545/2&3 CHEMISTRY SEMINAR SCENARIO ITEMS COMPILED BY JJ CHRIS EVENTS

AN OVERVIEW OF PAPER 2

Chemistry paper two consists of one(1) item(question) which is developed or set from one of the four (4) Constructs(main setting areas) namely

1. Rates of reaction,
2. Thermochemistry (Enthalphies/Heat of reactions/Heat changes)

a) Heat of Solution

b) Heat of Nutralization

3. Reactivity series/Displacement reactions
4. Hard Water **NOTE:**

Volumetric analysis is there inform of chemical kinetics, thermochemistry etc but not as titration. Other investigations from other areas as indicated in the syllabus can be examined but the above mentioned areas capture the attention and interest of the UNEB examiners and setters **Learners are supposed to,**

- **Approach to science enquiry / investigation/process scenario items.**

Presentation of scientific study/ inquiry / investigation should follow the order;

a. Aim of the experiment/title
b. Stating the hypothesis
c. Stating the variables
d. List of requirements.
e. Procedure
f. Risks and ways of mitigating the risks
g. Data presentation
h. Data analysis
i. Conclusion
j. Recommendation **NOTE:**

The learner understands that chemistry is a process of evidence-based enquiry involving the collection of evidence and the development of theories that help us explain the evidence (science process skills)

NO	Basis of Assessment	Assessment criteria BASIS OF ASSESSMENT	Scoring
A	**Aim of the experiment**	• Aim of experiment with both key words	02
		• Aim of experiment with one key word	01
		• No aim of the experiment	00

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B	**Variable for the experiment**	• Independent, dependent and controlled	03
		• Independent and dependent or independent and controlled or dependent and controlled variable	02
		• Independent or dependent or controlled variable	01
		• No variable	00
C	**Hypothesis**	• Hypothesis related to experiment with both key words	02
		• Hypothesis related to experiment with one of key words	01
		• No / wrong hypothesis of the experiment	00
D	**Procedure of the experiment**	• Relevant material, relevant procedure, coherent procedure of the experiment	03
		• Relevant materials and procedure	02
		• Either relevant material or relevant procedure	01
		• No relevant material and procedure	00
E	**Risks and Mitigations**	• Any one risk identified and mitigated	02
		• Any one risk identified or mitigated	01
		• No risk identified or mitigated	00
F	**Presentation of data**	• 2/3 of required sets of data appropriately presented	04
		• 1/3 of required sets of data appropriately presented	03
		• Data appropriately presented without required sets	02
		• Data partially appropriately presented with no required sets	01
		• No set of data presented	00
G	**Recording of Data**	• Appropriate recording of data within the error margin	04
		• Partial appropriate recording data within the error margin	03
		• Appropriate recording of data outside the error margin	02
		• Partial appropriate recording of data outside error margin	01
		• No data recorded/ data recorded outside error margin	00

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H	**Data analysis and interpretation**	• Appropriate and accurate	03
		• Appropriate and partially accurate	02
		• Appropriate and inaccurate	01
		• Inappropriate and inaccurate	00
I	**Conclusion**	Conclusion based on data interpretation	01
		No conclusion based on data interpretation	00

PRACTICAL ELEMENTS OF CONSTRUCT (ASSESSABLE AREAS)

1. Chemical reaction rates	4. The reactivity series
2. Energy changes during chemical reactions	5. Solubility of Salts
3. Formulae, stoichiometry and mole concept	6. Soapy detergents and hardwater

PRACTICAL ITEM 1: HARD WATER

Atimango is a resident of Nagongera – Tororo district. She washes clothes for people as her main income earning job. Her customers have often complained of white spots that remain in their clothes after washing and she is most likely to lose most of her customers. Her friend Opendi informed her that she can buy washing soda and always add to water before washing, however she does not know the quantity of washing soda to be added.

Atimango uses 5 jerrycans of each 20 litres of water every day.

You have been provided with,

BA1: Which is washing soda (sodium carbonate solution);

Mineral in water sample reacts with washing soda according to the equation.

MgSO4 (aq) + Na2CO3 (aq) ⟶ ***MgCO3(s) + Na2SO4 (aq)***

Tasks.

(a) Plan and design a scientific investigation to guide Aketch on required amount of washing soda.

RESPONSE

Aim: *An experiment to investigate the quantity of Sodium Carbonate*✓ *required to soften the 5 Jerry cans of Hard water each at 20 litters.*✓ **02 scores**

Hypothesis: *5liters of sodium Carbonate is required to soften 5 jerrycans of hard water.*✓ **02 scores** **Variables:**

Independent Variable: *Volume of Hard water measured*✓

Dependent variable: *Volume of Sodium Carbonate solution added*✓ **03 scores**

Controlled variable: *Water Hardness /concentration of ions in hard water*✓

Requirements/Materials.

100c^3/ 50cm^3 Measuring cylinder,✓ *250cm^3 conical flask, 50cm^3 burette,*✓ *and*

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Retort stand, solution ***BA1*** *(Sodium carbonate solution), Hard water*✓ **03 scores**.

(b) Conduct the investigation on the water sample provided.

Procedures

(a) *20cm³ of hard water was measured using a 100cm³ or 50cm³ measuring cylinder and transferred into a 250cm³ clean conical flask.* ✓

(b) *Solution* ***BA1*** *(Sodium carbonate solution) was filled into a burette and adjusted to the zero mark. And* ***BA1*** *is then run into hard water in a conical flask and shake till a white precipitate forms.* ✓

(c) *The burette reading is noted and recorded. The content in the conical flask is then poured away and conical flask washed.* ✓

(d) *Procedure (a) to (c) was repeated for 30cm³, 40cm³, 50cm³, 60cm³* respectively. ✓

04 score

Risks and Mitigations: *Acid pouring on the skin or question paper.* ✓

Mitigation; *Put on a lab coat, gloves, closed shoes.* ✓

Dry the working table as soon as it is wetted by the chemical. ✓

Clean the conical flask and burrete before using in another solution to ensure no reaction occurs before mixing the ***two*** *solutions. Handle glass ware with care to avoid accidents and breakages.* ✓

Risk: *Breakage of Conical flask and burrete being glass is fragile*

Mitigation: *Handle with care*✓

Risk: *Spilling solutions on table*

Mitigation: *Use a filter funnel for filling the burette.* ✓ **04 scores *(c)***

Show treatment of your results obtained in (b) above.

The results is recorded in a suitable table below **06 scores**

Volume of hard water (cm³)	10	20	30	40	50	60
Volume of **BA1** used (cm³)	1.00✓	2.00✓	3.00✓	4.00✓	5.00✓	6.00✓

The above results is plotted in a graph below

Draw conclusions(s) from your results to guide Atimango on how much washing soda to buy per day and how the water would completely be improved.

A GRAPH OF VOLUME OF HARD WATER AGAINST VOLUME OF BA1 SOLUTION✓

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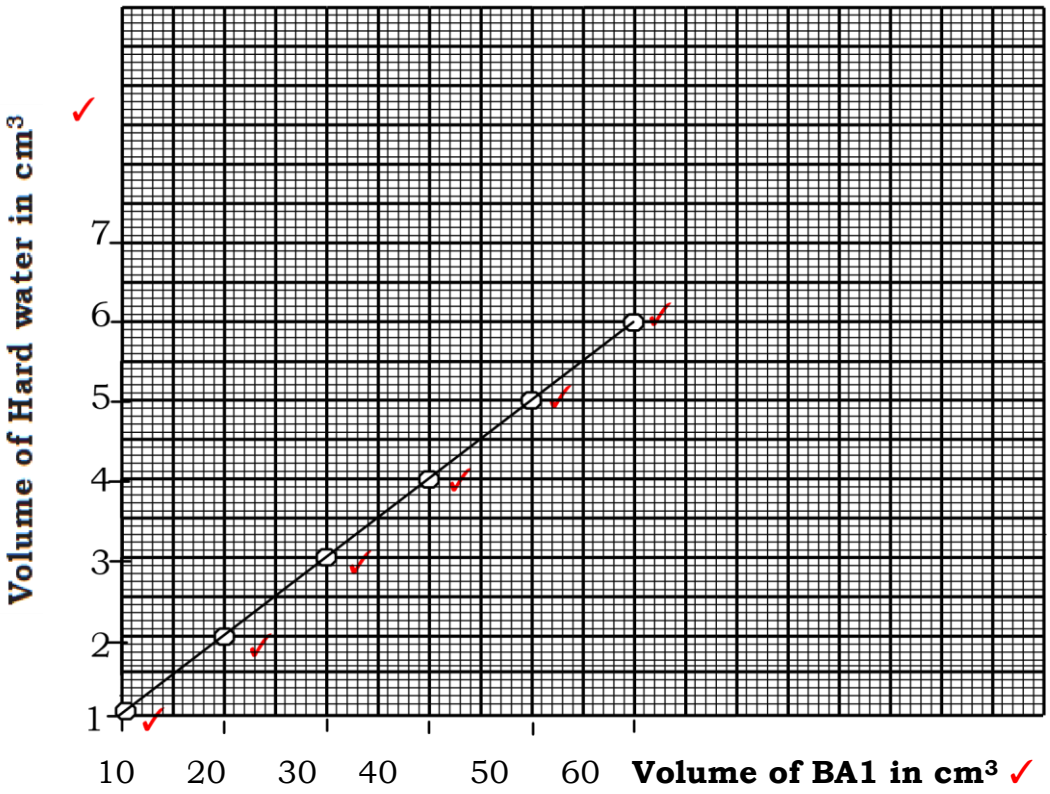

