UNDERSTAND O LEVEL CHEMISTRY PRACTICALS HIGHLY

TABLE OF CONTENTS:

Mpangativicentmorgan8@gmail.com

GENERAL INTRODUCTION

The two questions set in UCE-545/3/4 chemistry practical are normally from: - Quantitave (volumetric) analysis, rates of chemical reactions, thermometry and qualitative analysis.

(a) **Quantitave (volumetric) analysis**: - this involves an acid-base titration. Basically titration consists of running one solution, from the burette, into a known / fixed volume (10 cm^3, 20cm^3 or 25cm^3)of the other in a conical flask until the two solutions have just reacted completely, when a suitable acid-base indicator is used just changes colour.

Choice of indicators:

An acid-base indicator is a substance, which is either a weak acid or base, but changes colour depending on the pH of the medium in which it is dissolved.

The pH scale of acidity and alkalinity is shown below.

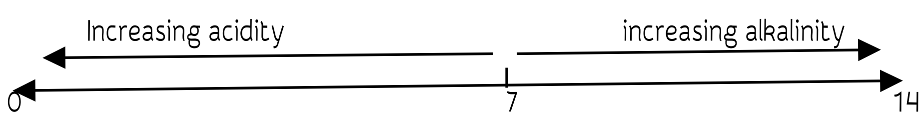


Table showing acid-base colour changes

Indicator	Colour of medium		Nature of the titration
	Acidic	Alkaline	
Litmus	Red / pink	Blue	Strong acid and bases
Methyl orange	Red / pink	yellow	Strong acids and bases
phenolphthalein	colourless	Red/ pink	Weak acids and bases

Note: 2-3 drops of the indicator are introduced and the end point or neutral point of the titration is reached , when the used indicator just changes to the colour of the new formed medium.

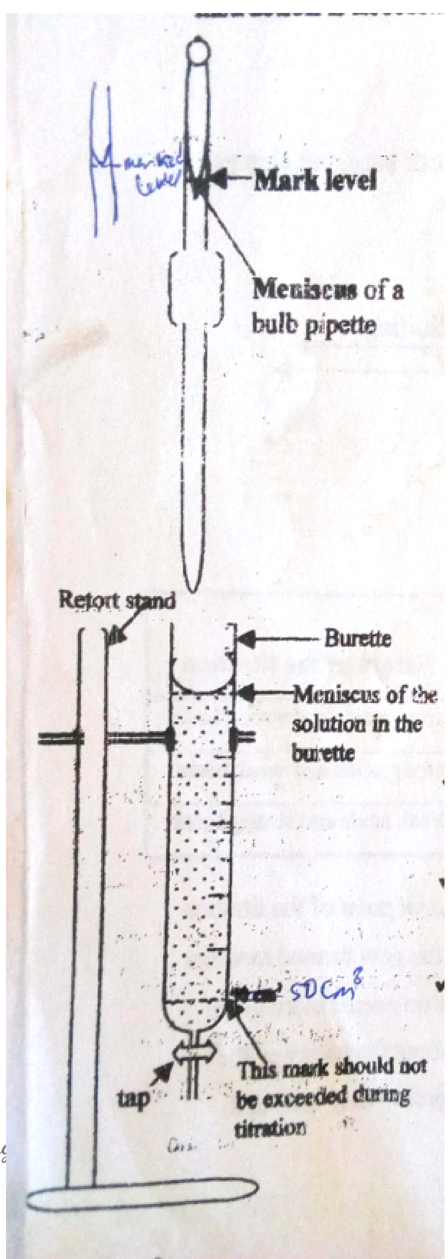
(b) Qualitative analysis: - this requires a student to carry out sample tests on one or more given substances and record observations and then make logical deductions about the nature of the substances. However students at this level should be well versed with preliminary tests and confirmatory tests for the ions.

Mpangativicentmorgan8@gmail.com

GENERAL INSTRUCTIONS ON:

(a) Handling of solutions and the use of apparatus

The following must be noted when dealing with pipettes and burettes in volumetric analysis



1. Identify clearly the apparatus and reagents to be used and find out the capacity of the given pipette. Make sure you have all required solutions in labeled flasks i.e BA1, BA2 etc.

Caution! Do not contaminate the given solutions. Take care!

2. Rinse out the burette, pipette and conical flasks with distilled water before use.

3. Read the instructions carefully and understand what you are exactly to do. Re -read the instructions if necessary and then follow the guide lines for pipettes and burettes below;

- ✓ Pipette the solution until the level of solution is above the mark and then close the end with the moistened tip of the forefinger.
- ✓ Gently release the pressure until the meniscus is exactly at the mark.
- ✓ Transfer the pipette into a conical

flask and release the solution by removing the finger.

- ✓ The volume or capacity of the bulb pipette used must be recorded to one decimal place i.e recorded as 10.0 cm^3, 20.0 cm^3, 25.0 cm^3.

- ✓ A solution put into the burette should be added by use of a filter funnel .
- ✓ Always remove the funnel before you start titrating.
- ✓ Titrate a little of the solution at a time and swirl the conical flask to ensure thorough mixing of the solutions.
- ✓ The end point is reached when the indicator immediately changes colour from alkalinity to acidity or from acidity to alkalinity.
- ✓ The volume read from the burette must be recorded to two decimal places in the given table i.e recorded as 0.00,24.00, 22.60 cm^3 etc .

(b) <u>Recording results</u>

1. Always record titre values in the given table to two decimal places.
2. Record all the burette readings in the table as soon as they are obtained from the burette.

Note: Don't first record the burette readings on a rough piece of paper.

All measurements must be recorded in the table.

(c) <u>Treatment of results</u>

This involves finding the average titre from consistent results, which should differ by 0.20cm3 , and

Mpangativicentmorgan8@gmail.com

using the results to answer the set questions.

NB: All calculations must be done from first principles and avoid using mathematical formulae for computing molarity, concentration etc.

(d) Plotting of graphs

The following steps must be taken:

i. Give a title to your graph.

ii. The horizontal and vertical axes should have a label of the quantity and their units indicated.

iii. Choose a suitable scale so that when the graph is plotted, it fills at least three-quarters of the graph paper.

iv. Use free hand to draw a curve with a pencil. A ruler is used to draw a line of the best fit for a straight line graph.

Mpangativicentmorgan8@gmail.com

VOLUMETRIC ANALYSIS EXPERIMENTS

(a) Introduction

Volumetric analysis is the experimental analysis of determining the mass or concentration of a substance relative to another substance of known concentration called a standard solution.

The procedure involves volume measurement using a pipette, burette, volumetric flask etc.

In volumetric analysis, two aqueous solutions are used; the concentration of one is known and the concentration of the other is unknown. The solution whose concentration is accurately known is called a standard solution:

Standard solution is one, which contains a known mass of solute in a given volume of solution. Normally the concentration of the standard solution is given as molar, ''M'' and the solution is known as a molar solution (one which contains one mole of a solute in $100cm^3$ of solution)

(b) Applications of volumetric analysis in chemistry

i. Standardization of acids or bases

ii. Determination of atomic mass of metallic element or radical

iii. Determination of number of moles of water of crystallization in hydrated compound

iv. Determination of basicity of an acid

v. Determination of stiochiometry of the neutralization reaction

vi. Determination of formulae of organic acids

vii. Determination of percentage purity / impurity of substances.

Mpangativicentmorgan8@gmail.com

<u>**Worked out example of volumetric analysis practical presentation**</u>:

You are provided with the following solutions;

- BA1: which is a solution prepared by dissolving 11.4grams of $Na_2CO_3.XH_2O$ per litre.
- BA2: which is 0.1M hydrochloric acid solution
- Methyl orange indicator.

  You are required to determine the number of moles of water of crystallization in hydrated sodium carbonate.

Procedure

- ✓ Pipette 25.0cm^3 or 20.0cm^3 of BA1 into a clean conical flask. Add 2-3 drops of methyl orange indicator and titrate with solution BA2 from the burette to the end point (i.e. the endpoint is reached when the solution just turns pink).
- ✓ Repeat the titration until successive readings differ by no more than 0.10cm^3 and record your results in the table below.

Results

Volume of pipette used=……………………………………..cm^3

Burette readings

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Mpangativicentmorgan8@gmail.com

Values used to calculate average volume of BA2 used………………………………………………………………………

Average volume of BA2 used ……………………………………………………………………………………………

……………………………………………………………………………………………….

Questions:

(a) Write the balanced equation between hydrochloric acid and sodium carbonate.

………

………

(b) Calculate the:

a. Number of moles of hydrochloric acid solution in the average volume.

………

……..

i. Number of moles of sodium carbonate that reacted with BA2

………

………

……..

ii. Molarity of hydrated sodium carbonate, $Na_2CO_3.XH_2O$

………

………

………

………

Concentration of hydrated sodium carbonate in grams per litre

………

………

……..

Mpangativicentmorgan8@gmail.com

(c) Determine

i. The relative molecular mass of hydrated sodium carbonate

……

……

……

……

ii. Hence, deduce the value of X in $Na_2CO_3.XH_2O$ (Na=23, C=12, O= 16, H= 1)

……

……

……

POINTS TO NOTE

- ✓ Relative molecular mass has no units
- ✓ 'M' means a molar solution which contains one mole of a substance dissolved in a litre of solution
- ✓ Molarity of a solution can also be termed as molar concentration or concentration in moles per litre

SECTION I

STANDARDISATION OF ACIDS & BASES

Experiment 1

Aim: standardization of hydrochloric acid with sodium hydroxide solution.

You are provided with the following solutions;

- **BA1**: which is 0.1M sodium hydroxide solution
- **BA2**: which is hydrochloric acid solution of unknown concentration
- Phenolphthalein indicator.

Mpangativicentmorgan8@gmail.com

You are required to determine the molar concentration of hydrochloric acid solution

Procedure:

Pipette $25.0cm^3$ or $20.0cm^3$ of solution BA1 into a clean conical flask . Add 2-3 dops of phenolphthalein indicator and titrate with solution BA2 from the burette until the pink solution just turns colourless and record the readings in the table below.

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than +/- $0.10cm^3$

Table of results

Volume of pipette used……………………………………………………………………………………………………

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Values used to calculate average volume of BA2 used……………………………………………………………………

Average volume of BA2 used ……………………………………………………………………………………

……………………………………………………………………………………………

Questions:

(a) Write down the equation for the reaction between BA1 AND BA2

……

……

Experiment 2

You are provided with the following solutions;

- **BA1**: which is a solution prepared by dissolving 11.4grams of $Na_2CO_3.XH_2O$ per litre.
- **BA2**: which is 0.1M hydrochloric acid solution

Mpangativicentmorgan8@gmail.com

- Methyl orange indicator.

  You are required to determine the number of moles of water of crystallization in hydrated sodium carbonate.

Procedure;

- ✓ Pipette $25.0cm^3$ or $20.0cm^3$ of BA1 into a clean conical flask . Add 2-3 drops of methyl orange indicator and titrate with solution BA2 from the burette to the end point (i.e the endpoint is reached when the solution just turns pink).
- ✓ Repeat the titration until successive readings differ by no more than $0.10cm^3$ and record your results in the table below.

Results

Volume of pipette used=……………………………………..cm^3

Burette readings

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Values used to calculate average volume of BA2 used…………………………………………………………………………

Average volume of BA2 used ………………………………………………………………………………………

………………………………………………………………………………………….

Questions:

(a) Write the balanced equation between hydrochloric acid and sodium carbonate.

………

………

Mpangativicentmorgan8@gmail.com

Experiment 3

Aim: standardization of hydrochloric acid with sodium hydroxide solution.

You are provided with the following solutions;

- **BA1**: which is 0.1M sodium hydroxide solution
- **BA2**: which is hydrochloric acid solution of unknown concentration
- Phenolphthalein indicator.

You are required to determine the molar concentration of hydrochloric acid solution

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA1 into a clean conical flask . Add 2-3 dops of phenolphthalein indicator and titrate with solution BA2 from the burette until the pink solution just turns colourless and record the readings in the table below.

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than +/- 0.10cm^3

Table of results

Volume of pipette used……

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Values used to calculate average volume of BA2 used………………………………………………………………………………

Average volume of BA2 used ……………………………………………………………………………………………

……………………………………………………………………………………………

Questions:

Mpangativicentmorgan8@gmail.com

(a) Write down the equation for the reaction between BA1 and BA2

………

………

(b) Calculate the:

Number of moles of sodium hydroxide used.

………

………,.

………

………

………

………..

……
………..

(c) Number of moles of hydrochloric acid solution that reacted with sodium hydroxide

………

………,.

………

………

………

………..

……
………..

(d) Determine the molar concentration of hydrochloric acid solution

………

Mpangativicentmorgan8@gmail.com

……,.

………

……….

……….

………..

………
……..

Experiment 4

Aim: standardization of hydrochloric acid with sodium carbonate solution

You are provided with the following solutions;

- BA1: which is 0.1M sodium carbonate solution
- BA2: which is hydrochloric acid solution of unknown concentration
- Methyl orange indicator

You are required to determine the concentration of hydrochloric acid solution in mol dm^{-3}

Procedure

- ✓ Pipette 25.0cm^3 or 20.0cm^3 of BA1 into a clean conical flask. Add 2-3 drops of methyl orange indicator and titrate with solution BA2 from the burette to the end point (i.e. the endpoint is reached when the solution just turns pink).
- ✓ Repeat the titration until successive readings differ by no more than 0.10cm^3 and record your results in the table below.

Results

Volume of pipette used=………………………………………..cm^3

Burette readings

Titration	1	2	3

Mpangativicentmorgan8@gmail.com

Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Values used to calculate average volume of BA2 used………………………………………………………………………

Average volume of BA2 used ………………………………………………………………………………………

………………………………………………………………………………………….

