PRACTICAL 1101

CONFIDENTIAL

ACCESS TO:-

- ***1M NaOH***
- ***1M NH_4OH***
- ***1M HCL***
- ***0.01m PB $(NO_3)_2$***
- ***Source of heat***
- ***pH chart (PH=1 to 14)***
- ***10ml of solution K***
- ***Sodium hydrogen carbonate***

PREPARATION OF SOLUTIONS:

1. Solution J

Dissolve 17g of ammonium iron (II) sulphate in 50cm^3 of 2M H_2SO_4 dilute to 1dm^3

2. Solution K $KMnO_4$

Dissolve 1.6g of potassium manganate vii in 20cm^3 of 2 MH_2SO_4 dilute to 1dm^3

3. Solution R

Dissolve 40g of sodium thiosulphate in 1dm^3 of solution

4. Solution S

Dissolve 172cm^3 of concentrated hydrochloric acid in 1dm^3 of solution

5. Solid Y is aluminium sulphate

6. Solid Z is oxalic acid.

Each candidate will require:

Q1.

1. ***Solution J - 100cm^3***
2. ***Burette***
3. ***Solution K- 100cm^3***
4. ***Pipette***
5. ***2 conical flasks***
6. ***Filter funnel***
7. ***Retort stand***

1. **You are provided with**:

Solution J:xM ammonium iron(II)sulphate solution

Solution **K: 0.02M** potassium manganate (VII)solution

You are required to determine:

-The molarity, **x** of the ammonium iron (II) sulphate

- The amount of water of crystallisation, **N** in ammonium iron (II) sulphate

-The formula mass of ammonium iron (II)sulphate.

Procedure

The ammonium iron (II) sulphate, $(NH_4)_2SO_4FeSO_4nH_2O$ solution provided was made by dissolving 8.5g of the salt in 50.0cm^3 of dilute sulphuric(VI)acid, then making the solution to 250cm^3 using distilled water.

Fill the burette with solution **K.** Pipette 25cm^3 of solution **J** and release into a conical flask. Titrate **J** against **K** until the solution becomes permanent pink. Repeat two more times and complete the table below;-

Table 1

	I	II	III
Final burrete racing (cm^3)			
Final burrete reading (cm^3)			
Volume of Solution **K** used (cm^3)			

a) Calculate the average volume of solution **K** used

b) The number of moles of solution **K** reacting

c) Given that equation for the reaction is:

$$MnO^-_{4(aq)} + 8H^+_{(aq)} + 5Fe^{2+}_{(aq)} \longrightarrow Mn^{2+}_{(aq)} + 5\,Fe^{2+}_{(aq)} + 4H_2O_{(l)}$$

Determine:

i) The number of moles of iron (II) salt solution **J** in $25cm^3$ of the solution used

ii) The molarity of solution **J**

iii) The concentration of solution **J** in grams per litre

d) From your results in **C** (iii) above, determine:

i) the value of "**n**" in the formula $(NH_4)_2SO_4FeSO_4\mathbf{n}H_2O$.
(N=14, H= 1, S=32, O=16, Fe=56)

ii) Correct formula of the iron (II) salt

iii) The formula mass of the iron (II) salt

Q2.

1. $120cm^3$ of solution **R**
2. $80cm^3$ of solutions
3. $250cm^3$ of tap water
4. 25ml or 50ml measuring cylinder
5. $100cm^3$ glass beaker
6 5 x 5cm piece of white paper
7. Stop watch or clock.

2. ***You are provided with:***

i) Sodium thiosulphate containing $40g/dm^3$ solution **R**

ii) 2M hydrochloric acid solution **S**

You are to determine the rate of reaction between solution S and the thiosulphate

Procedure:

Measure $20cm^3$ of solution **R** into an empty $100cm^3$ breaker. Place it on a mark '**X**' on a white plain paper. Measure another $20cm^3$ of solution **S**. add into **R** and start off the stop watch. Then record the time taken for the mark '**X**' to become invisible from above. Repeat the procedure by measuring $17.5cm^3$ of solution **S** and adding $2.5cm^3$ of water and complete the table;-

Table 2

Experiment	**1**	**2**	**3**	**4**	**5**
Volume of solution **R** cm^3	20	20	20	20	20
Volume of solution **S** cm^3	20	17.5	15	12.5	10
Volume of water (cm^3)	0	2.5	5.0	7.5	10
Time taken for **x** to become invisible(seconds)					
1/time (Sec^{-1})					

a) Draw a graph of reciprocal time ($^1/_t$) against volume of solution S

b) Explain the shape of the graph

c) From the graph determine the time taken for the cross '**X**' to be invisible at $16.5cm^3$ of solution **S Q3.**

1. Solid **Y**-1spatulaful

2. Solid **Z**-1spatulaful
3. 6 test tubes
4. 1 red + 1blue litmus papers
5. Metallic spatula
6. pH paper

3. You are provided with solid **Y** and **Z** to carry out the tests below. Write your observations and inferences in the spaces provided:-

a) i) Place all solid **Y** in a clean test tube. Add 10cm^3 of distilled water and shake. Divide the solution in **a (i)** above into 4 portions

ii) To the first portion add sodium hydroxide dropwise until in excess

iii) To the second portion add aqueous ammonia dropwise until in excess

iv) To the third portion add 5 drops of dilute hydrochloric acid

v) To the fourth portion add 3 drops of lead (II) nitrate solution

b) i) Scoop a little solid **Z** on a metallic spatula and heat it over a bunsen flame

ii) Add all the remaining solid to 10cm^3 of distilled water in a test tube and shake. Divide the solution into 3portions

iii)to the first portion dip a pH indicator paper

iv) to the second portion add 3 drops of acidified potassium permanganate warm gently

KKC*

v)to the third portion add ½ spatula full of sodium hydrogen carbonate

PRACTICAL 1102

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INSTRUCTIONS.

Apart from the normal fittings in the laboratory, each candidate will need the following chemicals and apparatus.

1. ***500ml of distilled water supplied in a wash bottle***
2. ***50ml burette***
3. ***25ml***
4. ***a pipette filler***
5. ***2 conical flasks (250ml)***
6. ***Source of heat (means of heating)***
7. ***Stop watch/clock***
8. ***A ruler***
9. ***100ml measuring cylinder***
10. ***50ml measuring cylinder***
11. ***Complete retort stand***
12. ***12cm long magnesium ribbon labelled C***
13. ***100ml of solution A (sulphuric acid)***
14. ***80ml of solution B (Sodium hydroxide soltn.)***
15. ***100ml empty beaker***
16. ***Funnel***
17. ***Sand paper***
18. ***3g of solid E***
19. ***1g of solid F***
20. ***Means of labeling***

21. ***Six clean test tubes in a test tube rack***
22. ***3 boiling tubes in a rack***
23. ***Metallic spatula***
24. ***About 0.2g of sodium hydrogen carbonate***
25. ***Glass rod.***

Access

1. ***2M Ammonia solution supplied with a dropper***
2. ***2M Sodium hydroxide solution supplied with a dropper***
3. ***2M Lead (II) Nitrate supplied with a dropper***
4. ***0.2M Silver Nitrate solution supplied with a dropper***
5. ***Acidified potassium dichromate (VI) supplied with a dropper***
6. ***Acidified Potassium Manganate (VII) supplied with dropper***

N/B

1. ***Solution A is prepared by accurately measuring 27.5cm^3 of concentrated Sulphuric acid, then adding it to 700ml of distilled water then topping it to one litre. Density of acid 1.84g/cm^3***
2. ***Solution B is prepared by accurately measuring 20g of NaOH pellets and dissolving it in 800cm^3 of distilled water then topping to one litre with distilled water.***
3. ***Solid E and F will be provided by the council. Solid E is highly deliquescent and should be handled cautiously***

QUESTION 1.

You are provided with:

- Sulphuric acid solution A
- 0.5M sodium hydroxide solution B
- Magnessium ribbon labelled C

You are required to:-

- Investigate the rate of reaction between solution A and metal C
- Determine the concentration of sulphuric acid in moles per litre

Procedure I

(i) Using a ruler, make 6 marks at 2cm length interval on the Magnesium ribbon provided.

(ii) Transfer 50cm^3 of acid solution using a measuring cylinder into a clean dry 100ml beaker. Place 2cm length piece of magnesium ribbon into the beaker with the acid and immediately start the stop watch/clock. Shake gently and note the time taken for the piece of magnesium ribbon to react completely.

(iii) Record in table I below. Place another piece of magnesium ribbon (2cm) to the same solution and again note the time taken.