Conclusion **(02 scores)**

From the above graph and table of results of the experiment, the volume of ***BA1*** *(sodium carbonate solution) added to soften hard water is directly proportional to the volume of hard water softened:*✓

The results show that 10cm³ of hard water required 1cm³ of sodium hydroxide solution and the ratio of 10:1✓

Thus, for 5 jerry cans (5x20x1000cm³) of hard water will require

$$= \frac{1x(5X20x1000)}{10}\ cm^3 \text{ of sodium carbonate}$$ ✓

$$= \frac{(100,000)}{10}\ cm3 \text{ of sodium carbonate}$$ ✓

$= 10,000cm^3$ *of sodium Carbonate solution*

But 1 litre $= 1000cm^3$

Therefore, 10,000cm3 of Na_2CO_3 *requires* $\frac{10000}{1000} = 10$ *litres* ✓

Recommendation: **(01 score)**

Basing on the above results, I therefore, recommend Atimango to add 10 liters of Solution ***BA1*** *(Sodium Carbonate solution) to the five jerry cans 20litres each (100 litres) of hard water she uses and this will save her from wasting soap, and avoid chalky marks on clothes of her customers.* ✓

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PRACTICAL ITEM 2: HARD WATER

Apolot is a resident of Apapar Village in Eastern Uganda. She washes clothes in the nearby trading center for money. Due to water shortages in her area during dry season, she treks for long distances looking for clean water so as to satisfy her customers. There are three water sources available in the trading center where most of her customers live. She wants to understand which of the three water sources would be better to use when washing clothes for maximum profit. You are provided with a sample of each of the water sources labeled solution **A**, **B** and **C** and a soap solution labeled **FA1. Task**

Plan and carry out an investigation to find out which of the three water samples easily forms lather with soap and use your results to recommend the appropriate water Apolot should use to avoid wasting soap.

RESPONS AND SCORING GRID.

AIM: (2 scores)

To determine which of the three water samples A, B and C easily forms lather with soap.

Variables. (3 scores)

Independent variable: *Hardness of water sample A, B and C/ Concentration of the ions responsible for hardness in water sample A, B and C*

Dependent variable: *Volume of soap solution*

Controlled variable: *Volume of water sample measured*

Hypothesis (2 scores)

Soap reacts with hard water forming an insoluble substance. In the absence of ions responsible for hardness, soap with water to form lather.

Procedures (03 scores)

*(a) Pipette 20 or 25 cm^3 of water sample **A** into a clean conical flask.*

(b) Fill the burette with solution FA1(soap solution) to the zero mark as initial burette reading,

(c) Titrate the water with the soap solution from the burette while shaking the conical flask to mix until permanent lather is formed.

(d) Note and record the final burette volume for soap solution used to form permanent lather

(e) Pour away the resultant mixture and wash the conical flask.

*(f) Repeat procedures (a) to (e) for each of the water sample **B** and **C***

(g) Record the volumes of soap solution added in cm^3

Risk and mitigations. (02 scores)

Pouring soap solution on clothes or paper and wetting tables,.

Mitigatio: *Mitigated by use of a funnel when pouring soap solution into the burette.*

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Presentation of data (04 scores)

The results are recorded in the table below for all the water samples A, B and C;

Volume of Pipette used = 20.0 cm^3 or 25.0 cm^3

Type of hard water	**A**	**B**	**C**
Final burette reading (cm^3)	35.00	23.00	15.00
Initial burette reading (cm^3)	0.00	0.00	0.00
Volume of soap solution (cm^3)	35.00	23.00	15.00

Data analysis and interpretation: (03 scores)

*The Volume of soap required to form lather with Water sample **A** is **35.00cm³** The Volume of soap required to form lather with Water sample **B** is **23.00cm³** The Volume of soap required to form lather with Water sample **C** is **15.00cm³***

Conclusion: (01 score)

Water sample C requires the least amount of soap to form lather. Therefore it is the best water sample to use when washing since it saves soap.

Recommendation:

*Basing on the above results of the experiment, I therefore recommend Jane to use water sample **C** for washing clothes because it easily forms lather with soap than water sample A and B which take much soap to form lather.*

ITEM 3: REACTIVITY OF METALS

Mukwano group of companies in Uganda are the leading manufacturers of cooking oils using locally available Agricultural produce such as simsim, groundnuts and sunflower seeds. The company started adding value to oil by turning it into margarines, and blue band. The process is done by adding hydrogen gas to liquid oil in order to harden it, a process called hardening of oils. Hydrogen is obtained by reacting metals with an acid. Due to high demand for blue band and margarine from the customers, the company has decided to purchase metals for the production of hydrogen gas instead of importing it. Three metals **L, N** and **M** were purchased but the workers want to know the metal that can produce the Hydrogen gas
faster per day. The acid reacts with the metal as below;

Metal + Acid ——— Metal Chloride + Hydrogen gas

You have been provided with **FA1** which is Hydrochloric acid solution and Metals **L**, **N** and **M**.

Task:

As a Chemistry student who has studied reactivity of metals, plan and carry out a scientific investigation on metals L, N and M using FA1 which is a solution of Hydrochloric acid. Write a report and include your recommendations on which metal the company can use.

RESPONSES

BASIS OF ASSESSMENT

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S/N	BASIS OF ASSESSMENT	ASSESSMENT	SCORE
(a)(i) **A**	**AIM OF THE EXPERIMENT**	*An experiment to investigate which metal can be used to produce hydrogen gas faster in a short time when* ✓ 1A *Hydrochloric acid reacts with metals L, N and M* ✓ 1A	**02**
B	**HYPOTHESIS**	*Metal L reacts with Hydrochloric acid* ✓ 1H *faster than metals N, and M* ✓ 1H	**02**
C.	**VARIABLES OF THE EXPERIMENT**	**(DV) Dependent variable:** *Time taken for the gas bubbles to stop.* ✓ 1DV **(IV) Independent variable:** *Metal L, N and M reactivity* ✓ 1V **(CV) Controlled variable:** *Volume of FA(Hydrochloric acid) added* ✓ 1CV	**03**
D.	**PROCEDURE OF EXPERIMENT WITH RELEVANT MATERIALS**	**Procedures** (a) *0.5 grams of Metal L were weighed on a beam balance and transferred into a 250cm³ clean conical flask* ✓ 1P (b) *Measured 50cm³ of Solution* ***FA1*** *(Hydrochloric acid) using a 100cm³ / 50cm³ measuring cylinder and transferred into a 250cm³ clean conical flask containing 0.5g of metal L, stirred for 20 seconds and immediately started a stop clock.* ✓ 1P (c) *The time taken for the gas bubbles to stop was observed and recorded in the table of results. The content in the conical flask is then poured away and conical flask washed.* ✓ 1P (d) *Procedure (a) to (c) were repeated for metals N and M respectively.* ✓ 1P **Requirements/Materials.** *100c³/ 50cm³ Measuring cylinder, 250cm³ conical flask, Cup/ beaker, Metals L, N and M,* ✓ 1R *Beam balance, and solution* ***FA₁*** *(Hydrochloric acid).* ✓ 1R.	**06**
E.	**RISKS AND MITIGATIONS**	**Risk–** *Spilling solution FA1 on table, pouring on the skin or question paper.* ✓ 1RM **Mitigation:** *Put on a lab coat, gloves, and closed shoes. Dry the working table with tissue as soon as it is wetted by the chemical.* ✓ 1RM *Handle conical flask with care to avoid accidents and breakages.*	**02**

