}$$

(g/L) coefficient  $\rightarrow 0.0905 \frac{\text{mol}}{\text{L}} \times 97.18 \text{ g/mol} = 8.7966 \text{ g/L}$

part D → determination of an unknown mixture of halides (NaCl + KCl)  
 No of unknown = **45**

① Mohr method:

① volume of (unknown solution) = 10.00 ml ± 0.05 →  $\frac{1}{2} \times 0.1 = 0.05$

② volume of (AgNO<sub>3</sub>) solution = trial ① → 10.40 ± 0.07

trial ② → 9.60 ± 0.07

$$\sqrt{(6.05)^2 + (6.05)^2} = 0.07$$

$$\bar{V} \text{ of } (AgNO_3) = \frac{V_1 + V_2}{2} = \frac{(10.40 + 9.60) \pm 0.07}{2} = 10.00 \pm 0.1$$

indicator: potassium chromate

④ mass of unknown = 0.065g

$$x + y = 0.065g$$

x → mass of NaCl  
 y → mass of KCl

⑤ M of AgNO<sub>3</sub> = 0.0907 M → from AFB

⑥ number of moles (AgNO<sub>3</sub>) = M $\bar{V}$  = 0.0907 × 10.00 × 10<sup>-3</sup> L = **0.907 × 10<sup>-3</sup> moles** or

x + y → masses sum → convert them to number of moles :-

$$\frac{x}{58.5} + \frac{y}{74.5} = 0.907 \times 10^{-3} \quad \text{①}$$

$$x + y = 0.065 \quad \text{②}$$

$$\frac{74.5x}{(58.5)(74.5)} + \frac{y(58.5)}{(74.5)(58.5)} = 0.907 \times 10^{-3} \quad \rightarrow \quad \frac{74.5x + 58.5y}{4358.25} = 0.907 \times 10^{-3}$$

$$x + y = 0.065 \quad \rightarrow \quad y = 0.065 - x$$

$$\frac{74.5x + 3.8025 - 58.5x}{4358.25} \times 0.907 \times 10^{-3}$$

$$3.9529 = 16x + 3.8025$$

$$x = 9.4 \times 10^{-3} \text{ g NaCl} \quad \rightarrow \quad (g/L) = \frac{\text{mass NaCl}}{v(L)} = \frac{9.4 \times 10^{-3}}{10 \times 10^{-3}} = 0.94$$

$$y = 0.0556$$

$$(g/L) = \frac{\text{mass KCl}}{v(L)} = \frac{0.0556}{10 \times 10^{-3}} = 5.56 \text{ g/L}$$

$$x = 0.94 \text{ g/L}$$

$$y = 5.56 \text{ g/L}$$

Q1: Why precipitation titrations by Mohr's method requires a neutral solution?

Ans:

Because if we basic the silver would react, so we will lose part of the silver that we want to calibrate in, and if the maximum was acidic it would produce  $(K_2Cr_2O_7)$  & there for we also have errors.

Q2: What is the effect of using acidic solution in the Fajans' method?

Ans:

It is possible to produce  $FeOH$ , so we will ~~take~~ longer to reach the end point and a lot of mistakes.

Q3: What is the effect of using  $(K_2Cr_2O_7)$  instead of  $K_2CrO_4$  as an indicator on the titration results?

Ans: Because the  $K_{sp} \rightarrow K_2Cr_2O_7 > K_2CrO_4$  the end-point it will need less than the titration.

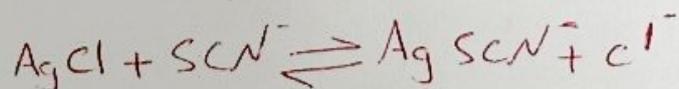
Q4: What is the effect of using basic solution on the results in precipitation?

Ans: in Fajans and Mohr's we will have  $(AgOH)$  so we need more silver nitrate to reach endpoint as for Volhard, Iron reacts with  $(OH^-)$  & we need also more silver.

Q5: Why nitrobenzene is added in case of titration of  $Cl^-$  by the Volhard's method?

Ans: silver doesn't react with  $(SCN^-)$  and there for we need more large amount.

cover the surface of  $AgCl_{(ppt)}$  and prevent the following rxn



Name :- Majid emad Al-zoubi

Reg No :- 0222387

locker No :- 163

10  
10

Instructor :- Dr. Mohammed Rasheed.

