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.**	**AIM OF THE EXPERIMENT**	An experiment to determine the maximum heat produced during reaction of sodium hydroxide and hydrochloric acid or between **BA2** 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**	$20/25cm^3$ 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 of $5cm^3/10cm^3$ each time stirring and noting the highest temperature of the mixture for seven readings upto $35cm^3/40cm^3/50cm^3$.	03

S/N	Basis of Assessment	Assessment Criteria	Scoring
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.	The results are recorded in the table below. Table of Results: Initial Temperature of **BA1**- $\qquad$ 25.0 $^\text{o}$C Initial Temperature of **BA2**- $\quad$ 27.5/28.0$^\text{o}$C Average Initial Temperature- 26.25/26.5$^\text{o}$C Volume of **BA2 used** - $\qquad$ 25.0 cm^3	04

	RECORDING OF DATA.	Initial Temperature of **BA1**- 25.0 °C Initial Temperature of **BA2**- 27.5/28.0°C Average Initial Temperature- 26.25/26.5°C Volume of **BA2 used** - 25.0 cm^3									04

TABLE, T_1

Volume of pipette= 25.0cm^3.

G.	**Volume of BA1 added / cm^3.**	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	
	Highest temp. of mixture/ °C.	28.0	31.0	33.5	33.5	36.5	35.0	34.0	33.0	32.0	04
	Temperature change.	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_2

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

Volume of **BA2** used = 20.0cm^3**.**

TABLE, T_3

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

4

TABLE, T_4

Volume of BA1 added / cm^3.	0	10	20	30	40	50
Highest temp. of mixture/ ^{o}C.	26.0	34.0	35.5	33.0	32.0	30.5
Temperature Change	0	8.0	9.5	7.0	6.0	4.5

S/N	Basis of Assessment	Assessment Criteria	Scoring
(a) (ii) **H.**	D**ATA 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. $=mC\theta$. Graph **1**, (**G1**): Heat evolved $=(20 +25) \times 4.2 \times (36.5 – 28.0)$ $= ^-1,606.5$ J mol^{-1}. Graph **2**, (**G2**): Heat evolved $=(20 +25) \times 4.2 \times (37.0 – 27.5)$ $= ^-1,795.5$ J mol^{-1}. Graph **3**, (**G3**): Heat evolved $=(20 +15) \times 4.2 \times (36.0 – 27.0)$ $= ^-1,323$ J mol^{-1}. Graph **4**, (**G4**): Heat evolved $=(20 +20) \times 4.2 \times (35.5 – 26.0)$ $= ^-1,596$ J mol^{-1}	03

5

(b) **I.**	**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

ALTERNATIVE METHOD:

S/N	Basis of Assessment	Assessment Criteria	Scoring
	PROCEDURE OF EXPERIMENT	**(VARIABLES INTERCHANGED)** (a) All the **BA1** provided $(50cm^3)$ was diluted by adding an equal volume of water $(50cm^3)$ to form $100cm^3$ of solution. The resultant solution was labelled **BA3**. Its initial temperature is noted. (b) $20cm^3$ of **BA3** was measured using a measuring cylinder into a plastic beaker followed by $5cm^3$ of **BA2** and the mixture stirred. The highest temperature of the mixture is noted and recorded. (c) Procedure (b) is repeated for values of **BA2** equal to 10, 15, 20 and 25 cm^3. The results are then entered in the table below.	03
	PRESENTATION OF DATA. **RECORDING OF DATA.**	− Initial temperature of **BA3**= 25.0 ^oC − Initial temperature of **BA2**= 26.0 ^oC − Average temperature= 25.5 ^oC − Volume of **BA3** used= 20.0 cm^3	03

6

TABLE, T_5

Volume of BA2 added / cm^3.	0	5	10	15	20	25
Highest temp. of mixture / $^{\circ}$C.	25.0	30.0	32.5	32.0	31.0	30.0

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

BOTH VARIABLES FIXED / CONTROLLED:

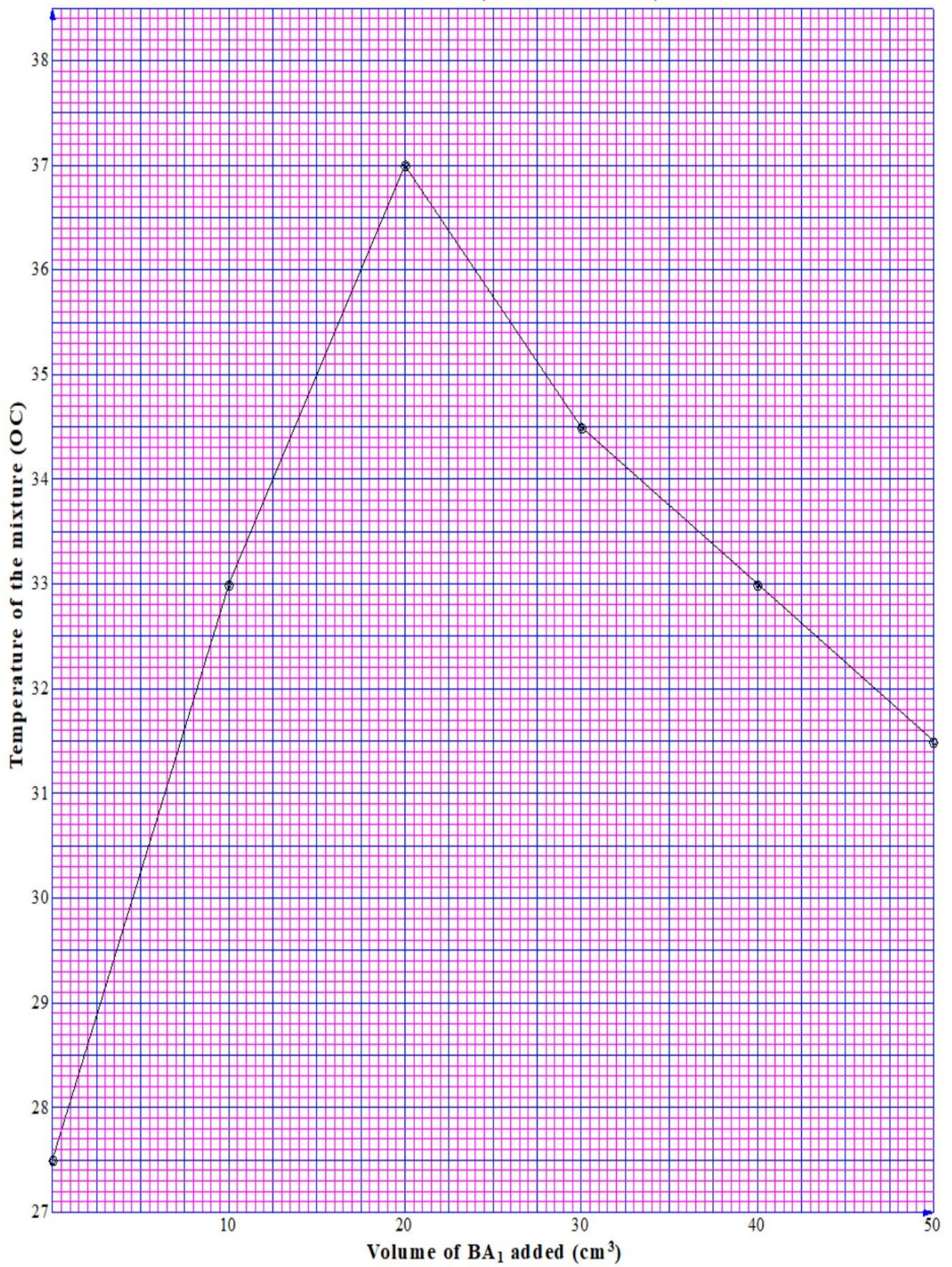| S/N	Basis of Assessment	Assessment Criteria	Scoring
		(BOTH VARIABLES FIXED / CONTROLLED) 25cm^3 of **BA1** is measured into a plastic beaker and its initial temperature noted and recorded. 25cm^3 of **BA2** is also measured and its initial temperature noted and recorded. The two volumes of **BA1**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