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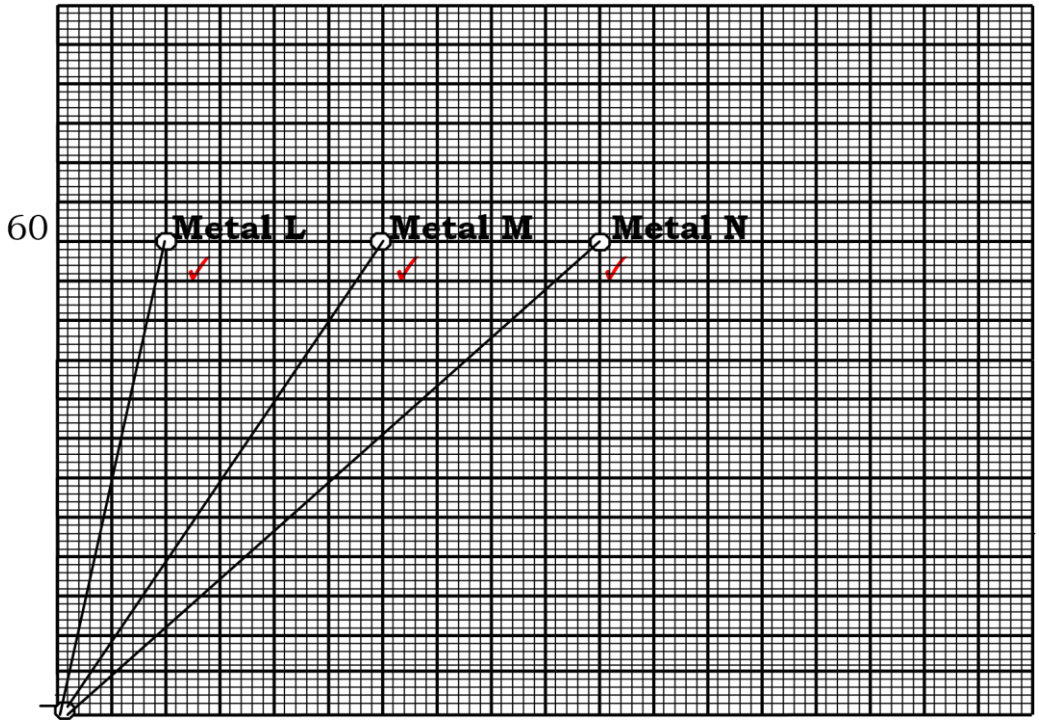
F.	**PRESENTATION OF DATA.** **RECORDING OF DATA.**	*The results is recorded in a suitable table below The graph of volume of FA1(Hydrochloric acid) against time taken for the reaction to stop plotted✓ 1PD The mass values are recorded to one decimal place✓ 1PD*	

TABLE, *OF RESULTS* **06**

Metal	L	M	N
Mass of metals weighed in grams	0,5	0.5	0.5
Volume of **FA1** added (cm^3)	50✓	50✓	50✓
Time taken for the bubbles to stop(minutes)	10	30	5

The above results is plotted in a graph below

A



GRAPH OF VOLUME OF HARD FA1 AGAINST TIME✓

Volume Of HCl✓ In cm^3

40

	20 0 ✓ 0 10 20 30 40 50 **Time taken in minutes**✓	
H. DATA ANALYSIS AND INTERPRETATION / CREATING MEANING	*A graph of Volume of hydrochloric acid against time for the bubbles of Hydrogen gas to stop from each metal to completely react shows that metal L reacts rapidly, metal M reacts moderately and metal N reacts very slowly and takes a longer time for bubbles to stop.*✓ *This implies that metal L is more reactive than metal M and N respectively.*✓	**02**
I. CONCLUSION AND RECOMMENDATION	*Basing on the above results, I therefore, recommend that Metal L be used for the production of hydrogen gas since it reacts with hydrochloric acid faster than metals N and M.*✓	**01**

ITEM4. ENTHALPY CHANGES *(ENTHALPY OF NEUTRALIZATION)*

An organization operating in fishing around Lake Kyoga organized a workshop to train local fish dealers on how to make common salt on a small scale which they can use to preserve fish fresh. This involved mixing sodium hydroxide and hydrochloric acid. During the training, a participant was randomly picked and instructed to add a prepared solution of an acid to a base solution in a container. The participant noted that the container became warmer as he kept on adding the acid. He could not understand why and how much heat had been generated.

Sodium hydroxide reacts with hydrochloric acid according to the following equation.

$$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)} + Heat$$

The heat produced varies with the volume of acid added to the base. The acid provided is labeled **BA1** and the base provided is labeled **BA2**. **Task:**

(a) As a learner of chemistry;

(i) Design an experiment you will carry out to determine the amount of heat, produced during reaction between **BA1** and **BA2** or produced when **BA1** is added to **BA2**.

S/N	BASIS OF ASSESSMENT	ASSESSMENT	SCORING
(a)(i) **A**	**AIM OF THE EXPERIMENT**	An experiment to determine the maximum heat produced during reaction of sodium hydroxide and hydrochloric acid or between **BA1** and **BA2** (student may start like this).	**02**
B	**VARIABLES OF THE EXPERIMENT**	(DV) Dependent variable: *Temperature of solution.* (IV) Independent variable: *Volume of acid added.* (CV) Controlled variable: *Volume of base fixed/volume of base measured.*	**03**
C.	**HYPOTHESIS**	The reaction between **sodium hydroxide** and **hydrochloric** acid **produces heat**. **Or** Reaction between sodium hydroxide and hydrochloric acid is **exothermic**.	**02**

D.	**PROCEDURE OF EXPERIMENT WITH RELEVANT MATERIALS**	3 20/25cm of **BA2** is pipetted into a plastic beaker and its initial temperature noted and recorded. The initial temperature of **BA1** is also noted and recorded and then filled into a burette and adjusted to the zero mark. **BA1** is added to **BA2** in the beaker at uniform intervals 3 3 of 5cm /10cm each time stirring and noting the highest temperature of the mixture for 3 3 3 seven readings upto 35cm /40cm /50cm .	**03**
E.	**RISKS AND MITIGATIONS**	– Swallowing of the base during pipetting. **Mitigation**: Use a pipette sucker or filler. Or stop sucking in as soon as solution goes past the mark. – Acid pouring on the skin or question paper. **Mitigation** Put on a lab coat, gloves, closed shoes. Dry the working table as soon as it is wetted by the chemical. Clean the thermometer before using in another solution to ensure no reaction occurs before mixing the **two** solutions. Handle glass ware with care to avoid accidents and breakages. **Risk**: Blockage of burette. **Mitigation:** Pipetting the base inside of acid to avoid blockages in the burette when the base reacts with carbon dioxide forming sodium carbonate. **Risk:** Breakage of thermometer **Mitigation:** Putting back the thermometer in its case/container after use. **Risk:** Spilling solutions on table **Mitigation:** Use a filter funnel for filling the funnel.	**02**

F.	**PRESENTATION OF DATA.** **RECORDING OF DATA.**	The results are recorded in the table below. Table of Results: Initial Temperature of **BA1**-25.0 ^{o}C Initial Temperature of **BA2**-27.5/28.0^{o}C Average Initial Temperature-26.25/26.5^{o}C Volume of **BA2 used** -25.0 cm^{3} Initial Temperature of **BA1**-25.0 ^{o}C Initial Temperature of **BA2**- 27.5/28.0^{o}C Average Initial Temperature-26.25/26.5^{o}C Volume of **BA2 used** -25.0 cm^{3}	**04**

TABLE, *OF RESULTS*

Volume of pipette = 25.0cm^{3} .