(iv) Repeat the procedure until all six pieces of magnesium ribbon have reacted with the same solution initially placed in the beaker

(v) Complete the table I below:

Note: Keep the solution obtained in this experiment for use in procedure II

(a) Table I

Piece of magnesium added	1	2	3	4	5	6
Length of magnesium added (cm)	2	4	6	8	10	12
Time taken t(second)						
Reciprocal of time $^1/_{t}{}^{(s-1)}$						

(b) (i) Plot a graph of total length of magnesium ribbon added against reciprocal of time ($^{1/}_{t}$)

for the reaction to go to completion

(ii) From your graph, determine the time taken when 4.5cm length of magnesium ribbon reacts completely. (Show parts on the graph)

(iii) Write a chemical equation for the reaction between magnesium and sulphuric acid

(iv) Given that the mass of solid V, which reacted was 0.12g and that atomic mass of magnesium is 24.0g, determine the number of mole of sulphuric acid that were used up during the reaction

(v) From your graph, state and explain the relationship between the length of magnesium ribbon and the reciprocal of time ($^1/_t$)

Procedure II

Place all the solution obtained in procedure I in a clean 100ml measuring cylinder. Add distilled water to make 100cm^3 of solution. Transfer all the solution into a beaker and shake well. Label it solution D. Fill the burette with solution B. Pipette 25.0cm^3 of solution D into a conical flask. Add 2-3drops of phenolphthalein indicator and titrate with solution. Record your results in the table II below. Repeat the titration two more times

(f) Table II

Titration	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution B (cm^3) used			

(c) (i) Determine the average volume of solution B used

(ii) Calculate the number of moles of sodium hydroxide solution B used

(d) Calculate:

(i) The number of moles of sulphuric acid in 25.0cm^3 of solution D

(ii) The number of moles of sulphuric acid in 100cm^3 of solution D

(e) Determine the total number of moles of sulphuric acid in 50cm^3 of solution A

(f) Calculate the concentration of the original sulphuric acid solution A in moles per litre

2. You are provided with solid E. Carry out the following tests and write your observations and inferences in the table below:

(a) Place all the solid E in a boiling tube. Add about 15cm^3 of distilled water and shake vigorously for about 2 minutes

b) (i) divide the solution into five equal portions in five different clean test tubes.

(i) To the first portion, add 2M ammonia solution drop wise until in excess

ii) To the second portion add 2M Sodium hydroxide solution drop wise until in excess

iii) To the third portion add 4 drops of 2M Lead (II) nitrate solution

iv) To the fourth portion, add 4 drops of 0.2M silver nitrate solution, then add 2M ammonia solution drop wise, until in excess

(v) Clean one end of the glass rod provided. Dip the clean end of the glass rod in the fifth portion.

Remove the end and heat it in the non-luminous part of a Bunsen burner flame. Note the colour of the flame and record below:-

3. You are provided with solid F. Carry out the tests below. Write your observations and inferences in the spaces provided

(a) Place about a half of solid F on a metallic spatula and burn it using a Bunsen burner flame

(b) Place the remaining of solid F in a boiling tube. Add about 10cm3of distilled water and shake the mixture well.

(c) (i) Divide the mixture obtained into three portions.
(ii) To the first portion, add a small amount of solid sodium hydrogen carbonate
(iii) To the second portion, add about 1cm^3 of acidified potassium dichromate (VI) and warm
(iv) To the third portion, add two drops of acidified potassium magnate (VII)

PRACTICAL 1103

CONFIDENTIAL
INSTRUCTIONS
Each candidate should be provided with:

- ***About 1g of malleic acid – solid P***
- ***A clean metallic spatula***
- ***Bunsen burner***
- ***500ml distilled water in a wash bottle***
- ***Six test-tubes in a rack***
- ***One test tube holder***
- ***2 boiling tubes***
- ***About 1g of $AlCl_3$ – solid M***
- ***One blue and one red litmus paper***
- ***One volumetric flask (250ml)***
- ***One pipette 25cm^3***
- ***One pipette filter***
- ***One label***
- ***Solid G – oxalic acid (exactly 3g) in a stoppered container***
- ***50ml or 100ml measuring cylinder***
- ***100cm^3 beaker***
- ***One thermometer***
- ***One stopwatch/clock***
- ***About 0.2g $NaHCO_3$ solid***
- ***100ml of solution H***
- ***One burette (50ml)***
- ***2 conical flasks***

Access to:-

- ***0.2M $Pb(NO_3)$ Solution supplied with a dropper***
- ***0.2M $Ba(NO_3)_2$ Solution supplied with a dropper***
- ***0.1M KI Solution supplied with a dropper***
- ***2M NaOH Solution supplied with a dropper***
- ***2M $NH_{3(aq)}$ Solution supplied with a dropper***
- ***Acidified $K_2CV_2O_7$ Solution supplied with a dropper***

Preparation instruction
- Dissolve 6.4g of $KMnO_4$ in 400cm^3 2M H_2SO_4 and top to 1litre using distilled water

1. ***You are provided with:***
   - 0.0238 Moles (equivalent to 3g) of solid **G**
   - Solution **H**, 0.04M acidified potassium manganate (VII)

   You are required to:
   I. Determine the enthalpy of solution of solid **G**
   II. The number of moles of water of crystallization in solid **G**

Procedure I:-

Using a measuring cylinder place 50cm^3 of distilled water into a 100cm^3 of beaker.
Stir the water gently with a thermometer and take its temperature after every half-minute.
Record the reading in table I below. At exactly two minutes, add all solid **G** to the water at once. Stir well and take the temperature of the mixture after every half minute up to the fourth minute. Record your results in table I. Keep the solutions for procedure II below:

Table I

(a)

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4
Temperature (^oC)					**X**				

(b) On the grid provided, plot a graph of time (x-axis) against temperature

(c) (i) On the graph, show the change in temperature ΔT

(ii) Calculate :

The molar enthalpy of solution (ΔH solution)

(Assume density of solution = 1g/cm^3 and show the sign of ΔH solution specific heat capacity of solution = 4.2jg^{-1}k^{-1})

Procedure II

Transfer the contents of the beaker into a 250ml volumetric flask. Rinse both the beaker and the thermometer with distilled water and add to the volumetric flask. Add more distilled water to eh mark.

Label this solution **G**

Fill the burette with solution **H**

Using a pipette and pipette filter, place 25.0cm^3 of solution **G** into a conical flask. Warm the mixture to about 60^{o}C. Titrate the hot solution **G** with solution H until a permanent pink colour persists (while shaking). Record your readings in table 2. Repeat the titration two more times and complete table 2

Table 2.

Titre	**I**	**II**	**III**
Final burette reading			
Initial burette reading			
Volume of solution **H** used (cm^3)			

(e) **Calculate the**:

1. Average volume of **H** used

II. Number of moles of potassium manganate VII used

III. Number of moles of **G** in 25cm^3 solution **G** given that 2moles of potassium manganate (VII) reacted completely with 5moles of **G**

IV. Relative formula mass of **G**

(f) Formula of **G** has the form G**.** XH_2 Determine the value of **X** in the formula given the relative formula mass for **G** is 90.0 and atomic mass of Oxygen is16 and that of Hydrogen is 1.0

2. You are provided with solid **M** and carry out the tests below write your observations and inferences in the spaces

(i) To a dry boiling tube, place all solid **M** and add 12cm^3 of distilled water and use the solution for the tests below:-

(ii) To 2cm^3 of solution, add both litmus papers

(iii) To 2cm^3 of solution, add aqueous sodium hydroxide drop wise until excess

(iv) To 2cm^3 of solution, add aqueous ammonia drop wise until in excess

(v) To $2cm^3$ of the solution, add 2 drops of aqueous potassium iodide
(vi) To $2cm^3$ of solution, add 3 drops of aqueous lead (ii)nitrate
(vii) To $2cm^3$ of solution, add 3 drops of aqueous Barium nitrate solution

2. B. You are provided with solid **P**. Carry out the test below. Write your observations and inferences in the spaces provided:-
(a) Place one third of solid **P** on a metallic spatula and burn it using a Bunsen burner
(b) Place the remaining of solid **P** in a test-tube . Add about $6cm^3$ of distilled water and shake the mixture (retain the mixture for use in test **(c)**
(c) (i) To $2cm^3$ of the mixture in **(b)** above add a spatula end full of $NaHCO_3$ solid
(ii) To $2cm^3$ of the mixture, add $2cm^3$ of acidified potassium dichromate (VI) and warm
(iii) To $2cm^3$ of the mixture add two drops of acidified potassium manganese (VII) and shake well

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Requirements:

In addition to the equipment, apparatus and chemical found in the chemistry laboratory each candidate will require the following:

- ***About 100cm³ of solution L***
- ***About 100cm³ of solution N***
- ***A burette***
- ***A pipette***
- ***3 conical flasks***
- ***4.0g of solid K***
- ***Thermometer***
- ***Distilled water***
- ***Test tube holder***
- ***3 boiling tubes***
- ***Phenolphthalein indicator***
- ***Filter paper***
- ***Filter funnel***
- ***Source of heat***
- ***1g of solid x***
- ***10ml measuring cylinder***
- ***2M HNO3***
- ***Seven test tubes***
- ***Stirring rod***
- ***2M NaOH***
- ***2M NH_4OH***
- ***2M HCL***
- ***0.5M lead (II) nitrate***
- ***0.5M barium chloride***

NOTES

-Solution L is prepared by dissolving 5g of NaOH in a litre of distilled water
-Solution N is prepared by dissolving 9.84g of $C_2H_2O_4.2H_2O$ in a litre of distilled water (oxalic acid)
-Solid K is potassium chlorate
-Solid X is a mixture of copper (II) oxide and zinc sulphate in the ratio 1:1

1. **You are provided with**:-

(i) Solution **L** containing 5g per litre of sodium hydroxide
(ii) Solution **N** containing 9.84g per litre of oxalic crystals of formula $C_2H_2O_4$.X H_2O
(iii) You are required to determine the number of moles of water of crystallization X in one mole of oxalic acid ($C_2H_2O_4$. XH_2O)
(iv) You are required to determine the number of moles of water of crystallization X; in one mole of oxalic acid (C_2H_2O4. XH_2O)

Procedure

(i) Fill the burette with solution **N**.
(ii) Pipette 25cm^3 of solution **L** into 250cm^3 conical flask and add 2 drops of phenolphthalein indicator to it and titrate with solution **N**.
(iii) Record your results in the table below
(iv) Repeat the experiment twice to obtain consistent readings and complete the table

Table 1

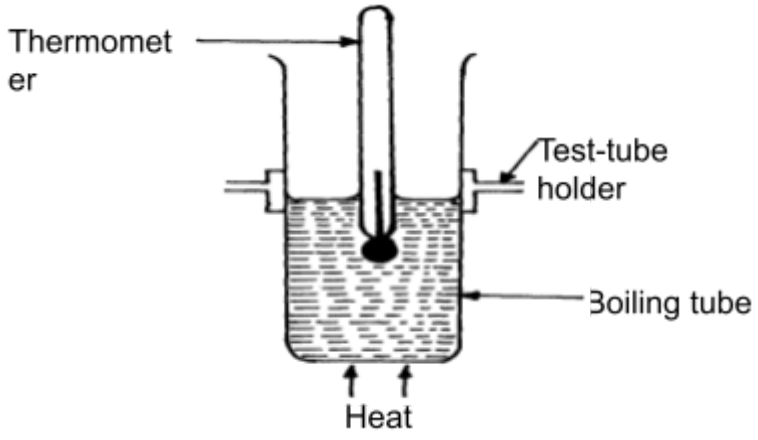
Titration	**1**	**2**	**3**
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution **N** used (cm^3)			

(a) Calculate the average volume of solution **N** used
(b) Determine:-
(i) The concentration of sodium hydroxide in one litre of solution **L**
(Na =23, O= 16, H= 1)
(ii) Write the equation of the reaction taking place
(iii) The number of moles of anhydrous carbohydrates oxalic acid in one litre of the solution **N**
(iv) The relative formula mass of anhydrous oxalic acid, solution **N** (C = 12, H=1, O = 16)
(v) The number of moles of water of crystallization in one mole of oxalic acid

2. You are provided with solid **K**, a boiling tube and a thermometer. You are required to determine the solubilities of solid **K**, at various temperatures.

Procedure:-

(a) Carefully transfer all the 4.0g of solid **K** into a clean boiling tube and add 10cm^3 of distilled water from a burette.
(b) Heat the boiling tube and its contents gently with shaking until all the solid dissolves. (Do not spill the solution during heating.) Stop heating when all the solid dissolves. See the diagram below:-



(c) Gently stir the solution using the thermometer and record the temperature at which crystals appear. (The crystals appear as small shining particles)

(d) Using a burette add 2.5cm^3 of water to the solution and heat until all the solid dissolves. Repeat procedure**(c)**

(e) Repeat the experiment each time adding 2.5cm^3 of distilled water from a burette. Record the results in the table below:-

Total volume of water (cm^3)	10.00	12.50	15.00	17.50	20.00	22.50
Mass of solid K (g)	4.00	4.00	4.00	4.00	4.00	4.00
Solubility of K in g/100g of water	40.00			22.90		17.78
Temperature at which crystals appear (^oC)						

(i) Complete the table by filling in the row for solubility of **K** and temperature at which crystals appear

(ii) On the grid provided, draw the graph of solubility of **K** versus temperature

(iii) At which temperature is solubility 24/100g of water?

(iv) If a solution containing 30g of **K** at 85^{o}C is cooled to 60^{o}C

(a) At which temperature will crystals first appear?

(b) What would be the total mass of the crystals obtained when the solution finally cools to 60^{o}C

(c) What is the solubility of **K** at 75^{o}C

3. You are provided with solid **X** which is a mixture of two solids. Carry out the following tests to identify the cations and anions present in the mixture.

(a) Add about 10cm^3 of water, stir and then filter. Keep both the residue and the filtrate for further reactions.

(b) Place the residue in a boiling tube and add dilute nitric acid and warm. Divide the solution into two portions

(c) To the 1st portion add $NaOH_{(aq)}$ till in excess

(d) To the 2nd portion add aqueous ammonia till in excess

(e) Divide the filtrate into 5 portions. To the 1st portion add dilute HCl

(f) To the 2nd portion add lead (II) Nitrate solution

(g) To the third portion add Barium Chloride solution

(h) To the 4th portion add sodium hydroxide solution till in excess

(i) To the 5th portion add aqueous ammonia till in excess

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IDENTITIES OF SOLIDS

M- Potassium manganate (VII) crystals, $KMnO_4$

N – Ammonium Ferous sulphate hexahydrate, $(NHa)_2 .Fe(SO_4)_2. 6H_2O$

S – Oxalic acid $H_2C_2O_4.2H_2O$

Q- Hydrated Barium Chloride, $BaCl_2. 2H_2O$

R- Oxalic acid

Note: S and R are the same substances

INSTRUCTIONS

In addition to the apparatus and chemicals found in the chemistry laboratory, each candidate will require the following:

1. ***150cm^3 of solution M***
2. ***100cm^3 of solution N***
3. ***100cm^3 of solution S***
4. ***One 50cm^3 burette***
5. ***One 25cm^3 pipette and pipette filter***
6. ***One thermometer (-10^{o}C – 110^{o}C)***
7. ***One filter funnel***
8. ***Two conical flasks***
9. ***Tripod stand and wire gauze***
10. ***Source of heat***
11. ***8 clean dry test tubes in a rack***
12. ***2 boiling tubes***
13. ***1 metallic spatula***
14. ***250ml of distilled water in a wash bottle***
15. ***About 1g of solid R***
16. ***About 1g of solid Q***
17. ***1 red and 1 blue litmus paper***

<u>Access to:</u>

1) ***2M NaOH supplied with a dropper***
2) ***0.5M Na_2SO_4 supplied with a dropper***
3) ***0.1M $Pb(NO_3)_2$ supplied with a dropper***
4) ***Methyl orange indicator***
5) ***0.5M Ba(NO3)2 supplied with a dropper***

<u>Notes:</u>

1. ***Solution M is prepared by dissolving 3.16g of solid M in 400cm^3 of 2M H_2SO_4 and making it up to 1 litre of solution with distilled water.***
2. ***Solution N is prepared by dissolving 23.5g of solid N in 200cm^3 of 2M H_2SO_4 and making it up to 1 litre of solution with distilled water.***
3. ***Solution S is prepared by dissolving 5g S in 600cm^3 of distilled water and making it up to 1 litre of solution with distilled water***

6) ***QUESTION 1***

You are provided with:

- Acidified aqueous Potassium manganate (VII) $KMnO_4$, solution M(to be used also in question 3).
- Solution N, containing 23.5g of ammonium iron (II) sulphate, $(NH_4)_2 Fe(SO_4)_2 . 6H_2O$, per litre.
- Solution S, containing 5.0g of a dibasic acid, H2X.2H2O per litre

You are required to:-

1. Standardize the potassium manganate (VII), solution M, using the ammonium
- iron (II) sulphate, solution N.

- Use the standardized potassium manganate (VII), solution M to determine the concentration of the dibasic acid $H_2 X•2H_2O$, solutions S and then the formula mass of X.

