

**545/2&3 Inst. Sch.  
CHEMISTRY  
PRACTICAL  
INSTRUCTIONS  
2024**



**UGANDA NATIONAL EXAMINATIONS BOARD**

**Uganda Certificate of Education**

**CHEMISTRY PRACTICAL INSTRUCTIONS**

**545/2&3 Inst. Sch.**

***CONFIDENTIAL***

**This information is given only to facilitate preparation of examination.**

**Great care should be taken that the information given below does not reach the candidates either directly or indirectly.**

**INSTRUCTIONS FOR PREPARING CHEMICALS AND APPARATUS**

The head teacher **must** ensure that the teacher responsible for preparing the chemicals and apparatus hands in his/her trial results properly sealed in a separate envelope and **firmly** fastened (attached) to the candidates' scripts envelop(s).

1. The description of the reagents and chemicals specified below does **not** necessarily correspond with the description in the question paper. Candidates must **not** be informed of the differences.
2. Candidates are **not** allowed to use reference books (i.e. text books, booklets on qualitative analysis etc.) during examination.
3. In addition to the fittings and substances ordinarily contained in a chemistry laboratory, each candidate will require:
  - 2 plastic beakers.
  - 1 thermometer.
  - 1 measuring cylinder of  $50\text{cm}^3$  or  $100\text{ cm}^3$ .
  - 1 burette.
  - 2 conical flasks.
  - 6 test tubes.
  - 1 pipette of  $25.0\text{cm}^3$  or  $20.0\text{cm}^3$ .
  - 1 stop clock.
  - 5 labels.

**100 cm<sup>3</sup>** of distilled water.

**50 cm<sup>3</sup>** of BA1.

**250 cm<sup>3</sup>** of BA2. Easy access to:
  - Heat source.
  - Phenolphthalein and methyl orange indicators.

**BA1** is prepared by diluting  $112\text{cm}^3$  of concentrated hydrochloric acid ( $1.18\text{g/cm}^3$ , 36%) acid with distilled water to make one litre of solution.

**BA2** is prepared by dissolving **80g** of **Q**, to make one litre with distilled water.

**Q**, will be provided by **UNEB**.

**This information MUST be completed and returned in a separate envelope firmly attached to the script envelope(s).**

# **UGANDA CERTIFICATE OF EDUCATION**

2024

# **REPORT ON CHEMISTRY PRACTICAL 545/2&3**

## **Section I:**

Any information which the teacher responsible for preparing the apparatus thinks may be useful to the examiners should be given on this sheet. The teacher must try the items and submit his/her results in the space provided below to guide the examiners about the apparatus and concentrations of the chemicals used.

**NB:** Teachers who **DO NOT** submit their trial results will be held responsible for their candidates' performance.

## Results:

## **Section II:**

The Invigilator in consultation with the teacher responsible for preparing the apparatus should give details below of any difficulties experienced by particular candidates, giving their names and personal numbers. This should include reference to:

- (a) difficulties due to faulty apparatus,

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- (b) accidents due to apparatus or materials,

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- (c) physical handicaps of candidates,

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- (d) any other information.

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Other cases of hardship e.g. illness, disability, should be reported directly to UNEB in the normal way.

**A plan of work benches, giving details by personal numbers of the places occupied by the candidates for each session, must be enclosed with the scripts.**

**DO NOT STAMP ANYWHERE ON THIS DOCUMENT.**

Invigilator's Name \_\_\_\_\_ Signature \_\_\_\_\_

Signature of the teacher responsible for preparing chemicals \_\_\_\_\_

Signature of the head teacher \_\_\_\_\_

Random Number \_\_\_\_\_

**545/2**  
**CHEMISTRY**  
**Paper 2**  
**2024**



**UGANDA NATIONAL EXAMINATIONS BOARD**

**Uganda Certificate of Education**

**CHEMISTRY**

**Paper 2**

*New Lower Secondary Curriculum*

***SCORING GUIDE***

## 545/2 - CHEMISTRY SAMPLE PAPER SCORING GUIDE

### ITEM 1:

S/N	Basis of Assessment	Assessment Criteria	Scoring
(a) (i) A.	<b>AIM OF THE EXPERIMENT</b>	An experiment to determine the maximum heat produced during reaction of sodium hydroxide and hydrochloric acid or between <b>BA2</b> and <b>BA2</b> (student may start like this).	02
B.	<b>VARIABLES OF THE EXPERIMENT</b>	(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.	<b>HYPOTHESIS</b>	The reaction between <b>sodium hydroxide</b> and <b>hydrochloric acid produces heat</b> .  <b>Or</b> Reaction between sodium hydroxide and hydrochloric acid is <b>exothermic</b> .	02
D.	<b>PROCEDURE OF EXPERIMENT WITH RELEVANT MATERIALS</b>	20/25cm <sup>3</sup> of <b>BA2</b> is pipetted into a plastic beaker and its initial temperature noted and recorded. The initial temperature of <b>BA1</b> is also noted and recorded and then filled into a burette and adjusted to the zero mark. <b>BA1</b> is added to <b>BA2</b> in the beaker at uniform intervals of 5cm <sup>3</sup> /10cm <sup>3</sup> each time stirring and noting the highest temperature of the mixture for seven readings upto 35cm <sup>3</sup> /40cm <sup>3</sup> /50cm <sup>3</sup> .	03

S/ N	Basis of Assessment	Assessment Criteria	Scoring								
E.	<b>RISKS AND MITIGATIONS</b>	<ul style="list-style-type: none"> <li>– Swallowing of the base during pipetting. <b>Mitigation:</b> Use a pipette sucker or filler. Or stop sucking in as soon as solution goes past the mark.</li> <li>– Acid pouring on the skin or question paper. <b>Mitigation</b> 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 <b>two</b> solutions. Handle glass ware with care to avoid accidents and breakages.</li> <li><b>Risk:</b> Blockage of burette. <b>Mitigation:</b> Pipetting the base inside of acid to avoid blockages in the burette when the base reacts with carbon dioxide forming sodium carbonate.</li> <li><b>Risk:</b> Breakage of thermometer <b>Mitigation:</b> Putting back the thermometer in its case/container after use.</li> <li><b>Risk:</b> Spilling solutions on table <b>Mitigation:</b> Use a filter funnel for filling the funnel.</li> </ul>	02								
F.	<b>PRESENTATION OF DATA.</b>	<p>The results are recorded in the table below.</p> <p><u>Table of Results:</u></p> <table> <tbody> <tr> <td>Initial Temperature of <b>BA1-</b></td> <td>25.0 °C</td> </tr> <tr> <td>Initial Temperature of <b>BA2-</b></td> <td>27.5/28.0 °C</td> </tr> <tr> <td>Average Initial Temperature-</td> <td>26.25/26.5 °C</td> </tr> <tr> <td>Volume of <b>BA2 used -</b></td> <td>25.0 cm<sup>3</sup></td> </tr> </tbody> </table>	Initial Temperature of <b>BA1-</b>	25.0 °C	Initial Temperature of <b>BA2-</b>	27.5/28.0 °C	Average Initial Temperature-	26.25/26.5 °C	Volume of <b>BA2 used -</b>	25.0 cm <sup>3</sup>	04
Initial Temperature of <b>BA1-</b>	25.0 °C										
Initial Temperature of <b>BA2-</b>	27.5/28.0 °C										
Average Initial Temperature-	26.25/26.5 °C										
Volume of <b>BA2 used -</b>	25.0 cm <sup>3</sup>										

	<b>RECORDING OF DATA.</b>	Initial Temperature of <b>BA1</b> - 25.0 °C Initial Temperature of <b>BA2</b> - 27.5/28.0 °C Average Initial Temperature- 26.25/26.5 °C Volume of <b>BA2</b> used - 25.0 cm <sup>3</sup>	04
		<b>TABLE, T<sub>1</sub></b> <b>Volume of pipette= 25.0cm<sup>3</sup>.</b>	
G.	<b>Volume of BA1 added / cm<sup>3</sup>.</b>	0      5      10      15      20      25      30      35      40	
	<b>Highest temp. of mixture/ °C.</b>	28.0      31.0      33.5      33.5      36.5      35.0      34.0      33.0      32.0	04
	<b>Temperature change.</b>	0.0      3.0      5.0      7.0      8.0      7.0      6.0      5.0      4.0	04
		Trend: Increasing and decreasing temperatures.	

## ALTERNATIVE METHODS

**TABLE, T<sub>2</sub>**

<b>Volume of BA1 added / cm<sup>3</sup>.</b>	0	10	20	30	40	50
<b>Highest temp. of mixture/ °C.</b>	27.5	33.0	37.0	34.5	33.0	32.5
<b>Temperature Change</b>	0.0	5.5	9.5	7.0	5.5	5.0

Volume of **BA2** used = 20.0cm<sup>3</sup>.