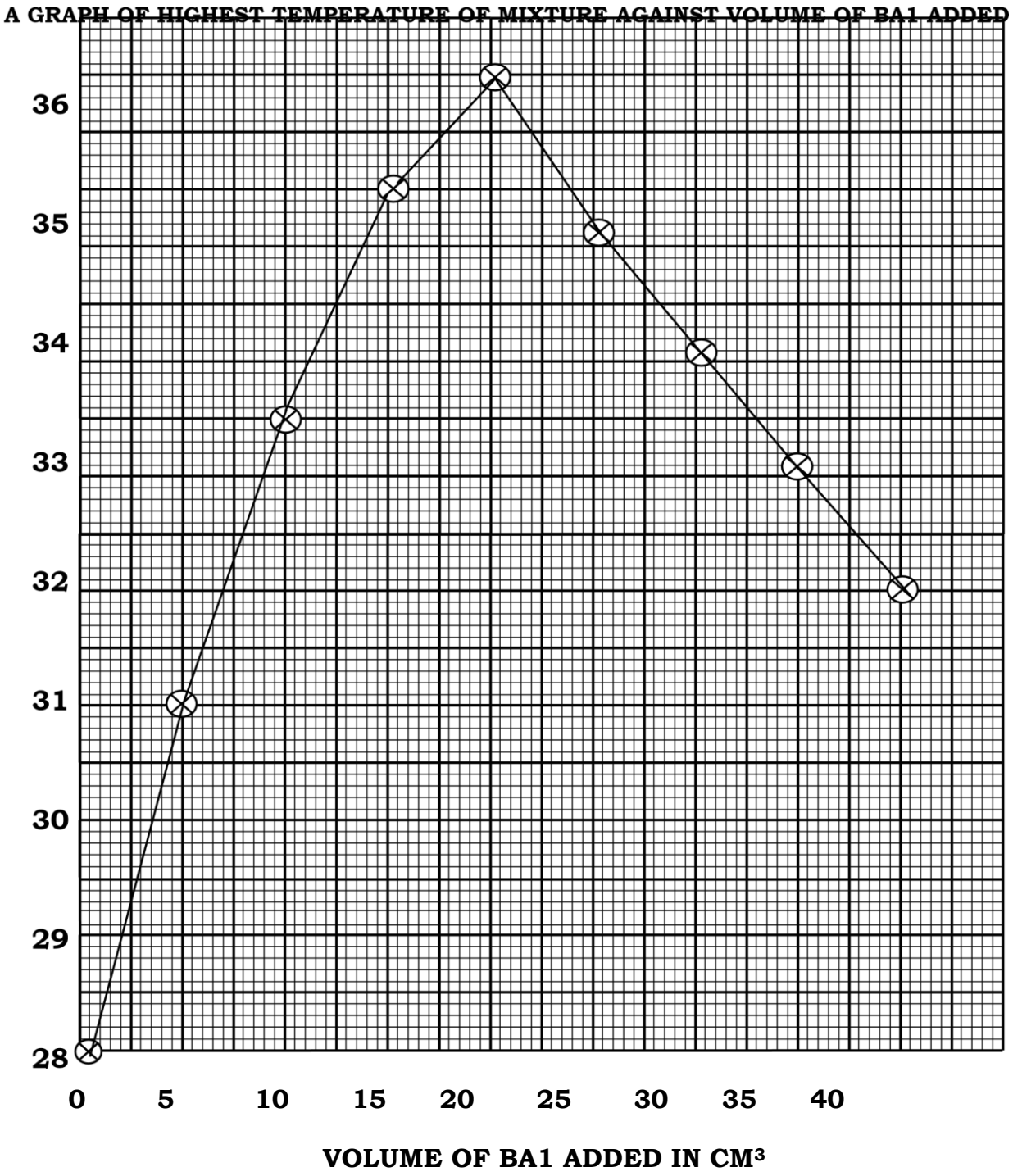
	Volume of BA1 added/cm^{3}	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**
	Highest temp of mixture/ ^{o}C.	**28.0**	**31.0**	**33.5**	**35.5**	**36.5**	**35.0**	**34.0**	**33.0**	**32.0**
	Temperature change.	**0.0**	**3.0**	**5.0**	**7.0**	**8.0**	**7.0**	**6.0**	**5.0**	**4.0**

03 **06**

Trend: Increasing and decreasing temperatures

H. DATA ANALYSIS AND INTERPRETATION/ CREATING MEANING	A graph of highest temperature against volume of **BA1** added was plotted as shown on graph paper. Heat evolved by reaction: = Heat gained by mixture. Heat evolved $=mC\theta$ Heat evolved =(20 +25) X 4.2 X (36.5 – 28.0) = -1,606.5 Jmol^{-1}.	**02**

II. CONCLUSION	Heat is evolved when sodium hydroxide reacts with hydrochloric acid. The maximum heat evolved when $25cm^3$ of sodium hydroxide is mixed with 20cm of hydrochloric acid is 1606. 5 $Jmol^{-1}$	**01**



NB: Other four alternative methods can be used (See UNEB Samples)

ITEM 5: RATES OF REACTION

The Military barracks urgently needs more supply of sulphur for the manufacture of gun powder at the military gun factory. You are provided with the following chemical solutions used for the production of sulphur;

BA1 which is sodium thiosulphate solution,

BA2 which is dilute hydrochloric acid

Sodium thiosulphate reacts with hydrochloric acid to form sulphur which makes the solution yellow according to the equation.

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

Task:

You are required to investigate how the rate of the reaction varies with temperature during the production of Sulphur and make your recommendations based on your experiment.

SOLUTION

Title/Aim: *An experiment to investigate the effect of increasing temperature on the rate of production of sulphur (rate of reaction)* *1A*

Hypothesis: *Increase in temperature of reaction increases the rate of production of Sulphur* *1H* ***Variables:***

Independent variable: *Temperature*

Dependent variable: *1V_2Time taken for the cross to disappear* *1V_1*

Control variable: *The Volumes of BA1 and BA2 are kept constant* *1V_3*

Requirements:

100cm^3 Measuring cylinders, 50cm^3 measuring cylinder, 250cm^3 conical flask, stop clock/watch, heat source, pen, plain paper, thermometer, solution BA1 and solution BA2.

Precautions: *Glass ware such as conical flask and thermometers should be handled with care to minimize injuries in case of breakages; acid and alkaline Solutions be handled with care to avoid pouring as they are corrosive and incase of splashes on skin wash it with running tap water* ***Procedure:***

a) *A cross(x) was made with a pen on a white paper, and placed on the table.* *1P*
b) *A 250cm^3 Conical Flask was Placed onto the cross.*
c) *Using a measuring cylinder, 50cm^3 of BA1 was transferred into the flask which is over the cross.*
d) *Using another measuring cylinder, 5.0cm^3 of BA2 was measured and added onto BAI in the conical flask and immediately started the stop clock/watch, the mixture was shaken and conical flask placed back over the cross. The temperature of the mixture was noted and recorded.*
e) *The cross was viewed from above through the mixture, and the time taken for the yellow coloration to just make the cross invisible was noted and recorded.*

(This is the time in seconds for the reaction to occur at room temperature).

f) *A fresh 50cm^3 of BA1 was transferred into a clean conical flask and the solution heated to 30°C.*

g) *5.0cm³ of BA2 was added to the hot solution and at the same time started the stop-clock (watch). The mixture was shaken to mix and the flask placed back over the cross.*

h) *Looked at the cross from above through the mixture.*

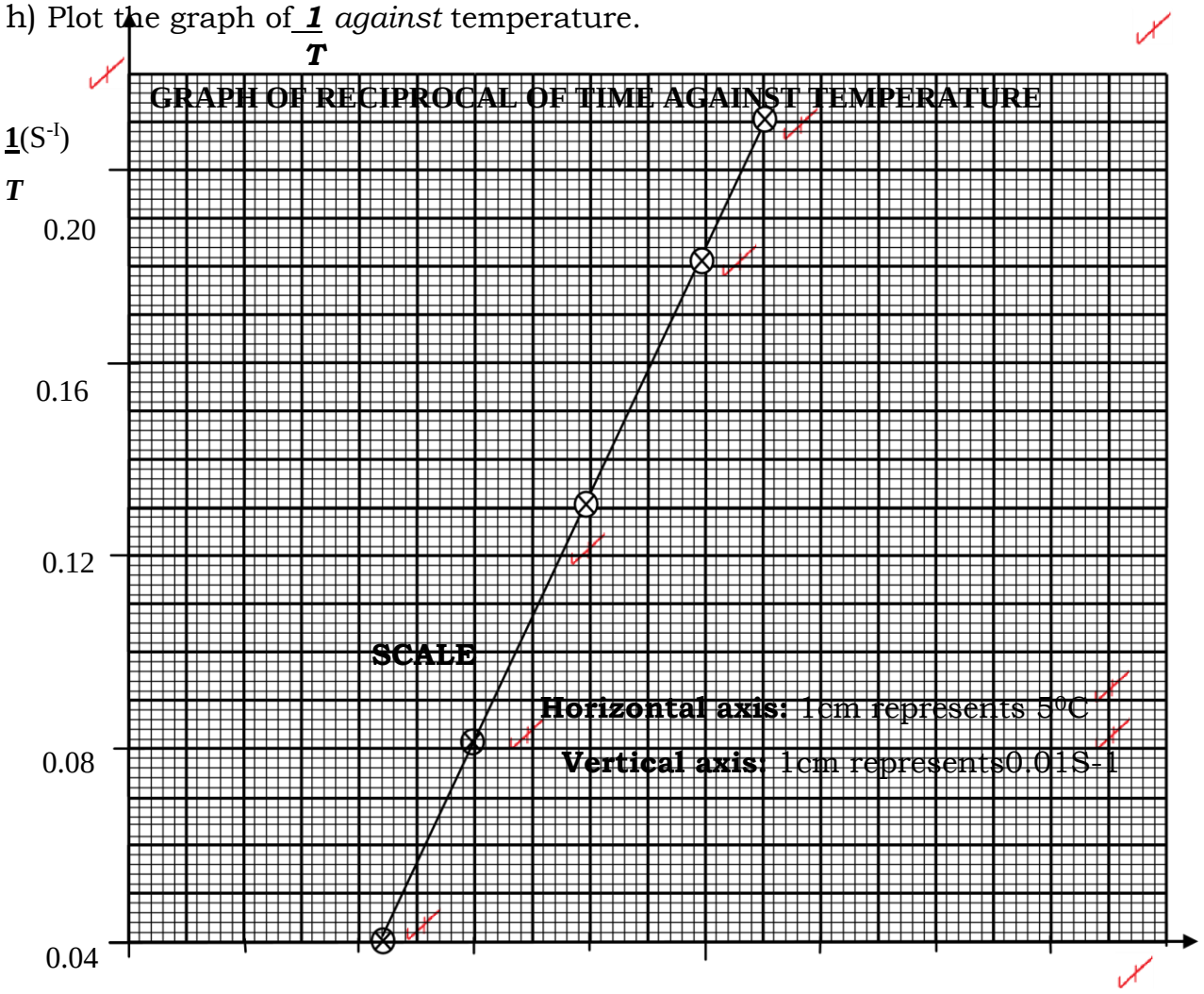
i) *Noted and recorded the time, t, taken for the yellow coloration to just make the cross invisible (The time, in seconds for the reaction to occur at 30°C).*