Questions:

(a) Write the balanced equation between BA1 and BA2.

………

………

……….

(b) Calculate the:

Number of moles of sodium carbonate used

…….

……,.

……….

……….

Number of moles of hydrochloric acid solution that reacted with BA1

…….

……,.

……….

……….

…….

……,.

Mpangativicentmorgan8@gmail.com

………

………

Determine the concentration of hydrochloric acid solution in moles per litre.

………

………

………

………

………

………

………

………

Mpangativicentmorgan8@gmail.com

Experiment 5

Aim : to standardize sodium hydroxide using sulphuric acid solution

You are provided with the following solutions;

- **BA1**: which is a solution of sodium hydroxide of unknown concentration
- **BA2**: which is 0.1M sulphuric acid solution
- Phenolphthalein indicator.

You are required to determine the concentration of sodium hydroxide solution in grams dm^{-3}

Procedure:

Pipette $25.0cm^3$ or $20.0cm^3$ of solution BA1 into a clean conical flask . Add 2-3 drops of phenolphthalein indicator and titrate with solution BA2 from the burette until the end point and record the readings in the table below.

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than +/- $0.10cm^3$

Table of results

Volume of pipette used………

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Values used to calculate average volume of BA2 used………………………………………………………………………………

Average volume of BA2 used ………………………………………………………………………………………………

………………………………………………………………………………………………

Questions:

(a) Write the balanced equation between sulphuric acid and sodium hydroxide

…….

Mpangativicentmorgan8@gmail.com

……

(b) Calculate the:

i. Number of moles of sulphuric acid used

……….

………,.

………

……….

……….

………,.

………

……….

ii. Number of moles of sodium hydroxide that reacted with sulphuric acid

……….

………,.

………

……….

……….

………,.

………

……….

(c) Determine the concentration of sodium hydroxide solution in grams dm^{-3}(Na=23,O=16,H=1)

……….

………,.

………

Mpangativicentmorgan8@gmail.com

…….

………

………,.

……

…….

Experiment 5

Aim: to standardize a solution of sulphuric acid using sodium carbonate

You are provided with the following solutions;

- ✓ BA1: which was prepared by dissolving 7.15 grams of $Na_2CO_3.10H_2O$ per 250cm^3 of solution
- ✓ BA2: which is sulphuric acid solution
- ✓ Methyl orange indicator.

You are required to determine the concentration of sulphuric acid solution in mol dm^{-3}

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA1 into a clean conical flask. Add 2-3 drops of methyl orange indicator and titrate with solution BA2 from the burette until the end point and record the readings in the

Mpangativicentmorgan8@gmail.com

table below.

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than +/- 0.10cm^3

Table of results

Volume of pipette used……………………………………………………………………………………………………

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Values used to calculate average volume of BA2 used………………………………………………………………………

Average volume of BA2 used ……………………………………………………………………………………

……………………………………………………………………………………………

Questions:

(a) Write the balanced equation between sulphuric acid and sodium carbonate.

………..

………

(b) Calculate the:

i. Molarity of sodium carbonate solution. (Na=23, C=12,O=16,H= 1)

……
………………

………,.

………

……….

Mpangativicentmorgan8@gmail.com

……….

……,.

………

………..

ii. Number of moles of sodium carbonate used

……….

……,.

………

………..

……….

……,.

………

………..

iii. Number of moles of sulphuric acid solution that reacted with sodium carbonate

……..

……,.

………

………..

……….

……,.

………

………..

(c) Determine the concentration of sulphuric acid solution in moles per litre.

……….

Mpangativicentmorgan8@gmail.com

………,.

………

……….

……

………,.

………

……….

SECTION II

DETERMINATION OF ATOMIC MASS OF A METALLIC ELEMENT/ RADICAL

Experiment 1

Aim: determination of atomic mass of M in the metal hydroxide, $M(OH)_2$

You are provided with the following solutions;

- **BA1:** which is 0.2M hydrochloric acid solution
- **BA2**: which is a solution containing 5.75 grams of a metal hydroxide , $M(OH)_2$, per litre (M represents a metallic element)
- Methyl orange indicator.

You are required to determine the atomic mass of M.

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA1 into a clean conical flask . Add 2-3 drops of methyl orange indicator and titrate the resultant solution with BA2 from the burette until the solution just turns orange and record the readings in column 1 of the table below.

Mpangativicentmorgan8@gmail.com

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than +/- 0.10cm^3

Table of results

Volume of pipette used………………………………………………………………………cm^3

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Average volume of BA2 used …………………………………………………………………………………………

…………………………………………………………………………………………

(a) Calculate the:

i. Number of moles of hydrochloric acid used

………

………,.

………

………

ii. Number of moles of $M(OH)_2$ that reacted with hydrochloric acid

………

………,.

………

………

………

………,.

Mpangativicentmorgan8@gmail.com

………

………

iii. Molarity of the metal hydroxide, $M(OH)_2$

………

………

………

………

………

………

………

………

………

………

………

………

iv. Formula mass of $M(OH)_2$

………

………

………

………

………

………

v. Atomic mass of M in $M(OH)_2$

………

Mpangativicentmorgan8@gmail.com

……,.

………

……….

Experiment 2

Aim: determination of relative atomic mass of W in a metal carbonate, W_2CO_3

You are provided with the following solutions;

- **BA1**: which is 0.1M hydrochloric acid solution
- **BA2**: which is a solution containing 5.75 grams per litre of a metal carbonate , W_2CO_3
- Phenolphthalein indicator.

You are required to determine the relative atomic mass of W.

Hydrochloric acid reacts with W_2CO_3 according to the ratio of 2:1

Procedure;

- ✓ Pipette 25.0cm^3 or 20.0cm^3 of solution BA2 into a clean conical flask.
- ✓ Titrate the resultant solution with BA1 from the burette using phenolphthalein indicator
- ✓ Repeat the titration until you obtain consistent results.
- ✓ Record your results in the table below.

Volume of pipette used………

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			

Mpangativicentmorgan8@gmail.com

Volume of BA2 used/ cm^3			

Values used to calculate average volume of BA2 used………………………………………………………………………

Average volume of BA2 used ……………………………………………………………………………………

……………………………………………………………………………………

Questions:

(a) Write an ionic equation for the reaction between hydrochloric acid and W_2CO_3

………

………,.

(b) Calculate the :

i. Number of moles of BA1 that reacted

………

………,.

………

………,.

………

………,.

ii. Molarity of BA2

………

………,.

………

………,.

………

Mpangativicentmorgan8@gmail.com

……

……,.

……

……,.

……

……

……,.

……

……,.

……

iii. Relative atomic mass of W. (C=12, O=16)

……

……,.

……

……,.

……

……

……,.

……

……,.

……

……,.

……

……,.

Mpangativicentmorgan8@gmail.com

……….

………

Experiment 3

You are provided with the following solutions;

- ✓ **BA1**: This is 0.1M sodium hydroxide solution
- ✓ Phenolphthalein indicator
- ✓ **BA2**: which is a solution made by dissolving 13.60 grams of an acid salt, KHX per litre of solution.

  (X represents a sulphate or carbonate radical) . You are required to identify radical X).

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA2 into a clean conical flask . Add 2-3 drops of phenolphthalein indicator and shake well. Titrate the resultant solution with BA1 from the burette until the solution just turns pink and record the readings in the table below.

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than +/- 0.10cm^3

Table of results

Volume of pipette used…………………………………………………………………………………cm^3

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Mpangativicentmorgan8@gmail.com

Average volume of BA2 used ……………………………………………………………………………………………

……………………………………………………………………………………………

(a) Calculate the:

i. Number of moles of sodium hydroxide solution in the average volume

………,.

………

………,.

………

………,.

………

………,.

………

………

ii. Number of moles of the acid salt ,KHX that reacted with sodium hydroxide

………,.

………

………,.

………

………,.

………

………,.

………

………

iii. Molarity of the acid salt, KHX.

Mpangativicentmorgan8@gmail.com

………,.

………

………,.

………

………,.

………

………,.

………

………

………,.

………

………,.

………

………,.

………

………,.

………

………

(b) Determine the relative molecular mass of the acid salt, KHX .

………,.

………

Mpangativicentmorgan8@gmail.com

………,.

……

………,.

………

………,.

………

……

………,.

………

………,.

……

………,.

………

………,.

………

……

(c) Identify X in the acid salt , KHX . (K=39, H=1)

………,.

………

………,.

……

………,.

………

Mpangativicentmorgan8@gmail.com

………,.

…….

………

………,.

…….

………,.

……….

………,.

…….

………,.

…….

………

Mpangativicentmorgan8@gmail.com

SECTION III

DETERMINATION OF NUMBER OF MOLES OF WATER OF CRYSTALLIZATION IN A HYDRATED COMPOUND

Experiment 1

Aim: to determine the number of moles of water of crystallization in sodium carbonate

You are provided with the following solutions;

- ✓ **BA1**: which is solution made by dissolving 7.20 grams of NaCO3.XH2O per 250 cm3 of solution
- ✓ **BA2**: which is 0.1M sulphuric acid solution
- ✓ Methyl orange indicator.

You are required to determine the number of moles of water crystallization in hydrated sodium carbonate.

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA1 into a clean conical flask. Add 2-3 drops of methyl orange indicator and titrate the resultant solution with sulphuric acid from the burette until the solution just turns orange and record the readings in column 1 of the table below.

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than 0.10cm3 and record your results in the table below.

Results

Volume of pipette used……………………………………………………………………………cm^3

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Average volume of BA2 used …………………………………………………………………………………………

…………………………………………………………………………………………………

Mpangativicentmorgan8@gmail.com

Questions

(a) Write a balanced equation for the reaction between sulphuric acid and hydrated sodium carbonate.

……,.

…….

……….

(b) Calculate the :

Number of moles of sulphuric acid solution in the average volume

……,.

…….

……….

……,.

…….

……….

Number of moles of hydrated sodium carbonate that reacted with BA2

…….

……….

……,.

…….

………
……….

……….

……,.

…….

………

Molarity of hydrated sodium carbonate

Mpangativicentmorgan8@gmail.com

……

……

……,.

……

……

……

……

……,.

……

……

Concentration of hydrated sodium carbonate in grams per litre (Na=23, C=12,H=1, O=16)

……

……

……,.

……

……

……

……

……,.

……

……

……

……

Mpangativicentmorgan8@gmail.com

(c) Determine the relative molecular mass of hydrated sodium carbonate

……

……

……,.

……

……

……

……

……,.

……

……

……

……

……,.

……

……

(d) Hence , deduce the value of X in $Na_2CO_3.XH_2O$ (Na=23,C=12, O=16, H=1)

……

……

……,.

……

……

……

Mpangativicentmorgan8@gmail.com

……

……,.

……

……
……

……

……,.

……

……

Experiment 2

Aim: to determine the number of moles of water of crystallization in oxalic acid.

You are provided with the following solutions;

- **BA1**: which is 0.1M sodium hydroxide solution
- **BA2**: which is a solution made by dissolving 6.30 grams of $H_2C_2O_4.WH_2O$ per litre of solution
- Phenolphthalein indicator.

You are required to determine the number of moles of water of crystallization in hydrated Oxalic acid,

Mpangativicentmorgan8@gmail.com

$H_2C_2O_4.WH_2O$.

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA1 into a clean conical flask. Add 2-3 drops of phenolphthalein indicator and shake well. Titrate the resultant solution with BA2 from the burette until the solution just turns pink and record the readings in the table below. Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than 0.10cm^3

Table of results

Volume of pipette used……………………………………………………………………………cm^3

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Average volume of BA2 used ……………………………………………………………………………………………cm^3

……………………………………………………………………………………………

Equation of reaction

$H_2C_2O_4$ (aq) + 2NaOH(aq) $\longrightarrow$ $Na_2C_2O_4$(aq) + $2H_2O$ (l)

(a) Calculate the:

i. Number of moles of sodium hydroxide solution used.

……

……,.

……

……

ii. Number of moles of hydrated oxalic acid that reacted with BA1

Mpangativicentmorgan8@gmail.com

……

……

……

……

……

……

……

……

iii. Molarity of hydrated oxalic acid, $H_2C_2O_4.WH_2O$

……

……

……

……

……

……

……

……

……

……

……

……

iv. Concentration of hydrated oxalic acid, $H_2C_2O_4.WH_2O$ in grams per litre

……

……

……

Mpangativicentmorgan8@gmail.com

……….,….

…….

…….

……….,….

…….

…….

……….,….

…….

…….

……….,….

…….

…….

……….,….

…….

…….

(b) Determine the relative molecular mass of hydrated oxalic acid.

……….,….

…….

…….

……….,….

…….

…….

……….,….

Mpangativicentmorgan8@gmail.com

…….

…….

………,….

…….

…….

………,….

…….

…….

………,….

…….

…….

(c) Hence, deduce the value of W in $H_2C_2O_4.WH_2O$(C=12, O=16, H=1)

…….

…….

………,….

…….

…….

………,….

…….

…….

………,….

…….

…….

…….

Mpangativicentmorgan8@gmail.com

…….

……,….

…….

…….

……,….

…….

…….

……,….

…….

…….

SECTION IV

DETERMINATION OF BASICITY OF AN ACID

Experiment 1

Aim : to determine the concentration of monobasic acid solution in grams dm^{-3}

You are provided with the following solutions;

- **BA1**: which is a solution of monobasic acid, HX of formula mass 37.
- **BA2**: which is a solution made by dissolving 5.3 grams of sodium carbonate per litre of solution
- Methyl orange indicator.

You are required to determine the concentration of monobasic acid solution in grams dm^{-3}

Procedure:

Pipette $25.0cm^3$ or $20.0cm^3$ of solution BA1 into a clean conical flask. Add 2-3 drops of methyl orange indicator and titrate with BA2 from the burette until the pink solution just turns yellow.