Procedure I

Fill the burette with solution M.
Pipette 25.0cm3 of solution N into a conical flask. Titrate solution N with solution M until a permanent pink colour just appears. Record your results in table I below.
Repeat this procedure to complete table I

(a) Table I

	I	II	III
Final burette reading (cm3)			
Initial burette reading (cm3)			
Volume of solution M used (cm3)			

(b) Determine the average volume of solution M used,

(c) Calculate the concentration of the ammonium iron (II) sulphate, solution N, in moles per litre. (RFM of $(NH_4)_2\ Fe(SO_4)_2\ .6H_2O = 392$)

(d) Calculate the number of moles of iron (II) ions in the $25.0cm^3$ of solution N

(e) Using the ionic equation for the reaction between manganate (VII) and iron (II) ions, given below, calculate the concentration of manganate (VII) in solution M in moles per litre.

$$MnO^-_{4\,(aq)} + 5Fe^{2+}_{(aq)} + 8H^+_{(aq)} \longrightarrow Mn^{2+}_{(aq)} + 5Fe^{3+}_{(aq)} + 4H_2O_{(l)}$$

Procedure II

Pipette $25.0cm^3$ of solution S into a conical flask. Heat this solution to about 70^oC and titrate the hot solution S with solution M until a permanent pink colour just appears. Shake thoroughly during the titration. Record your results in table II. Repeat this procedure to complete the table II

(f) Table II

	I	II	III
Final burette reading (cm3)			
Initial burette reading (cm3)			
Volume of solution M (cm3)			

(g) Record the average volume of solution M used (show how you arrive at the answer)

V_2=……

(h) Calculate the number of moles of the manganate (VII) ions in volume V_2

(i) Given that 2 moles of the manganate (VII) ions react with 5 moles of the dibasic acid, $H_2X{\bullet}2H_2O$, calculate the number of moles of the dibasic acid, $H_2X\ .\ 2H_2O$ in $25cm^3$ of solution S

(j) Calculate the concentration of the dibasic acid $H_2X\ .\ 2H_2O$, in moles per litre

(k) Calculate the formula mass of X in the dibasic acid, $H_2X\ .\ 2H_2O$. (H= 1.0, O = 16.0

2. You are provided with solid Q. Carry out the following tests and write your observations and inferences in the spaces provided

(a) Place about one-half of solid Q in a dry test tube. Heat strongly and test any gas produced using litmus papers

b) Place the remaining solid Q in a boiling tube. Add about $10cm^3$ of distilled water and shake well.

i) To about $2cm^3$ of the solution in a test tube add sodium hydroxide solution till in excess

ii) To about $2cm^3$ of solution Q in a test tube add about $2cm^3$ of 0.5M sodium sulphate solution

iii) To about $2cm^3$ of solution Q in a test tube, add about 4cm3 of barium nitrate solution

(iv) To about $2cm^3$ of solution Q in a test tube, add 3 drops of lead (II) nitrate solution and heat the mixture to boiling

3. You are provided with solid R. Carry out the following tests and write your observations and inferences in the spaces provided

(a) Place a little of solid **R** in a clean metallic spatula and ignite with a bunsen flame

(b) Place all the remaining solid R in a boiling tube. Add about 6cm^3 of distilled water and shake well. Use 2cm^3 portions to carry out the test below:

(i) Add 2cm^3 of solution obtained by diluting 1cm^3 of solution M with 5cm^3 of distilled water to 2cm^3 of solution R.

(ii) Add 3 drops of methyl orange to 2cm^3 of solution R

PRACTICAL 1106

CONFIDENTIAL

INSTUCTIONS.

In addition to the apparatus and fittings found in the laboratory each candidate should have:

1. ***One 25ml pipette***
2. ***One 3-way pipette filler***
3. ***One 0-50m/s Burrette***
4. ***Two 250m/s conical flask***
5. ***One 100ml measuring cylinder***
6. ***One 100ml glass beaker***
7. ***One thermometer (-10^{o}C to 110^{o}C)***
8. ***One stop watch / clock***
9. ***One label***
10. ***One 10m/s measuring cylinder***
11. ***White tile***
12. ***250ml beaker***
13. ***Stand and clamp***
14. ***10cm^3 of solution A***
15. ***80cm^3 of solution B***
16. ***160cm^3 of solution C***
17. ***200cm^3 distilled water supplied in wash bottle***
18. ***10cm^3 Potassium manganate***
19. ***250cm^3 1.0M sulphuric acid***
20. ***75cm^3 of solution X***
21. ***About 0.5g of solid K***
22. ***About 0.5g of solid F***
23. ***One blue and one red litmus papers***
24. ***One metallic spatula***
25. ***Six dry and clean test-tubes***
26. ***One boiling tube***
27. ***About 0.5g Sodium hydrogen carbonate***

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3. ***Solution Q (aqueous sodium sulphate) supplied with a dropper***
4. ***Acidified lead II nitrate supplied with a dropper***
5. ***Ethanol***
6. ***Conc. H_2SO_4***

NOTE:

1. ***Solution A is 4.0m hcl***
2. ***Solution B is 0.1m $H_2C_2O_4.2H_2O$***
3. ***Solution C is 0.2m NaOH***
4. ***Solution X is made by dissolving 5g of sugar (sucrose) in 100m/s distilled water***
5. ***Potassium Manganate (VII) solution D is made by dissolving 3.16g of the solid in 600cm^3 of distilled water and diluting to 1 litre.***
6. ***Solid K is Zinc chloride***
7. ***Solid F is oxalic acid***

Question 1

You are provided with:

- Aqueous Hydrochloric acid solution **A**
- Solution **B** containing 6.3g of dibasic acid, $H_2C_2O_42H_2O$ in 500cm^3 of solution.
- Aqueous sodium hydroxide solution **C**
- Phenolphthalein indicator

You are required to:

(a) Standardize the sodium hydroxide solution **C**

(b) Use the standardized solution **C** to determine the concentration of solution **A**

Procedure 1

- Fill the burette with solution **B**
- Using a pipette and pipette filler, place 25.0cm^3 of solution **C** into a 250ml conical flask.
- Add 2-3 drops of Phenolphthalein indicator
- Titrate solution **B** against solution **C**
- Repeat the procedure and complete table 1 below:

Table 1

	I	**II**	**III**
Final burette readings (cm^3)			
Initial burette readings (cm^3)			
Volume of solution **B** used (cm^3)			

(a) Calculate the average volume of solution **B** used

(b) Calculate the concentration of the dibasic acid (C = 12, H = 1, O = 16)

(c) Calculate the molarity of solution **C**

Procedure 2

- Using a 100cm^3 measuring cylinder, measure 90cm^3 of distilled water and place it into a 250cm^3 beaker.
- Add 10cm^3 of aqueous hydrochloric acid solution **A**
- Using a 10cm^3 measuring cylinder, mix the solution well and label it solution **D**
- Fill a burette with solution **D**.
- Pipette 25.0cm^3 of the solution **C** into a 250cm^3 conical flask
- Titrate using phenolphthalein indicator

Record your results in table 2

Table 2

	I	**II**	**III**
Final burette readings (cm^3)			

Initial burette readings (cm^3)			
Volume of solution **D** used (cm^3)			

(a) Calculate the average volume of solution **D** used
(b) How many moles of hydrochloric acid were present in $100cm^3$ of solution **D**
(c) Calculate the molarity of the original solution **A** used

Question 2

You are provided with:

- 1.0M sulphuric acid
- Potassium manganate (VII) solution D
- Aqueous glucose, solution **X**

You are required to:

Determine the rate of reaction between acidified potassium manganate (VII) and aqueous glucose at different temperatures.

Procedure

- Place $2cm^3$ of solution **D** into a 250ml beaker. Using a 100ml measuring cylinder, add $50cm^3$ of 1.0M Sulphuric acid to the beaker containing solution **D**.
- Heat the mixture to about 65ºC, add $15cm^3$ of solution **X** and start a stop watch immediately.
- Stir the mixture using a thermometer and note the time and temperature at which the colour of the mixture changes from purple to colourless.
- Clean the beaker and repeat the procedure at temperatures, 60ºC, 55ºC, 50ºC and 45ºC to complete table 3 below:-

Table 3

Temperature before mixing (ºC)	60	55	50	45
Temperature when solution becomes colourless (ºC)				
Time (seconds)				
$^1/_{time}$ (s^{-1})				

(a) Plot a graph of $^1/_t$ (y-axis) against the temperature at the point when the solution becomes colourless
(b) From your graph, determine the time that the reaction would take if the temperature at which the solution becomes colourless is 42.5ºC
(c) Explain the shape of your graph

Question 3.