j) *Procedure (f) to (i) is repeated for temperatures 40, 50 and 60°C respectively. The results are Recorded in the table below;*

Temperature	Room temperature 22	30	40	50	60
Time t for yellow coloration to cover the cross (s)	27.0	12.0	8.0	6.0	4.5
$\frac{1}{T}$ (S^{-1})	0.04	0.08	0.13	0.17	0.22

g) Calculate the reciprocal of time $\frac{1}{T}$ for each temperature and record it in the table above

h) Plot the graph of $\frac{1}{T}$ *against* temperature.



0 10 20 30 40 50 60 **Temperature in ^{0}C)**

Conclusion

i) ***State how the rate of the reaction varies with temperature.***

Basing on the above results, the rate of reaction is directly proportional to temperature or the rate of reaction increases with increase in temperature which is in agreement with the hypothesis stated above.

Recommendations:

Basing on the above hypothesis, I therefore recommend that the military factory should increase the temperature of reaction of mixture of thiosulphate and acid in order to increase faster production of sulphur

ITEM 5. RATES OF REACTIONS

Most health centers in Uganda use sulphur for the treatment of skin conditions by mixing it with other substances. Due to large number of patients, there is high demand to increase sulphur production by increasing the concentration of chemicals used to produce sulphur. You are required to investigate the rate of reaction between sodium thiosulphate and hydrochloric acid at different concentrations.

You are provided with the following solutions used for sulphur production;

BA1 which is sodium thiosulphate solution,

BA2 which is hydrochloric acid solution,

Sodium thiosulphate reacts with hydrochloric acid as follows: **$S_2O_3^{2-}$ (aq) + 2H (aq) ———— H_2O (I) + SO_2 (g) + S(s)**

TASK:

You are required to investigate the effect of concentration on the rate of the reaction above. You are to do this by noting the time taken for the yellow coloration to appear in the mixture as sulphur (yellow coloration) is formed according to the above equation.

Carry out the investigation and write a report about your findings

Response

PROPOSED RESPONSE

Aim of the experiment:

An experiment to investigate the effect of concentration on rate of reaction between BA1 and BA2 solutions; 1A

Hypothesis: *Increase in concentration of BA1 increase rate of reactions leading to the faster disappearance of the cross "X";* 1H **Variables of the experiment:**

(i) Manipulated variable: Concentrations of BA1 (sodium thiosulphate solution); 1MV

(ii) Responding Variable: Time of the disappearance of the cross "X"; 1RV

(iii) Controlled variable: Temperature and volume of sodium thiosulphate solution and hydrochloric acid; 1CV

d) List of Apparatus and Materials

Measuring cylinders (50cm^3 and 10cm^3); 1LM five Conical flasks (250cm^3), filter paper stop watch, distilled water, solutions BA1 and solution BA2; 1LM thermometer burette;

e) Procedure of the experiment:

(i) Five conical flasks were arranged labeled 1, 2, 3, 4, and 5; *1p*

(ii) To flasks 2 to 5 was added 5, 10, 15, 20cm^3 of distilled water respectively, to make the total volume of the solution in each flask (1-5) up to 25cm^3 by adding 25, 20, 15, 10, 5cm^3 of BA1 respectively; *1p*

(iii) A small cross was marked on a filter paper with a pen; *1p*

(iv) 5.0cm^3 of BA2 was released from the burette to the first flask and simultaneously started a Stop clock (watch). Shaken to mix and placed back the flask over the cross; *1p*

(v) The cross is viewed from above through the mixture: 1p

(vi) Noted and recorded the time taken for the yellow coloration to make the cross invisible (disappear); *1p*

(vii) Procedures d) and e) were repeated for the other four flasks; 1p

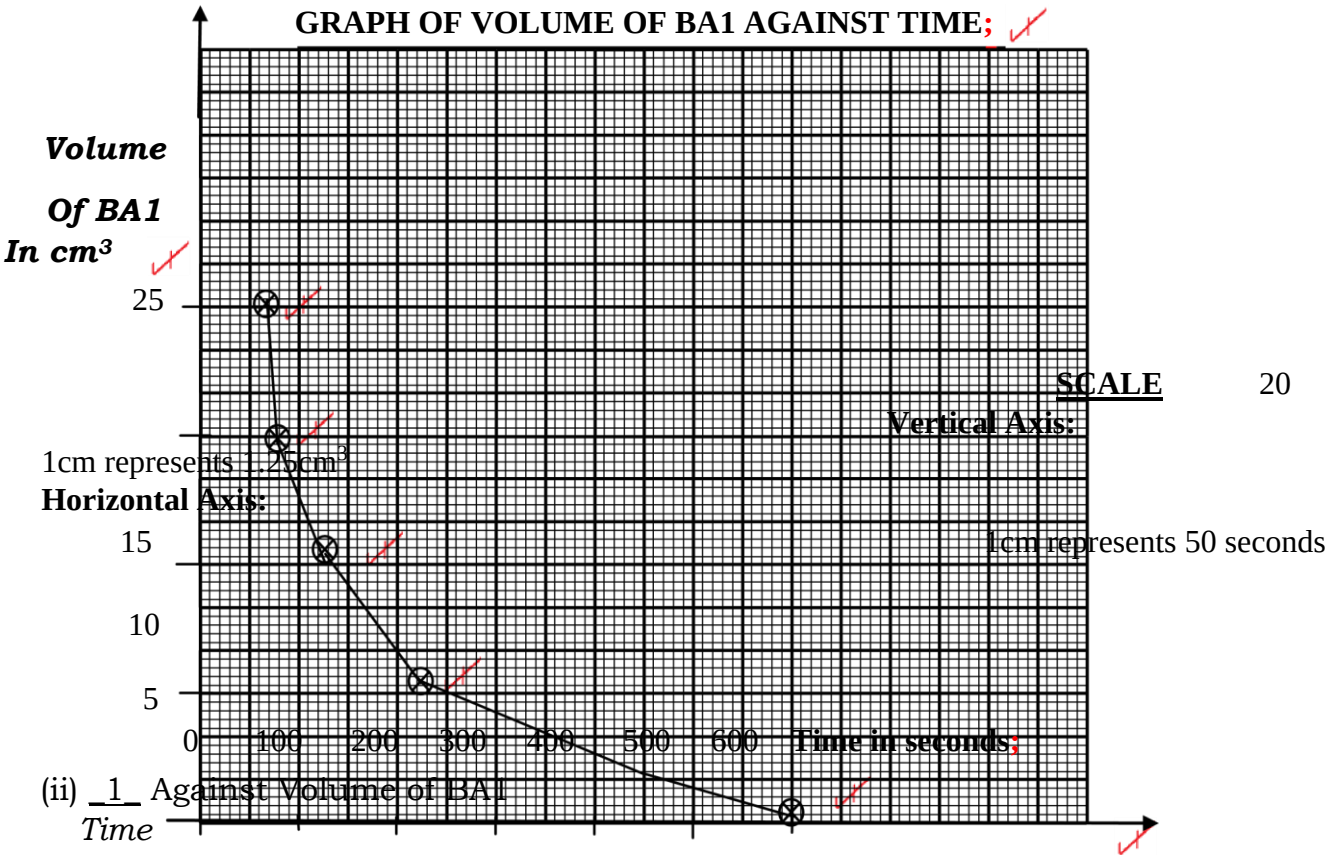
f) Results: The results were tabulated as below