Date to Delivery :- 19. 11. 2025

section :- 9

Experiment Number :- 5

Title of the experiment :- Redox Titrations (Dichroatic titrations)

36

# Experiment 5 Data Sheet and Calculations

Name: *Majid Al-Zoubi*  
Reg. No.: *0222387*

Section:  
Date: *11/11/2025*

Unknown ID No.: <i>36</i>	
(A) Determination of $Fe^{2+}$ in a mixture	
Vol. of unknown solution	Vol. of $K_2Cr_2O_7$
1) <i>10.00 ± 0.05</i>	<i>5.10 ± 0.07</i>
2) <i>10.00 ± 0.05</i>	<i>4.60 ± 0.07</i>
3)	<i>-</i>
(B) Determination of $Fe^{2+}$ after reduction	
Vol. of unknown solution	Vol. of $K_2Cr_2O_7$
1) <i>10.00 ± 0.05</i>	<i>5.50 ± 0.07</i>
2)	

Wt. of  $Fe^{2+}$  per liter = *3.250 g/L*  
Wt. of  $Fe^{3+}$  per liter = *0.435 g/L*

Instructor's signature:  
*Fatema abdullah*  
Instructor's Name: ..

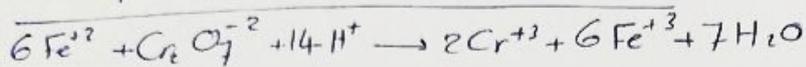
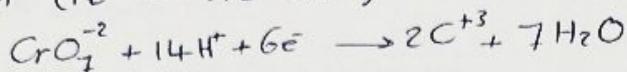
*11/11/2025*

9.7  
15.2

Calculations:-

Number of unknown (36)

→ part A Determine of  $Fe^{+2}$  in a mixture



① volume of unknown =  $10.00 \text{ mL} \pm 0.05$  (in two trial)  $\rightarrow \frac{1}{2} \times \text{least division}$   
 $\frac{1}{2} \times 0.1 = 0.05$

② volume of  $H_2SO_4 = 10.00 \text{ mL} \pm 0.05$

③ volume of  $H_3PO_4 = 5.00 \text{ mL}$  ( $V_f - V_i$ )

④ volume of  $K_2Cr_2O_7 = \text{trial (1)} = V = 5.10 \pm 0.07$   $\rightarrow \sqrt{(0.05)^2 + (0.05)^2}$   
trial (2) =  $V = 4.60 \pm 0.07$   $\rightarrow \sqrt{(0.05)^2 + (0.05)^2}$

$$\bar{V} = \frac{V_1 + V_2}{2} = \frac{4.60 + 5.10}{2} = 4.85 \pm 0.1 \rightarrow \sqrt{(0.07)^2 + (0.07)^2}$$

⑤ Amount ( $Fe^{+3}$ ) (g/L) =  $M_{K_2Cr_2O_7} = 0.02 \text{ M}$   
 $V_{K_2Cr_2O_7} = 4.85 \text{ mL}$

$$6 \times M \times V_{K_2Cr_2O_7} = M V_{Fe^{+2}}$$

$$10^{-3} \times 6 \times 4.85 \times 0.02 = M \times (10.00 \times 10^{-3})$$

$$M = 0.0582 \text{ M}_{Fe^{+2}}$$

molar mass of Fe =  $55.845 \text{ g/mol}$

$$\rightarrow 0.0582 \frac{\text{mol}}{\text{L}} \times 55.845 \frac{\text{g}}{\text{mol}} = 3.250 \frac{\text{g}}{\text{L}}$$

A & B: Determine of  $Fe^{+3}$  after reduction

formula  $\rightarrow Fe^{+3} + \text{Joh's reductor} \rightarrow Fe^{+2}$

① volume of unknown solution =  $10.00 \pm 0.05 \text{ mL}$

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

② volume of  $K_2Cr_2O_7 = 5.50 \pm 0.07 \text{ mL}$   $\sqrt{(0.05)^2 + (0.05)^2}$

③  $6M \times V_{K_2Cr_2O_7} = M V_{Fe^{+2}}$

$6(0.02) \times (5.25 \text{ mL}) = M(10.00) \text{ mL}$

$M = 0.066 \text{ M}$

④  $0.066 \frac{\text{mol}}{\text{L}} \times 55.845 \frac{\text{g}}{\text{mol}} = 3.685 \frac{\text{g}}{\text{L}} Fe^{+2}$

$Fe^{+3} \text{ g/L} = Fe^{+2}(B) - Fe^{+2}(A)$

~~$= 13.250 \text{ g/L}$~~

$3.685 - 3.250 = 0.435 \frac{\text{g}}{\text{L}} Fe^{+3}$

Sources of errors

① not complete reduction of  $Fe^{+3}$

② Error when we use pipette

③ Error when we read final initial reading of the buret.

