MBOONI WEST SUB-COUNTY
FORM 4 JOINT EXAMINATIONS 2014
CHEMISTRY 233/3
CONFIDENTIAL

In addition to the apparatus found in the laboratory each candidate should be provided with :-

1. $50cm^3$ of solution Q.
2. $50cm^3$ of solution R.
3. 1 burette 50ml.
4. 1 pipette 25ml.
5. 1 thermometer $(-10 – 110)^0C$.
6. 6 test tubes.
7. 2 boiling tubes.
8. $70cm^3$ of solution S.
9. 6 pieces of 1cm long polished magnesium ribbon.
10. 10 ml measuring cylinder.
11. Stop watch.
12. Distilled water in a wash bottle.
13. Piece of tissue paper.
14. $100cm^3$ of Mc.
15. Pipette filler.
16. 1 volumetric flask 250 mls.
17. 2 labels.
18. 3 conical flasks.
19. Phenolphthalein indicator in a bottle dropper
20. White tile.
21. Clamp stand.
22. 1g of solid P (About).
23. About 1g of solid T.
24. Ph – chart.
25. 1 metallic spatula.
26. 5 cm^3 of 0.5M Nitric (V) Acid in a test tube labeled Z
27. 2 litmus papers (1 blue & 1 red).
28. 2 filter papers.
29. 1 filter funnel.
30. $100cm^3$ of solution A.
31. 1 100ml beaker (empty)

Access to:

1. 2M ammonia solution supplied with a dropper.
2. 0.5M $KI_{(aq)}$ supplied with a dropper.
3. 1M Nitric (V) acid with a dropper.
4. 0.1M Lead (II) Nitrate solution with a dropper.
5. Source of heat.
6. Acidified potassium dichromate (VI) with a dropper.
7. Bromine water, with a dropper.
8. Universal indicator supplied with a dropper.

Preparations

- Solution Q is made by dissolving 48g of NaOH pellets in about $800cm^3$ of distilled water and diluting to 1 litre.
- Solution R is made by dissolving $51.6cm^3$ of concentrated HCl (1.18g/cm3) in $800cm^3$of distilled water and diluting to 1 litre.
- Solution S is made by dissolving 172cm3 of conc. HCl ($1.18g/cm^3$) in 800cm3 of water and diluting to 1 litre.
- Solution A – Add $12.9cm^3$ of concentrated HCl ($1.18g/cm^3$) in $500cm^3$ of distilled water and diluting to 1 litre.
- Solution Mc – Dissolve 87.5g of $Na_2CO_3.10H_2O$ in $400cm^3$ of distilled water and top up with distilled water to 1 litre.
- Solid T is benzoic acid
- Solid P is a mixture of Pb (NO_3) and Na_2CO_3 in the ratio 2:1 respectively by mass.

NAME ……..…….. **DATE** ……

INDEX NO. ……..……..……...…..… **SIGNATURE** ……..……..

233/3
CHEMISTRY
PRACTICAL
PAPER 3
JULY/AUGUST, 2014
TIME: 2¼ HOURS.

MBOONI WEST SUB - COUNTY JOINT EVALUATION TEST

Kenya Certificate of Secondary Education.

233/3
CHEMISTRY
PAPER 3
PRACTICAL
TIME: 2¼ HOURS.

INSTRUCTIONS TO CANDIDATES.

- Write your name and index number in the spaces provided above.
- Sign and write the date of exam in the spaces above.
- Answer **ALL** the questions in the spaces provided in this question paper.
- You are NOT allowed to start working with the apparatus for the first 15 minutes of the 2¼ hours allowed time for the paper.
- Use the 15 minutes to read through the question paper and note the chemicals and apparatus that you may need.
- Mathematical tables and electronic calculators may be used.
- All working **MUST** be clearly shown where necessary.
- This paper consists of 8 printed pages. Candidates should check to ensure that all pages are printed as indicated and no questions are missing

FOR EXAMINER'S USE ONLY.

Question	Maximum score	Candidate's score
1	8	
2	19	
3	13	
Total score	40	

1. You are provided with:-
   (i) Solution A a monobasic acid 0.15M, HA
   (ii) Solution Mc, containing 7.0g of a metal M carbonate (whose formula is $M_2CO_3.\ xH_2O$) in $80cm^3$ of the solution.