You are provided with:

- Solid **K**

Procedure

Carry out the tests below. Record your observations and inferences in the spaces provided.
(a) Heat about half spatula end full of solid **K** in a clean test tube, heat gently then strongly. Test any gas produced using blue litmus papers.
(b) Dissolve the remaining solid **K** in a boiling tube in about $10cm^3$ of distilled water and

use the solution for the tests below:

(i) To about $2cm^3$ of solution **K**, add aqueous potassium hydroxide dropwise until in excess

(ii) To about $2cm^3$ of solution **K**, add about $5cm^3$ of solution **Q** (aqueous sulphate)

(iii) To about $3cm^3$ of the solution **K**, add about $6cm^3$ of acidified lead II nitrate

You are provided with:

- Solid **F**

Procedure

Add about $10cm^3$ of distilled water into half spatula end full of solid **F** in a boiling tube and shake thoroughly.

(c)To about $2cm^3$ of solution **F**, add the whole of sodium hydrogen carbonate

(d) To about $2cm^3$ of solution **F**, add about 5 drops of acidified potassium manganate (VII) then warm the mixture.

(e) Place about $5cm^3$ of ethanol in a test-tube and add drops of concentrated sulphuric acid then add the remaining solid **F**. Warm the mixture carefully. Shake well and pour the mixture into $20cm^3$ of water in a beaker

PRACTICAL 1107

CONFIDENTIAL

INSTRUCTIONS.

In addition to ordinary apparatus in the laboratory each candidate will require;

1. ***2g Solid A***
2. ***100cm³ solution B - Hydrochloric acid***
3. ***200cm³ solution C - Sodium hydroxide***
4. ***Burette***
5. ***Pipette***
6. ***Two 250ml conical flask***
7. ***Methyl orange indicator***
8. ***100ml measuring cylinder***
9. ***10ml measuring cylinder***
10. ***Distilled water***
11. ***Means of labelling***
12. ***30cm³ solution S***
13. ***50cm³ solution S- Hydrochloric acid***
14. ***50cm³ solution T-Sodium hydroxide***
15. ***Ten test tubes***
16. ***Rack***
17. ***100ml***
18. ***Thermometer***
19. ***Source of heat***
20. ***Solid U***
21. ***Spatula***
22. ***Red and blue litmus paper***
23. ***Filter funnel***
24. ***Filter paper***

Access to the following:-

- ***2M Sodium hydroxide***
- ***2M potassium iodine***
- ***2M Nitric acid***

- ***2M Ammonia hydroxide***
- ***Solid A – Per student measure [0.32g $CaCO_3$ + 1.68NaCl]***
- ***Solution B - [0.5M HCl]***
- ***Solution C - [0.4M NaOH]***
- ***Solution S -[1.0M HCl]***
- ***Solution T - [1.0M NaoH]***
- ***Solid U - [One spatula $CuCO_3$ + one spatula $Pb(NO_3)_2$***

QUESTION 1.

You are provided with:

- 2g of an impure calcium carbonate, solid **A**
- Hydrochloric
- Hydrochloric acid, solution **B**
- 16g per litre solution of sodium hydroxide, solution **C**

You are required to determine;

- Concentration of solution **B** in moles per litre
- Percentage of the carbonate in mixture **A**

PROCEDURE I:

Pipette 25.0cm^3 of solution **C** into a 250ml flask. Add 2-3 drops of methyl orange indicator. Titrate solution **C** with the hydrochloric acid solution **B.** Repeat this procedure two more times and record your results in table I below:-

Table I:-

Titration	**I**	**II**	**III**
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution **B** (cm^3) used			

Calculations:-

(a) (i) Calculate the average volume of solution **B** used
(ii) Calculate the number of moles of sodium hydroxide solution **C** pipetted
(iii) Calculate the number of moles of hydrochloric acid solution **B** that reacted with sodium hydroxide in **(a) (ii)** above
(iv) Calculate the molarity of hydrochloric acid solution **B**

PROCEDURE II:

(a) Place all the 2g of solid a provided into a conical flask and add 25.0cm^3 of hydrochloric acid solution **B** to it using a clean pipette. Swirl the contents of the flask vigorously until effervescence stops. Using a 100ml measuring cylinder, add 175cm^3 of distilled water to make up the solution up to 200cm^3 of solution. Label this solution **D.** Using a clean pipette, transfer 25.0cm^3 of solution D into a conical flask and add 2-3 drops of methyl orange indicator. Titrate solution D with sodium hydroxide solution **C**. Repeat the procedure two more times and record your in the table II below:-

table II:

Titration	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution **C** (cm^3) used			

(b) (i) Calculate the average volume of solution **C** used *KSM*

(ii) Calculate the number of moles of sodium hydroxide solution **C** present in the average volume

(iii) Calculate the number of moles of hydrochloric acid present in the original 200cm^3 of solution **D**

(iv) Calculate the number of moles of hydrochloric acid solution **B** contained in the original 25.0cm^3 of solution **B** used

(v) Calculate the moles of calcium carbonate that reacted with hydrochloric acid solution ***D***

(vi) Calculate the mass of calcium carbonate in 2g of solid **A**

(vii) Calculate the percentage of calcium carbonate present in the mixture (solid **A**)

2. ***You are provided with :-***

- Solution of hydrochloric acid, **S**
- 1.0M solution of sodium hydroxide, solution **T**

You are required to:

(i) Calculate the heat of molarity of hydrochloric acid, solution **S**

(ii) Determine the heat of reaction for mole of hydrochloric acid with sodium hydroxide.

PROCEDURE

I. Place six test tubes on a test tube rack. Using a 10ml measuring cylinder, measure and pour 5cm^3 of solution **T** into each of the test tubes

II. Measure 20.0cm^3 of solution **S** and pour into a 100ml beaker. Measure the temperature of this solution and record in table III below.

III. Pour the first portion of the 5cm^3 of solution **T** into the beaker containing the 20.0cm^3 of solution **S**. Stir the mixture carefully using a thermometer and record the highest temperature reached in table III.

IV. Pour the second portion immediately into the mixture in the beaker, stir carefully and record the highest temperature in table III continue this procedure with the remaining portions of solution **T** to complete table III.

Table III:

(a)

Titration	0	5	10	15	20	25	30
Volume of solution **T** added (cm^3)							
Volume of solutions **S** + **T** (cm^3)							
Temperature of mixture (^{o}C)							

(c) From the graph, determine:-

(i) The volume of solution **T** required to react completely with solution **S**

(ii) The highest temperature change, Δ**T**

(d) Calculate the heat change for the reaction ;

(Heat change = M x 4.2Jg^{-1} ^{o}C $^{-1}$ x Δt, assume the density of the solution to be 1g/cm^3)

(e) Calculate the number of moles of the sodium hydroxide solution T used in the experiment

(f) Calculate the number of moles of the hydrochloric acid, solution **S** used in the experiment

(g) Determine the heat of reaction per mole of hydrochloric acid, solution **S**

3. You are provided with solid **U**, carry out the test below. Record your observations and inferences in the table. Identify any gas(es) evolved .

(a) Heat a spatula end full of mixture **U** in a test tube.

(b) (Dissolve a part of mixture **U** in abort 10cm^3 of distilled water

(c) Filter the mixture and retain both filtrate and the residue. Divide the filtrate into two portions.