**TABLE, T<sub>3</sub>**

<b>Volume of BA1 added / cm<sup>3</sup>.</b>	0	5	10	15	20	25	30	35
<b>Highest temp. of mixture/ °C.</b>	27.0	31.0	34.0	36.0	35.0	33.5	32.5	31.5
<b>Temperature Change</b>	0	4.0	7.0	9.0	8.0	6.5	5.5	4.5

**TABLE, T4**

<b>Volume of BA1 added / cm<sup>3</sup>.</b>	<b>0</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>
<b>Highest temp. of mixture/ °C.</b>	<b>26.0</b>	<b>34.0</b>	<b>35.5</b>	<b>33.0</b>	<b>32.0</b>	<b>30.5</b>
<b>Temperature Change</b>	<b>0</b>	<b>8.0</b>	<b>9.5</b>	<b>7.0</b>	<b>6.0</b>	<b>4.5</b>

S/N	Basis of Assessment	Assessment Criteria	Scoring
(a) (ii) H.	<b>DATA ANALYSIS AND INTERPRETATION/ CREATING MEANING</b>	<p>A graph of highest temperature against volume of BA1 added was plotted as shown on graph paper.</p> <p>Heat evolved by reaction:</p> $= \text{Heat gained by mixture.}$ $= mC\theta.$ <p>Graph 1, (G1):</p> <p>Heat evolved</p> $= (20 + 25) \times 4.2 \times (36.5 - 28.0)$ $= -1,606.5 \text{ J mol}^{-1}.$ <p>Graph 2, (G2):</p> <p>Heat evolved</p> $= (20 + 25) \times 4.2 \times (37.0 - 27.5)$ $= -1,795.5 \text{ J mol}^{-1}.$ <p>Graph 3, (G3):</p> <p>Heat evolved</p> $= (20 + 15) \times 4.2 \times (36.0 - 27.0)$ $= -1,323 \text{ J mol}^{-1}.$ <p>Graph 4, (G4):</p> <p>Heat evolved</p> $= (20 + 20) \times 4.2 \times (35.5 - 26.0)$ $= -1,596 \text{ J mol}^{-1}$	03

(b) I.	<b>CONCLUSION</b>	Heat is evolved when sodium hydroxide reacts with hydrochloric acid. The maximum heat evolved when $25\text{cm}^3$ of sodium hydroxide is mixed with $20\text{cm}$ of hydrochloric acid is $1606.5 \text{ Jmol}^{-1}$ .	01
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### **ALTERNATIVE METHOD:**

S/N	<b>Basis of Assessment</b>	<b>Assessment Criteria</b>	<b>Scoring</b>
	<b>PROCEDURE OF EXPERIMENT</b>	<p><b>(VARIABLES INTERCHANGED)</b></p> <p>(a) All the <b>BA1</b> provided (<math>50\text{cm}^3</math>) was diluted by adding an equal volume of water (<math>50\text{cm}^3</math>) to form <math>100\text{cm}^3</math> of solution. The resultant solution was labelled <b>BA3</b>. Its initial temperature is noted.</p> <p>(b) <math>20\text{cm}^3</math> of <b>BA3</b> was measured using a measuring cylinder into a plastic beaker followed by <math>5\text{cm}^3</math> of <b>BA2</b> and the mixture stirred. The highest temperature of the mixture is noted and recorded.</p> <p>(c) Procedure (b) is repeated for values of <b>BA2</b> equal to <math>10, 15, 20</math> and <math>25 \text{ cm}^3</math>. The results are then entered in the table below.</p>	03
	<b>PRESENTATION OF DATA.</b>  <b>RECORDING OF DATA.</b>	<ul style="list-style-type: none"> <li>– Initial temperature of <b>BA3</b>= <math>25.0 \text{ }^\circ\text{C}</math></li> <li>– Initial temperature of <b>BA2</b>= <math>26.0 \text{ }^\circ\text{C}</math></li> <li>– Average temperature= <math>25.5 \text{ }^\circ\text{C}</math></li> <li>– Volume of <b>BA3</b> used= <math>20.0 \text{ cm}^3</math></li> </ul>	03

**TABLE, T5**

<b>Volume of BA2 added / cm<sup>3</sup>.</b>	<b>0</b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>25</b>
<b>Highest temp. of mixture / °C.</b>	<b>25.0</b>	<b>30.0</b>	<b>32.5</b>	<b>32.0</b>	<b>31.0</b>	<b>30.0</b>

A graph of highest temperature against volume of **BA2** added is plotted.

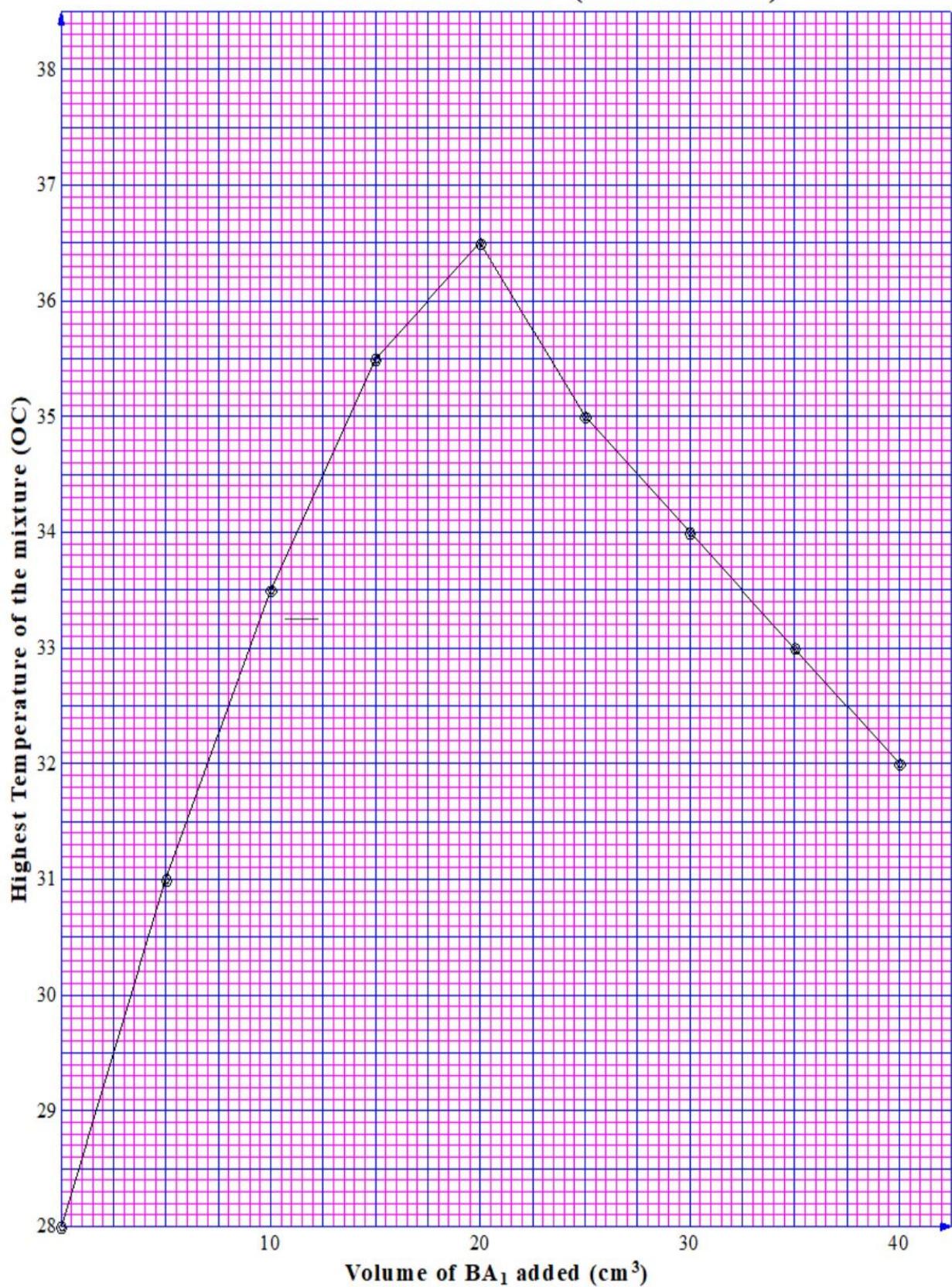
### **BOTH VARIABLES FIXED / CONTROLLED:**