What is the role of  $H_3PO_4$  in determination of  $Fe^{+3}$  by titration with  $K_2Cr_2O_7$ ?  
 $H_3PO_4$  reacts with yellow  $Fe^{+3}$  (resulting for titration to form  $[Fe(HPO_4)]$ ) which is colorless so that the end point of reduction is more clearly visible. Moreover,  $H_3PO_4$  lowers the reduction potential and  $Fe^{+3}-Fe^{+2}$  couple by complexation ( $Fe^{+3}$  is reduced) and hence tends to increase the reducing power of  $Fe^{+2}$ .

\* Can you determine Iron in ores using  $K_2Cr_2O_7$ ?

Yes, Iron, because the iron ores contains  $Fe_2O_3$  and  $Fe_3O_4$  which can be dissolved in an acidic solution in order to have  $Fe^{+3}$  and reduced it as the equation  $Fe^{+3} + e^- \rightarrow Fe^{+2}$  then titrate it with titrant  $Cr_2O_7^{2-}$  with the use of  $H_3PO_4$  and diphenylamine sulphuric acid indicator.

\* How 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  $NH_4SCN$  as a precipitant, if no blood-red color formation appears, this means that there is a complete reduction of  $Fe^{+3}$  to  $Fe^{+2}$ .

# practical Analytical Chemistry

9/10

Name :- Majd emad Al-zoubi

Reg No :- 0222387

Id Card No :- 163

Date Delivery :- 25-11-2025

experiment :- Redox titration (iodine titration)

exp No :- "6"

30

## Experiment 6 Data Sheet and Calculations

Name: *Majd emad Al-zoubi*  
 Reg. No.: *0222387*

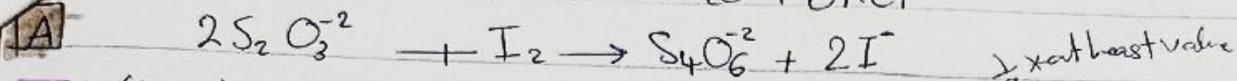
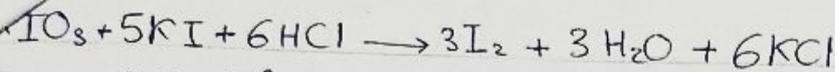
Section:  
 Date:

(A) Standardization of 0.1M thiosulfate			
Wt of $KIO_3 = 0.4861 \pm 0.001$ g			
Volume of $KIO_3$		Volume of $Na_2S_2O_3$	
1- <del>10.00</del> <i>10.00 ± 0.05</i>	ml	<i>12.80 ± 0.07</i>	ml
2- <i>10.00 ± 0.05</i>	ml	<i>12.50 ± 0.07</i>	ml
3- <i>10.00 ± 0.05</i>	ml		ml
(B) Standardization of 0.1M iodine:			
Volume of $I_2$		Volume of $Na_2S_2O_3$	
1- <i>10.00 ± 0.05</i>	ml	<i>13.40 ± 0.07</i>	ml
2- <i>10.00 ± 0.05</i>	ml	<i>14.50 ± 0.07</i>	ml
3- <i>10.00 ± 0.05</i>	ml		ml
(C) Determination of tin in the unknowns:			
Unknown ID #: <i>30</i>			
Volume of $I_2$	volume the unknown solution		Volume of $Na_2S_2O_3$
1- <i>15.00 ± 0.05</i> ml	<i>10.00 ± 0.05</i>	ml	ml <i>12.30 ± 0.07</i>
2- ml		ml	ml <del>12.30 ± 0.07</del>
3- ml		ml	ml

Instructor's Signature:   
 Instructor's Name: *Dee ma Ahmad*

*18-11-2025*

relations :-



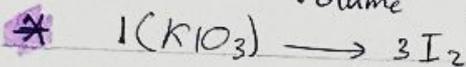
$$\rightarrow V(KIO_3) = 10.00 \text{ mL}, \quad wt(KIO_3) = 0.4861 \text{ g} + 0.001 \quad Mw_{KIO_3} = 214 \text{ g/mol}$$

$$\rightarrow \bar{V} Na_2S_2O_3 = \frac{12.80 + 12.5}{2} = 12.65 \text{ mL} + 0.1 \rightarrow \sqrt{6.07^2 + 6.07^2}$$

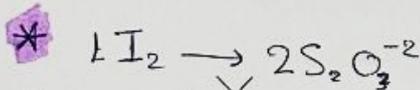
$$Mw_{Na_2S_2O_3} = 158 \text{ g/mol}$$

$$* n(KIO_3) = \frac{m}{mm} = 2.271 \times 10^{-3} \text{ mol}(KIO_3)$$

$$* M(KIO_3) = \frac{\text{mol}}{\text{Volume}} = \frac{2.271 \times 10^{-3}}{100.0 \times 10^{-3}} = 0.02271 \text{ M}(KIO_3)$$



$$2.271 \times 10^{-3} (KIO_3) \rightarrow ?? \quad n(I_2) = 6.813 \times 10^{-3} \text{ mol}(I_2)$$