   You are required to:
   (a) Prepare a dilute solution of the metal M carbonate solution Mc
   (b) Determine the value of x in $M_2CO_3.\ xH_2O$

   Procedure I
   - Using a pipette and a pipette filler place 50.0cm3 of solution Mc into a 250 ml volumetric flask. Add about 200ml of distilled water. Shake well. Add more distilled water to make upto the mark. Label this as solution Md

   Procedure II
   - Fill a burette with solution A.
   - Using a clean pipette and pipette filler, place $25.0cm^3$ of solution Md into a 250ml conical flask.
   - Add two drops of phenolphthalein indicator and titrate with solution A.
   - Record your results in the table 1 below.
   - Repeat the titration two more times and complete the table.

   TABLE 1

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution A (cm^3)			

(3 Marks)

(a) Calculate the:
(i) Average volume of solution A used. (½ Mark)

……

……

(ii) Number of moles of the acid used (1 Mark)

……

……

(b) Write equation for the reaction that took place between the acid, HA and the carbonate $M_2CO_3.xH_2O$ (1 Mark)

……

……

(c) Determine the:
(i) number of moles of the metallic carbonate in $25cm^3$ of solution Md. (½ Mark)

……

……

……

……

(ii) number of moles of the metallic carbonate in $50.0cm^3$ of solution Mc (½ Mark)

……

……

……

……