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than 0.10cm3 and record your results in the table below.

Mpangativicentmorgan8@gmail.com

Results

Volume of pipette used……………………………………………………………………………cm^3

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Average volume of BA2 used …………………………………………………………………………………………

…………………………………………………………………………………………

Questions:

(a) Write a balanced equation between the monobasic acid and sodium carbonate

……….

………

(b) Calculate the:

i. Molarity of sodium carbonate solution.

……….

……….

……….

……….

……….

……….

ii. Number of moles of sodium carbonate that reacted with the acid

……….

……….

Mpangativicentmorgan8@gmail.com

……

……

……

……

iii. Number of moles of the acid that reacted with sodium carbonate

……

……

……

……

……

……

(c) Determine the;

i. Molarity of the monobasic acid.

……

……

……

……

……

……

ii. Concentration of the monobasic acid solution in grams per litre.

……

……

……

……

Mpangativicentmorgan8@gmail.com

……

……

……

……

……

……

……

……

Experiment 2

Aim: to determine the basicity of an acid of formula H_nX.

You are provided with the following solutions;

- **BA1**: This is 0.1M acid of formula HnX.
- **BA2**: which is solution prepared by dissolving 2.0 grams of sodium hydroxide per 250cm^3 of solution.
- Phenolphthalein indicator.

You are required to determine the basicity of the acid of formula H_nX

Note: the basicity of an acid is the number of hydrogen atoms in one molecule of an acid, which are replaceable by a metal.

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA1 into a clean conical flask. Add 2-3 drops of phenolphthalein

Mpangativicentmorgan8@gmail.com

indicator and titrate the resultant solution with BA2 from the burette until the solution just turns pink .

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than 0.10cm3

Table of results

Volume of pipette used…………………………………………………………………………cm^3

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Average volume of BA2 used …………………………………………………………………………………………cm^3

…………………………………………………………………………………………

Questions:

(a) Write;

i. The balanced molecular equation between acid, H_nX and sodium hydroxide.

……….

……….

……….

ii. An ionic equation for the reaction

……
……
……

(b) Calculate the:

i. Molarity of sodium hydroxide solution

Mpangativicentmorgan8@gmail.com

……

……

……

……

……

……

ii. Number of moles of sodium hydroxide that reacted with the acid.

……

……

……

……

……

……

iii. Number of moles of the acid, H_nX that reacted with sodium hydroxide

……

……

……

……

……

……

iv. Calculate the basicity of the acid of formula HnX.

Mpangativicentmorgan8@gmail.com

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

Experiment 3

Aim: to determine the molar concentration of a dibasic acid, H_2X

You are provided with the following solutions;

- **BA1**: This is a solution of a dibasic acid.
- **BA2**: which is 0.2M sodium hydroxide solution
- Phenolphthalein indicator.

You are required to determine the molar concentration of the dibasic acid.

Procedure:

Mpangativicentmorgan8@gmail.com

Pipette $25.0cm^3$ or $20.0cm^3$ of solution BA2 into a conical flask . Add 2-3 drops of phenolphthalein indicator and titrate with BA1 from the burette until the solution just turns colourless.

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than 0.10cm3

Table of results

Volume of pipette used…………………………………………………………………………cm^3

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Average volume of BA2 used ……………………………………………………………………………………………cm^3

…………………………………………………………………………………………………

(a) Write;

i. The balanced molecular equation between a dibasic acid and sodium hydroxide.

…….

…….

…….

ii. The ionic equation for the reaction

……

……

………

(b) Calculate the:

i. Molarity of sodium hydroxide solution in BA2

Mpangativicentmorgan8@gmail.com

……
……
…………………………………………………………………………………………….

……….

……….

……….

……….

ii. Number of moles of sodium hydroxide that reacted with the acid.

……….

……….

……….

……….

……….

……….

iii. Number of moles of the acid, H_2X that reacted with sodium hydroxide

……….

……….

……….

……….

……….

……….

iv. Molarity of the acid H_2X in BA1

……….

Mpangativicentmorgan8@gmail.com

…….

…….

…….

…….

…….

(C) Determine the concentration of the acid H2X in BA1 in gdm^{-3}(H=1, X=88)

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

SECTION V

DETERMINATION OF STIOCHIOMETRY OF THE NEUTRALIZATION REACTION

Experiment 1

Aim: determination of stoichiometric ratio for the reaction between hydrochloric acid and substance T

You are provided with the following solutions;

- BA1: which is 0.3M hydrochloric acid solution

Mpangativicentmorgan8@gmail.com

- BA2: which is a solution containing 5.75 grams per litre of substance T.
- Phenolphthalein indicator.

You are required to determine the stoichiometric ratio for the reaction between hydrochloric acid and substance T.

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA2 into a clean conical flask. Add 2-3 drops of phenolphthalein indicator. Titrate with BA1 from the burette.

Repeat the titration until the successive burette readings differ by no more than+/- 0.10cm^3. Record your results in the table below.

Table of results

Volume of pipette used…….

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Values used to calculate the average volume of BA1……………………………………………………………………………cm^3

Average volume of BA2 used …………………………………………………………………………………………………cm^3

……………………………………………………………………………………………………

Questions:

(a) Calculate the;

Number of moles of BA1 that reacted

………

………

………

………

Mpangativicentmorgan8@gmail.com

Number of moles of BA2 that reacted with BA1 .(formula mass of T=60)

....

....

....

....

....

....

....

....

....

....

....

....

....

....

The mole ratio in which hydrochloric acid reacts with substance T

....

....

....

....

....

....

....

....

Mpangativicentmorgan8@gmail.com

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

SECTION VI

DETERMINATION OF FORMULAE OF ORGANIC ACIDS

Experiment 1

Aim: to determine the formula of an organic acid, $H\text{-}(CH_2)_x\text{-}COOH$ and name it.

You are provided with the following solutions;

- ✓ **BA1:** which is 0.2M sodium hydroxide solution
- ✓ **BA2:** which is a solution prepared by dissolving 6 grams of $H\text{-}(CH_2)_x\text{-}COOH$ per litre.
- ✓ Phenolphthalein indicator.

Mpangativicentmorgan8@gmail.com

You are required to determine the formula of an organic acid, H-$(CH_2)_x$-COOH and give it a name.

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA1 into a clean conical flask . Add 2-3 drops of phenolphthalein indicator and shake well . Titrate the resultant solution with BA2 from the burette until the pink solution just turns colourless and record the readings in the table below.

Repeat the titration until the successive burette readings differ by no more than+/- 0.10cm^3.

Table of results

Volume of pipette used…….

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Average volume of BA2 used ……………………………………………………………………………………………cm^3

……………………………………………………………………………………………

(a) Write an equation for the reaction between BA1 and BA2

……….

……….

……….

(b) Calculate the:

i. Number of moles of sodium hydroxide solution used.

……….

Mpangativicentmorgan8@gmail.com

……

……

……

……

……

ii. Number of moles of the organic acid that reacted with BA1

……

……

……

……

……

……

iii. Molarity of the organic acid, $H\text{-}(CH_2)_x\text{-}COOH$.

……

……

……

……

……

……

……

……

……

Mpangativicentmorgan8@gmail.com

………

………

………

(c) Determine the relative molecular mass of the organic acid, H-$(CH_2)_x$-COOH.

………

………

………

………

………

………

………

………

………

………

………

………

(d) Deduce the value of X in the organic acid, H-$(CH_2)_x$-COOH and hence, determine the formula of an organic acid, H-$(CH_2)_x$-COOH and give it a name. (C=12, O=16, H=1)

………

………

………

………

………

………

………

Mpangativicentmorgan8@gmail.com

………

………

………

………

………

SECTION VII

DETERMINATION OF PERCENTAGE PURITY / IMPURITY OF SUBSTANCES

Experiment 1

Aim: determination of percentage purity of sodium carbonate in a given sample.

You are provided with the following Solutions;

- **BA1**: which is a solution containing 15.5 grams of an impure sample of sodium Carbonate, $Na_2CO_3.10H_2O$ per litre of solution
- **BA2**: This is a 0.1M hydrochloric acid solution.
- Methyl orange indicator

You are required to determine the percentage purity of sodium carbonate.

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA1 into a clean conical flask . Add 2-3 drops of methyl orange indicator and titrate the resultant solution with BA2 from the burette until the solution just turns pink and record the readings in column 1 of the table below.

Mpangativicentmorgan8@gmail.com

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than +/- 0.10cm^3. Record your results in the table below.

Table of results

Volume of pipette used……………………………………………………………………………cm^3

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Values used to calculate average volume of BA2 use d……..

Average volume of BA2 used ……………………………………………………………………………………………

……………………………………………………………………………………………….

………..

………..

………..

Questions:

(a) Calculate the ;

i. Molarity of BA1

………..

………..

Mpangativicentmorgan8@gmail.com

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

ii. Mass of sodium carbonate in a litre of BA1 (Na=23, C=12, O=16, H=1)

……

……

……

……

……

Mpangativicentmorgan8@gmail.com

………

………

………

………

………

………

………

………

………

………

………

………

………

………

………

………

(b) Percentage purity of sodium carbonate in the sample

………

………

………

………

………

………

………

Mpangativicentmorgan8@gmail.com

…….

…….

…….

…….

…….

…….

…….

Experiment 2

Aim : determination of percentage impurity in a sample of impure sodium hydroxide.

You are provided with the following solutions;

- **BA1**: which is a solution containing 5.0 grams of an impure sample of sodium hydroxide , NaOH per litre of solution.
- **BA2**: which is a 0.1M hydrochloric acid solution
- Methyl orange indicator.

You are required to determine the percentage impurity in a sample of impure sodium hydroxide.

Procedure:

Pipette 25.0cm^3 or 20.0cm^3 of solution BA1 into a clean conical flask . Add 2-3 drops of methyl orange indicator and titrate the resultant solution with BA2 from the burette until the solution just turns pink and record the readings in column 1 of the table below.

Repeat the titration with other portions of the solution BA1 until the successive burette readings differ by no more than +/- 0.10cm^3. Record your results in the table below.

Mpangativicentmorgan8@gmail.com

Table of results

Volume of pipette used……………………………………………………………………………cm^3

Titration	1	2	3
Final readings/ cm^3			
Initial readings / cm^3			
Volume of BA2 used/ cm^3			

Values used to calculate average volume of BA2 use d……cm^3

Average volume of BA2 used …………………………………………………………………………………………cm^3

…………………………………………………………………………………………………

……….

……….

……….

Questions:

(a) Calculate the ;

i. Molarity of BA1

……….

……….

……….

……….

……….

……….

……

……

……

……

……

……

……

……

……

……

……

……

ii. Mass of sodium hydroxide in a litre of BA1 (Na=23, O=16, H=1)

……

……

……

……

……

……

Mpangativicentmorgan8@gmail.com

(b) Percentage impurity of sodium hydroxide in the sample

Mpangativicentmorgan8@gmail.com

……….

……….

……….

……….

……….

……….

CHAPTER TWO

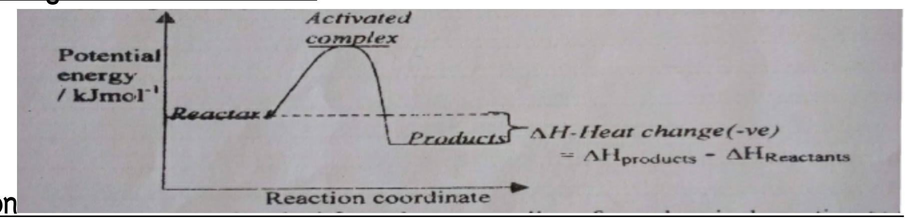
THERMOMETRIC TITRATIONS

Mpangativicentmorgan8@gmail.com

Introductory notes: Thermometry deals with the study of chemical reaction accompanied by a marked heat change or enthalpy change. The term heat is defined as energy, which is transferred from one place to another owing to a temperature difference between them.

- ✓ When the heat from a chemical reaction is liberated to the surroundings, the reaction is called an exothermic reaction.

Energy diagram for an exothermic reaction



- ✓ When the heat is absorbed from the surroundings for a chemical reaction to take place, the reaction is called an endothermic reaction. Hence enthalpy change is given +ve sign.

- ✓ The heat change which occurs in a chemical reaction is named after the type of reaction in which it occurs.

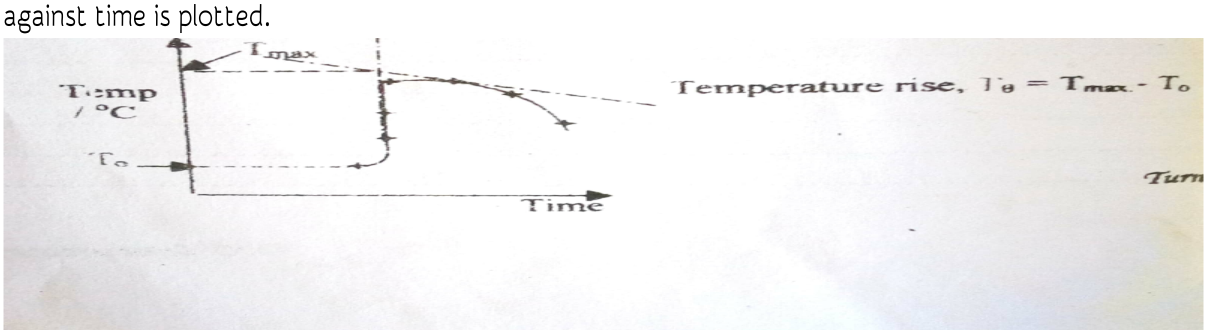
- ✓ Example; heat of neutralization is defined as heat given out when one mole of an acid is completely neutralized by one mole of a base, when the reaction is carried out in very dilute solution.