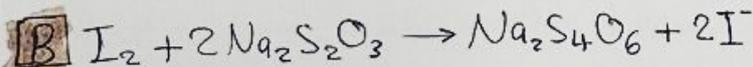


$$6.813 \times 10^{-3} \rightarrow ?? \quad n_{S_2O_3^{2-}} = 0.0136 \text{ mol}(S_2O_3^{2-})$$

$$* n(KIO_3) = \frac{n(S_2O_3^{2-})}{6} \rightarrow MV_{KIO_3} = MV_{S_2O_3^{2-}} \rightarrow M_{S_2O_3^{2-}} = \frac{6 \times (0.0227) \times (10.00 \times 10^{-3})}{12.65 \times 10^{-3}}$$

$$M_{S_2O_3^{2-}} = 0.1076 \frac{\text{mol}}{\text{L}}$$

$$* M_{S_2O_3^{2-}} \left( \frac{\text{g}}{\text{L}} \right) \rightarrow 0.1076 \frac{\text{mol}}{\text{L}} \times 158 \frac{\text{g}}{\text{mol}} = 17.01 \text{ g/L}$$



$$\rightarrow V(I_2) = 10.00 \pm 0.05 \text{ mL} \quad \xrightarrow{\frac{1}{2} \times 0.1 \pm 0.05} \quad \sqrt{(0.05)^2 + (0.05)^2}$$

$$\bar{V}(Na_2S_2O_3) = \frac{(3.40 + 14.50) \pm 0.07}{2} = 13.95 \text{ mL}$$

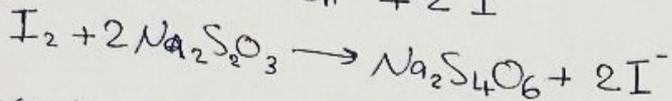
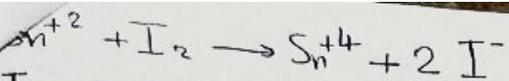
$$Mw(I_2) = 253.81 \text{ g/mol}$$

$$n_{I_2} = \frac{n_{S_2O_3^{2-}}}{2}$$

$$M_1 V_1 = \frac{M_2 V_2}{2} \rightarrow M_{I_2} \times 10.00 \times \frac{0.1076 \times 13.95}{2}$$

$$M_{I_2} = 0.075 \text{ M } I_2$$

$$M_{I_2} \left( \frac{\text{g}}{\text{L}} \right) \rightarrow 0.075 \frac{\text{mol}}{\text{L}} \times 253 \frac{\text{g}}{\text{mol}} = 18.98 \text{ g/L}$$



unknown  
(30)

$$\rightarrow V(\text{I}_2) = 15.00 \pm 0.05 \rightarrow \frac{1}{2} \times 0.1 = 0.05$$

$$\rightarrow V_{\text{unknown}} = 10.00 \pm 0.05$$

$$\rightarrow MW_{\text{Sn}^{+2}} = 118.7 \text{ g/mol}$$

$$\rightarrow V_{\text{S}_2\text{O}_3} = 12.30 \pm 0.07 \rightarrow \sqrt{(0.05)^2 + (0.05)^2}$$

$$\rightarrow n_{\text{I}_2} = n_{\text{Sn}^{+2}} \rightarrow n_{\text{Sn}^{+2}} = n_{\text{I}} - n_{\text{I}} \text{ result with } \text{S}_2\text{O}_4^{2-}$$

$$MV_{\text{I}_2} = \frac{MV}{2} = MV_{\text{Sn}^{+2}}$$

~~(0.075)(15) - (0.1076)(12.30) = M(10)~~

$$(0.075)(15) - \frac{(0.1076)(12.30)}{2} = M(10)$$

$$1.125 - 0.6617 = 10M$$

$$M = 0.0463 \text{ M}_{\text{Sn}^{+2}}$$

$$\rightarrow M_{\text{Sn}^{+2}} \left( \frac{\text{g}}{\text{L}} \right) \rightarrow 0.0463 \frac{\text{mol}}{\text{L}} \times 118.7 \frac{\text{g}}{\text{mol}} = 5.498 \frac{\text{g}}{\text{L}}$$

### Questions:-

- 1) not is strongly acidic median because don't want to hydrolysis of starch
- 2) to make sure that all the bacteria that convert  $\text{S}_2\text{O}_3^{2-}$  to  $\text{SO}_4^{2-}$  be killed because it is very active in reaction with  $\text{O}_2$ .
- 3) when I do  $\text{Na}_2\text{S}_2\text{O}_4$  standardization with the  $\text{KIO}_3$  I must, during calibration move the lasso, and I also need to be calibrated quickly, why? E to prevent or reduce the oxidation of  $\text{I}^-$  by  $\text{O}_2$ .
- 4) Because they produce  $\text{CO}_2$ , which prevents oxidation from occurring.