(i) To the first portion, add sodium hydroxide drop wise until in excess

ii) To the second portion, add Potassium iodide solution

(d) Divide the residue into two parts:-

(i) Put one part in a test tube and add dilute nitric acid until the residue just dissolves
(ii) Divide the resulting solution into two parts. To part one, add dilute sodium hydroxide solution drop wise until in excess
(iii) To part two, add aqueous ammonia drop wise until in excess

PRACTICAL 1108

CONFIDENTIAL
INSTRUCTIONS .
In addition to common fittings, apparatus and chemicals found in the school laboratory.
Each candidate requires:-

1. ***50.0ml burette***
2. ***250ml pipette***
3. ***Pipette filler***
4. ***Two 25.0ml conical flasks***
5. ***A clean metallic spatula***
6. ***One boiling tube***
7. ***A white tile/plain paper (white)***
8. ***Eight clean dry test-tubes on a rack***
9. ***1.5g of carbonate A- accurately weighed and placed in a stoppered test-tube***
10. ***75cm^3 of 0.1M sodium hydroxide labeled C***
11. ***75cm^3 of 1M hydrochloric acid labeled solution B***
12. ***10ml measuring cylinder***
13. ***One filter paper***
14. ***A filter funnel***
15. ***A glass rod***
16. ***45cm^3 of 0.42M glucose, labeled X***
17. ***130cm^3 of 2.0M H_2SO_4 labelled Z***
18. ***10ml of 0.04M $KMnO_4$ labelled Y***
19. ***Stop watch/stop clock***
20. ***Thermometer (-10^{o}C – 110^{o}C)***
21. ***100ml measuring cylinder***
22. ***Solid K (about 2g)***
23. ***Distilled water in a wash bottle***
24. ***A 250ml volumetric flask (one)***
25. ***Means of labeling (one)***

Access to the following:-

1. ***Bunsen burner***
2. ***Phenolphthalein indicator solution supplied with a dropper***
3. ***Tripod stand and a wire gauze***
4. ***2.0M NaOH supplied with a dropper***
5. ***2.0M HCl***
6. ***2.0M HNO_3 supplied with a dropper***
7. ***0.5M $BaCl_2$ supplied with a dropper***
8. ***Calcium hydroxide solution in a stoppered container***
9. ***2.0M ammonia solution supplied with a dropper***
10. ***0.05M potassium iodide solution supplied with a dropper***

Preparation of chemicals

(i) ***Solid A – Calcium Carbonate***

(ii) ***Solid K – Mixture of Lead (II) carbonate and sodium sulphate in the ratio 1:1***

1. ***You are provided with:***
   - 1.5g of metal Carbonate **A**
   - 75cm^3 of 1M hydrochloric acid labelled **B**
   - 75cm^3 of 0.1M sodium hydroxide labelled **C**

   You are required to determine the molar mass of the carbonate

Procedure I

Transfer carefully all solid **A** into a clean 250ml volumetric flask. Add 50cm^3 of the acid labelled **B** into the flask containing the carbonate. Wait until the reaction is complete (No more effervescence takes place)

Question 1.

(a) Find the moles of hydrochloric acid present in 50cm^3 of solution **B**

Procedure II

When the reaction is complete, add 100cm^3 of distilled water to the contents of the flask and shake. Add more distilled water to top the solution to the mark. Label it as solution D. Pipette 25cm^3 of solution **D** into a 250cm^3 of conical flask and titrate with solution **C** using 1 to 2drops of phenolphthalein indicator. Record your results in table 1 below. Repeat this procedure to obtain accurate values:

	I	**II**	**III**
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution **C** used (cm^3)			

(b) Determine the average volume of solution **C** used

(c) (i) Calculate the volume of sodium hydroxide that would react with 250cm^3 of the diluted acid

(ii) Calculate the moles of sodium hydroxide solution **C** in the volume obtained in **c(i)** Above

(d) Write down equation for the reaction between hydrochloric acid and sodium hydroxide

(e) How many moles of hydrochloric acid are left after the reaction with the metal carbonate **A**

(f) Calculate the moles of hydrochloric acid that reacted with 1.5g of the metal Carbonate **A**

(g) (i) Write down the ionic equation between carbonate and hydrochloric acid

(ii) Calculate moles of carbonate **A**

(iii) Calculate the molar mss of the carbonate **A**

2. ***You are provided with:-***
   - 2.0M sulphuric (VI) acid solution, solution Z
   - 0.42M glucose, solution **X**
   - 0.04M potassium manganate (VII) solution **Y**

   You are required to determine the rate of reaction between aqueous glucose solution and acidified potassium manganate (VII) at different temperatures.

Procedure

Place 1cm^3 of solution **Y** into a conical flask. Using a 100cm^3 measuring cylinder add 25cm^3 of solution Z to the conical flask containing solution **Y**. Warm the mixture to

about 70°C. Stop warming and allow the mixture to cool. When the temperature is exactly 65°C add 7.5cm^3 of solution **X** and start the stop watch immediately. Stir the mixture with a thermometer and measure the time taken for the colour of the mixture to change from purple to colourless. Record the time in table 2 below also record the temperature at which the mixture turns colourless. Clean the conical flask and repeat the procedure at temperature of 60°C, 55°C 50°C and 45°C instead of 65°C.

(a) Calculate $1/_{time}$ and complete the table

Table 2 (6mks)

Temperature before mixing (°C)	65	60	55	50	45
Temperature when solution becomes colourless (°C)					
Time in seconds					
$^1/_{time}(s^{-1})$					

(b) Plot a graph of $^1/_{time}$ (y-axis) against the temperature at the point when the solution becomes Colourless

(c) From your graph, determine the time that the reaction would take if the temperature at which the solution becomes colourless is 52.5°C

(d) From your graph, determine the rate of reaction if the temperature at which the solution becomes colourless is 47°C

(e) Explain the shape of your graph

3. You are provided with mixture **K**. You are required to perform tests on the mixture in order to determine its composition. Record your observations and inferences in their spaces provided:-

(a) Place a spatula of **K** on a white tile and observe its appearance:-

(b) Place the remaining portion of **K** in a boiling tube and add 10cm^3 of distilled water. Shake vigorously, filter and retain both the residue and filtrate

(i) Divide the filtrate into 3 portions. To the first portion sodium hydroxide drop-wise until excess

(ii) Dip one end of a metallic spatula in 2M HCl and heat it in a Bunsen burner flame for a few seconds and allow it to cool. Scoop a little of the solution from the second portion with the heated end of the spatula and place it as the hottest part of the non-luminous flame.

(iii) To the third portion add 3-4 drops of dilute $HNO_{3(aq)}$ followed by 3-4 drops of $BaCl_{2(aq)}$

(c) Scrap the residue from the filter paper and place a half of it in a clean dry test tube. Add about 3cm^3 of 2M HNO_3. Test for any gas produced by use of calcium hydroxide solution on a glass rod. Preserve the solution for use in procedure **(d)** below:-

(d) Add about 3cm^3 of distilled water to the solution obtained in **(c) above** and shake to mix. Divide the solution into 3 portions

(i) To the first portion, add sodium hydroxide drop-wise until in excess

(ii) To the second portion, add ammonia solution drop-wise until in excess

(iii) To the third portion, add 2-3drops of potassium iodide solution

PRACTICAL 1109

CONFIDENTIAL

INSTUVTIONS.

You are provided with:

- 25cm^3 of 0.2M Copper(II) sulphate solution
- 0.5g of metal **A**
- 0.5g of metal **B**
- One thermometer of -10 to 110°C range

- Two $100cm^3$ plastic beakers

You are required to determine the molar enthalpy change for metal A and B and arrange them in order of reactivity

Procedure

1. a) Using the thermometer provided, take the initial temperature of copper (II) sulphate solution and record your results in table A below

b) Add all the 0.5g of metal A into copper (II) sulphate solution; stir the mixture for about 5 minutes. Using a thermometer and record the final temperature (highest temperature) in table A below:

TABLE A;

Initial temperature of $CUSO_{4(aq)}$ (C)	
Final temperature of $CUSO_{4(aq)}$ (C)	
Temperature change T (^oC)	

Question 2;

2. a) Using a thermometer take initial temperature of another 25cm3 fresh sample of copper(II) sulphate solution in the plastic beaker and record your results in table B below;

TABLE B;

Initial temperature of $CUSO_{4(aq)}$ (C)	
Final temperature of $CUSO_{4(aq)}$ (C)	
Temperature change T (c)	

a) i) State and explain whether the reactions above between metals A and B with copper (II) sulphate are endothermic or exothermic

ii) Calculate the moles of copper ions present in $25cm^3$ of 0.2M copper (II) sulphate solution

b) i) Calculate the enthalpy change that occurs when $25cm^3$ of copper (II) solution reacts with metal A. (Specific heat – capacity of the solution = $4.2Jg^{-1}K^{-1}$, Density of the solution = $1g/cm^3$

ii) Determine the molar enthalpy change for the reaction of copper (II) sulphate solution with metal **A**

c) i) Explain the significance of using powdered metals **A** and **B** in this experiment

ii) Record the colour of the powdered metals **A** and **B**

d) State and explain major observations made when metal **A** reacts with copper (II) sulphate solution

e) i) Determine the molar enthalpy change for the reaction of metal B with $25cm^3$ of 0.2 M copper (II) sulphate solution (C = $4.2^Jg^{-1}K^{-1}$, Density of solution = $1g/cm^3$, RAM of metal B= 65)

ii) Arrange metals **A** and **B** in order of reactivity beginning with the more reactive one. Give a reason for your answer

Question 2

You are provided with;

- Solution **C,** 0.1 M hydrochloric acid
- Solution **D**, $MOH_{(aq)}$ solution of unknown concentration
- Phenolphthalene indicator