Note: the following must be noted:

- ✓ The initial temperature ,T_o of the solution (acid + base) is taken as the average

$$T_o{}^\circ C = \frac{(Ta\ +Tb)}{2}$$

- ✓ Temperature cannot reach the expected maximum since there are constant heat losses to the surroundings. So to obtain the theoretical maximum temperature, a graph of temperature rise against time is plotted.



Mpangativicentmorgan8@gmail.com

Experiment 1

You are provided with the following;

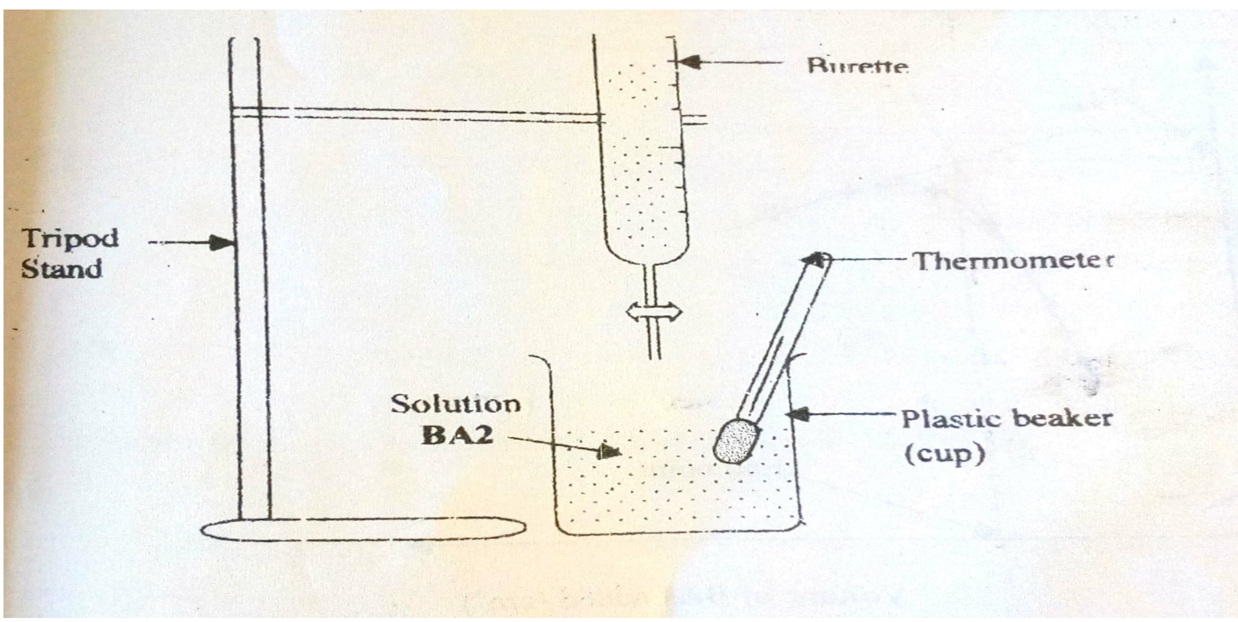
BA1: This is 1M hydrochloric acid solution.

BA2: This is sodium hydroxide solution

You are required to determine the molar concentration of BA21 by thermometric titration.

Procedure:

- ✓ Rinse the inside of a plastic beaker or cup provided with distilled water. Also rinse the thermometer. Record your results in the table below.
- ✓ Pipette $25cm^3$ or $20cm^3$ of BA2 into the beaker; record the temperature of the solution as T_1. This is taken to be the initial temperature for the reaction.
- ✓ Fill the burette with standard solution BA1. Assemble the apparatus as shown below



Mpangativicentmorgan8@gmail.com

- ✓ Carry out the titration by steadily adding $4.00 cm^3$ portions of BA1 from the burette at regular time intervals (say 15s) .After each addition stir the mixture carefully with the thermometer and record the steady temperature of the mixture.
- ✓ In each case record total volume of BA1 that has been added, and take up to 10 readings throughout the titration.

Results;

Temperature T_1……………………………………………………………………………………..^oC

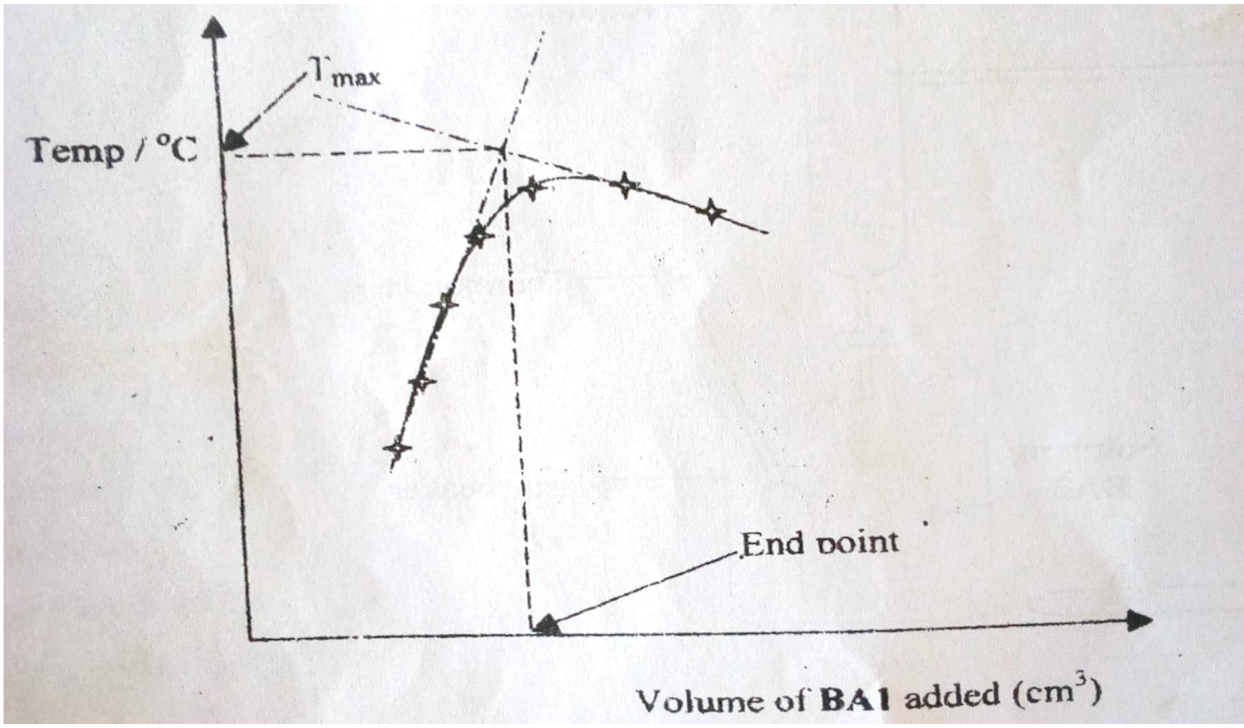
Volume of pipette used……………………………………………………………………………cm^3

Burette readings	1	2	3	4	5	6	7	8	9	10
Total volume of BA1 added/ cm^3	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00
Temperature of mixture(^oC)										

Questions;

(a) Plot a graph of temperature against volume of BA1 added, to obtain the following shape.

Mpangativicentmorgan8@gmail.com



(b) From you graph determine;

(i) The value of the end point.

…….

…….

…….

(ii) The maximum temperature of reaction mixture, T_{max}.

…….

…….

…….

(c) Determine the molar enthalpy of neutralization for this reaction. Neglect specific heat capacity of the plastic beaker and take the specific heat capacity and density of solution to be eual to that of water.

…….

…….

Mpangativicentmorgan8@gmail.com

……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….

(d) Why did we have to use a plastic vessel in this experiment?

……….
……….

Mpangativicentmorgan8@gmail.com

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

Experiment 2

You are provided with the following;

BA1: which is 1.0 gram of a metal ribbon (atomic mass =24)

BA2: This is 2M hydrochloric acid solution.

You are required to determine the heat change for one mole of BA1

Procedure

Measure accurately 100cm^3 of BA2 and transfer it into 250cm^3 plastic beaker. Note the temperature of the solution, which is the initial temperature of the reaction, T_1°C.

Cut BA1 carefully into small pieces of about 2cm. N.B don't lose any piece

Transfer all the pieces of BA1 you have cut into the plastic beaker containing BA2

Stir the mixture carefully with the thermometer and note the final/ steady temperature, which is the final temperature. Record your results in the table below.

Table of results

Mpangativicentmorgan8@gmail.com

Total mass of solution	101.0 grams
Final temperature	
Initial temperature	
Therefore temperature rise, DT	

(a) Is the reaction endothermic or exothermic? Give a reason for you answer.

………..

………..

………..

(b) (i) Calculate the enthalpy change of the reaction. (Specific heat capacity of the solution, s.h.c $=4.2kJkgK^{-1}$)

………..

………..

………..

………..

………..

………..

………..

………

………..

(ii) Calculate the molar enthalpy change of solution BA1

………..

………..

………..

Mpangativicentmorgan8@gmail.com

……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….
……….

Mpangativicentmorgan8@gmail.com

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

……….

CHAPTER THREE

RATES OF CHEMICAL REACTIONS

Theory:

Rate of reaction is the change of concentration of reactant or product with time as the reaction proceeds.

During the course of a chemical reaction, the concentration or the amount of products increases whereas the concentration of reactants decreases.

Measurement of rate of reaction:

The choice of the quantity to be used to measure the rate of reaction depends on which of the substances in the reaction mixture is easier to measure experimentally. E.g.

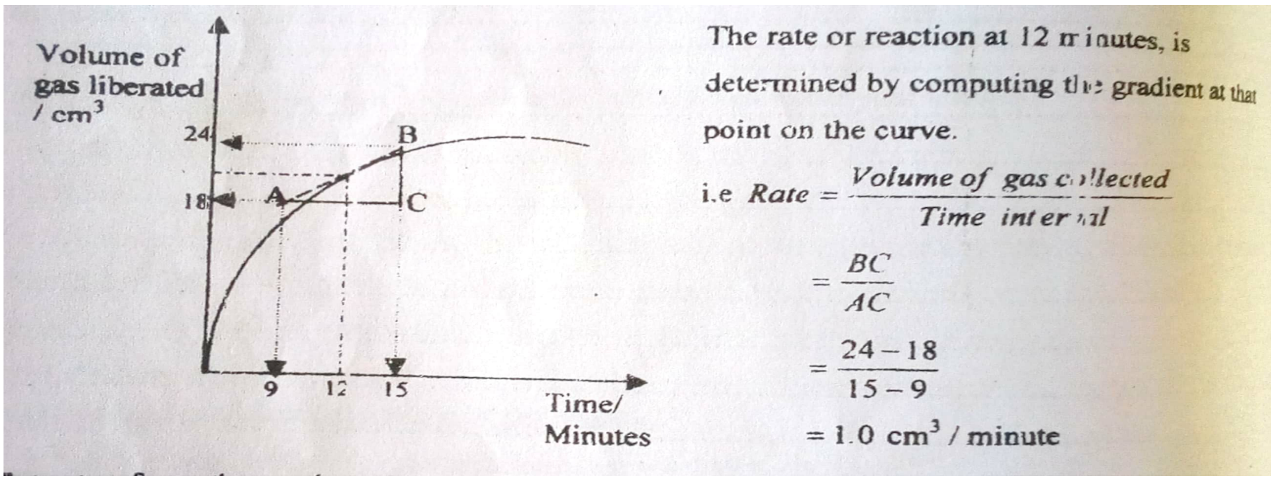
Titration method can be used to analyze the change in concentration of a substance with time during the course of reaction

$$\text{i.e} \quad \text{Rate} = \frac{\text{Change in concentration}}{\text{Time interval}}$$

Mpangativicentmorgan8@gmail.com

Measuring the volume of gas collected over time interval, if one of the products in a reaction is a gas i.e $\text{Rate} = \dfrac{\text{Volume of gas collected}}{\text{Time interval}}$

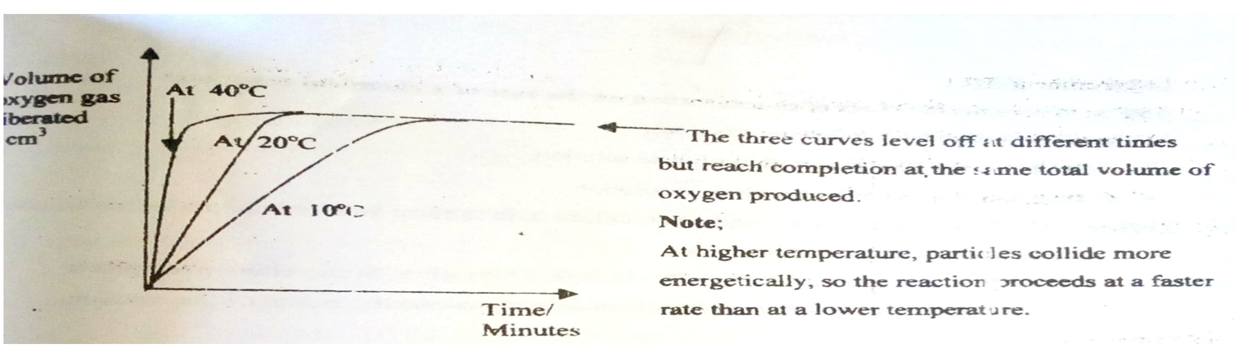
Note: The rate of such a reaction can be obtained by plotting a graph of volume of gas against time.



The rate of reaction at time= 12 minutes, is the slope of the tangent AB of the graph.