# Analytical practical Chemistry.

Name: Majd emad Al-zoubi

10/10

Reg No: 0222387

Section No: "9"

Title of exp: Complexometric Titration using EDTA

exp No: "7"

33

146

24.16  
2

# Experiment 7 Data Sheet and Calculations

Name: *Majd emad Al-zoubi*

Section:

Reg. No.: *0222387*

Date: *25.11.25*

## (A) Standardization of EDTA

Mass of $ZnSO_4 \cdot 7H_2O$	<i>0,3383 ± 0.0001</i>			
Data	Trial 1	Trial 2	Trial 3	Average
Volume of $ZnSO_4 \cdot 7H_2O$ Solution	<i>18.00 mL ± 0.05</i>			
Volume of EDTA solution	<i>22.6 ± 0.07</i>	<i>21.5 ± 0.07</i>		<i>22.05 ± 0.1</i>
Molarity of EDTA solution				<i><math>5.30 \times 10^{-3}</math> M</i>

## (B) Determination of Water Hardness

Data	Trial 1	Trial 2	Trial 3	Average
1- Vol. of tap water	<i>50.00 mL ± 0.05</i>			
2- Vol. of EDTA solution ( $V_1$ ) (corresponding to Ca and Mg)	<i>12.50 ± 0.07</i>			
3- Vol. of tap water	<i>50.00 mL ± 0.05</i>			
4- Vol. of EDTA ( $V_2$ ) (corresponding to Ca)	<i>7.30 ± 0.07</i>			

*ErChromate black* ←

*Murioxide* ←

*Deema Ahmad*  
*25.11.2025*

Majid emad A 1-Zoubi

0222387

21.7

11.8

Data	Trial 1	Trial 2	Trial 3	Average
Volume of EDTA Corresponding to Mg ( $V_1 - V_2$ )	5.20 $\pm 0.07$			
ppm Ca	31.30 $\frac{mg}{L}$			
ppm Mg	13.39 $\frac{mg}{L}$			
Water hardness (mg $CaCO_3/L$ )	132.6 $\frac{mg}{L}$			

(C) Unknown solution

Unknown ID No.

Data	Trial 1	Trial 2	Trial 3	Average
1. Vol. of unknown solution	10.00 mL $\pm 0.05$	10.00 $\pm 0.05$	—	10.00 $\pm 0.07$
2. Vol. of EDTA solution	36.40 $\pm 0.07$	37.70 $\pm 0.07$	—	37.05 $\pm 0.1$
3. ppm Ca and Mg	—	—	—	719.24 $\frac{mg}{L}$
4. Vol. of unknown solution	10.00 mL $\pm 0.05$	10.00 mL $\pm 0.05$	—	10.00 $\pm 0.07$
5. Vol. of EDTA solution	<del>36.40</del>	28.7 $\pm 0.07$	29.2 $\pm 0.07$	28.95 $\pm 0.1$
6. ppm Ca	—	—	—	614.83 $\frac{mg}{L}$

Em black

miraxide

Instructor's Signature

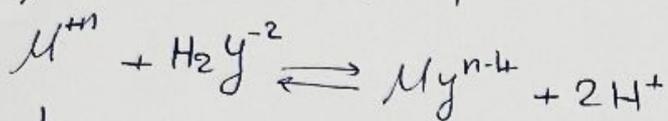


Instructor's Name: Deema Ahmad

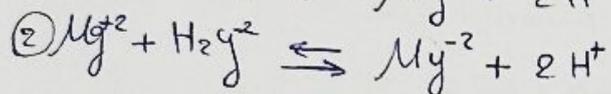
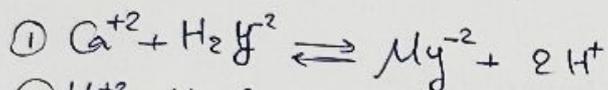
25.11.2025