Flask Number	1	2	3	4	5
Volume of water added (cm^3)	0	5	10	15	20
Volume of thiosulphate BA1 added (cm^3)	25	20	15	10	5
Volume of BA2 added from burette (cm^3)	5.0	5.0	5.0	5.0	5.0
Time (*T*) taken for the cross to disappear(s)	60	75	130	230	600

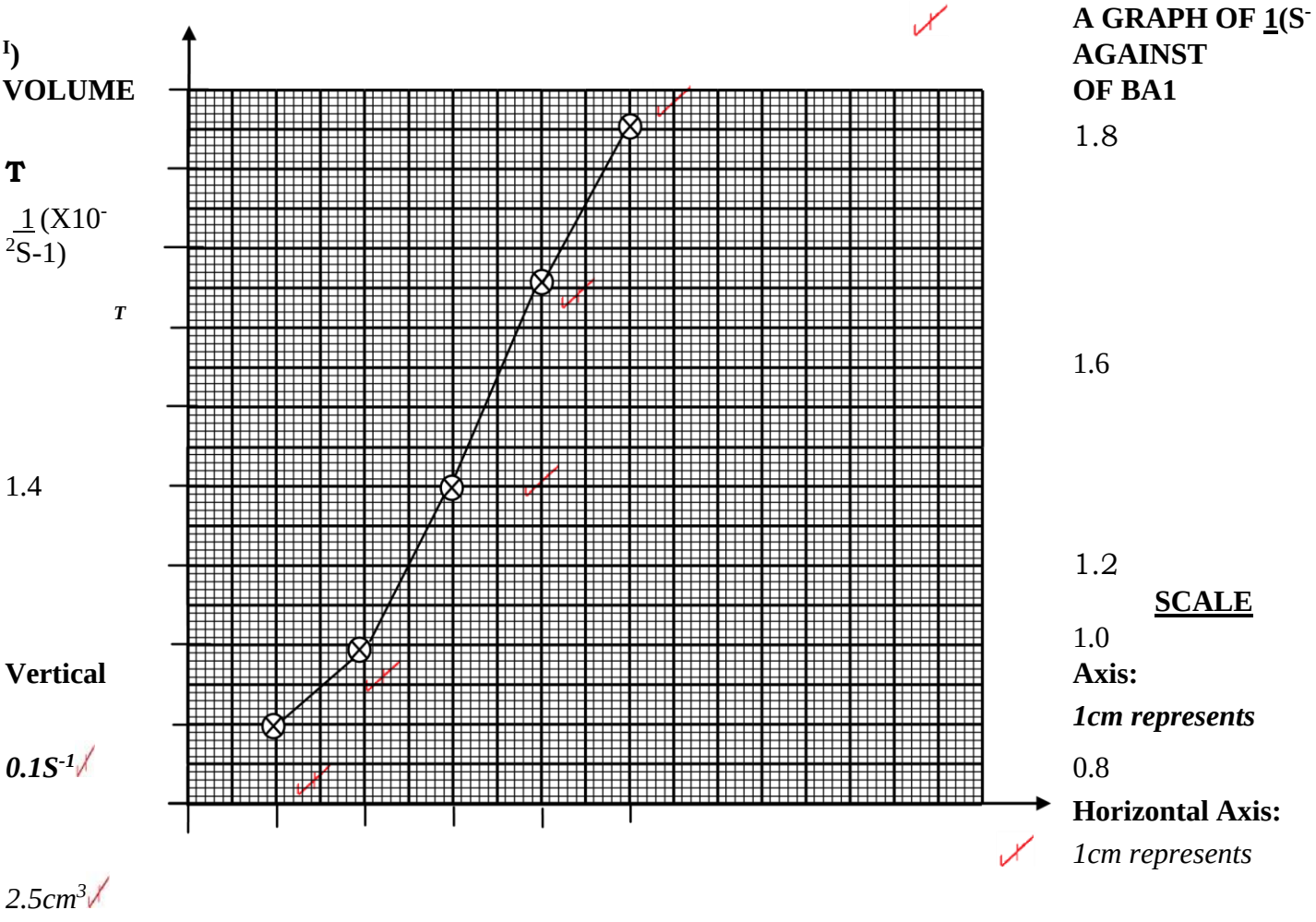
$\frac{1}{T}$ (S-1)	0.017	0.013	0.008	0.004	0.002

a) The reciprocal of time ($\frac{1}{T}$) for each flask was calculated and values recorded in the table above?

b) (i) Plot a graph of volume of BA1 according to the values obtained from table?



(ii) $\frac{1}{Time}$ Against Volume of BA1



iii) Determine the slope of the graph in b(ii) and state its units.

Slope = Change in vertical axis

Change in Horizontal axis

$= \frac{1.7-0.4}{25-10} = \frac{1.3}{15}$

Slope = 0.09 s^{-1} cm^3 iv) What conclusion can you make from the slope determined in C (i)?

CONCLUSION

The slope gives the rate at which the reaction proceeded and therefore this implies that;

The higher the concentration of sodium thiosulphate, (Solution BA1), the faster the rate of reaction leading to the faster rate of disappearance of the cross and therefore this is in agreement with the suggested hypothesis. that was stated earlier.

OTHER SCENARIOS FOR TRIALS

ITEM 6:

Nalemu is a resident of Morulem Village in Abim district of North Eastern Uganda. She washes clothes for people as her main income earning job. Her customers have often complained of chalky spots that remain in their clothes after washing and she mostly likely to lose most of her customers. Her friend Apio informed her that she can buy washing soda and always add to water before washing, however she does not know the quantity of washing soda to be added. Nalemu uses 5 jerry cans of each 20 litres of water every day.

You have been provided with,

BA1: Which is washing soda (sodium carbonate solution);

Mineral in water sample reacts with washing soda according to the equation.

MgSO4 (aq) + Na2CO3 (aq) ⟶ ***MgCO3(s) + Na2SO4 (aq)***

Tasks.

(a) Plan and design a scientific investigation to guide Aketch on required amount of washing soda.

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_____ **ITEM 7**

Local people of Nakasongola district usually face shortage of water for domestic use during the dry season. The only water reserves during this period are the valley dams. Water inn these dams usually cost the people a lot of soap to form lather when using it. Water collected from the dams contains dissolved minerals of both calcium sulphate and magnesium hydrogen carbonate. Washing soda is a commercially available solution that the local people may buy to overcome the challenges. Each day the local people use a minimum of 20 litres per day.

FA1: Which is solution of washing soda.

FA2 Which is water sample obtained from one of the valleys in the area. FA1 reacts with FA2 according to the equation.

[CaSO4 (aq) and MgHCO3)2 (aq)]+ Na2 CO3 (aq) ⟶ **CaCO3(s) + Na2 SO4 (aq) + unreacted (MgHCO3)2 (**

Task.

(a***) Plan and design an experiment to guide local people on amount of washing soda needed per day.***

ITEM 8

Activity
In this experiment, you will determine the enthalpy of neutralization of Hydrochloric acid by sodium hydroxide using thermometric titration
You are provided with the following;
BA1 which is sodium hydroxide solution
BA2 which is Hydrochloric acid solution
In groups of five, you are required to determine enthalpy of Neutralization of acid and base.

Title/Aim: *An experiment to determine the enthalpy of Neutralization between a base BA1 and an acid BA2* **Hypothesis:**

Variables:

Independent variable: *Volumes of solutions of BA1 and* **Dependent Variable:** *Temperature of solutions*
Control Variable: *Volume of BA2*
Materials/Requirements:

Precautions/Risks and ways of mitigating the riske

Procedure:
I. Transfered 5.0cm^3 of **BA1** into a plastic beaker using a measuring cylinder.

Noted its temperature T_1 and also measured and recorded temp T_2 of **BA2** II.

Filled the burette with **BA2.**

III. 5.0cm^3 of **BA2 from the burette** was run into **BA1** in the plastic beaker.

IV. Gently stired with the thermometer and recorded the highest temperature of the solution mixture in the plastic beaker.

V. The Plastic beaker was washed and experiments III to IV repeated for volumes of BA1; 10, 15, 20, 25, 30 and 35cm^3.

VI. Maximum temperature was observed every time and recorded in the table of results below

Results:

Initial temperature of acid, T_1 = _____ Initial temperature of Base, T_2 = _____ **Table of results:**

Experiment number	1	2	3	4	5	6	7
Volume of **BA_2** (cm^3)	0	10	15	20	25	30	35
Volume of **BA1** (cm^3)	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Temperature **T** (in ^{0}C)							

Questions

a) Explain why a plastic beaker was used instead of a glass beaker during the experiment?