Note: Different graphs of volume of gas liberated against time at different temperature or concentration can also be plotted

An example of a graph of volume of oxygen gas liberated during decomposition of hydrogen peroxide against time at different temperatures; 10°C, 20°C and 40°C is given below;



Factors affecting the rate of a chemical reaction:

Mpangativicentmorgan8@gmail.com

- **Concentration:**

The rate of reaction increases with increasing concentration of reactants. This is because concentration increases the number of ions of reactants in a given volume and this increases the number of collisions per second between reactant molecules.

- **Temperature:**

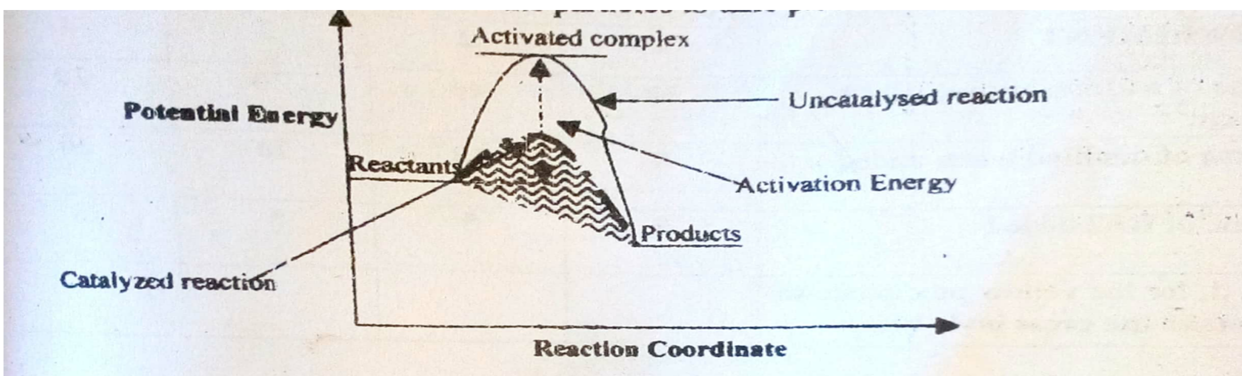
The rate of reaction increases with increasing temperature. This is because of the increase in the number of collisions per second between reactant molecules as temperature increases . A rise of 10°C approximately doubles the rate of reaction.

- **Surface area:**

If the surface area of the solid is large, the rate of collision of the reacting particles is high i.e powdered reactants present a larger surface area over which the reaction occurs than the large solid pieces hence the rate of reaction also increases.

- **Catalyst:**

The catalyst just speeds up the chemical reaction by providing an alternative pathway for the collisions between the particles to take place i.e it lowers the activation energy.



Experiment 1

Aim: to investigate the effect of concentration on the rate of a chemical reaction.

You are provided with the following solutions;

BA1: This is 0.25M sodium thiosulphate solution.

BA2: This is a 2M hydrochloric acid solution.

Mpangativicentmorgan8@gmail.com

Theory; sodium thiosulphate reacts with hydrochloric acid to form coegration of sulphur according to the following equation

$S_2O_3^{2-}(aq) \quad + \quad H^+(aq) \longrightarrow H_2O\,(l) \quad + \quad SO_2\,(g) \quad + \quad S(s)$

The intensity of the precipitate at any given t5ime represents the extent of the reaction.

Procedure:

1. Mark a small cross (X) with a pen on a sheet of a white paper and place it on the table.
2. Place a 250 cm^3 conical flask right onto the cross X
3. Using a measuring cylinder, transfer 50.0 cm^3 of BA1 into the conical flask which is over the cross.
4. Using another measuring cylinder, measure 5.0 cm^3 of BA2 and add it once to the solution BA1 in the conical flask, and start timing immediately.
5. Shake the flask occasionally and allow it to stand.

   Note and record time taken for the yellow colouration to just make the cross invisible when the contents of the beaker are viewed from above.
6. Repeat procedures 3 to 5 for different concentrations of sodium thiosulphate, varied by taking $40cm^3$, $30cm^3$, $20cm^3$, and $10cm^3$ ofBA1 and making up the total volume of $50.0cm^3$ with distilled water each time according to the table below.
7. Record your results in the table below.

Note; in each experiment, the cleaning of measuring cylinders and conical flasks is essential.

Results;

EXPERIMENT	1	2	3	4	5
Volume of sodium thiosulphate used/cm^3	50	40	30	20	10
Volume of distilled water added / cm^3	0	10	20	30	40
Volume of BA2 added cm^3	5	5	5	5	5
Time , t, for the yellow					

Mpangativicentmorgan8@gmail.com

precipitate to just make the cross invisible					

Questions;

(a) Calculate the rate of the chemical reaction

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……………………………………………

(b) State how the rate of a chemical reaction varies with volume of sodium thiosulphate used.

……
……
……
……
………………………………………………………………………………………………

……
……
……
……
………………………………………………………………………………………………

(c) Plot a graph of volume of sodium thiosulphate used(along the vertical axis) against time(horizontal axis).

Mpangativicentmorgan8@gmail.com

Experiment 2

Aim; investigation of how the rate of a chemical reaction varies with temperature for the reaction

You are provided with the following solutions;

BA1: This is sodium thiosulphate solution

BA2: This is a dilute hydrochloric acid solution.

Sodium thiosulphate reacts with hydrochloric acid to form coegration of sulphur according to the following equation

$S_2O_3^{2-}$(aq) + H^+(aq) $\longrightarrow$ H_2O (l) + SO_2 (g) + S(s) yellow colouration

The rate of reaction at a particular temperature can be followed by noting the time taken for the yellow colouration to appear at that temperature.

Procedure:

1. Mark a small cross (X) with a pen on a sheet of a white paper and place it on the table.
2. Place a 250 cm^3 conical flask right onto the cross X
3. Using a measuring cylinder, transfer 50.0 cm^3 of BA1 into the conical flask which is over the cross.
4. Using another measuring cylinder, measure 5.0 cm^3 of BA2 and add it once to the solution BA1 in the conical flask, and start timing immediately.
5. Shake the flask occasionally and allow it to stand.

   Note and record time taken for the yellow colouration to just make the cross invisible when the contents of the beaker are viewed from above. Through the beaker, note and record time taken for the yellow colouration to just make the cross invisible (this is the time, t, in seconds for the reaction to occur at room temperature.
6. Transfer a fresh 50.0cm3 of BA1 into a conical flask, and heat the solution to 30^0C.
7. Add 5.0cm3 of BA2 to the hot solution and at the same time start a stop clock or watch.

Mpangativicentmorgan8@gmail.com

8. Shake to mix and place the flask over the cross.
9. Look at the cross from above through the mixture.
10. Note and record time, t, taken for the yellow colouration to just make the cross invisible.(this is the time , t , in seconds for the reaction to occur at 30^oC).
11. Repeat procedures 3 to 5 for different concentrations of sodium thiosulphate, varied by taking $40cm^3$, $30cm^3$, $20cm^3$, and $10cm^3$ ofBA1 and making up the total volume of $50.0cm^3$ with distilled water each time according to the table below.
12. Record your results in the table below.

Note; in each experiment, the cleaning of measuring cylinders and conical flasks is essential.

Results;

EXPERIMENT	1	2	3	4	5
Temperature (^oC)	Room temp.	30	40	50	60
Time, t, for the yellow colouration to just make the cross invisible					
Reciprocal of time , 1/t(sec^{-1})					

Questions;

(a) Calculate the reciprocal of time (1/t) for each reaction temperature and record the values in the table above.

(b) State how the rate of a chemical reaction varies with temperature.

………
………
………
………

Mpangativicentmorgan8@gmail.com

………
………
………
………
………
………
………
………
………
……………………………………………………

(c) Plot a graph of 1/t (along the vertical axis) against temperature/ ^{0}C (horizontal axis)

………
………
………
………
………
………
……

(d) Use the graph to determine the;

i. Slope of the graph and state its units

………
………
………
………
………
………
………
………
………
………
………
………
………
……………………………………………………

Mpangativicentmorgan8@gmail.com

………
………
………
………
………
………
…………………………………………………………………………………………………

ii. Volume of BA1 used at time, t=90 seconds

………
………
………
………
………
………
…………………………………………………………………………………………………

CHAPTER FOUR

QUALITATIVE ANALYSIS

INTRODUCTION:

Qualitative analysis is concerned with the identification of unknown ions contained in inorganic compounds. The negatively charged ions are called anions and the positively charged are known as cations.

The safety precautions below must be adhered to when handling reagents and experiments in a chemistry laboratory;

- Always check the label on the reagent bottle to find whether it is that of your need.
- Never point a test tube, which contains chemicals you are heating towers yourself or anyone.
- Always handle acids and other reagents with care.

Mpangativicentmorgan8@gmail.com

- Never perform unauthorized experiments.
- Always wash your hands after practical work.

In qualitative analysis, a student is always provided with a table consisting of tests, observations, and conclusions or deductions as one designed below:

Tests	Observations	Conclusion/ deduction
(a)		
(b)		
Etc.		

A student should note the following when attempting qualitative analysis;

The column for tests is always filled and serves as instructions to the student.

A student is required to record any observations made as soon as possible, and the conclusions based on these observations.

A student should remember that marks would be awarded for a correct conclusion corresponding to a wrong observation. However , a student can score some marks if the observations are correct, but loses marks for a wrong conclusion.

A student is required to read through the column for tests before attempting the qualitative analysis experiment because the tests provide a clue that helps the student to predict the nature of unknown substance to be identified.

Therefore. A student is required to be well versed with theory for laboratory reagents used in qualitative analysis and the student should also know the purpose of each reagent.

Preliminary tests of unknown substances:

Always note the physical properties of the unknown sample.

Example;

Its appearance

- Colour provides a hint as to what metallic ions are contained in the sample.

Mpangativicentmorgan8@gmail.com

- Nature of the substance (either crystalline or Powderly substance).

Solubility in water;

- ✓ Water and dilute acids are used as solvents to dissolve compounds; soluble salts dissolve to form a solution & dilute acids dissolve insoluble salts to form a solution.

Deliquescence of the substance

The appearance of common cations and anions are given in the table below

Nature of substance	Deduction	
Black	Oxide or sulphides of Cu^{2+}	
Green	Fe^{2+}, Cu^{2+} salt	Transition salts
Blue	Cu^{2+} salt	
Yellow/brown	Fe^{3+} salt	
Yellow	Lead oxide	
White	Zn^{2+}, Pb^{2+}, Ca^{2+}, Al^{3+}, Mg^{2+}, Sn^{2+} or Ba^{2+}	
Deliquescent	Cl^- or nitrate(NO_3^-)	
(deliquescent substance is one which absorbs water from the atmosphere and dissolves in it to form a solution)		

NOTE; if the given unknown substance;

Is crystalline, then its probably a hydrated compound. When a hydrated crystalline substance is heated in a boiling tube, a colourless liquid is formed on the cooler parts of the test tube. This shows that the substance contains water of crystallization and is confirmed by anhydrous copper (ii) sulphate.

Is in powdered form, then it is probably anhydrous substance such as most carbonates, sulphides and oxides.

Has a pungent chocking smell of ammonia. Then this predicts an NH_4^+ salt.

Absorbs water from the atmosphere and gradually dissolves in it to form a solution, then you can predict a Cl^-, or NO_3^- of a metal.

Mpangativicentmorgan8@gmail.com

Action of heat on substances:

Heating a compound may result into decomposition of the compound, formation of a sublimate, colourless liquid condensing on cooler parts of the boiling tube or evolution of gas (es) and formation of residue.

A spatula endful of the unknown sample is heated gently and then very strongly in a dry boiling tube until no further change. The following must be noted during heating;

- ✓ The colour of solid left after heating(or colour of residue)
- ✓ Any gas or vapour evolved, which must be tested and identified with reference to the information below

Observation	Conclusion
o Colourless liquid which turns anhydrous copper(II)sulphate to blue	Water of crystallization (or water vapour from a hydrated compound)
o White sublimate o A colourless gas gives dense white fumes when in close contact with a glass rod dipped in Conc. Hydrochloric acid	Ammonium salt NH_3 gas (only alkaline gas) from an NH4+
o Brown fumes of a gas turns moist litmus paper red	An acidic gas; NO_3 gas from a nitrate.
o Yellow gas turns moist litmus paper red and then bleaches it.	An acidic gas; chlorine gas from Cl^- ion
o A colourless gas evolved on strong heating decolorizes acidified potassium permanganate solution	An acidic gas; SO_4 gas from a SO_3^{2-}, $S_2O_3^{2-}$ or certain SO_4^{2-}
Note: SO_4^{2-} are not easily decomposed to produce SO2 gas	
o A colourless gas evolved turns wet litmus paper slightly red and limewater milky	An acidic gas; CO_2 gas from a CO_3^{2-} or HCO_3^- ion

Residue (i.e. solid substance left in a boiling tube after heating)

Observation	Deduction
Black residue	CuO thus Cu^{2+} suspected

Mpangativicentmorgan8@gmail.com

Yellow when hot and white on cooling	ZnO thus Zn^{2+} suspected
Brown solid when hot and yellow on cooling	PbO present thus Pb^{2+} suspected
White residue	Oxides of group (II) and group (III) salts

Solubility in water;

This is used to separate two salts whereby one is soluble in water and the other is insoluble; a spatula endful of a given sample is shaken with about 5cm^3 of water to produce either a solution or a suspension, which is then filtered to generate a filtrate and residue.

Note the following observations;

A readily soluble salt in water forms a coloured or colourless solution containing a soluble salt.

Example: NO_3^-, SO_4^{2-}, Cl^- of Zn^{2+}, Al^{3+}, Mg^{2+}, Fe^{2+}, Fe^{3+}, NH_4^+, Cu^{2+} salts.

A partially soluble salt in water forms a suspension which when filtered gives a residue containing an insoluble salt and a filtrate.