7

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

PIPETTE VOLUME 25cm³ (5cm³ Intervals)
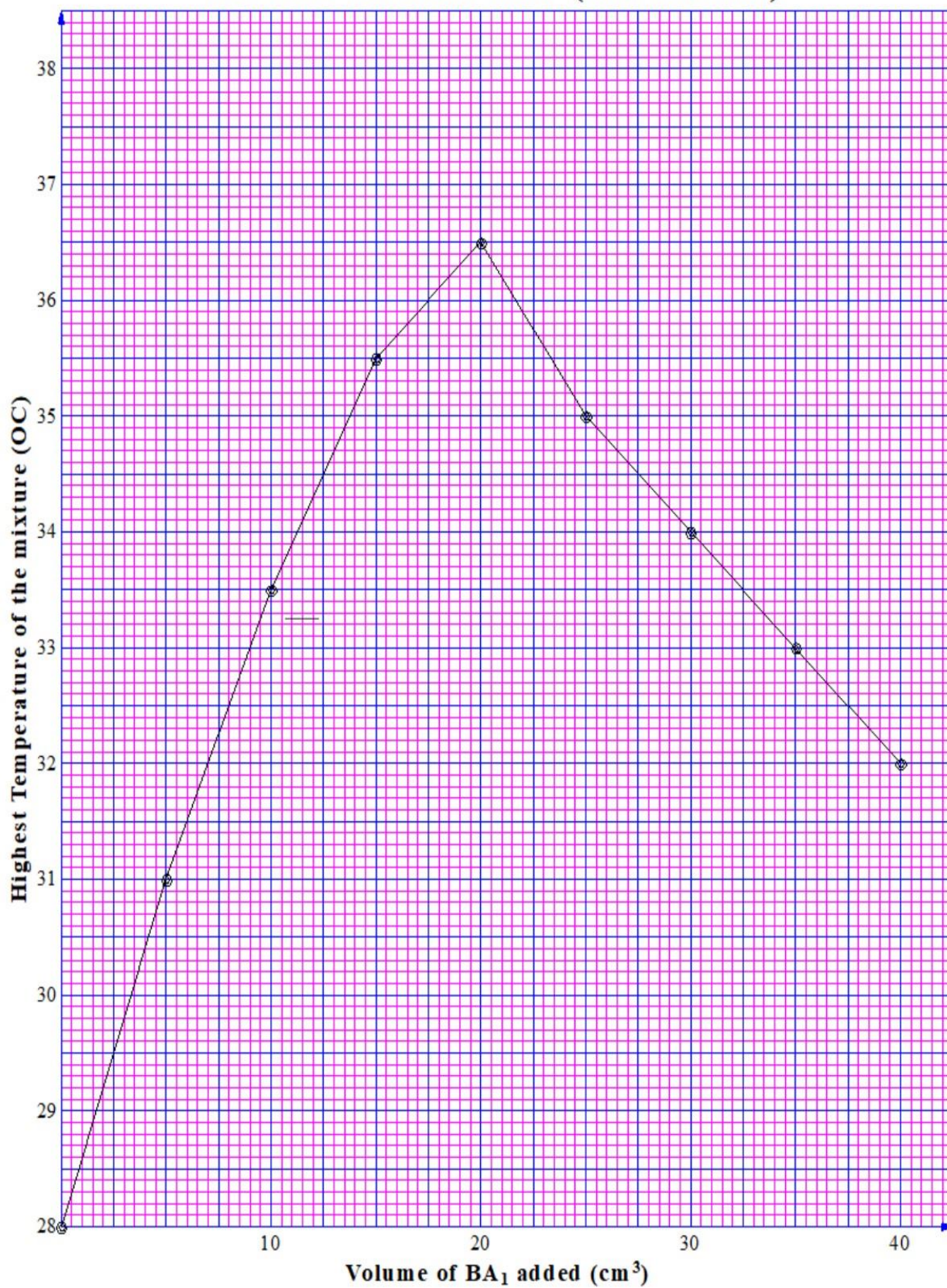
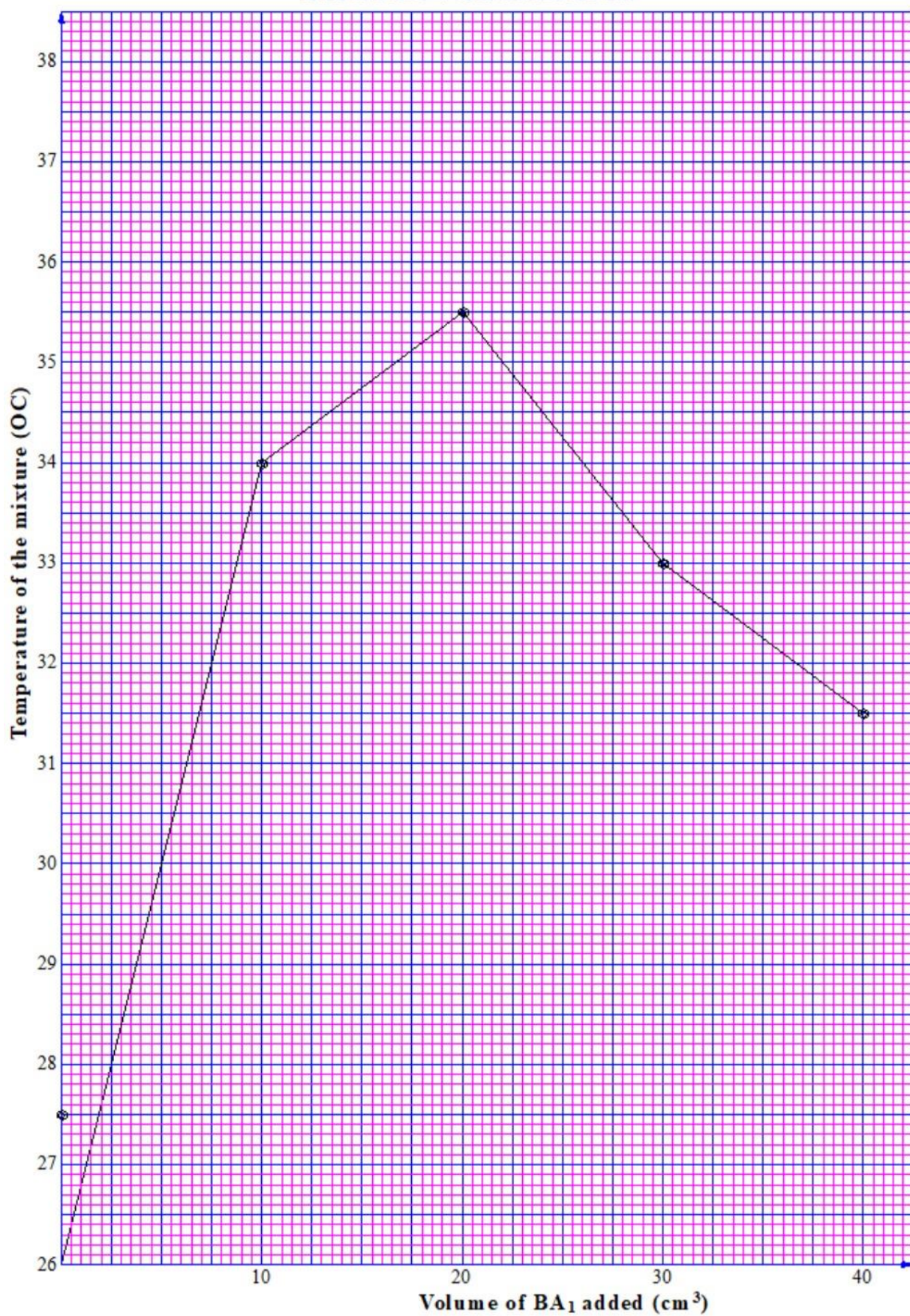# PIPETTE VOLUME 25cm³ (10cm³ Intervals)

Temperature of the mixture (OC) vs **Volume of BA₁ added (cm³)**

PIPETTE VOLUME 20cm³

Temperature of the mixture (OC) vs Volume of BA₁ added (cm³)

PIPETTE VOLUME 20cm³

Temperature of the mixture (°C) vs Volume of BA₁ added (cm³)

12

PIPETTE VOLUME 25cm³ DILUTED ACID

Temperature of the mixture (OC)

Volume of BA₂ added (cm³)

13