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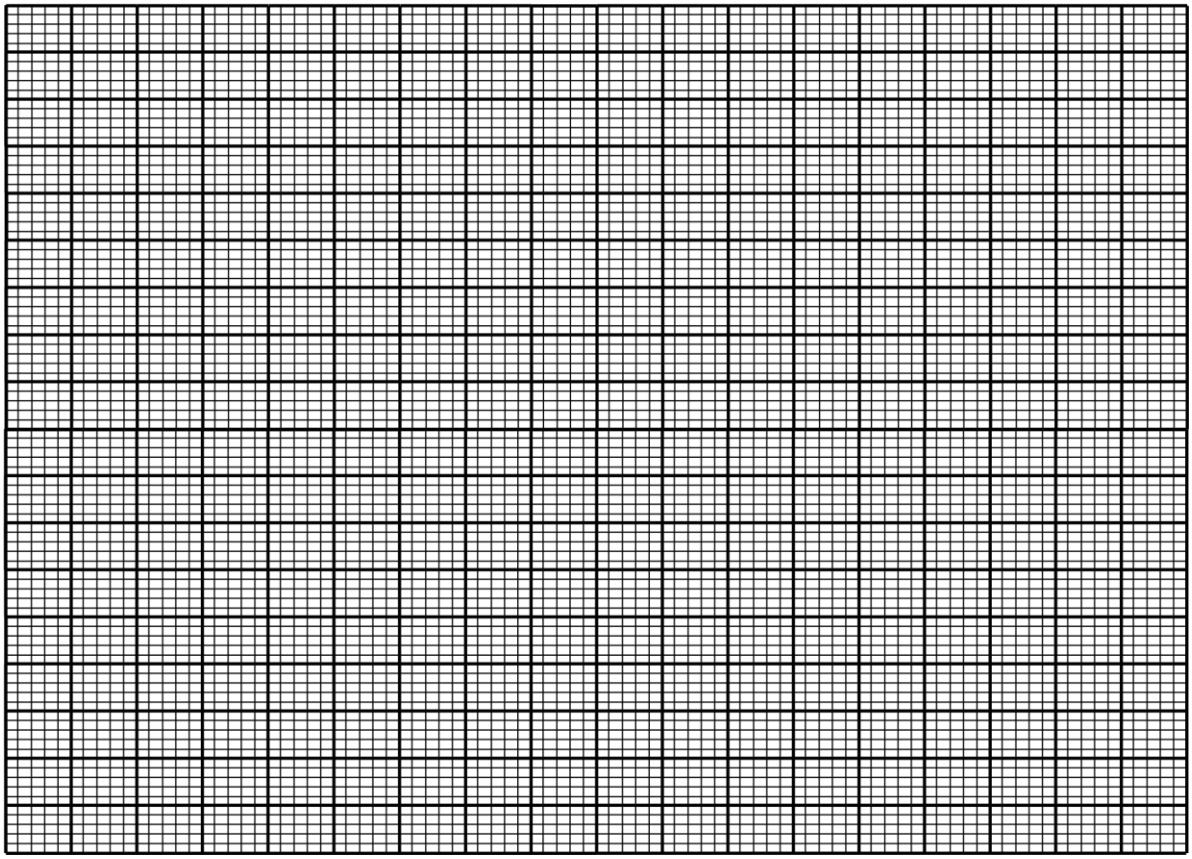
_____

b) Plot a graph of temperature (**T**) against Volume of **BA2**



c) (i) From the graph determine the volume of BA2 required to neutralize 50cm^3 of **BA1**

(ii) Determine the maximum Temperature change

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ITEM 9

In Uganda, Tobacco growing is done widely in West Nile Region of Arua. However, most suitable fertilizers in tobacco farms is potassium sulphate fertilizer. Potassium sulphate fertilizer is prepared by reacting a base and an acid according to the following equation.

Government supplied farmers with nitric acid and potassium hydroxide solution to make fertilizer in preparation for other seasons. During mixture, the plastic container that was being used became hot. The farmer also are still bothered on how much potassium hydroxide and sulphuric acid to use for preparation. The equation for the reaction accurred as below;

$2KOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow K_2SO_{4(aq)} + 2H_2O_{(l)} + heat$

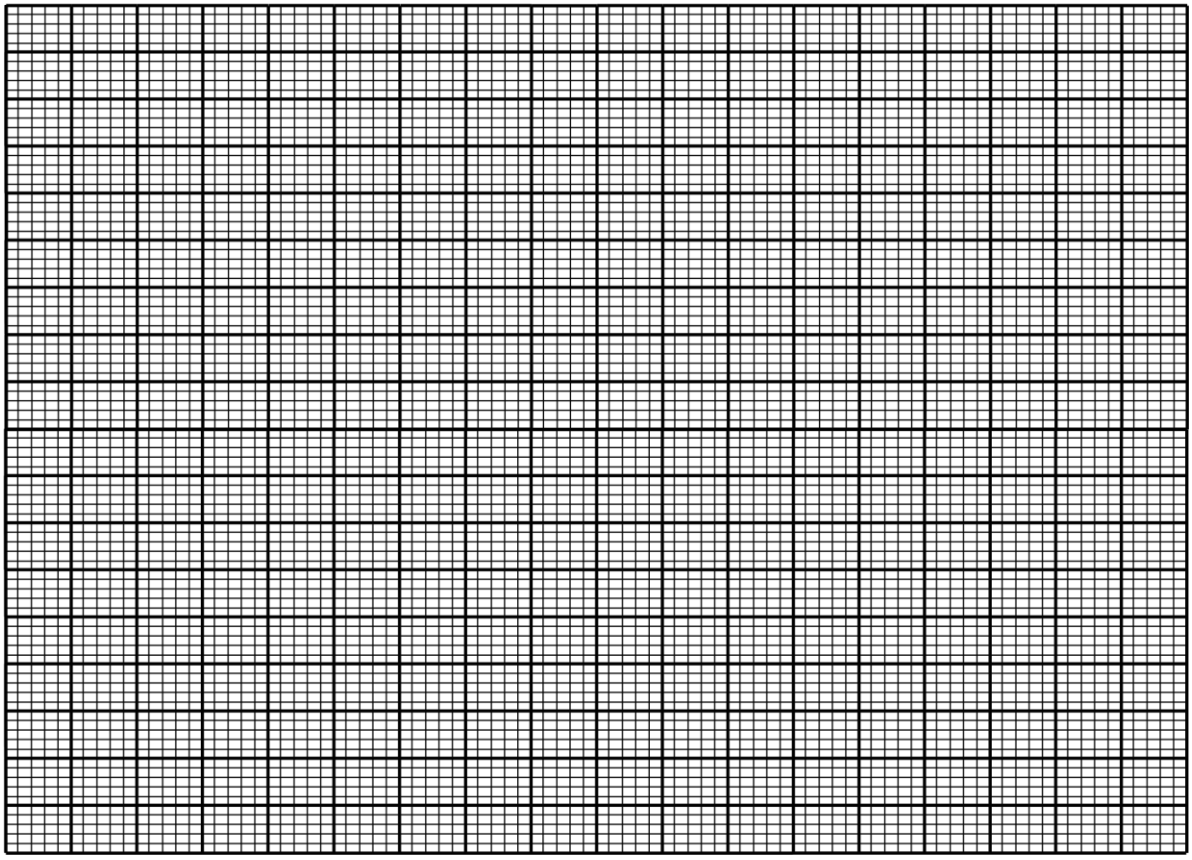
You are provided with the following;

BA1: which is a solution of sulphuric acid

BA2: which is a solution of potassium hydroxide

Task:

(a) Plan an investigation using a fixed volume of BA2 to advise the local farmers on the volume of BA1 required for complete formation of potassium sulphate fertilizer from 0,10,15,20,25,30,35,40,45,50,55,60cm^3 of BA1.



ITEM 10
ACTIVITY 1

In this experiment, you will investigate the effect of adding a more reactive metal to copper (II) Sulphate solution.
You are provided with the following; Solid **D** which is zinc powder;

FA1: which is copper (ii) sulphate solution; Plastic Beaker, stop clock/watch and thermometer. **Aim of Experiment:**

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_____

_____

Hypothesis of experiment:

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_____

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Variables of experiment

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_____

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Materials/Requirements for the experiment:

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Procedure

(a) Using a measuring cylinder 30cm^3 of copper (II) sulphate solution was measured into a plastic beaker; and stired gently with a thermometer and the temperature T_1 of the solution was recorded.