Observation	Conclusion
1. Partially dissolves in water to give a colourless filtrate. Residue is white.	▪ Filtrate is probably NO_3^-, SO_4^{2-}or Cl of white soluble salts .e.g. Zn^{2+}, Al^{3+}, Mg^{2+} etc ▪ Residue is probably CO_3^{2-} or HCO_3^- of white salts.
2. Readily dissolves in water to form a colourless solution	▪ Probably NO_3^-, SO_4^{2-}or Cl of NH_4^+, Zn^{2+}, Al^{3+}or Mg^{2+} salts.

Mpangativicentmorgan8@gmail.com

3. Readily dissolves in water to form a coloured solution(e.g. blue, green, Brown, yellow, etc)	▪ Blue solution: Cl^-, SO_4^{2-} of Cu^{2+} ▪ Green solution: Cl^-, SO_4^{2-} or NO_3^- of Fe^{2+} or Cu^{2+} ▪ Yellow solution: Cl-, SO_4^{2-} or NO_3^- of Fe^{2+} salt
4. Partially dissolves in water to form a green filtrate. Residue is brown, green, etc	▪ Filtrate is probably Cl^-, SO_4^{2-} or NO_3^- of Fe^{2+} or Cu^{2+} salts ▪ Residue is probably CO_3^{2-} or HCO_3^- of transition salts.
Note: an insoluble salt is usually dissolved in dilute nitric acid or dilute hydrochloric acid to form a soluble salt.	

Addition of reagents:

1. **Aqueous sodium hydroxide solution**

The test is used to identify cations by precipitating the insoluble hydroxides.

Note; The amphoteric hydroxides dissolves in excess sodium hydroxide to form a solution

Observation		Conclusion
Drop wise	Excess	
No precipitate	On heating a colourless solution,	

Mpangativicentmorgan8@gmail.com

	a colourless gas is evolved , it turns wet litmus blue and forms dense white fumes with a glass rod dipped in conc. HCl	NH_3 gas from an NH_4^+ salt
	Explanation: heating gives off ammonia gas according to the equation below. $NH_4^+(aq) + OH^-(aq) \longrightarrow NH_3(g) + H_2O(l)$	
	No precipitate	Ba^{2+} ion
White precipitate formed	Insoluble in excess	Mg^{2+} or Ca^{2+}
	Soluble in excess alkali to form a colourless solution.	Al^{3+}, Zn^{2+} and Pb^{2+}
	Explanation: amphoteric hydroxides dissolve in excess NaOH solution to form soluble complexes: $Al(OH)_3(s) + 2OH^-(aq) \longrightarrow Al(OH)_4^-(aq)$ $Zn(OH)_2(s) + 2OH^-(aq) \longrightarrow Zn(OH)_4^{2-}(aq)$ $Pb(OH)_2(s) + 2OH^-(aq) \longrightarrow Pb(OH)_4^{2-}(aq)$	
Blue/ green precipitate formed	Insoluble in excess alkali and turns black on heating.	Cu^{2+} ion (i.e. copper hydroxide turns to CuO on heating)
Green precipitate formed	Insoluble in excess alkali. It rapidly turns brown at the surface on standing.	Fe^{2+} ion Aerial oxidation of Fe^{2+} to Fe^{3+}
Brown precipitate formed	Insoluble in excess alkali	Fe^{3+} ion

Mpangativicentmorgan8@gmail.com

2. <u>Aqueous ammonia solution</u>

This test is also used to identify cations by precipitating the insoluble hydroxides.

Note: some hydroxides dissolves in excess ammonia solution to form soluble complexes.

Observation		cations
Drop wise	Excess	
No precipitate	No observable colour change. Solution remains colourless.	NH_4^+ ion
	Cloudy solution	Ba^{2+} ion
White precipitate formed	Insoluble in excess alkali	Al^{3+} and Pb^{2+}
	Soluble in excess alkali to form a colourless solution	Zn^{2+} ion
	Explanation: zinc (II) hydroxide dissolves in excess ammonia to form a soluble complex: $Zn(OH)_2(s) + 4NH_3(aq) \rightarrow Zn(NH_3)_4^{2+}(aq) + 2OH^-(aq)$	
Pale blue precipitate formed	Soluble in excess alkali to form a deep blue solution	Cu^{2+} ion (i.e copper hydroxide turns to CuO on heating)

Mpangativicentmorgan8@gmail.com

	Explanation: copper (II) hydroxide dissolves in excess ammonia solution to form a soluble complex; $Cu(OH)_2(s) + 4NH_3(aq) \longrightarrow Cu(NH_3)_4^{2+}(aq) + 2OH^-(aq)$	
Green precipitate formed	Insoluble in excess alkali and rapidly turns brown at the surface on standing.	Fe^{2+} ion Aerial oxidation of Fe^{2+} to Fe^{3+}
Brown precipitate formed	Soluble in excess alkali to form a colourless solution	Ag^+ ion
	Explanation: brown Ag_2O precipitate formed, dissolves in excess ammonia to form a soluble complex; $Ag^+(aq) + 2NH_3(aq) \longrightarrow Ag(NH_3)_2^+(aq)$	
	Insoluble in excess alkali	Fe^{3+} ion

3. **Confirmatory tests for common cations:**

Cations	reagents	Observation
	To the solution, add ammonium carbonate solution	
	To the solution, add ammonium oxalate solution	

Mpangativicentmorgan8@gmail.com

<table>
<tr><td>Ca^{2+}</td><td>Add potassium hexacyanoferrate(II) solution (potassium ferrocyanide)</td><td>White precipitate formed</td></tr>
<tr><td>NH_4^+</td><td>Add sodium hydroxide solution and heat. Test for the gas evolved using litmus paper or Conc. HCl</td><td>No observable change but on heating, gas turns damp red litmus blue & forms white fumes with Conc. HCl i.e. Ammonia gas is evolved</td></tr>
<tr><td rowspan="6">Pb^{2+}</td><td>To the solution, add dilute hydrochloric acid solution and heat</td><td>White precipitate dissolves on heating to form a colourless solution. On cooling, the white precipitate reappears.</td></tr>
<tr><td colspan="2">Explanation: lead (II) chloride formed, $Pb^{2+}(aq) + 2Cl^-(aq)$ $PbCl_2(s))$ + $2Cl^-(aq)$ $\longrightarrow$ $PbCl_2(s)$ is insoluble in cold water but dissolves in hot water (i.e. dissolves on increasing temperature)</td></tr>
<tr><td>To the solution, add potassium iodide solution</td><td>Yellow precipitate is formed</td></tr>
<tr><td colspan="2">Explanation; Yellow precipitate is due to the formation of potassium iodide.

i.e. $Pb^{2+}(aq) + 2I^-(aq) \longrightarrow PbI_2(s)$</td></tr>
<tr><td>To the solution, add potassium chromate solution</td><td>Yellow precipitate, turns orange on heating</td></tr>
<tr><td colspan="2">Explanation: yellow precipitate is due to the formation of lead(II) chromate,

i.e. $Pb^{2+}(aq) + CrO_4^{2-}(aq) \longrightarrow PbCrO_4(s)$, yellow ppt</td></tr>
</table>

Mpangativicentmorgan8@gmail.com

Cations	Reagents	Observation
Mg^{2+}	Add ammonia solution and ammonium chloride followed by disodium hydrogen phosphate solution	White crystalline solid is formed
	To the solution, add sodium carbonate solution	White precipitate is formed
	Explanation: White precipitate is due to the formation of insoluble magnesium carbonate, i.e. $Mg^{2+}(aq) + CO_3^{2-}(aq) \longrightarrow MgCO_3(s)$, white ppt	
	To the solution, add aqueous ammonia	White precipitate formed,

Mpangativicentmorgan8@gmail.com

	dropwise until in excess.	dissolves in excess to form a colourless solution
Zn^{2+}	Explanation; Zinc (II) hydroxide dissolves in excess ammonia solution to form a soluble complex; $Zn(OH)_2(s) + 4NH_3(aq) \rightarrow Zn(NH_3)_4^{2+}(aq) + 2OH^-(aq)$	
	To the solution, add 2-3 drops of ammonia solution and warm the suspension.	White precipitate formed. On warming, a yellow suspension when hot is formed and turns white on cooling.
Al^{3+}	Add ammonium chloride followed by sodium phosphate solution	White precipitate is formed
	To the solution, add sodium carbonate solution	

Mpangativicentmorgan8@gmail.com

Cations	Reagents	Observations
Cu^{2+}	To the solution, add aqueous ammonia dropwise until in excess	Blue precipitate formed, dissolves in excess to form a deep blue solution
	To the solution, add potassium iodide solution	White precipitate, stained brown is formed
	Explanation; white precipitate is due to the formation of insoluble copper (I) iodide which is stained with iodine solution. i.e. $2Cu^{2+}(aq) + 4I^-(aq) \longrightarrow Cu_2I_2(s) + I_2(aq)$	
	To the solution, add potassium hexacyanoferrate (II) solution	Brown precipitate is formed
	To the solution, add potassium chromate solution	Yellow precipitate is formed

Mpangativicentmorgan8@gmail.com

Ba^{2+}	Explanation; yellow precipitate is due to the formation barium chromate, i.e. $Ba^{2+}(aq) + CrO_4^{2-}(aq) \longrightarrow BaCrO_4(s)$, yellow ppt	
	To the solution, add ammonium oxalate solution	White precipitate, soluble in hot ethanoic acid.
Fe^{2+}	Add potassium hexacyanoferrate (III) solution	Deep blue precipitate is formed
Fe^{2+}	Add potassium hexacyanoferrate (II) solution	Deep blue precipitate is formed
	Add dilute sulphuric acid followed by zinc powder and heat	A green solution is formed
	Explanation; Zinc powder reduces Fe^{3+} salt to green Fe^{2+} salt i.e. $2Fe^{3+}(aq) + Zn(s) \longrightarrow 2Fe^{2+}(aq) + Zn^{2+}(aq)$	
	Add potassium(or ammonium) thiocyanate solution	A deep red blood solution is formed

4. **Reaction With Dilute Sulphuric Acid, Hydrochloric Acid Or Dilute Nitric Acid**

Add little of the acid to the test tube containing the solution. Observe any changes and then add the reagent in excess. If there is reaction, always warm gently. Identify any gases evolved.

Observations	**Deductions**
Effervescence occurs and a colourless, odorless gas	CO_2 evolved from a CO_3^{2-} or HCO_3^- ion

Mpangativicentmorgan8@gmail.com

is evolved, turns damp blue litmus slightly red/ pink and lime water milky. Solid dissolves to form a coloured/ colourless solution	Insoluble salt dissolves in acid to form a soluble salt; probably NO_3^-, SO_4^{2-} or Cl^- of a white soluble salt
Colourless gas with pungent smell, turns damp litmus red and acidified potassium dichromate paper green No precipitate is formed	SO_2 evolved from SO_3^{2-} SO_2 produced reduces $Cr_2O_7^{2-}$ to Cr^{3+}
With dilute hydrochloric acid, a white precipitate is formed. Ppt dissolves on warming/ boiling and reappears on cooling	Pb^{2+}

5. **Addition Of Sodium Carbonate Solution**

Addition of little of sodium carbonate solution to the test tube containing the solution , precipitates the insoluble carbonate, hydroxide or oxide.

Observation	Deduction
No gas is evolved White precipitate is formed	Pb^{2+}, Zn^{2+}, Ca^{2+}, Ba^{2+}, or Mg^{2+} metal CO_3^{2-} precipitated.

Mpangativicentmorgan8@gmail.com

White precipitate, accompanied by effervescence. A colourless, odorless gas evolved, turns damp blue litmus paper red and lime water milky.	Al $(OH)_3$ precipitated. Carbonate is unstable to produce carbon dioxide gas. Thus Al^{3+} present.
Observation	Deduction
Pale blue precipitate is formed. Precipitate darkens on heating and turns black.	Cu^{2+} suspected. $CuCO_3$ is [precipitated and decomposes on heating to black, CuO.
Brown precipitate, accompanied by effervescence of a colourless, odorless gas which turns damp litmus paper red and limewater milky	Fe $(OH)_3$ precipitated. Carbon dioxide gas from a CO_3^{2-} Thus, Fe^{3+} present
Dark green precipitate is formed. Turns brown on standing	Fe^{2+}, Fe $(OH)_2$ precipitated. Turns brown due to aerial oxidation of Fe^{2+} to Fe^{3+}

Mpangativicentmorgan8@gmail.com

6. <u>Confirmatory Tests For Common Anions:</u>

Anion	Reagent	Observation
SO_4^{2-}	To the solution, add barium nitrate solution followed by dilute nitric acid or barium chloride solution followed by dilute hydrochloric acid	White precipitate formed dissolves in acid
CO_3^{2-} & HCO_3^-	To the solution, add dilute acid solution e.g nitric acid and heat.	Effervescence occurs and a colourless, odorless, gas is evolved, turns damp litmus paper red and limewater milky.
Note: T o differentiate between CO_3^{2-} & HCO_3^- , add 2-3 drops of magnesium sulphate solution; With CO_3^{2-}, a white precipitate of magnesium carbonate is formed. While with HCO_3^-, no precipitate is formed, since $Mg(HCO_3)_2$ is soluble.		

Mpangativicentmorgan8@gmail.com

Anions	Reagents	Observations
NO_3^-	To the solution, add freshly prepared iron (II) sulphate solution and carefully pour conc. Sulphuric acid down the sides of the test tube.	Brown-ring layer is formed at the interface of the two separate liquids
	To the solution, add few copper turnings followed by conc. H_2SO_4. Warm the mixture.	Brown fumes observed and a blue solution is formed.
	To the solution, add dilute nitric acid followed by silver nitrate solution. Then add 2cm3 of ammonia solution	White precipitate is formed. Precipitate darkens on exposure to light and dissolves in ammonia solution.