(iii) molar mass of the metallic carbonate (½ Mark)

……

……

……

……

(iv) Value of x in $M_2CO_3 \cdot xH_2O$ (1 Mark)
(H = 1.0, C = 12.0, O = 16.0, M = 23.0)

……

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……

2. I. You are provided with:-
   - Sodium hydroxide solution prepared by dissolving 9.6g in water to make 200cm^3 of solution and labelled Q
   - 0.6M hydrochloric acid labelled solution R

   You are required to determine the molar heat of neutralization of sodium hydroxide with hydrochloric acid following the procedure given.

Procedure

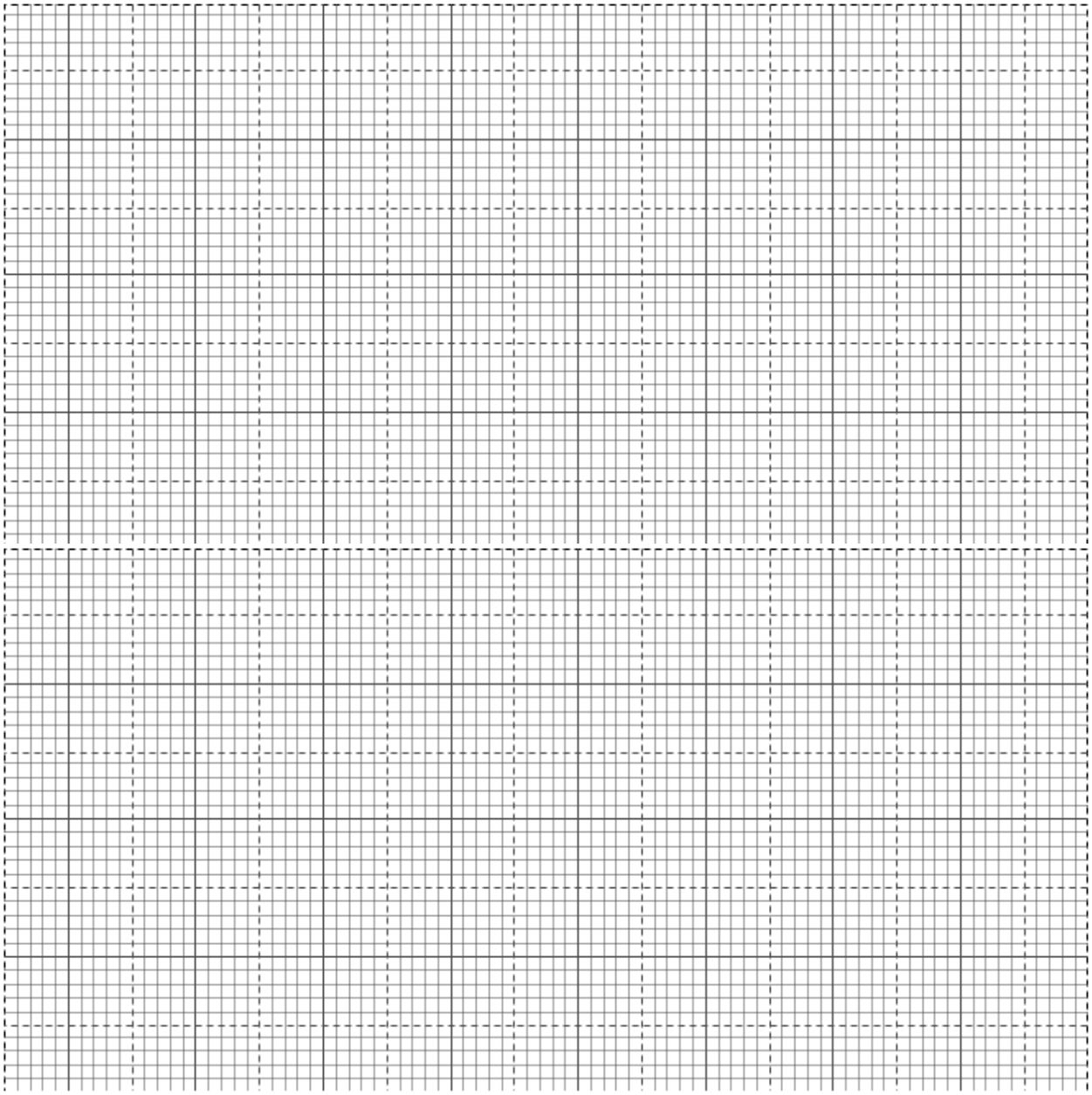
Fill the burette with solution R. Pipette 25.0cm^3 of solution Q into a 100ml beaker. Measure the temperature of solution Q in the beaker and record it in table below. Run out exactly 5.0cm^3 of solution R from the burette into a clean test tube. Add the solution in the test tube (solution R) into the beaker containing solution Q and stir with a thermometer. Record the highest temperature of the mixture in the table 2 below. Run out another 5cm^3 of solution R into the test tube and transfer it to the mixture already obtained above. Stir with the thermometer and record the highest temperature attained. Repeat the procedure with four more portions of 5cm^3 solution R. Record your readings in the table 2 below.