S/N	Basis of Assessment	Assessment Criteria	Scoring
		<p><b>(BOTH VARIABLES FIXED / CONTROLLED)</b></p> <p>25cm<sup>3</sup> of <b>BA1</b> is measured into a plastic beaker and its initial temperature noted and recorded. 25cm<sup>3</sup> of <b>BA2</b> is also measured and its initial temperature noted and recorded. The two volumes of <b>BA1</b> and <b>BA2</b> are mixed at once and the mixture stirred using a thermometer.</p> <p>The highest temperature of the mixture is noted and recorded.</p> <p>All the results are entered in the table below.</p>	03
		<p>Highest temperature of mixture= 37.0 °C  Initial temperature of <b>BA1</b>= 25.0 °C  Initial temperature of <b>BA2</b>= 26.0 °C  Average temperature of mixture= 25.5 °C</p> <p>Volume of <b>BA1</b> used = 25.0cm<sup>3</sup>.  Volume of <b>BA2</b> used = 25.0cm<sup>3</sup>.  Total volume of solution= 50.0cm<sup>3</sup>.</p>	03
	<b>DATA ANALYSIS</b>	Heat evolved by reaction:	

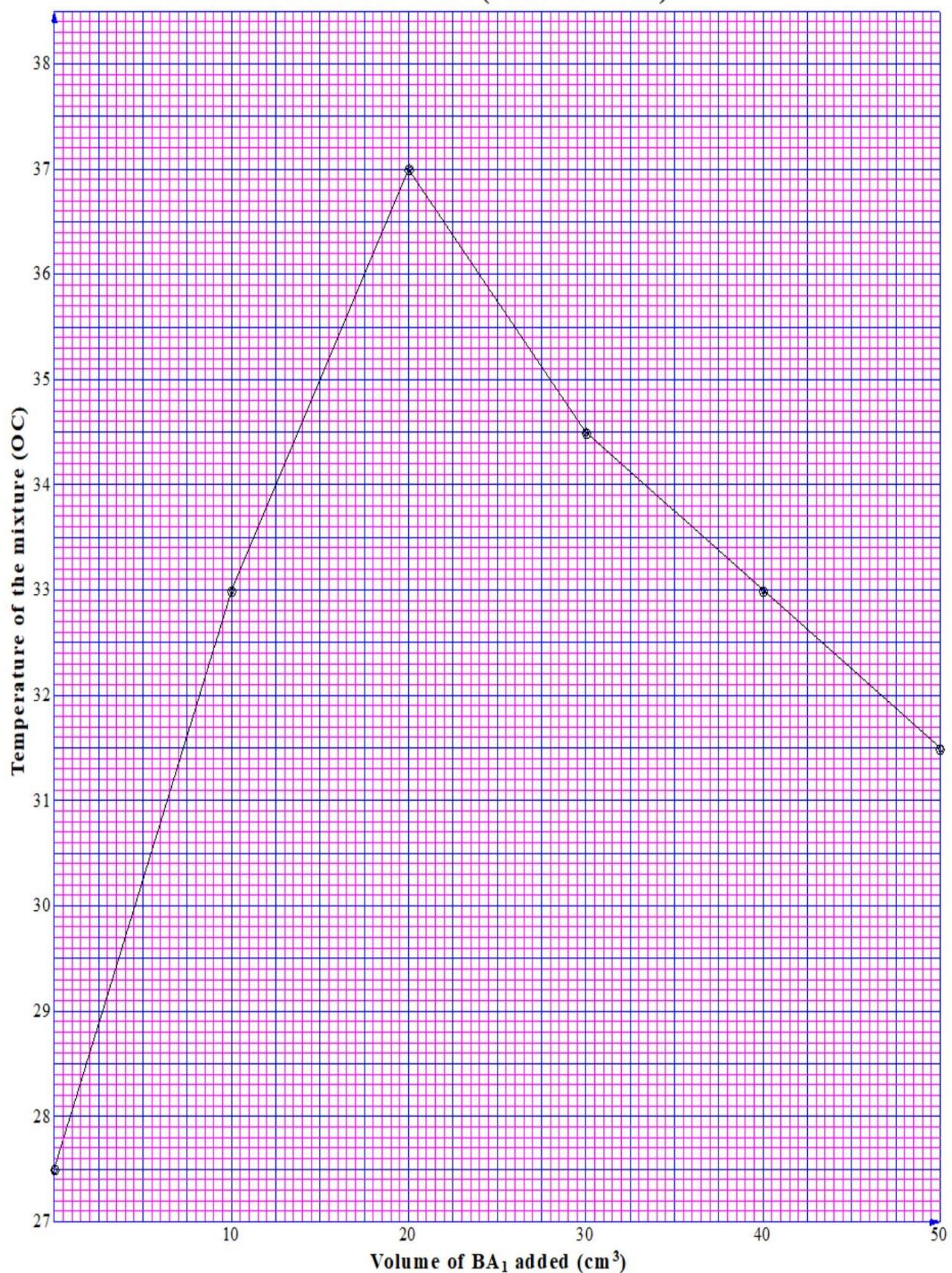
	<b>AND INTERPRETATION / CREATING MEANING.</b>	=heat gained by mixture. $=mC\theta$ . $=(50 \times 1 \times 4.2 \times (37 - 25.5))$ $=-2,415 \text{ Jmol}^{-1}$ .	
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SAMPLE

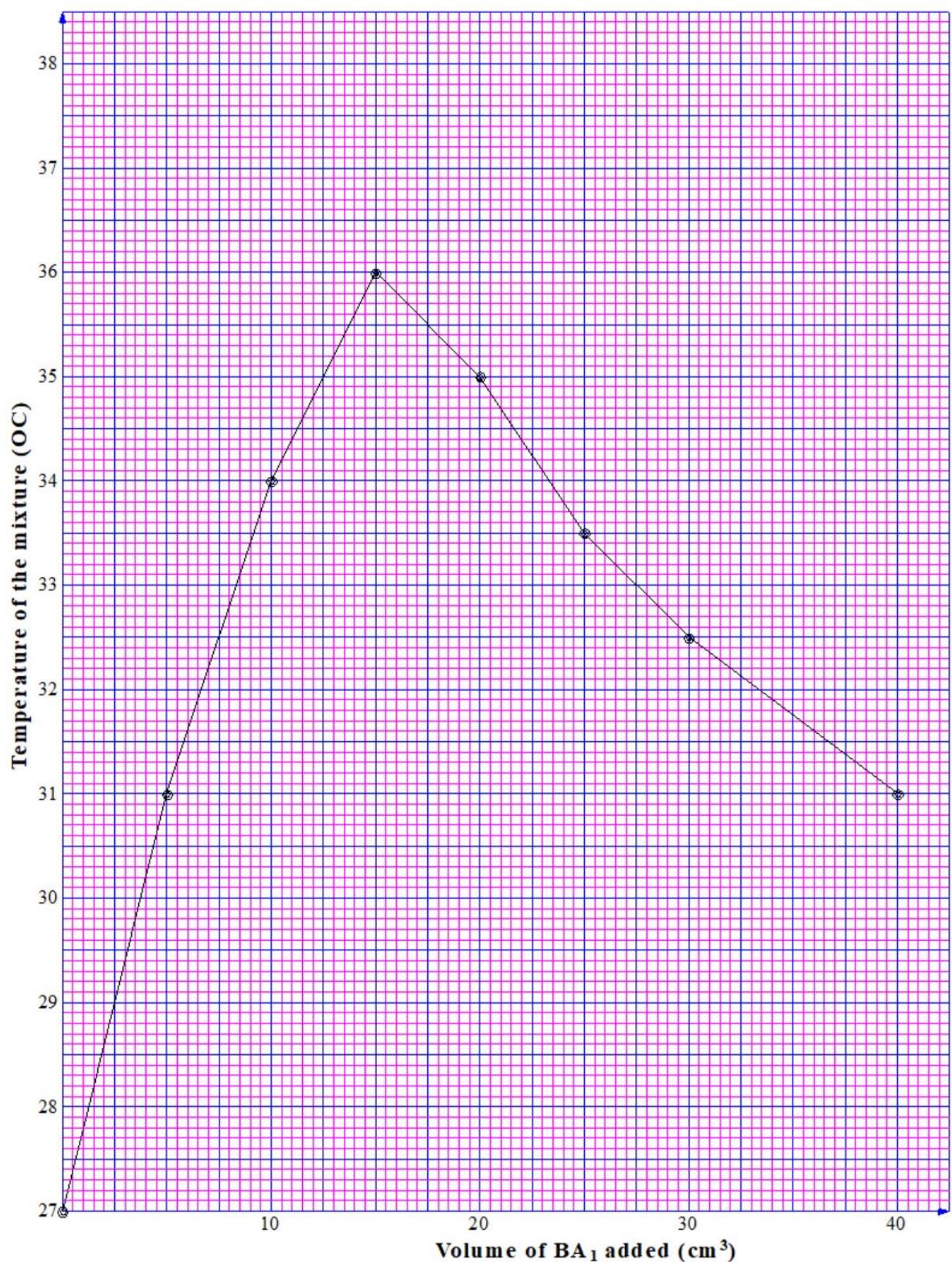
### **PIPETTE VOLUME 25cm<sup>3</sup> (5cm<sup>3</sup> Intervals)**