Mpangativicentmorgan8@gmail.com

Cl^-	Add manganese(IV) oxide solid followed by conc. H_2SO_4 and warm	Pale green gas is evolved, bleaches damp litmus paper.
	To the solution, add conc. H_2SO_4 and warm	Pungent colourless gas fumes in moist air and forms dense white fumes with ammonia solution
	To the solution, add lead(II) nitrate solution and heat	A white precipitate is formed. Precipitate dissolves on heating and reappears on cooling

<u>Practical presentation</u>

Question: You are provided with substance E, which contains two cations and two anions. You are required to identify the cations and anions in E. Carry out the tests below and record your observations and deductions in the spaces provided. Where a gas is evolved, it should be identified.

Tests	Observation	Deduction
(a) Note the physical appearance of substance E		

(b) Heat a spatula end-full of E in a hard glass tube first gently and then strongly until there is no further change.		
(c) To about one spatula end-full of E, add about 5cm^3 of water & filter. Keep both the filtrate and residue. Divide the filtrate into 4 parts.		
i. To the 1st part, add dilute sodium hydroxide solution drop wise until in excess and heat.		
ii. To the 2nd part, add dilute ammonia solution drop wise until in excess.		

Mpangativicentmorgan8@gmail.com

iii. To the 3rd part, add 3 drops of barium nitrate solution, followed by dilute nitric acid drop wise until in excess		
(d) Wash the residue and dissolve it in dilute nitric acid. Divide the resultant solution into 4 parts		
i. To the 1st part, add sodium hydroxide solution drop wise until in excess		
ii. To the 2nd part add dilute ammonia solution drop wise until in excess.		

Mpangativicentmorgan8@gmail.com

iii. To the third part, add hydrochloric acid		
iv. Use the 4th part to carry out a test of your own choice to confirm the cation in the residue.		

The cations in E…….

The anions in E……

TRIAL QUESTIONS

Experiment 1

You are provided with substance A which contains one cation and one anion. You are required to identify the cation and anion in A. Carryout the tests below and record your observations and deductions in the table below. Where a gas is evolved, it should identified.

Tests	Observations	Deductions
(a) Note the physical appearance of A		

(b) Dissolve a spatula end full of A in about $5cm^3$ of water. Divide the resultant solution into four portions.		
i. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		
ii. To the 2nd portion, add dilute ammonia solution drop wise until in excess.		
iii. To the 3rd portion, add 3 drops of lead(II) nitrate solution.		
iv. To the 4th portion, add		

Mpangativicentmorgan8@gmail.com

$1cm^3$ of dilute nitric acid followed by 3 drops of barium nitrate solution.		

(c) Identify the cation and anion in A.

Cation ………………………………………………………… Anion…………………………………………………………………….

Experiment 2

You are provided with substance B which contains one cation and one anion. You are required to identify the cation and anion in B. Carryout the tests below and record your observations and deductions in the table below. Where a gas is evolved, it should identified.

Tests	Observations	Deductions
(a) Note the physical appearance of B		
(b) Dissolve a spatula end full of B in about $5cm^3$ of water. Divide the resultant solution into four portions.		
I. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		

Mpangativicentmorgan8@gmail.com

II. To the 2nd portion, add dilute ammonia solution drop wise until in excess.		
III. To the 3rd portion, add 3 drops of lead(II) nitrate solution.		
IV. To the 4th portion, add 1cm^3 of dilute nitric acid followed by 3 drops of barium nitrate solution.		

(c) Identify the cation and anion in B.

Cation ………………………………………………………… Anion…………………………………………………………………….

Experiment 3

You are provided with substance C which contains one cation and one anion. You are required to identify the cation and anion in C. Carryout the tests below and record your observations and deductions in the table below. Where a gas is evolved, it should identified.

Tests	Observations	Deductions
(a) Note the physical appearance of C		

Mpangativicentmorgan8@gmail.com

(b) Dissolve a spatula end full of C in about 5cm^3 of water. Divide the resultant solution into four portions.		
I. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		
II. To the 2nd portion, add dilute ammonia solution drop wise until in excess.		
III. To the 3rd portion, add 3 drops of lead(II) nitrate solution.		
IV. To the 4th portion, add 1cm^3 of dilute nitric acid followed by 3 drops of barium nitrate solution.		

Mpangativicentmorgan8@gmail.com

(c) Identify the cation and anion in C.

Cation ……………………………………………………… Anion……………………………………………………………….

Experiment 4

You are provided with substance D which contains one cation and one anion. You are required to identify the cation and anion in D. Carryout the tests below and record your observations and deductions in the table below. Where a gas is evolved, it should identified.

Tests	Observations	Deductions
(a) Note the physical appearance of D		
(b) Dissolve a spatula end full of D in about 5cm^3 of water. Divide the resultant solution into four portions.		
I. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		
II. To the 2nd portion, add dilute ammonia solution		

drop wise until in excess.		
III. To the 3rd portion, add 3 drops of lead(II) nitrate solution.		
IV. To the 4th portion, add 1cm^3 of dilute nitric acid followed by 3 drops of barium nitrate solution.		

(c) Identify the cation and anion in D.

Cation ……………………………………………………………… Anion……………………………………………………………………………….

Experiment 5

You are provided with substance E which contains one cation and one anion. You are required to identify the cation and anion in E. Carryout the tests below and record your observations and deductions in the table below. Where a gas is evolved, it should identified.

Tests	Observations	Deductions
(a) Note the physical appearance of E		
(b) Dissolve a spatula end full of E in about 5cm^3 of		

Mpangativicentmorgan8@gmail.com

water. Divide the resultant solution into four portions.		
I. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		
II. To the 2nd portion, add dilute ammonia solution drop wise until in excess.		
III. To the 3rd portion, add 3 drops of lead (II) nitrate solution.		
IV. To the 4th portion, add $1cm^3$ of dilute nitric acid followed by 3 drops of barium nitrate solution.		

(c) Identify the cation and anion in E.

Mpangativicentmorgan8@gmail.com

Cation …………………………………………………………… Anion……………………………………………………………………………….

Experiment 6

You are provided with substance F which contains one cation and one anion. You are required to identify the cation and anion in F. Carry out the required tests below and record your observations and deductions in the table below. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Note the physical appearance of substance F		
(b) Dissolve a spatula end full of F in about 5cm^3 of water. Divide the resultant solution into five portions.		
i. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		
ii. To the 2nd portion, add 3 drops of potassium iodide solution.		
a. iii. To the 3rd portion, add dilute ammonia solution drop wise until in excess.		
iv. To the 4th portion, add 3 drops of lead (II) nitrate solution		

Mpangativicentmorgan8@gmail.com

v. To the 5th portion, add $1cm^3$ of dilute hydrochloric acid followed by 3 drops of barium chloride solution		

(C) Cation……………………………………………………………….. Anion………………………………………………………………

Experiment 7

You are provided with substance G which contains one cation and one anion. You are required to identify the cation and anion in G. Carry out the required tests below and record your observations and deductions in the table below. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Note the physical appearance of substance G		
(b) Dissolve a spatula end full of G in about $5cm^3$ of water. Divide the resultant solution into five portions.		
i. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		
ii. To the 2nd portion, add 3 drops of potassium iodide solution.		

Mpangativicentmorgan8@gmail.com

iii. To the 3rd portion, add dilute ammonia solution drop wise until in excess.		
iv. To the 4th portion, add 3 drops of lead (II) nitrate solution		
v. To the 5th portion, add $1cm^3$ of dilute hydrochloric acid followed by 3 drops of barium chloride solution		

(c) Cation……………………………………………………………….. Anion………………………………………………………………

Experiment 8

You are provided with substance H which contains one cation and one anion. You are required to identify the cation and anion in H. Carry out the required tests below and record your observations and deductions in the table below. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Note the physical appearance of substance H		
(b) Dissolve a spatula end full of H in about $5cm^3$ of water. Divide the resultant solution into five portions.		

i. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		
ii. To the 2nd portion, add dilute ammonia solution drop wise until in excess.		
iii. To the 3rd portion, add sodium carbonate solution.		
iv. To the 4th portion, add 3 drops of lead (II) nitrate solution		
v. To the 5th portion, add $1cm^3$ of dilute hydrochloric acid followed by 3 drops of barium chloride solution		

(c) Cation………………………………………………. Anion…………………………………………………….

Experiment 9

You are provided with substance I which contains one cation and one anion. You are required to identify the cation and anion in I. Carry out the required tests below and record your observations and deductions in the table below. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions

Mpangativicentmorgan8@gmail.com

(a) Note the physical appearance of substance I		
(b) Dissolve a spatula end full of I in about 5cm^3 of water. Divide the resultant solution into five portions.		
i. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		
ii. To the 2nd portion, add dilute ammonia solution drop wise until in excess.		
iii. Use the 3rd portion to carry out a test of your own choice to confirm the cation in I		
iv. To the 4th portion, add 3 drops of lead (II) nitrate solution		
v. To the 5th portion, add 1cm^3 of dilute hydrochloric acid followed by 3 drops of barium chloride solution		

Mpangativicentmorgan8@gmail.com

(c) Cation………………………………………………………………….. Anion…………………………………………………………………

Experiment 10

You are provided with substance J which contains one cation and one anion. You are required to identify the cation and anion in J. Carry out the required tests below and record your observations and deductions in the table below. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Note the physical appearance of substance J		
(b) Dissolve a spatula end full of J in about $5cm^3$ of water. Divide the resultant solution into five portions.		
i. To the 1^{st} portion, add dilute sodium hydroxide drop wise until in excess.		
ii. To the 2^{nd} portion, add dilute ammonia solution drop wise until in excess.	.	
iii. To the 3^{rd} portion, add 3 drops of potassium iodide solution		
iv. To the 4^{th} portion, add 3 drops of lead (II) nitrate solution		

Mpangativicentmorgan8@gmail.com

v. To the 5th portion, add $1cm^3$ of dilute hydrochloric acid followed by 3 drops of barium chloride solution		

(c) Cation………………………………………………………………….. Anion………………………………………………………………….

Experiment 11

You are provided with substance K which contains one cation and one anion. You are required to identify the cation and anion in K. Carry out the required tests below and record your observations and deductions in the table below. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Note the physical appearance of substance K		
(b) Dissolve a spatula end full of K in about $5cm^3$ of water. Divide the resultant solution into five portions.		
i. To the 1st portion, add dilute sodium hydroxide drop wise until in excess.		
ii. To the 2nd portion, add dilute ammonia solution drop wise until in excess.	.	

Mpangativicentmorgan8@gmail.com

iii. To the 3rd portion, add 3 drops of potassium iodide solution		
iv. To the 4th portion, add 3 drops of lead (II) nitrate solution		
v. To the 5th portion, add $1cm^3$ of dilute nitric acid followed by 3 drops of barium nitrate solution		

(c) (i) Cation……………………………….. (ii) Anion…………………………………………………………

Experiment 12

You are provided with substance L which contains one cation and two anions. Carry out the following tests to identify the cation and anion in L .

Tests	Observations	Deduction
(a) To 2 spatulas end full of L in a test tube, add $5cm^3$ of water shake and filter. Keep both filtrate and residue. (b) Divide the filtrate into four parts.		
i. To the 1st part add dilute		

Mpangativicentmorgan8@gmail.com

sodium hydroxide solution drop wise until in excess.		
ii. To the 2nd part add dilute ammonia solution drop wise until in excess.		
iii. To the third part add 3 drops of lead (II) nitrate solution		
iv. To the 4th part add 3 drops of hydrochloric acid followed by 3 drops of barium nitrate solution.		
(c) Put the residue in a test tube and add 2cm^3 of dilute hydrochloric acid. Divide the resulting solution into 2 parts.		
i. To the 1st part add dilute sodium hydroxide solution drop wise until in excess.		

Mpangativicentmorgan8@gmail.com

ii. To the 2nd part add dilute ammonia solution drop wise until in excess.		

(d) Identify the:

(i) Cation …….

(ii) Anion …….

Experiment 13

You are provided with substance M which contains one cation and two anions. Carry out the following tests to identify the cation and anion in M.

Tests	Observations	Deduction
(a) To 2 spatulas end full of M in a test tube, add 5cm^3 of water, shake and filter. Keep both filtrate and residue. (b) Divide the filtrate into four parts.		
i. To the 1st part add dilute sodium hydroxide solution drop wise until		

Mpangativicentmorgan8@gmail.com

in excess.		
ii. To the 2nd part add dilute ammonia solution drop wise until in excess.		
iii. To the third part add 3 drops of lead (II) nitrate solution		
iv. To the 4th part add 3 drops of hydrochloric acid followed by 3 drops of barium nitrate solution		
(c) Put the residue in a test tube and add 2cm^3 of dilute hydrochloric acid. Divide the resulting solution into 2 parts.		
i. To the 1st part add dilute sodium hydroxide solution drop wise until		

Mpangativicentmorgan8@gmail.com

in excess.		
ii. To the 2nd part add dilute ammonia solution drop wise until in excess.		

(d) Identify the:

(i) Cation ……….

(ii) Anion ……….

Experiment 14

You are provided with substance N which contains one cation and two anions. Carry out the following tests to identify the cation and anion in N.

Tests	Observations	Deduction
(a) To 2 spatula end full of N in a test tube, add $5cm^3$ of water, shake and filter.		