36.5  
37.2

equations for the principle reaction in the analysis:-



↳  $M^{+n} \rightarrow Ca^{+2}$  and  $Mg^{+2}$  so we have 2 equations:-



→ **part (A) : standardization of EDTA :-**

$$\textcircled{1} \text{ number of moles } (ZnSO_4 \cdot 7H_2O) = \frac{\text{mass}}{\text{molar mass}} = \frac{0.3383 + 0.0001}{287.54} =$$

$$n = 1.176 \times 10^{-3}$$

$$\textcircled{2} \text{ Molarity } (ZnSO_4 \cdot 7H_2O) \rightarrow \frac{\text{number of moles}}{\text{volume (L)}} = \frac{1.176 \times 10^{-3}}{100 \times 10^{-3}} = 0.0117 M$$

$$\bar{V} [EDTA] = \frac{V_1 + V_2}{2} = \frac{\sqrt{(6.05)^2 + (0.05)^2} (22.6 \pm 0.07) + \sqrt{(6.07)^2 + (0.07)^2} (21.5 \pm 0.07)}{2} = 22.05 \pm 0.10$$

$$\textcircled{4} \text{ Molarity EDTA} = (M\bar{V})_{ZnSO_4 \cdot 7H_2O} = M\bar{V}_{EDTA}$$

$$(0.0117) * (10 \times 10^{-3}) = (22.05) (M \times 10^{-3})$$

$$M_{EDTA} = 5.30 \times 10^{-3} M$$

**part (B) : Determination of water Hardness :-**

$$\textcircled{1} \text{ molar mass} \rightarrow (Ca^{+2} \rightarrow 40.078 \text{ g/mol}) \quad (Mg^{+2} \rightarrow 24.3050 \text{ g/mol})$$

$$(CaCO_3 \rightarrow 100.086 \text{ g/mol})$$

Calculations:-

$$\textcircled{1} \text{ ppm} \rightarrow Ca^{+2}$$

$$V_1 \rightarrow V_{Ca^{+2}} + V_{Mg^{+2}} \quad / \quad V_2 \rightarrow V_{Ca^{+2}}$$

→

$$(M V_2)_{\text{EDTA}} = (M V)_{\text{Ca}^{2+}} \Rightarrow V_2 = 7.30 \pm 0.07$$

$$M_{\text{Ca}^{2+}} = \frac{5.30 \times 10^{-3} \times 7.30 \times 10^{-3}}{50.00 \times 10^{-3}} \Rightarrow 0.773 \times 10^{-3}$$

$$\text{ppm Ca}^{2+} = \frac{0.773 \times 10^{-3} \text{ M} \times 40.078 \frac{\text{g}}{\text{mol}} \times 10^3 \frac{\text{mg}}{\text{g}}}{\text{L}} = 31.30 \text{ mg/L}$$

② ppm Mg<sup>2+</sup>

$$\rightarrow V_{\text{(corresponding to Mg}^{2+})} = V_1 - V_2$$

$$= 12.50 \pm 0.07 - 7.30 \pm 0.07 \rightarrow \sqrt{(0.05)^2 + (0.05)^2}$$

$$= 5.20 \pm 0.1$$

$$\rightarrow \sqrt{(0.05)^2 + (0.07)^2}$$

$$\rightarrow (M V)_{\text{EDTA}} = (M V)_{\text{Mg}^{2+}} \rightarrow M_{\text{Mg}^{2+}} = \frac{5.30 \times 10^{-3} \times 5.20 \times 10^{-3}}{50.00 \times 10^{-3}}$$

$$M_{\text{Mg}^{2+}} = 5.512 \times 10^{-4} \text{ M}$$

$$\text{ppm (Mg}^{2+}) = \frac{5.512 \times 10^{-4} \text{ mol}}{\text{L}} \times 24.3050 \frac{\text{g}}{\text{mol}} \times \frac{10^3 \text{ mg}}{1 \text{ g}} =$$

$$= 13.39 \frac{\text{mg}}{\text{L}}$$

③ Water Hardness

$$(M V_1)_{\text{EDTA}} = (M V)_{\text{CaCO}_3}$$

$$M_{\text{CaCO}_3} = \frac{5.30 \times 10^{-3} \times 12.50 \times 10^{-3}}{50 \times 10^{-3}} = 1.32 \times 10^{-3} \text{ M}$$

$$\text{ppm CaCO}_3 = \frac{1.32 \times 10^{-3} \text{ mol}}{\text{L}} \times \frac{100.086 \text{ g}}{\text{mol}} \times 10^3 \frac{\text{mg}}{\text{g}}$$

$$\text{ppm CaCO}_3 = 132.60 \frac{\text{mg}}{\text{L}}$$

Calculation:-

part (c) → unknown solution: unknown (33)

① water hardness →  $MV_{EDTA} = M\bar{V}_{CaCO_3}$

$$\bar{V}_{EDTA} = \frac{V_1 + V_2}{2} = \frac{36.40 + 37.7}{2} = 37.05 \pm 0.1$$