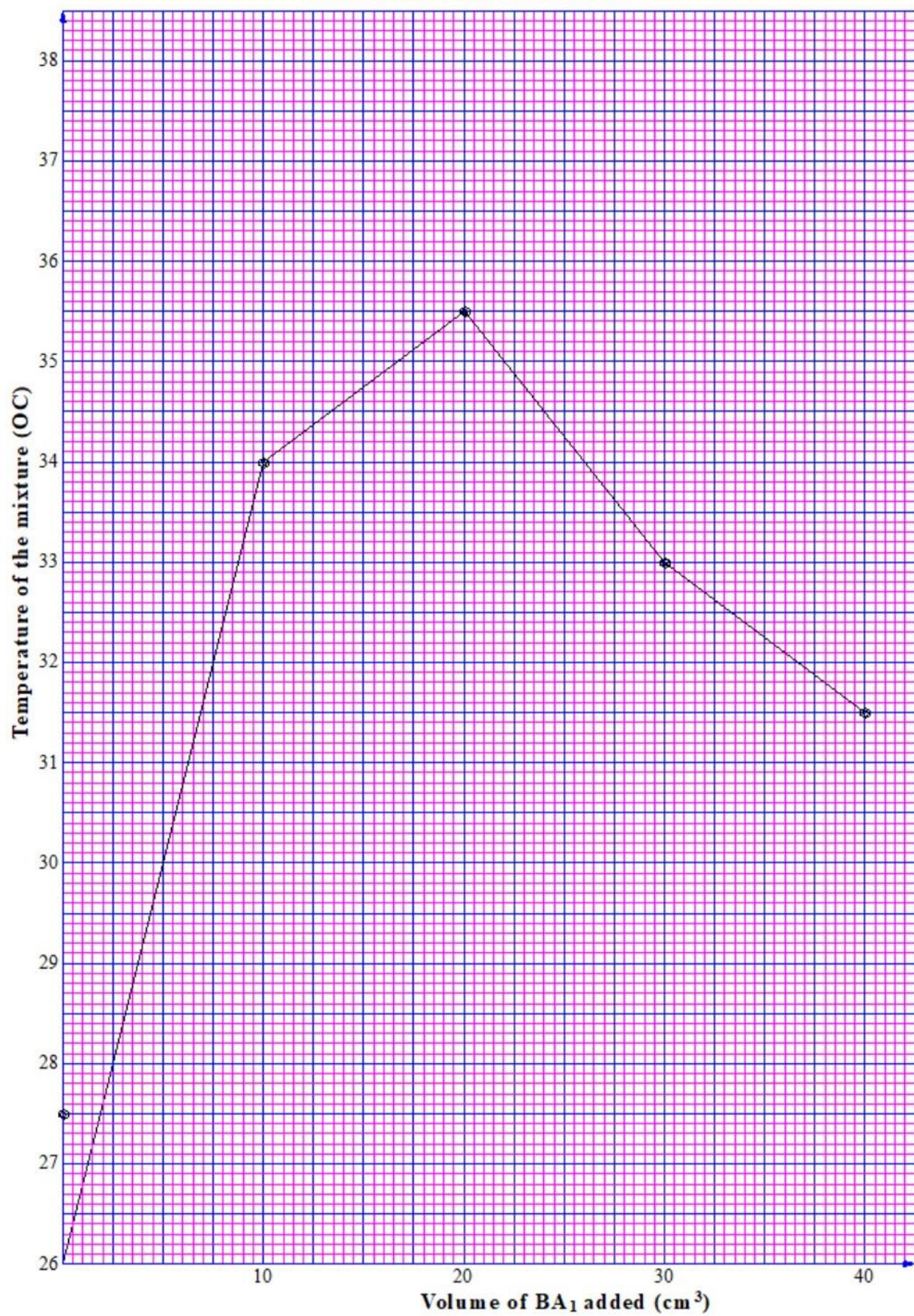
**PIPETTE VOLUME 25cm<sup>3</sup> (10cm<sup>3</sup> Intervals)**



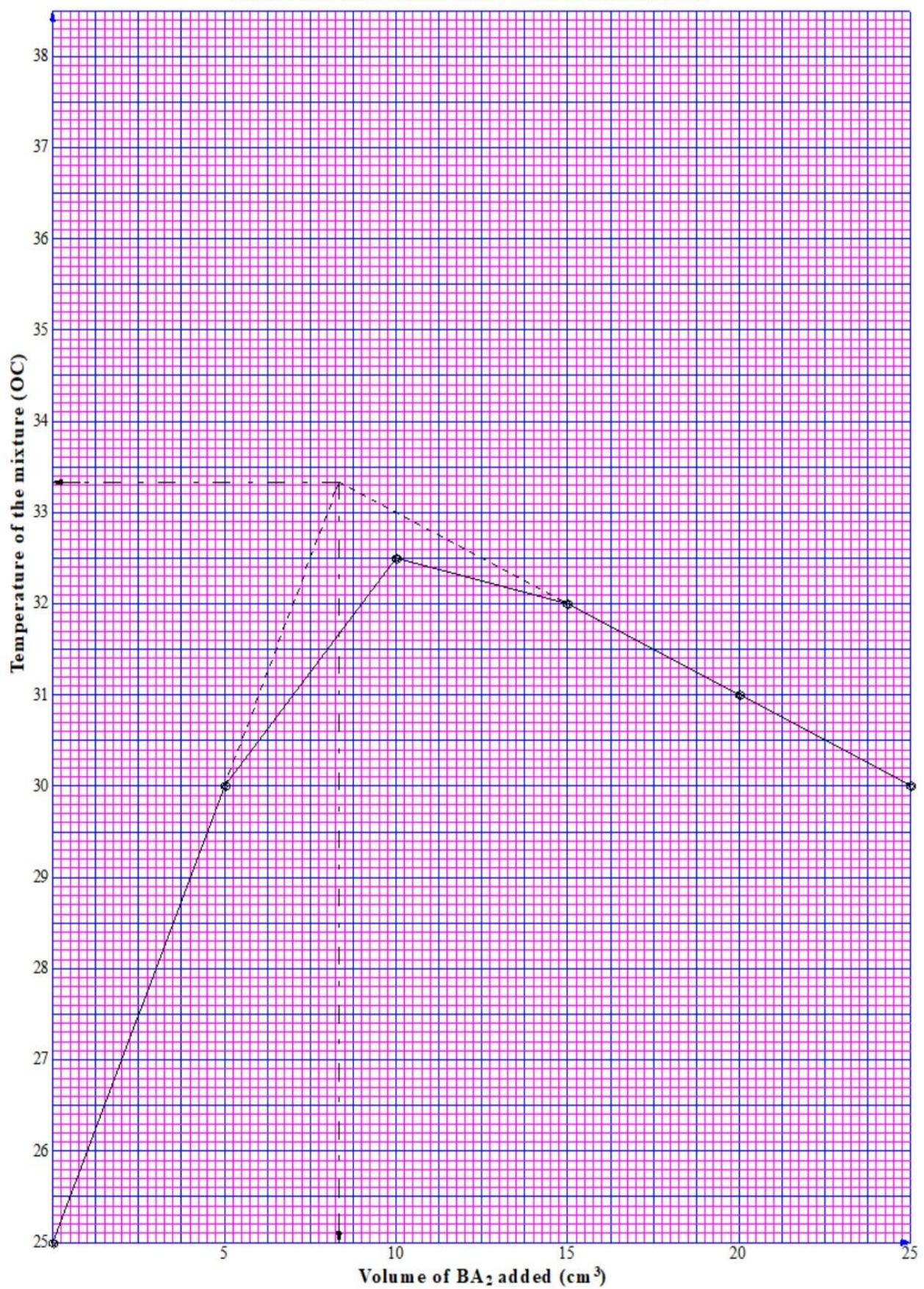
**PIPETTE VOLUME 20cm<sup>3</sup>**



**PIPETTE VOLUME 20cm<sup>3</sup>**



**PIPETTE VOLUME 25cm<sup>3</sup> DILUTED ACID**



Candidate's Name: .....