You are required to standardize solution **D** using solution **C** and to determine the value of M in the formula $MOH_{(aq)}$

Procedure

1. a) Pipette $25cm^3$ of solution **D** into the conical flask. Using a dropper, add 2 drops of phenolphthalene indicator to solution **D**

b) Fill the burette with solution **C** and correct to the "**O**" mark

c) Titrate solution **C** against solution **D**

2. Repeat procedure **1(a), (b)** and **(c)** twice and record your results in a table of results below;

Table of results

Experiment	I	II	III
Final volume of solution **C** (cm^3)			
Initial volume of solution **C** (cm^3)			
Volume of solution **C** used (cm^3)			

a) Volume of pipette used _____ cm^3

b) Calculate the average volume of solution C used in this experiment

c) Calculate the number of moles of solution **C** used in this experiment

d) Given that solution **C** is hydrochloric acid while solution **D** is MOH (the base),

i) Write a chemical equation to show the reaction of solution **C** with **D**

ii) Write the ionic equation for the reaction of solution C with D in **d (i)** above

iii) From the reaction equation written in d(i) above, determine the moles of solution **D** that reacted with solution **C**

e) i) Determine the molarity of solution **D** (i.e. $MOH_{(aq)}$) used in this experiment

ii) Given that 6016g of solid $MOH_{(s)}$ were dissolved in distilled water and made to 1 litre, calculate the relative molecular mass of $MOH_{(s)}$

iii) From your answer in **e (ii)** above, determine the value of M in the formula MOH

Question 3.

You are provided with solid **E**. Carry out the following tests on solid **E** so as to try and find out the ions present in solid **E**

Complete the table below to show your observation and inference (conclusions)

Experiment	**Observation**	**Inference**
a) Observe solid **E** and record your findings		
b) Dissolve solid **E** in about ¾ of distilled water in a boiling tube and divide the solution into 5 portions in 5 test tubes		
i) To portion 1 add $NaOH_{(aq)}$ drop wise to excess		
ii) To portion 2 add $NH_{3(aq)}$ drop wise to excess		
iii) To portion 3 add a few drops of $Ba(NO_3)_2$ followed by few drops of dilute $HNO_{3(aq)}$		
iv) To portion 4 add lead (II) Nitrate drop wise followed by dil. $HNO_{3(aq)}$		
v) To portion 5 dip a looped nichrome wire to it and put the wire in the Bunsen flame		

PRACTICAL 1110

CONFIDENTIAL INSTRUCTIONS

Each student should be provided with:

1. ***100 cm^3 of solution M_2***
2. ***80 cm^3 of solution M_1***
3. ***50 cm^3 of solution M_3***

4. ***Pipette (25 ml)***
5. ***Burette (50 mls)***
6. ***Methyl Orange indicator with a dropper***
7. ***Two conical flasks***
8. ***Filter funnel***
9. ***Measuring cylinder (10 mls)***
10. ***Measuring cylinder (50 mls)***
11. ***Thermometer (-10 to 110^0c)***
12. ***100 mls plastic beaker***
13. ***3 test tubes in a test tube rack***
14. ***1 Boiling tube***
15. ***Solid W. (One spatula full)***

Access to:

1. ***2M $NaOH_{(aq)}$ with a dropper***
2. ***2M NH_3 $(_{aq})$ with a dropper***
3. ***1M $BaCl_2$ with a dropper***
4. ***2M HNO_3 with a dropper***
5. ***Distilled water in a wash bottle***

Note:

1. ***Solution M_1 is prepared by mixing 53g of Sodium Carbonate and 42g of Sodium Chloride solid and dissolved to make one litre solution.***
2. ***M_2 is 1M Hydrochloric acid.***
3. ***M_3 is 1M Sodium Hydroxide.***
4. ***Solid W is Aluminium Nitrate***

1. You are provided with the following solutions:-
- M_1 containing 95g of a mixture of sodium carbonate and sodium chloride per litre of solution.
- M_2 which is 1M HCL.

You are to determine the percentage of sodium chloride in the mixture.

Proceed as follows:

Pipette 25 cm^3 of M_1 and titrate with M_2 from burette using 3 – 4 drops of methyl orange indicator. Stop titrating when a permanent pink colour appears. Repeat the experiment and complete the table below.

TABLE 1

	I	II	III
Final burette reading ($cm^{3)}$			
Initial burette reading (cm^3)			
Volume of M_2 used (cm^3)			

a) Determine the average volume of M_2 used. Show your workings.
b) Determine the number of moles of M_2 used.
c) Write down an ionic equation for the substances that react.
d) Determine the number of moles of the base used.
e) Calculate the concentration of sodium carbonate.
f) Determine the mass of sodium carbonate in 1 litre of the solution.
(Na = 23, C = 12, O = 16)
g) Determine the percentage of sodium chloride in the mixture.

2. You are provided with the following solutions:-
- 1 M HCl solution M_2
- 1 M NaOH solution M_3

You are expected to determine the molar heat of neutralization of hydrochloric acid.

Proceed as follows:

Measure 23 cm^3 of M_2 and put in a 100 ml beaker. Measure its temperature and record in the table below under first column. By use of a measuring cylinder measure 5 cm^3 of M_3 and to M_2 in the beaker. Stir with the thermometer and record the final steady temperature. Continue adding 5 cm^3 at a time and recording the temperature till 35 cm^3 has been added, complete the table below.

a) **TABLE II**

Volume of M_2 added (cm^3)	0	5	10	15	20	25	30	35
Temperature (^0c)								

b) Plot a graph of temperature (vertical axis) against volume of NaOH added.

c) From your graph determine:-

(i) Volume of 1M NaOH needed to neutralize 23 cm^3 of 1M HCl

(ii) Rise in temperature ΔT.

d) Calculate the amount of heat evolved in the above reaction. Take specific heat capacity of solution to be 4.2. J/g/k, density of solution. 1g/cm^3.

e) Calculate the number of moles of HCl used.

f) Hence determine the Molar heat of neutralization of hydrochloric acid.

3. You are given solid W. Carry out the tests below and answer accordingly.

a) Take a spatula endful of W and put in a boiling tube. Add about 8cm^3 of water and shake. Keep the mixture for the tests below.

b) To about 2 cm^3 of solution of W add sodium hydroxide (2M NaOH) drop wise till in excess.

c) To about 2 cm^3 of solution W, add Ammonia solution (2M NH_{2aq}) drop wise till in excess.

d) To about 2 cm^3 of solution W, add about 5 drops of Nitric acid ($HNO_{3\ (aq)}$) followed by 2 drops of Barium chloride.

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REQUIREMENTS

In addition to the equipment, apparatus and chemical found in the chemistry laboratory, each candidate will require the following:

- ***Solution P: about 100cm3***
- ***Solution Q: about 50cm^3***
- ***Solution R: about 100cm^3***
- ***Distilled water***
- ***100ml measuring cylinder***
- ***One filter funnel***
- ***One 25cm^3 pipette***
- ***A clamp and stand***
- ***Aphenolphalein indicator***
- ***3 conical flasks***
- ***White tile***
- ***Solution F: about 30cm^3 of 1.0M sodium hydroxide solution***
- ***A 10ml measuring cylinder***
- ***A 100ml plastic beaker***
- ***Means of labeLling***

- ***A 110°C thermometer***
- ***Solid D, 0.5g Zinc Sulphate crystals***
- ***Metallic spatula***
- ***1 boiling tube***
- ***5 clean dry test tubes***
- ***Test tube holder***
- ***Bench solutions supplied with droppers***
- ***Dilute nitric acid solution, 2***
- ***2M sodium hydroxide solution***
- ***2M aqueous ammonia solution***
- ***0.5M Barium nitrate solution***
- ***0.5M Lead (ii) Nitrate solution***

NOTES

(a) (i) Solution P is prepared by dissolving 17.2cm^3 of concentrated hydrochloric acid in about 250cm^3 of distilled water and adding water to make 1litre of solution

(ii) Solution Q is prepared by dissolving 64g of sodium hydroxide pellets in about 250cm^3 of distilled water and making it to 1litre of solution

(iii) Solution R is prepared by dissolving 13.75cm^3 of concentrated sulphuric acid in about 250cm of distilled water and making it to 1litre of solution

(b) Solid D is 0.5g of Zinc Sulphate crystals

1. **You are provided with:**

- Solution **P**, **0.2 M** hydrochloric acid
- Solution **Q**, sodium hydroxide solution
- Solution **R**, containing 49g/Litre of a dibasic acid, H_2A

You are required to:

Dilute solution **Q** with distilled water
Standardize the diluted solution **Q** with solution **P**
Determine the relative formula mass of **A**

Procedure 1:

Pipette 25cm^3 of **Q** into a clean dry 250ml volumetric flask. Measure 175cm^3 of distilled water using a 100cm^3 measuring cylinder and add it to solution **Q** in the flask. Shake well. Label this as solution **S** and keep it for further tests in procedure I and II. Pipette 25cm^3 of solution **S** into a clean dry conical flask. Add 2 to 3drops of Phenolphthalein indicator and titrate with solution **P**. record your results in the table I below. Repeat the procedure to obtain accurate results.