$\rightarrow \sqrt{(0.07)^2 + (0.07)^2}$

$$\bar{V}_{CaCO_3} = 10.00 \pm 0.07$$

$\rightarrow \sqrt{(0.05)^2 + (0.05)^2}$

$$M_{CaCO_3} = \frac{5.30 \times 10^{-3} \times 37.05 \times 10^{-3}}{10.00 \times 10^{-3}} = 0.0196 \text{ M}$$

$$\text{ppm} = 0.0196 \frac{\text{mol}}{\text{L}} \times \frac{100.086 \text{ g}}{\text{mol}} \times 10^3 \frac{\text{mg}}{\text{g}} = 1962.68 \frac{\text{mg}}{\text{L}}$$

②  $\text{ppCa}^{+2} \rightarrow MV_{EDTA} = M\bar{V}_{Ca^{+2}}$

$$M_{Ca^{+2}} = \frac{5.30 \times 10^{-3} \times 28.95 \times 10^{-3}}{10.00 \times 10^{-3}}$$

$$M_{Ca^{+2}} = 0.0153$$

$$\text{ppm} = 0.0153 \times 40.078 \times 10^3 \frac{\text{mg}}{\text{g}} = 614.93 \frac{\text{mg}}{\text{L}}$$

$$\bar{V}_{EDTA} = \frac{28.7 + 29.2}{2}$$

$$= 28.95 \pm 0.1$$

$$\rightarrow \sqrt{(0.07)^2 + (0.07)^2}$$

③  $\text{ppMg}^{+2}$  EDTA  $\bar{V}$  (corresponding to  $\text{Mg}^{+2}$ ) =  $37.05 \pm 0.1 \pm 28.95 \pm 0.1$

$$= 8.10 \pm 0.14$$

$$\rightarrow \sqrt{(0.1)^2 + (0.1)^2}$$

$$MV_{EDTA} = MV_{Mg^{+2}}$$

$$M_{Mg^{+2}} = \frac{5.30 \times 10^{-3} \times 8.10 \times 10^{-3}}{10.00 \times 10^{-3}} = 4.293 \times 10^{-3} \text{ M}$$

$$\text{ppm}_{Mg^{+2}} = 4.293 \times 10^{-3} \times 24.30 \frac{\text{g}}{\text{mol}} \times 10^3 \frac{\text{mg}}{\text{g}} = 104.31 \frac{\text{mg}}{\text{L}}$$

$$\text{ppm}(Ca^{+2} + Mg^{+2}) = 614.93 + 104.31$$

$$= 719.24 \frac{\text{mg}}{\text{L}}$$

10  
10

# Experiment 10 Data Sheet and Calculations

91

Name: *Majd emad Al-zoubi* Section:

Reg. No.: *0222387* Date:

Unknown ID No.:	
Volume of solution used	<i>10.00 ± 0.05</i>
Mass of empty crucible	<i>53.0457g ± 0.0001</i>
Mass of empty crucible + Ni(DMG) <sub>2</sub>	<i>53.1567g ± 0.0001</i>
Mass of Ni(DMG) <sub>2</sub> precipitate	<i>0.111 ± 0.0001</i>
Mass of Ni	<i>0.0226 ± 0.0001</i>
Mass of Ni per liter solution (mg/L)	<i>2260</i>

*mol  
L*

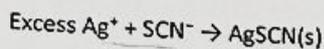
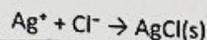
Instructor's Signature: .

Instructor's Name: ..

Student Name (Arabic): Majd emad Al-zoubi

St No. 0222387

A 0.5000 g solid sample suspected of containing NaCl was dissolved in water. The entire solution was treated with 25.00 mL of 0.1000 M AgNO<sub>3</sub> (excess) to precipitate chloride as AgCl. The excess Ag<sup>+</sup> was then back-titrated with 0.1000 M KSCN; the volume of KSCN required for the endpoint was 10.40 mL. Calculate the mass of NaCl in the sample and the percent (w/w) NaCl. MM(NaCl)=58.443 g/mole



$$MV(\text{Ag}^+) = MV(\text{Cl}^-) + MV(\text{SCN}^-)$$

$$25 \times 0.1 = n_{\text{Cl}} + 0.1 \times (10.40)$$

$$2.5 = n_{\text{Cl}} + 1.04$$

$$n_{\text{Cl}} = 1.46 \text{ mol}$$

$$\frac{8}{10}$$

$$n = \frac{\text{mass}}{\text{mm}}$$

$$n = 1.46 \times 10^{-3}$$

$$n = \frac{m}{\text{mm}}$$

$$m = 0.0853$$

$$\text{mass} = n \times \text{mm}$$

$$= 1.46 \times 58.443$$

$$\text{mass} = 85.326 \text{ g}$$

$$0.0853 \text{ g}$$

$$\text{percentage} = \frac{0.0853}{0.5000 \text{ g}} = 0.17 \times 100\% = 17\%$$

$$\text{percentage} = \frac{\text{mass NaCl}}{\text{mass all}}$$

$$= \frac{85.326}{100} \times 100\% = 85.326\% \approx 85\%$$

## 2) For Mohr's method

What is the titrant in the titration? AgNO<sub>3</sub> ✓

What is the Analyte in the titration? KCl ✓

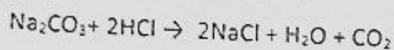
What is the indicator? potassium chromate ✓