Signature: .....

Random No.						Personal No.	

(Do not write your School/ Centre Name or Number anywhere on this Booklet.)

**545/1**

**CHEMISTRY**

**Paper 1**

**2024**

**2 hours**



**UGANDA NATIONAL EXAMINATIONS BOARD**

**Uganda Certificate of Education**

**CHEMISTRY**

**Paper 1**

**2 hours**

**INSTRUCTIONS TO CANDIDATES:**

*This paper consists of two sections; A and B. It has six examination items.*

*Section A has two compulsory items.*

*Section B has two Parts; I and II. Answer one item from each part.  
Answer four items in all.*

*Answers to Section A must be written in the spaces provided while those of  
Section B must be written on the answer booklet(s) provided.*

*Any additional item(s) answered will not be scored.*

## **SECTION A**

**Answer all the items from this section.**

### Item 1.

Onyera, living in an area where they use bore hole water, slid, fell and his white shirt became dirty. He decided to use a detergent to clean his shirt. The shirt remained with some brown spots yet he had rinsed it several times.

## Task:

As a chemistry learner;

- (a) point out the problem Onyera made when choosing a product.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- (b) help Onyera understand how the product works.

- (c) advice Onyera on the challenges associated with the long term use of the product.

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**Item 2.**

Peter is in the process of constructing his house without affecting the environment. He wants to build a good strong house; there are various building materials of different quality and properties on the market. However, he does not know the quality of materials to use.



Peter knows that choosing quality materials depends on the nature of the material and has come to you for advice.

**Task:**

Use your chemistry knowledge to;

- (a) Explain  
(i) Categories of materials.

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(ii) The suitability of the materials.

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(b) Advise peter on the choice of materials.

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## SECTION B

### Part I

*Answer one item from this part.*

#### Item 3.

One of the large scale uses of chlorine is treating water, to ensure that chlorine is readily available and at a cheaper cost. Government has cleared a local investor to set up a chlorine production plant near Lake Katwe in Kasese district. However, the community is concerned about its environmental effects and how the environmental process will occur.



The class teacher has appointed you to sensitize the other learners.

#### Task:

Prepare a presentation you will make during the meeting.

#### Item 4.

Air which is a mixture of different components contains 21% oxygen. Due to a wide spread of respiratory illnesses caused by COVID-19, there was an increased demand for oxygen by patients in hospitals. The government supply of oxygen is not enough and is planning to set up an oxygen production plant with minimal environmental impact.



However, the science club members in your school would like to know how the process of production will be carried out.

#### Task:

As chemistry student, make a write up you will use during the presentation.

## Part II

*Answer one item from this part.*

### Item 5.

Natural resources have been destroyed as a result of increasing population and human activities. This has attracted the attention of the officials from the National Environment Management Authority (NEMA).



The officials are planning to create awareness to the people of the country through sensitization workshops organized in different district communities.

#### Task:

As a chemistry student, prepare a short presentation you will deliver during the workshop upon invitation.

### Item 6.

Osukuru village in Tororo district is at the foot of Tororo rock. People of this village for a long time have practiced charcoal burning , animal husbandry , crop husbandry and stone quarrying, recently the animals have started dying and wells are drying up yet the little water available is not fresh. The locals are now wondering why all these are happening.



A sensitization workshop is to be organized to explain the existing situation in the village. The theme of the work shop is **MY ENVIRONMENT MY RESPONSIBILITY**.

#### Task:

As chemistry student, write a massage you will deliver upon invitation.

**545/1**  
**CHEMISTRY**  
**Paper 1**  
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**UGANDA NATIONAL EXAMINATIONS BOARD**

**Uganda Certificate of Education**

**CHEMISTRY**

**Paper 1**

*New Lower Secondary Curriculum*

***SCORING GUIDE***

## 545/1 - CHEMISTRY DRAFT GUIDE / BASIS

### Section A

#### Item 1.

S/N	Basis of Assessment	Assessment Criteria	Scoring
A.	<b>CATEGORY / TYPE</b>	Onyera used a soapy detergent (or soap) instead of a soapless detergent.	02
B.	<b>FUNCTIONS OF PRODUCTS (How It Works)</b>	<p>- The dirt is held on the cloth by a layer of oil.</p> <p>- Detergents (soaps) facilitate the emulsification and removal of grease / .</p> <p><b>Alternatively</b></p> <p>- Detergents facilitate breakdown of fats into small parts.</p> <p>- A soap molecule contains two parts; namely; the water-soluble /polar carboxylate head / hydrophilic end or lipophobic head and non-polar tail/fat-soluble part / hydrophobic part/lipophilic part.</p> <p>- During washing, soap acts by lowering the surface tension between water and oil/grease/other water insoluble materials and also emulsifies them. The hydro-carbon tail becomes attached to dirt /oil /fat while the polar head dissolves in water. With constant agitation, the dirt is pulled off the cloth and gets dispersed in water as tiny droplets which are then poured away. The cloth is then rinsed several times and dried.</p>	02
C.	<b>DANGERS OR SIDE EFFECT OF PRODUCTS.</b>	<p>(a) Soap contains chemicals that can cause:</p> <ul style="list-style-type: none"> <li>• Skin burns / blisters / irritation and hence pain or cancer.</li> </ul>	03

		<ul style="list-style-type: none"> <li>• Eye redness and pain; hence loss of vision.</li> <li>- Mitigation can be done by thoroughly washing the affected areas (or irrigation of the affected areas) like skin or eyes.</li> </ul> <p>(b) Soapless detergents contain phosphates which cause algae bloom/algal bloom and hence water pollution.</p> <p><b>N.B.</b> Algae/algae bloom already means accumulation.</p>	
D.	<b>EVALUATION OF PRODUCTS AND PROCESSS.</b>	<p>(a) <b>Similarities:</b></p> <ul style="list-style-type: none"> <li>• Both soapy detergents and soapless detergents are salts of Organic acids of long carbon chain.</li> <li>• Both soapy detergents and soapless detergents are effective cleansing agents in soft water / rain water.</li> </ul> <p>(b) (i) <b>Differences;</b> Soapy detergents:</p> <ul style="list-style-type: none"> <li>• Forms scum with hard water.</li> <li>• Gentle on skin during cleansing..</li> <li>• Sodium salts of carboxylic acid of long chains and cannot be used in strongly acidic solutions.</li> <li>• Biodegradable</li> </ul> <p>(b) (ii) Soapless detergents:</p> <ul style="list-style-type: none"> <li>• does not form scum with any form of water.</li> <li>• not gentle on skin during washing.</li> <li>• Sodium salts of long chain benzene sulphonic acids and can be used in strongly acidic solutions.</li> <li>• Non-biodegradable</li> </ul>	02

## Item 2.

S/N	Basis of Assessment	Assessment Criteria	Scoring
A.	<b>CATEGORY OF ELEMENT COMPOUND. (Substance and material with a reason.)</b>	<p>A material is a substance or a mixture of substances that constitute an object. It can be Natural or Artificial.</p> <p>Natural material is God made / exists in nature and its formation is not influenced by man e.g. rocks, sand, wood, water, soil etc.</p> <p>Artificial material is man-made / synthetic manufactured by man e.g. iron bars, plastics, paint, composites.</p>	03
B.	<b>PROPERTIES OR PREDICTIONS OF PROPERTIES OF MATERIAL.</b>	<p>Materials to be used for constructing a good strong house have different qualities based on their nature. A house is made up of the following:</p> <p>(a) Iron;</p> <ul style="list-style-type: none"> <li>- Very strong (can support heavy load.)</li> <li>- has high tensile strength (resists breakage).</li> <li>- its ductile and malleable (easy to mould.)</li> <li>- has high melting point (resists fires.)</li> <li>- Galvanised iron resists rusting.</li> <li>- steel has improved properties, making it suitable for many users.</li> </ul> <p>(b) Aluminium;</p> <ul style="list-style-type: none"> <li>- low density(used on top of buildings).</li> <li>- strong, not easy to break / durable.</li> <li>- has high melting points (resists fires).</li> <li>- has bright appearance (used for doors, roofing, window frames.)</li> <li>- high electrical/ heat conductivity (making utensils.)</li> </ul>	03