Mpangativicentmorgan8@gmail.com

Keep both filtrate and residue. (b) Divide the filtrate into four parts. (c)		
i. To the 1st part add dilute sodium hydroxide solution drop wise until in excess.		
ii. To the 2nd part add dilute ammonia solution drop wise until in excess.		
iii. To the third part add 3 drops of lead (II) nitrate solution		
iv. To the 4th part add 3 drops of hydrochloric acid followed by 3 drops of barium nitrate solution.		
(d) Put the residue in a test tube and add		

Mpangativicentmorgan8@gmail.com

$2cm^3$ of dilute hydrochloric acid. Divide the resulting solution into 2 parts.		
i. To the 1st part add dilute sodium hydroxide solution drop wise until in excess.		
ii. To the 2nd part add dilute ammonia solution drop wise until in excess.		

(e) Identify the:

(iii) Cation ……

(iv) Anion ……

Experiment 15

You are provided with substance O which contains one cation and two anions. Carry out the following tests to identify the cation and anion in O .

Tests	Observations	Deduction
(a) To 2 spatula end full of O in a test tube, add $5cm^3$ of water, shake and filter. Keep both filtrate and residue.		

Mpangativicentmorgan8@gmail.com

(b) Divide the filtrate into four parts.		
i. To the 1st part add dilute sodium hydroxide solution drop wise until in excess.		
ii. To the 2nd part add dilute ammonia solution drop wise until in excess.		
iii. To the third part add 3 drops of lead (II) nitrate solution		
iv. To the 4th part add 3 drops of hydrochloric acid followed by 3 drops of barium nitrate solution.		
(c) Put the residue in a test tube and add $2cm^3$ of dilute hydrochloric acid. Divide the resulting solution into 2 parts.		
i. To the 1st part add dilute sodium hydroxide solution		

Mpangativicentmorgan8@gmail.com

drop wise until in excess.		
ii. To the 2nd part add dilute ammonia solution drop wise until in excess.		

(d) Identify the:

(i) Cation ………

(ii) Anion ………

Experiment 16

You are provided with substance A which contains one cation and one anion. You are required to identify the cation and anion in A. Carry out the required tests below and record your observations and deductions in the table below. Where a gas is evolved, it should be identified.

Tests	Observation	Deduction
(a) Note the physical appearance of substance A		

Mpangativicentmorgan8@gmail.com

(b) Heat a spatula end-full of A in a hard glass tube first gently and then more strongly until there's no further change.		
(c) Dissolve one spatula end full of A in about 5cm^3 of water. Divide the resultant solution into five portions		
(i) To the first portion, add dilute sodium hydroxide solution drop wise until in excess and heat. Hold a glass rod dipped in conc.HCl near the mouth of the tube.		
(ii) To the second portion, add dilute		

Mpangativicentmorgan8@gmail.com

ammonia solution drop wise until in excess.		
(iii) To the third portion, add lead (II) nitrate solution and heat		
(iv) To the fourth portion, add 2-3 drops of barium chloride solution followed by dilute hydrochloric acid.		
(v) To the fifth portion, add aqueous magnesium sulphate solution.		

Mpangativicentmorgan8@gmail.com

Identify the:

(i) Cation in A ……….

(ii) Anion in A……

Experiment 17

You are provided with substance T which contains one cation and one anion. You are required to identify the cation and anion in T. Carry out the required tests below and record your observations and deductions in the table below. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Note the physical appearance of substance T		
(b) Dissolve a spatula end full of T in about $5cm^3$ of water. Divide the resultant solution into five portions.		
i. To the 1^{st} portion, add dilute sodium hydroxide drop wise until in excess.		
ii. To the 2^{nd} portion, add aqueous potassium iodide solution.	.	
iii. To the 3^{rd} portion, carry out a test of your own choice to confirm the cation in T		

Mpangativicentmorgan8@gmail.com

iv. To the 4th portion, add 3 drops of lead (II) nitrate solution and heat.		
v. To the 5th portion, add 3 drops of barium nitrate solution		

Identify the

(i) Cation in T……………………………………………………………………………………….

(ii) Anion in T……………………………………………………………………………………….

Experiment 18

You are provided with substance M which contains one cation and one anion. Carry out the required tests below and record your observations and deductions in the table below. Where a gas is evolved, it should be tested and identified.

Tests	Observations	Deductions
(a) Heat a spatula end full of M in a boiling tube until no further change.		
(b) To 2 spatula end fulls of M in a test tube, add 5cm^3 of dilute nitric acid and shake to dissolve. Divide the resultant solution into 5 parts.		

Mpangativicentmorgan8@gmail.com

(i) To the 1st part, add dilute sodium hydroxide solution dropwise until in excess.		
(ii) To the 2nd part, add dilute ammonia solution dropwise until in excess.		
(iii) To the 3rd part, add $2cm^3$ of dilute hydrochloric acid. Heat and cool the mixture.		
(iv) To the 4th part, add 3 drops of aqueous silver nitrate solution followed by dilute nitric acid drpwise until in excess.		
(v) To the last part, carry out a test of your own choice to confirm the cation in M;		

Mpangativicentmorgan8@gmail.com

Identify; Cation……………………………………………………. Anion………………………………………………………………….

Experiment 19

You are provided with substance X, which contains two cations and one common anion. You are required to identify the cation and anion in X. Carry out the tests below and record your observations and deductions in the spaces provided. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Heat a spatula end full of X in a hard glass tube first gently and then strongly until there is no further change		
(b) To about one spatula of		

Mpangativicentmorgan8@gmail.com

X, add about 5cm^3 of water. Shake vigorously & filter. Keep both the filtrate and residue. Divide the filtrate into 4 parts.		
(i) To the 1st part, add dilute sodium hydroxide solution dropwise until in excess and heat.		
(ii) To the 2nd part, add 2-3 drops of lead (II) nitrate solution and heat.		
(iii) To the 3rd portion, add 2-3 drops of silver nitrate solution followed by dilute nitric acid.		
(c) Wash the residue and dissolve it in dilute nitric acid. Divide the resultant solution into 2		

Mpangativicentmorgan8@gmail.com

parts		
(i) To the 1st part, add dilute sodium hydroxide solution dropwise until in excess.		
(ii) To the 2nd part, add dilute ammonia solution until in excess.		
(iii) To the third part, add potassium iodide solution		

(d) Identify the;

(i) Cations in X...

(ii) Anion in X...

Mpangativicentmorgan8@gmail.com

Experiment 20

You are provided with substance W, which contains one cation and two common anions. You are required to identify the cation and anions in W. Carry out the tests below and record your observations and deductions in the spaces provided. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) To about one spatula end full of W, add about 5cm^3 of water, shake vigorously & filter. Keep both filtrate and residue. Divide the filtrate into 4 parts		
(i) To the first part, add dilute sodium hydroxide solution dropwise until in excess.		
(ii) To the second part, add dilute ammonia solution dropwise until in excess.		

Mpangativicentmorgan8@gmail.com

(iii) To the third part, add 3 drops of lead (II) nitrate solution and heat.		
(iv) Use the fourth part, to carry out a test of your own choice to confirm the anion in the filtrate. Test :		

Mpangativicentmorgan8@gmail.com

(b) Wash the residue and divide it into two parts (i) Transfer the first part of the residue into a boiling tube. Heat strongly until there's no further change.		
(ii) To the second part, add dilute nitric acid until in excess.		

Mpangativicentmorgan8@gmail.com

(c) Identify the;

(i) Cations in W…………………………………………………………………………………………………….

(ii) Anion in W……………………………………………………………………………………………………

Experiment 21

You are provided with substance L, which contains one cation and two common anions. You are required to identify the cation and anions in L. Carry out the tests below and record your observations and deductions in the spaces provided. Where a gas is evolved, it should be identified.

Tests	Observation	Deduction
(a) Heat a spatula end-full of L strongly in a dry boiling tube until no further change. Keep the residue.		
(b) Cool the residue from part (a) and add dilute nitric acid dropwise until the solid just dissolves . Divide the solution into two parts		

Mpangativicentmorgan8@gmail.com

(i) To the 1st part, add dilute sodium hydroxide solution dropwise until in excess.		
(ii) To the 2nd part, add dilute ammonia solution dropwise until in excess.		
(c) To a spatula end full of L, add dilute nitric acid dropwise until the solid just dissolves. Divides the solution into		

Mpangativicentmorgan8@gmail.com

(i) To the 1st part, add 2-3 drops of lead (II) nitrate solution and warm.		
(ii) Use the 2nd part of the solution to carry out a test of your own choice to confirm one of the anions in L. TEST		

(d) Identify the;

(i) Cation in L……………………………………………………………………………………………………

(ii) Anions in L…………………………………………………………………………………………………….

Mpangativicentmorgan8@gmail.com

Experiment 22

You are provided with substance Q, which contains two cations and two anions. You are required to identify the cations and anions in Q. Carry out the tests below and record your observations and deductions in the spaces provided. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Heat a spatula end full of Q strongly. Allow to cool and shake the residue with little water.		
(b) Dissolve 3 spatula end fulls of Q in about $5cm^3$ of water. (c) Filter and keep both the filtrate and residue. Divide the filtrate into 4 parts.		
(i) To the first part, add dilute sodium hydroxide solution		

Mpangativicentmorgan8@gmail.com

dropwise until in excess		
(ii) To the second part, add dilute ammonia solution dropwise until in excess.		
(iii) To the third part, add 2-3 drops of lead (II) nitrate. Heat the mixture and allow it to cool.		
(iv) Use the fourth part to carry out a test of our own choice to confirm the anion in Q.		
(d) Wash the residue and dissolve it in dilute hydrochloric acid. Heat the mixture until all the solid has dissolved. Divide the resultant solution into 3 parts		

Mpangativicentmorgan8@gmail.com

(i) To the first part, add dilute sodium hydroxide solution dropwise until in excess.		
(ii) To the second part add dilute ammonia solution dropwise until in excess.		
(iii) To the third part, add a half spatula end full of zinc powder and warm the mixture.		

(e) Identify the;

Mpangativicentmorgan8@gmail.com

(i) Cations ……

(ii) Anions ……

(f) Write an ionic equation for the reaction that takes place in c(iii)

………

………

………

………

Experiment 23

You are provided with substance Y, which contains two cations and two anions. You are required to identify the cations and anions in Y. Carry out the tests below and record your observations and deductions in the spaces provided. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Heat a spatula end full of Y, first gently and then strongly until there is no further change		
(b) Dissolve 2 spatula end fulls of Y in about 5cm^3 of water in a boiling tube, shake and filter. Keep both the filtrate and residue. Divide the		

Mpangativicentmorgan8@gmail.com

filtrate into four parts. (i) To the first part of acidified filtrate, add sodium hydroxide solution dropwise until in excess.		
(ii) To the second part of acidified filtrate, add dilute ammonia solution dropwise until in excess.		
(iii) To the third part of the filtrate, add 3 drops of potassium iodide solution.		
(iv) To the fourth part, add 2-3 drops of lead (II) nitrate solution and warm.		
(v) Use the fifth part to carry out a test of your own choice to confirm the second anion in Y		
(c) Wash the residue with		

Mpangativicentmorgan8@gmail.com

water. Heat a small portion of the residue strongly in a dry test tube.		
(d) Dissolve the washed residue in hydrochloric acid. Divide the resultant solution into three parts. (i) To the first part, add dilute sodium hydroxide solution dropwise until in excess		
(ii) To the second part of the solution, add dilute ammonia solution dropwise until in excess.		
(iii) To the third part of the solution, add 2-3 drops of		

Mpangativicentmorgan8@gmail.com

potassium iodide solution.		

Identify the;

(i) Cations in Y…….

(ii) Anions in Y…….

Experiment 24

You are provided with substance S, which contains three cations and one common anion. You are required to identify the cations and anions in S. Carry out the tests below and record your observations and deductions in the spaces provided. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Heat a spatula end full of S strongly in a dry test tube until no further change		
(b) Dissolve two spatula end fulls of S in about $5cm^3$ of water. (i) To the first part, add 2-3 drops of lead (II)		

Mpangativicentmorgan8@gmail.com

nitrate solution		
(ii) Use the second part to carry out a test of your own choice to confirm the anion Test;		
(c) To the rest of the solution in (b), add dilute sodium hydroxide solution dropwise until there is no further change and filter. Keep both filtrate and residue		
(d) Add dilute hydrochloric acid drop wise to the filtrate until it is just acidic. Divide the resultant solution into 3 parts. (i) To the first part, add dilute sodium		

Mpangativicentmorgan8@gmail.com

hydroxide solution drop wise until in excess.		
(ii) To the second part add dilute ammonia solution drop wise until in excess.		
(iii) To the third part, add 2-3 drops of potassium iodide solution.		
(e) Put the residue in a test tube and add 2cm^3 of dilute hydrochloric acid. Divide the resultant solution into two parts.		
(i) To the first part, add dilute sodium hydroxide solution dropwise until in excess.		

Mpangativicentmorgan8@gmail.com

(ii) To the second part, add dilute ammonia solution dropwise until in excess.		

Identify the;

(i) Cations ………

(ii) Common anion ……

Experiment 25

You are provided with substance P, which contains three cations and one common anion. You are required to identify the cations and anions in P. Carry out the tests below and record your observations and deductions in the spaces provided. Where a gas is evolved, it should be identified.

Tests	Observations	Deductions
(a) Heat a spatula end full of P strongly in a dry test tube until no further change		
(b) Dissolve two spatula end fulls of P in about $5cm^3$ of water.		

Mpangativicentmorgan8@gmail.com

(i) To the first part, add 2-3 drops of lead (II) nitrate solution		
(ii) Use the second part to carry out a test of your own choice to confirm the anion Test;		
(iii) To the third part, add dilute sodium hydroxide solution dropwise until in excess and warm.		
(iv) To the fourth part, add dilute ammonia solution dropwise until in excess.		

Mpangativicentmorgan8@gmail.com

(v) To the fifth part, add 2-3 drops of potassium iodide solution.		

Identify the;

(i) Cations ……

(ii) Anions ……

Mpangativicentmorgan8@gmail.com