What is the medium (acidity)? Neutral ✓

## Quiz#2

Student Name (Arabic): محمد عمار الزعبيSt number #: 0222387

1- In a standardization titration of hydrochloric acid (HCl) using 0.12 g of sodium carbonate ( $\text{Na}_2\text{CO}_3$ , 105.99 g/mol) as the primary standard, the student required 10.20 mL of HCl to reach the endpoint. Calculate the concentration of the HCl solution in Molarity?



$$M V_{\text{HCl}} = 2 M V_{\text{Na}_2\text{CO}_3}$$

HCl →

$$\hookrightarrow V = 10.20 \text{ mL}$$

$$\text{Na}_2\text{CO}_3 \quad m = 0.12 \text{ g}$$

$$MM = 105.99 \text{ g/mol}$$

$$n = \frac{m}{MM} = \frac{0.12}{105.99} = 1.132 \times 10^{-3}$$

$$M = \frac{n}{V} = \frac{1.132 \times 10^{-3}}{10.20 \times 10^{-3}}$$

$$M_{\text{Na}_2\text{CO}_3} = 0.11094 \text{ M}$$

M \*

$$M_{\text{HCl}} = 2 * M_{\text{Na}_2\text{CO}_3} = 0.22188 \text{ M}$$

2- To determine the concentration of the unknown phosphoric acid ( $\text{H}_3\text{PO}_4$ ) solution in this experiment, which two indicators were used?

phenolphthalene

Bromocresol green

Student Name (Arabic): Majd emael Al-zoubiStudent no. #: 0222387

Q1, 6 marks) A 50.0-mL tap water sample was diluted to 100 mL, and titration of this diluted portion required 10.20 mL of 0.100 M EDTA. Calculate the total hardness of the original tap water sample, expressed as g/L of  $\text{CaCO}_3$  (Molar mass of  $\text{CaCO}_3 = 100 \text{ g/mol}$ ).

$$MV_{\text{EDTA}} = 10.20 \text{ mL} \times 0.1 = 1.02 \text{ M}$$

$$MV_{\text{EDTA}} = MV_{\text{CaCO}_3}$$

$$1.02 \times 10^{-3} = M \times 100 \times 10^{-3}$$

$$M_{\text{CaCO}_3} = 0.0102 \text{ M}$$

$$M_{\text{CaCO}_3} \frac{\text{g}}{\text{L}} = 0.0102 \frac{\text{mol}}{\text{L}} \times 100 \frac{\text{g}}{\text{mol}} = \frac{1.02 \text{ g}}{\text{L}} \times 2$$

معدل التصفية  $\frac{100}{50} = 2$

$$0.0102 \text{ M} \times 2 = 0.0204 \text{ M}$$

$$\frac{\text{g}}{\text{L}} \rightarrow 0.0204 \times 100 \frac{\text{g}}{\text{mol}} = \frac{2.04 \text{ g}}{\text{L}}$$

What indicators are used in EDTA titrations for calcium and magnesium ions, and why is it necessary to use two different indicators?

→ Erochrome black T  
→ and Murexide

using two indicators because Murexide it determine  $\text{Ca}^{+2}$   
and the Erochrome black T → to determine  $\text{Ca}^{+2} + \text{Mg}^{+2}$   
and we use two indicators to

because the variation value of pH

محمد الزبيبي

Quiz#1

Student Name (Arabic): Majd Al-zoubi St number #: 0222387

Q1) A 25.00 mL pipette was found to deliver 24.845 g of water at 20.0 °C. At this temperature, 1.0000 g of water occupies 1.0028 mL.

- a) Calculate the *actual volume* of water delivered by the pipette.  
b) Find the *correction* to the expected 25.00 mL mark.

$$1g \rightarrow 1.0028 \text{ mL}$$
$$24.845g \rightarrow ??$$

$$\boxed{\text{Actual volume} = 24.9145 \text{ mL}}$$

$$\text{Correction} = \text{Actual volume} - \text{apparent volume}$$

$$= 24.9145 - 25.00$$

$$= -0.0855$$

$$\approx \boxed{-0.09}$$



Q2) True or False:

1) Temperature affects the density of water, so it must be considered when converting mass to volume in a calibration experiment. True

2) If the pipette gives less water than it should, then the correction is negative True