	<p>(c) Wood;</p> <ul style="list-style-type: none"> <li>- Readily available so easy to get cheaply.</li> <li>- Strong, so it can support heavy load.</li> <li>- Light when dry so good for roofing.</li> <li>- Easy to smoothen to give nice appearance.</li> <li>- can rot or be eaten by termites when not treated.</li> </ul> <p>(d) Mortar; Composite made of cement, sand and water,</p> <ul style="list-style-type: none"> <li>- Hard so reacts deformation.</li> <li>-It is adhesive so can join bricks.</li> <li>-Cushioning to spread the vertical load</li> </ul> <p>(e) Glass;</p> <ul style="list-style-type: none"> <li>- Ordinary glass is transparent so good for windows to see through.</li> <li>- tinted glass allows light to pass through it in only one direction so good for windows (visual security.)</li> <li>- Double-glazed glass (tampered glass) is strong, resistant to fire attack and it is not brittle.</li> <li>- Glass is reflective, attractive and it adds value when put in doors and windows.</li> </ul> <p>(f) Paint; This is a liquid composite made of pigment, resin, solvent and additives.</p> <ul style="list-style-type: none"> <li>- Weather guard resists bad weather (water proof). So good for outside walls.</li> <li>- Silk vinyl paint does not burn, so good for interior purposes.</li> <li>- Paint can be insect repelling, light sensitive to beautify, protect walls.</li> </ul>	
	<p>(g) Plastics;</p> <ul style="list-style-type: none"> <li>- These are man-made polymers which</li> </ul>	

	<p>can undergo permanent deformation without breaking when subjected to a strong force. E.g. PVC, Polyethene, Nylon, Polyesters.</p> <ul style="list-style-type: none"> <li>- They are flexible so can be bent easily.</li> <li>- They are water prone so good for Plumbing and roofing.</li> <li>- They are light and strong, so good for shuttering purposes.</li> <li>- They have low melting points so can be attacked by fires easily.</li> </ul> <p>(h) Clay and Ceramics;</p> <ul style="list-style-type: none"> <li>- They are brittle so break easily.</li> <li>- They are water proof so good for flooring.</li> <li>- They are good looking, so nice for Finishing purpose like floors, walls.</li> <li>- They cannot be attacked by chemicals.</li> </ul> <p>(i) Bricks and blocks:</p> <ul style="list-style-type: none"> <li>- Resistant to fire so good for wall construction.</li> <li>- They are strong, so can support heavy loads.</li> </ul>	03
	<p><b>USES OF MATERIALS, ELEMENTS OR SUBSTANCES / APPLICATION.(Quantity of Matter i.e. Moles)</b></p> <p>The choice of material for construction is dependent on the purpose it is meant to do and its impact to the environment.</p> <p>(a) Iron;</p> <ul style="list-style-type: none"> <li>- Making shutters for doors, windows.</li> <li>- Making frames for doors windows.</li> <li>- Reinforcing concrete.</li> <li>- Irons used to fix / join objects like timber, iron sheets.</li> <li>- Used for plumbing.</li> </ul>	01

	<p>(b) Aluminium;</p> <ul style="list-style-type: none"> <li>- Making shutters for doors, and windows.</li> <li>- Making frames for doors and windows.</li> <li>- Reinforcing concrete.</li> <li>- Making roofing materials (struts and ties).</li> <li>- electrical installations, wires.</li> </ul> <p>(c) Wood;</p> <ul style="list-style-type: none"> <li>- Used to make shutters for windows, doors.</li> <li>- Making frames for doors, windows.</li> <li>- Making struts and ties during roofing.</li> <li>- Making poles, pillars and beams.</li> </ul> <p>(d) Mortar;</p> <ul style="list-style-type: none"> <li>- Joining and binding bricks.</li> <li>- Making concrete for floors.</li> <li>- Plastering walls.</li> </ul> <p>(e) Glass;</p> <ul style="list-style-type: none"> <li>- Making shutters for doors, windows.</li> </ul> <p>(f) Paint;</p> <ul style="list-style-type: none"> <li>- Beautifying (better appearance) of buildings.</li> <li>- Protecting materials, from rusting.</li> <li>- Enhancing durability.</li> </ul>	
	<p>The choice of material for construction is dependent on the purpose it is meant to do and its impact to the environment.</p> <p>(f) Plastics;</p> <ul style="list-style-type: none"> <li>- Making pipes (water pipes) for plumbing.</li> <li>- Making door and window shutters.</li> </ul>	03

		<p>(h) Clay and Ceramics;</p> <ul style="list-style-type: none"> <li>- Making bricks.</li> <li>- Making Tiles (floor tiles).</li> <li>- Making roofing tiles.</li> </ul> <p>(i) Bricks and blocks;</p> <ul style="list-style-type: none"> <li>- Constructing walls.</li> </ul>	
D.	<b>IMPACT/ POLLUTION OF ENVIRONMENT ELEMENTS, COMPOUND MATERIAL / SUBSTANCE.</b>  <b>(Quantity of Matter i.e. Moles)</b>	<p>Material used in construction of a house have impact to the environment.</p> <p>(a) Iron;</p> <ul style="list-style-type: none"> <li>- Depletes soil fertility when it accumulates.</li> <li>- Being a heavy metal can cause cancer.</li> <li>- Non biodegradable.</li> </ul> <p>(b) Aluminium;</p> <ul style="list-style-type: none"> <li>- Depletes soil fertility when it accumulates.</li> </ul> <p>(c) Plastics;</p> <ul style="list-style-type: none"> <li>- Non biodegradable spoils the soil.</li> </ul> <p>(d) Mortar;</p> <ul style="list-style-type: none"> <li>- Bulky, takes long to decompose and so spoils the soil.</li> </ul>	02

## **SECTION B**

### **Item 3**

S/N	Basis of Assessment	Assessment Criteria	Scoring
A.	<b>RAW MATERIAL (RM)</b>	Concentrated sodium chloride solution (brine).OR Sodium chloride crystals (Rock salt)	02
B.	<b>PROCESS OF PRODUCTION</b>	Chlorine from brine.	03

	<b>(Pp)</b>	<p>Brine is electrolysed in a cell made up of mercury cathode and graphite anode.</p> <p>Brine contains <math>Na^+</math>, <math>Cl^{-}</math>, <math>OH^-</math> and <math>H^+</math>.</p> <p>The ions migrate to oppositely charged electrodes.</p> <p><math>Na^+</math> are discharged at the cathode by electron gain in preference to <math>H^+</math> since <math>Na^+</math> are more concentrated.</p> $Na^{+}(aq) + e^- \rightarrow Na_{(s)}$ <p>At the anode chloride ions are discharged, in preference to hydroxide ions; being in higher concentration than hydroxyl ions chlorine gas is formed.</p> $2 Cl^{-}(aq) - 2e^- \rightarrow Cl_2(g) \text{ or } (l)$ <p>The chlorine formed is collected and stored in tightly closed tanks.</p> <p>The chlorine is dried, liquefied and stored.</p>	
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#### ALTERNATIVE USING ROCK SALT

S/N	Basis of Assessment	Assessment Criteria	Scoring
		<p>Solid sodium chloride (rock salt) and little calcium chloride are fed into Down's cell. The mixture is electrolysed using titanium or graphite anode and steel or iron cathode.</p> <p>The ions migrate to oppositely charged electrodes. At the cathode <math>Na^+</math> are discharged by reduction being the only ions present.</p> $Na^{+}(aq) + e^- \rightarrow Na_{(s)}$	02

		<p>At the anode <math>Cl^-</math> are discharged by electron loss forming chlorine gas.</p> $2Cl_{(aq)} \rightarrow Cl_{2(g)} + 2e^- .$ <p>The chlorine formed is collected and stored in tightly closed tanks</p> <p>The Chlorine is dried, liquefied and stored.</p>	
C.	<b>SIDE EFFECTS OF THE PROCESS OF PRODUCTION AND MITIGATION</b>	<p>(a) Air pollution by waste gases,            - acidic gases can cause acid rain which leads to crumbling of buildings, lowering soil pH and corrosion of roofs made of iron.</p> <p>Mitigation can be done by:</p> <ul style="list-style-type: none"> <li>- fitting catalytic converters in exhaust pipes of machines to convert oxides of nitrogen into nitrogen and carbon monoxide to carbon dioxide.</li> <li>- neutralise the acidic gases before releasing waste gases into the atmosphere.</li> </ul>	03

<b>ALTERNATIVE USING ROCK SALT</b>			
<b>S/N</b>	<b>Basis of Assessment</b>	<b>Assessment Criteria</b>	<b>Scoring</b>
	<b>C.SIDE EFFECTS OF THE PROCESS OF PRODUCTION AND MITIGATION</b>	<p>(b) Leakage of Chlorine.</p> <p>(c) Land degradation.</p>	03
	<b>D.SOCIAL BENEFITS</b>	<ul style="list-style-type: none"> <li>- Employment opportunity; improved income thus better standards of living.</li> <li>- Development of infrastructure e.g. electricity lines, roads, hospitals schools etc.</li> </ul>	03