(b) I Added 2g of Zinc powder to the copper (II) sulphate solution, and start the stop watch, stired the mixture and recorded the temperature of the mixture every after a minute

Risks and ways of mitigating them

_____

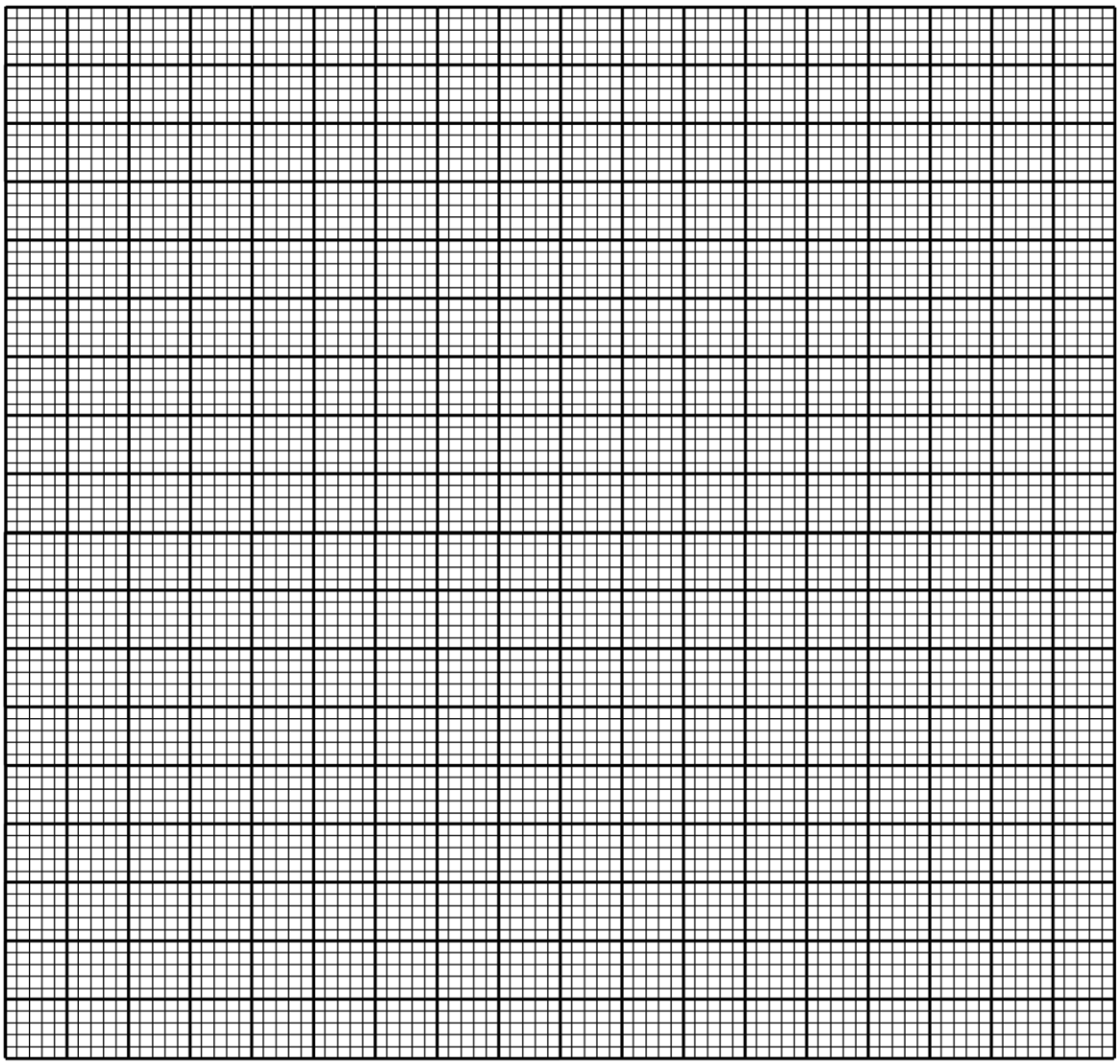
_____

_____

Complete the table of Results below

Time (minutes)	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Temperature T_1(^{0} C)											
Reciprocal of time1/t (S^{-1})											

a) Plot a graph of temperature against Time



a) From the graph determine the maximum temperature $\Delta T_{Max;}$ and thus temperature change T_2

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c) Write the ionic equation of the reaction of zinc and copper (ii) sulphate

_____

Give a reason why the plastic beaker was used instead of a glass one?

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ITEM 11

Iron sulphate is used in the hospital for treatment of deficiencies and anemic patients in children below ten years. During its production, in the pharmaceutical factories, heat is usually evolved and the plastic containers become hot. The security guard is interested in knowing why plastic containers used become hot? You are provided with the following;

BA1 which is a solution containing 45g/l of hydrated copper (ii) sulphate ($CuSO_4 .5H_2O$)
Solid **T** which is iron metal **Task:**
You are to determine the enthalpy of displacement of Copper by iorn metal

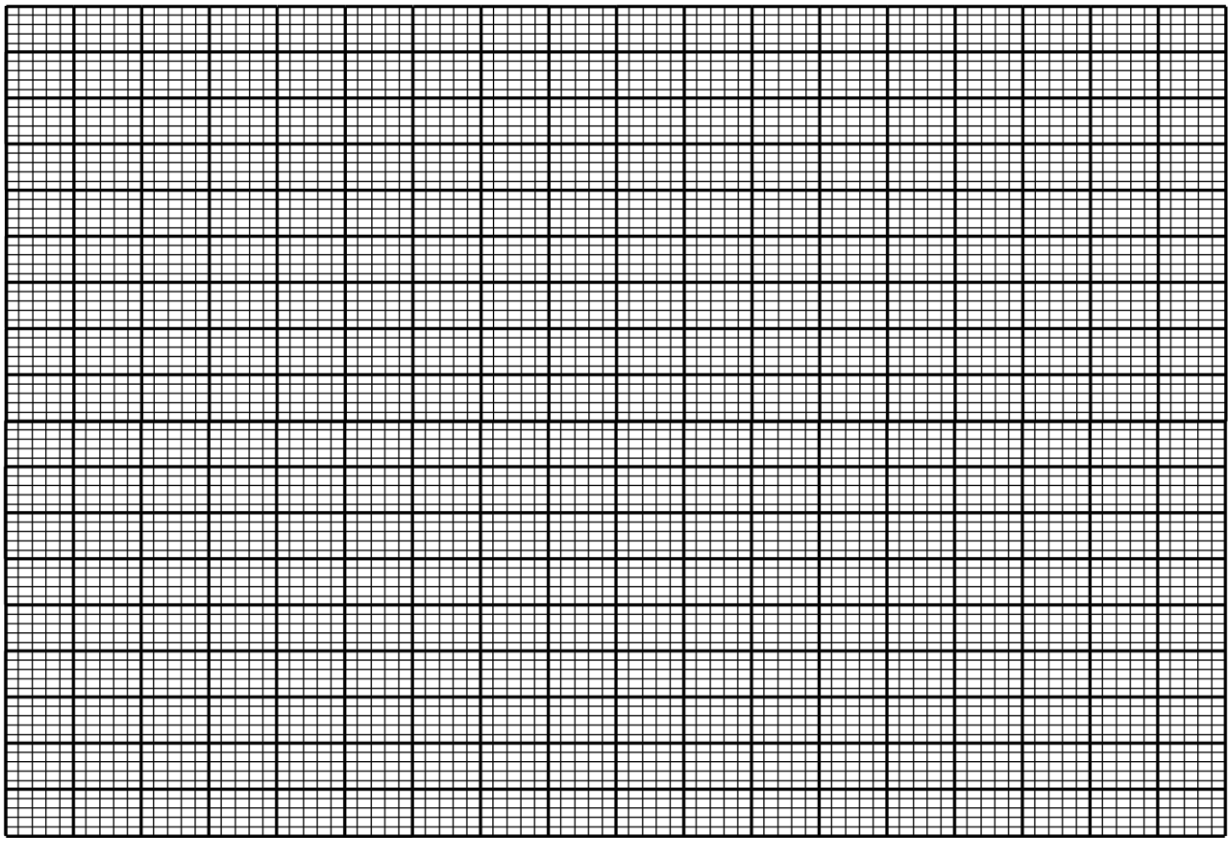
(a) Plan a scientific investigation and explain to the security guard why the heat is evolved and why glass vessels are not used

_____

(b) Show how you conducted the investigation?

_____

(c) Show treatment of your results and use the graph provided in your treatment of results



(d) Draw possible conclusion(s) and explanations to the security guard from your results.

_____

END