Table I

Titration number	I	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution **P** used (cm^3)			

(a) Determine the average volume of solution R used

(b) (i) Find the moles of solution **P** used to react with 25cm^3 of the diluted solution **S.**

(ii) Find the moles of solution **S** in 25cm^3 of the diluted solution.

(iii) Determine the number of moles of sodium hydroxide contained in the 100cm^3 of solution **S**

(c) Using your results in b (ii) above determine the concentration in moles per litre of the original sodium hydroxide solution **Q**

Procedure II

Pipette 25cm^3 of the standardized solution **S** into a clean, dry conical flask. Empty your burette completely of solution **P** and rinse it with some water. Now, fill your burette with solution **R** and titrate with solution **S** in the conical flask containing 2 to 3 drops of Phenolphthalein indicator.

Record your results in table II below. Repeat the procedure to obtain accurate results.

Table II

Titration number	I	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution R used (cm^3)			

(d) Determine the average volume of solution **R** used

……

(e) Determine the number of moles of Sodium hydroxide in 25cm^3 of solution **S** and hence the moles of solution **R** used

(f) Find the number of moles of **R** contained in one litre of solution

(g) Given that H= 1.0 :

(i) Find the relative formula mass of the dibasic acid H_2A

(ii) Determine the relative formula mass of **A** in the formula H_2A

2. **You are provided with:**

1.0M Sodium hydroxide solution **F**

0.6M solution of acid labelled **G**

You are required to determine the molar heat of neutralization of Sodium hydroxide with acid **G**

Procedure:

(a) Place six test tubes on a test rack. Using a 10cm^3 measuring cylinder measure 5cm^3 portions of solution **G** and place them in each of the tubes.

Measure 25.0cm^3 of solution **F** using a measuring cylinder and place it into a 100cm^3 beaker.

Measure the temperature of this solution F to the nearest 0.5^{o}C and record in table **III**.

Pour the first portion of the 5cm^3 of solution G from the test tube into the beaker containing 25.0cm^3 of solution **F**. Stir the mixture carefully and record the highest temperature of the mixture in table **III.**

Pour the second portion of solution **G** immediately into the mixture in the beaker. Stir carefully and record the highest temperature of this mixture in table **III**. Continue this procedure using the remaining portions of solution **G** to complete table **III**.

Table III

Volume of G added (cm^3)	0	5	10	15	20	25	30
Volume of F (cm^3)	25	25	25	25	25	25	25
Temperature (^{o}C)							

(b) On the grid provided, plot a graph of temperature (vertical axis) versus volume of solution **G** added

(c) From the graph, determine:

(i) The volume of solution **G** required to react with the 25cm^3 of sodium hydroxide solution **F**

(ii) The highest temperature change

(d) Calculate the heat change for the reaction

(Heat change = Mass x temperature change x 4.2jg^{-1}^{o}C. Assume density of each solution to be 1gcm^{-3})

(e) Calculate the volume of sodium hydroxide solution **F**, used

(f) Calculate the molar heat of neutralization of sodium hydroxide solution **F**

3 **You are provided with** substance **D**, which contains two cations and one anion.
Carry out the test below on the substance. Enter your observations in the table below.
Write your observations and inferences in the spaces Provided

(a) Place a spatula end full of **D** in a boiling tube. Add about 5cm^3 of distilled water and shake. Divide the resultant mixture into 4 portions

i) To the first portion, add Nitric acid followed by Barium nitrate solution.

ii) To the second portion, add Nitric acid, followed by lead (II) Nitrate solution

iii) To the third portion, add a few drops of sodium Hydroxide solution until in excess

iv) To the fourth portion, add aqueous ammonia drop wise till in excess solution

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INSTRUCTIONS

ACCESS TO

- 1M NaOH
- 1M NH_4OH
- 1M HCL
- 0.01m PB $(NO_3)_2$
- Source of heat
- PH chart (PH=1 to 14)
- 10ml of solution **K**
- Sodium hydrogen carbonate

Question 1.

1. ***Solution J 100cm^3***
2. ***Burette***
3. ***Solution K100cm^3***
4. ***Pipette***
5. ***2 conical flasks***
6. ***Filter funnel***
7. ***Retort stand***

PREPARATION OF SOLUTIONS

1. Solution **J -** Dissolve 17g of ammonium iron (ii) sulphate in 50cm^3 of 2M H_2SO_4 dilute to 1dm^3
2. Solution **K-$KMnO_4$** . Dissolve 1.6g of potassium manganate vii in 20cm^3 of 2 MH_2SO_4 dilute to 1dm^3
3. Solution **R -** Dissolve 40g of sodium thiosulphate in 1dm^3 of solution
4. Solution **S -** Dissolve 172cm^3 of concentrated hydrochloric acid in 1dm^3 of solution
5. Solid **Y** is aluminium sulphate
6. Solid **Z** is oxalic acid.

1. **You are provided with**:

- Solution M_1 aqueous solution of a monobasic acid, HB containing 1.62425, of the acid dissolve in 250cm^3 of the solution
- 0.208M sodium hydroxide solution.

You are required to determine

a) The molarity of the acid

b) The RFM of the acid and the RAM of **B** in HB (H=1, C=12, O=16)

Procedure

Pipette 25cm^3 of solution M1 into a clean dry conical flask. Add 2 drops of phenolphthalein indicators. Fill the burette with solution **Q** and titrate against solution M_1

Repeat the procedure two more times and complete the table below:

	I	**II**	**III**
Final burette reading(cm^3)			
Initial burette(cm^3)			
Volume of solution **Q** used (cm^3)			

a) Determine the average volume of solution **Q** used

b) Write an equation for the reaction between solution M_1 and **Q**

c) **Calculate:**

i) The number of moles of **Q** used

ii) The number of moles of $\mathbf{M_1}$ used

iii) The molarity of solution $\mathbf{M_1}$

d) **Determine;**

i) The RFM of acid

ii)The RAM of element **B**

2. **You are provided with**:

- 2M hydrochloric acid, solution M_2
- Magnesium ribbon.

You are required to determine;

i) The rate of the reaction between Hydrochloric acid and magnesium

ii) The mass of 2cm of magnesium ribbon

<u>Procedure II</u>

Using a clean measuring cylinder, measure 60cm^3 of 2M hydrochloric acid, solution M_2 and place it into a clean conical flask. Cut a 2cm piece of magnesium ribbon provided and place into the conical flask containing 2M hydrochloric acid and immediately start the slop- watch. Measure and record the time taken for the magnesium ribbon to completely react with the hydrochloric acid in table II below. Repeat the procedure using 50, 40, 30 and 20cm3 portions of 2M hydrochloric acid adding distilled water and complete the table below:

a) **Table II**

Experience	1	2	3	4	5
Volume of 2M HCl	60	50	40	30	20
Volume of distilled water added	0	10	20	30	40
Time taken for the ribbon to disappear(sec)					
1/time (sec^{-1})					

b) Plot a graph of ½ against volume of 2M hydrochloric acid used

c) From your graph determine the time taken for the ribbon to disappear when 36cm^3 of 2M hydrochloric acid were used

d) In terms of rate of reaction, explain the shape of your graph

3. You are provided with solids. You are required to carry out the tests shown below and write your observations and inference in the spaces provided. Identify any gases given out.

a) Place a small amount of solid **S** in a dry test tube and heat strongly

b) Place a spatula end- full of **S** in a boiling tube. Add about 5cm^3 of distilled water and shake. Divide the resultant mixture into 4 portions

i) to the first portion, add nitric acid followed by Barium nitrate solution

ii) To the second portion, add nitric acid followed by lead (II) nitrate solution. Warm the mixture

iii) To the forth portion, add aqueous ammonia drop wise until excess

3. b) You are provided with solid **F**. Carry out the texts below. Write your observations and inferences in the space provided.

Dissolve a spatula full of solid **F** in about 4cm^3 of distilled water and divide it into three parts.

i) To 2cm^3 of solution, add 5 drops of bromine water

ii) To the second portion add a spatula full of sodium hydrogen carbonate