**Item 4**

S/N	Basis of Assessment	Assessment Criteria	Scoring
A.	<b>RAW MATERIAL</b>	Liquid air / Air.	02
B.	<b>PROCESS OF PRODUCTION.</b>	<p>Air is passed through air filters to remove dust and smoke particles. Air is passed through concentrated sodium hydroxide solution to absorb/ remove carbon dioxide, which is acidic.</p> $2NaOH_{(aq)} + CO_{2(g)} \rightarrow Na_2CO_{3(aq)} + H_2O_{(l)}$ <p>Air is free from Carbon dioxide is now passed through Silicon(IV) oxide / silica gel to absorb water vapour. Carbon dioxide and water vapour are removed from air before it is liquefied because they solidify and block the apparatus.</p> <p>The air is now compressed at 200 atmospheres and allowed to cool by making it escape into a large space through a jet.</p> <p>The process of cooling is repeated several times to obtain liquid air at about <math>-200^{\circ}\text{C}</math>. The liquid air is fractionally distilled using a fractionating column / tower.</p> <p>Nitrogen boils off first because it has a lower boiling point (<math>-196^{\circ}\text{C}</math>) leaving behind oxygen with a higher boiling point (<math>-183^{\circ}\text{C}</math>). Both nitrogen and oxygen collected obtained contain traces of noble gases. Pure oxygen is then stored under pressure in steel cylinders.</p>	03
C.	<b>SIDE EFFECTS OF THE PROCESS OF PRODUCTION AND MITIGATION</b>	<p>(a) Explosion of oxygen cylinders due to high pressure. This can cause other materials to ignite spontaneously/catch fire.</p> <p>The resulting fire can cause damage to equipment and injury to people.</p> <p>Mitigation can be done by:</p>	03

		<ul style="list-style-type: none"> <li>- Regular maintenance and monitoring of cylinders.</li> <li>- keeping cylinders in cool areas / avoid exposure to heat.</li> </ul> <p>(b) Exposure to liquid oxygen can cause severe skin and eye irritations and burns. This may cause loss of vision and cancer.</p> <p>Mitigation can be done by:</p> <ul style="list-style-type: none"> <li>- Posting hazard and warning information in the working area.</li> <li>- Communicating all information on the health and safety hazards of oxygen to potentially exposed workers; for example; submerging the affected body parts in warm water.</li> </ul> <p>(c) Air pollution by waste gases. Acidic gases can cause acid rain which leads to crumbling of buildings,</p> <ul style="list-style-type: none"> <li>- acidic gases can cause acid rain which leads to crumbling of buildings, lowering of soil pH and corrosion of roofs made of iron.</li> </ul> <p>Mitigation can be done by:</p> <ul style="list-style-type: none"> <li>- fitting catalytic converters in exhaust pipes of machines to convert oxides of nitrogen into nitrogen and carbon monoxide to carbon dioxide.</li> <li>- neutralise the acidic gases before releasing waste gases into the atmosphere.</li> </ul>	
D.	<b>SOCIAL BENEFITS</b>	<ul style="list-style-type: none"> <li>- Employment opportunity; improved income thus better standards of living.</li> <li>- Development of infrastructure e.g. electricity lines, roads, hospitals schools etc., Improved road network will facilitate trade hence improved income and better standards of living.</li> </ul>	03

**Item 5.**

S/N	Basis of Assessment	Assessment Criteria	Scoring
A.	<b>IDENTIFY CATEGORY OF NATURAL RESOURCE REASON AND EXAMPLE.</b>	<p>They are classified as:</p> <p>Renewable and Non-renewable. Renewable Natural resources can be replenished e.g. Air, water vapour, dust etc.</p> <p>Non-renewable resources cannot be replenished (get used up) e.g. fossil fuels, rocks/ minerals.</p>	03
B.	<b>COMPOSITION OF NATURAL RESOURCES.</b>	<ul style="list-style-type: none"> <li>• Air contains Nitrogen, Oxygen Carbon dioxide, rare gases, water contains; Hydrogen and oxygen.</li> <li>• Fossil fuels contain Carbon, Hydrogen, Oxygen.</li> <li>• Rocks contain Iron, copper, calcium carbonate, and other minerals like Gold, Cobalt, etc.</li> </ul>	02
C.	<b>IMPACT OF NATURAL RESOURCES ON THE ENVIRONMENT AND HOW IT OCCURS / CHEMICALS AND PHYSICAL REACTIONS AND MITIGATION.</b>	<ul style="list-style-type: none"> <li>• Air <ul style="list-style-type: none"> <li>- Some components of Air pollute environment and cause global warming, and carbondioxide because its a green house gas thus traps heat in the atmosphere.</li> <li><math>C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}</math>.</li> <li>- Carbon monoxide is a poisonous gas and causes suffocation, carbon monoxide can also be converted to carbon dioxide e.e.</li> <li><math>2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}</math>.</li> </ul> </li> </ul> <p>Mitigation:</p> <ul style="list-style-type: none"> <li>• Increased Afforestation to replace the cut trees which absorb <math>CO_2</math> from the atmosphere to reduce global warming.</li> <li>• Carbon monoxide effects and production can be reduced by using catalytic converters on exhaust pipes of cars and other fuel engines to reduce the poison in the environment.</li> </ul>	03

	<ul style="list-style-type: none"> <li>• Water Impact and how it occurs.</li> </ul> <p>Water contains dissolved gases like <math>O_2</math> and <math>CO_2</math>. The <math>CO_2</math> in it forms carbonic acid.</p> $H_2O(l) + CO_{2(g)} \rightleftharpoons H_2CO_{3(aq)}$ <p>The carbonic acid makes water acidic. The acid rains dissolve or deplete rocks.</p> $H_2CO_{3(aq)} + CaCO_{3(s)} \rightarrow Ca(HCO_{3})_2(aq)$ <ul style="list-style-type: none"> <li>• Water has dissolved oxygen which facilitates rusting of iron containing materials according to the following equation:</li> </ul> $2Fe_{(s)} + xH_2O(l) + \frac{3}{2}O_{2(g)} \rightarrow Fe_2O_3 \cdot xH_2O(l)$ <ul style="list-style-type: none"> <li>• Hot water as an effluent from industries when introduced into the water bodies, increase the temperature of the water bodies affecting the life of aquatic organisms.</li> <li>• Water pollution caused by farming and Agriculture. So the use of fertilizers results in Eutrophication of nearby water bodies and Algae blooms/ algal bloom.</li> <li>• Re-afforestation to reduce the impact of acid rains.</li> <li>• Use of Alloys, painting, galvanising to reduce the effect of rusting.</li> <li>• Hot water reservoirs and effluent deposit points from factories to cool the exhaust water before introduction into the water bodies.</li> <li>• Use of organic fertilizers e.g. manure from both animal and plant waste which are Biodegradable and reduce on use of synthetic fertilisers.</li> <li>• Vehicles and machines burn fossil fuels leading to reduction of gaseous pollutants into the atmosphere.</li> </ul> $2C_{(s)} + O_{2(g)} \rightarrow 2CO_{(g)}$ $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O(l)$ $S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$	
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		$2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$ <p>Mitigation:</p> <ul style="list-style-type: none"> <li>• Use of alternative fuel and energy sources like solar and Hydroelectric Power (HEP) from the sun and water respectively reduce on depletion of Fossils and also the decrease in gaseous pollutants.</li> </ul>	
	<b>Benefits</b>	<ul style="list-style-type: none"> <li>• Air facilitates respiration, During respiration carbohydrates combine with oxygen in order to release energy and carbon dioxide used for proper body functioning.</li> <li>- Air facilitates photosynthesis. During photosynthesis, carbon dioxide from air combines with water in presence of sunlight trapped by chlorophyll to form glucose, carbohydrates and oxygen.</li> </ul> <p>Fossil fuels are used as fuels; fossil fuels when burnt produce heat energy used to run engines and machines and for cooking.</p> <ul style="list-style-type: none"> <li>• Water is a habitat for many aquatic organisms; water bodies like lakes, rivers, swamps, dams, pools contain necessary conditions for survival of animals like fish, snails, snakes, worms, bacteria and plants e.g. blue green algae planktons which are fish foods etc.</li> <li>• Water bodies like; lakes, rivers, pools, as well as water vapour from plants crucial role in rain formation.</li> </ul> <p>Water from the water bodies evaporates and eventually cools and condenses on the clouds, these results into precipitation.</p> <p>Water bodies like rivers can be used to generate electricity, fast moving waters to the rivers drives turbines at waterfalls which produce kinetic energy into electrical energy.</p>	02

**Item 6**

S/N	Basis of Assessment	Assessment Criteria	Scoring
A.	<b>IDENTITY CATEGORY OF NATURAL RESOURCE REASON AND EXAMPLE.</b>	<p>Theme ‘MY ENVIRONMENT MY RESPONSIBILITY’</p> <p>Resources in our environment which we use to satisfy our needs; water, air, trees, grass, rocks.</p> <p>They are classified as renewable and non-renewable.</p> <p>Renewable resources can be sustained e.g. air, water, grass.</p> <p>Non-renewable resources can be exhausted and not replaceable e.g. fossil fuels, rocks etc.</p>	03
B.	<b>COMPOSITION OF NATURAL RESOURCES.</b>	<ul style="list-style-type: none"> <li>• Air: is composed of Nitrogen, Oxygen, Carbon dioxide, rare gases, water vapour and dust in different proportions.</li> <li>• Water: is a compound made up of hydrogen and oxygen. It has dissolved minerals, micro-organisms and living things.</li> <li>• Rocks: are of different types of example igneous, sedimentary metamorphic.</li> </ul> <p>They contain minerals for example limestone, iron, gold, copper, quartz etc.</p> <ul style="list-style-type: none"> <li>• Trees and natural vegetation is made up of important elements like carbon, hydrogen, magnesium etc. (depending on the soil composition).</li> </ul>	02
C.	<b>IMPACT OF NATURAL RESOURCES ON THE ENVIRONMENT. HOW IT OCCURS AND MITIGATION./ CHEMICALS AND PHYSICAL REACTIONS</b>	<p>Impact to the Environment:</p> <ul style="list-style-type: none"> <li>- Several activities impact negatively on natural resources for example charcoal burning involves cutting down of trees which leads to deforestation and loss of habitat for wild animals.</li> </ul> <p>It leads to increased amount of carbon dioxide in the atmosphere which contributes to climate change and global warming.</p>	03

		<p>•<b>Mitigation:</b> Ensure sustainable fuel production using soft wood which is renewable. (Afforestation) Use charcoal briquettes made from waste organic materials.</p> <p>•<b>Stone quarrying:</b> Involves breaking of rocks into small stones and gravel for construction purposes. This disrupts the underground water cycle and sources hence reduced water quality, air pollution from dust, destruction of vegetation cover.</p> <p><b>Mitigation:</b> Strict government policies and laws against stone quarrying. Filling up holes made during the process of quarrying, encourage population to use alternative construction materials like tiles and clay bricks..</p> <p>•<b>Farming:</b> Involves the use of fertilisers and manure which pollutes water bodies and makes the water unsafe for use.</p> <p><b>Mitigation:</b> Sensitise farmers to use controlled doses of fertilisers and manure in gardens.</p> <p>•<b>Animal Husbandry:</b> Causes water pollution through their excreta.</p> <p><b>Mitigation:</b> People should ensure proper disposal of animal excreta and also convert it into other useful products for example biogas, organic fertilisers and briquettes.</p>	
D.	<b>BENEFIT / IMPORTANCE OF NATURAL RESOURCE</b>	<p>Air is used for respiration. During respiration carbohydrate combine with oxygen in air to release energy and carbon dioxide used for proper body functioning.</p> <p>Air facilitates photosynthesis, During photosynthesis carbon dioxide from air combines with water in presence of sunlight</p>	03

	<p>trapped by chlorophyll to form glucose and oxygen.</p> <p>Fossil fuels are used as fuels: Fossil fuels when burnt produce heat energy used to run engines and machines, even for cooking..</p>	
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***END.***

SAMPLE

Candidates Name: .....

Signature: .....

Random No.						Personal No.	

(Do not write your School/ Centre Name or Number anywhere on this Booklet.)

**545/2&3**

**CHEMISTRY**

**Paper 2**

**2024**

**2 Hours**



**UGANDA NATIONAL EXAMINATIONS BOARD**

**Uganda Certificate of Education**

**CHEMISTRY**

**Paper 2&3**

**Practical**

**2 Hours**

### **INSTRUCTIONS TO CANDIDATES:**

*This paper consists of one compulsory examination item. Answers to this item are to be written in the spaces provided in this booklet. Use blue or black ink.*

*All working must be clearly shown. Graph paper will be provided.*

*Mathematical table and silent non-programmable scientific calculators may be used.*

*You are not allowed to use reference books (i.e. text books, booklets on qualitative analysis etc.)*

*Candidates are advised to carefully read the item, make sure they have all the apparatus and chemicals they may need and then plan appropriately before starting.*

### **Item1.**

An organisation operating in fishing around Lake Kyoga organised 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.



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**.

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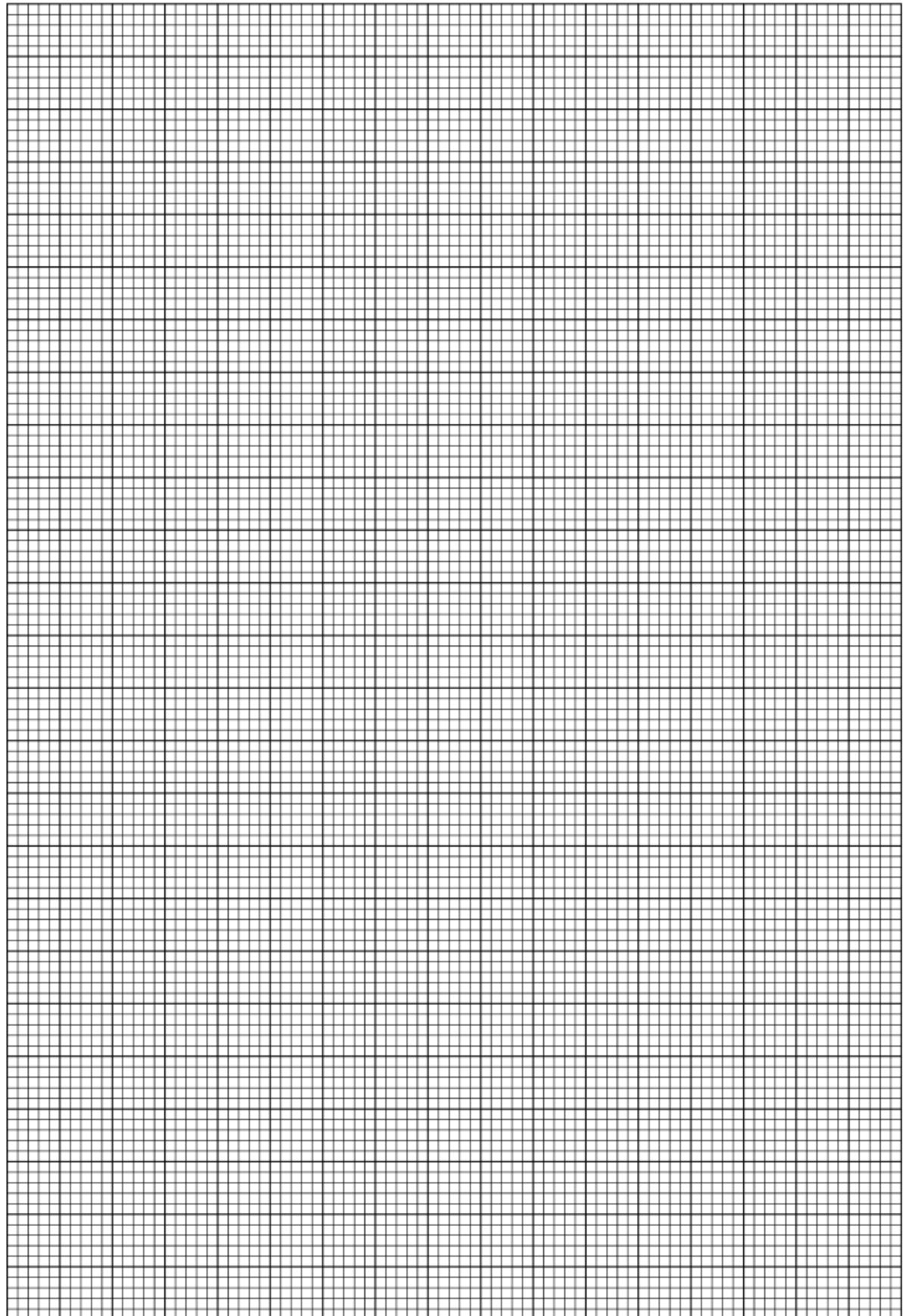
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SAMPLE PAPER



(ii) carry out the experiment and record your findings.

(iii) Obtain the maximum heat produced during the reaction.

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(b) What can the participant deduce from your findings?

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