(a) Table 2

Volume of R added (cm^3)	0	5	10	15	20	25	30
Volume of Q used (cm^3)	25	25	25	25	25	25	25
Temperature (0^C)							

(3 ½ marks)

(b) On the grid provided, plot a graph of temperature (Y- axis) against volume of R used. (3 Marks)



(c) From the graph determine:-

(i) the volume of R used to react with $25cm^3$ of solution Q. (½ Mark)

……

……

(ii) the highest temperature change (½ Mark)

……

……

(d) Assuming that specific heat capacity is 4.2 $kjkg^{-1}k^{-1}$ and taking density of solution as $1gcm^{-3}$, determine enthalpy change for the reaction. (1½ Marks)

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……

(e) Determine the moles of sodium hydroxide, solution Q, used hence calculate the molar heat of neutralization of the solution. (1 Mark)

……

……

2. II. You are provided with

- 2M hydrochloric acid, solution S
- 5 pieces of 1cm long polished magnesium ribbon

You are required to determine the time taken for complete reaction between magnesium ribbon and the acid.

Procedure

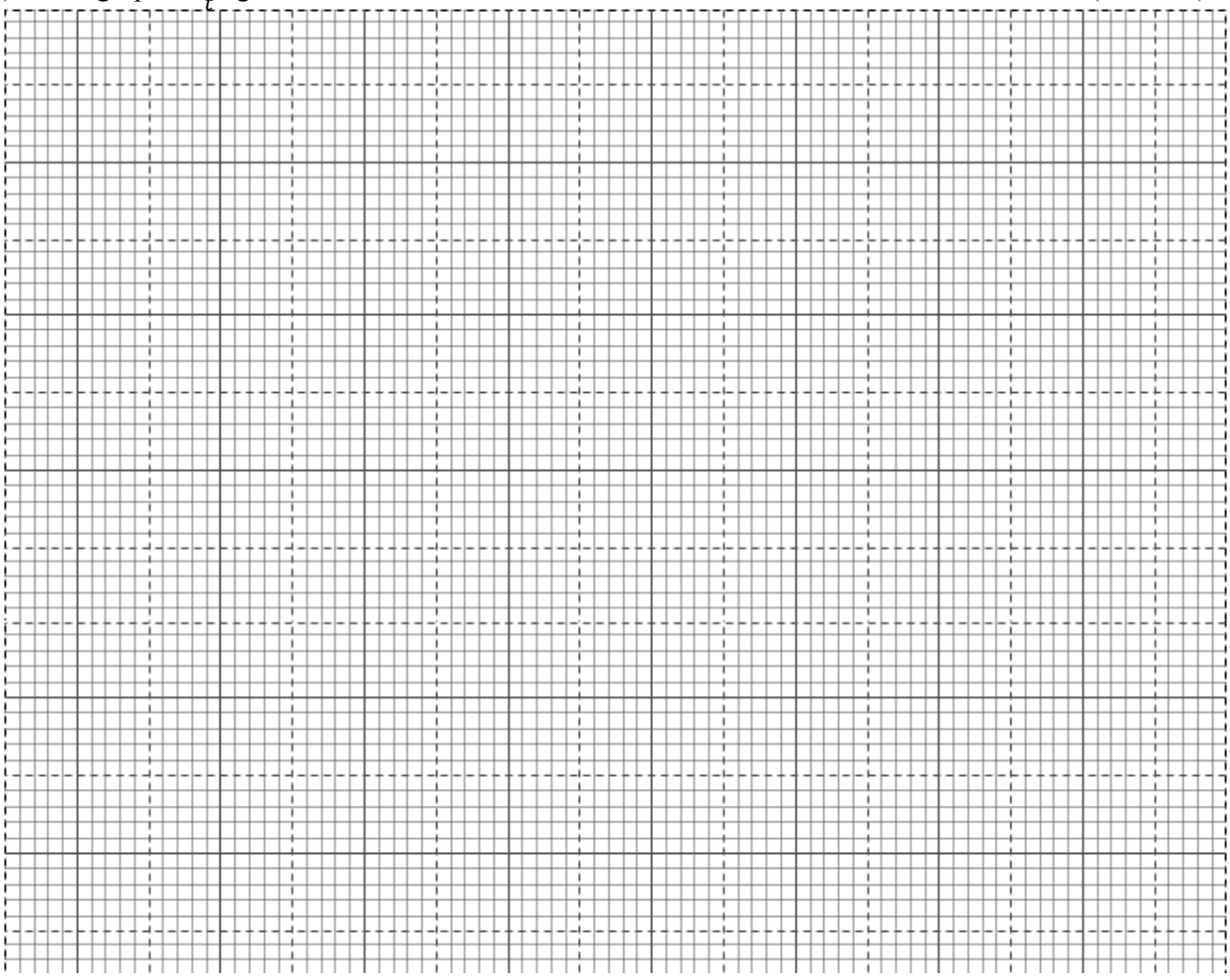
Measure exactly 14cm^3 of solution S into a clean dry 100ml beaker. Drop a piece of magnesium into the acid and immediately start a stop watch. Whirl the mixture and record the time taken for the magnesium ribbon to completely disappear. Discard the mixture. Clean the beaker with water and dry it using tissue paper. Repeat the procedure using 12cm^3 of solution S and 2cm^3 of distilled water. Repeat the procedure with the specified volumes of solution S and distilled water as shown in table 3 below.

(a) Table 3

Volume of S (cm^3)	14	12	10	8	6
Volume of distilled water (cm^3)	0	2	4	6	8
Time in seconds (s)					
$\frac{1}{t}$					

(5 Marks)

(b) Plot a graph of $\frac{1}{t}$ against volume of solution S. (3 Marks)



(c) From the graph, determine time taken for 1cm length of magnesium ribbon to react completely with $5cm^3$ of solution S. (1 Mark)

……

……

3. (a) You are provided with solid P. Carry out the tests below and record your observations and inferences in the tables provided.

(i) Transfer a half spatula end full of solid P into a clean-dry test tube.
Heat the solid strongly and test any gas produced using litmus papers.

Observations	Inferences
(1 Mark)	(1 Mark)

(ii) Place the remaining solid P into a boiling tube. Add about $8cm^3$ of distilled water and shake thoroughly. Filter the mixture into another boiling tube. Retain the filtrate for use in (iii) below.

Place the entire residue into a boiling tube. Add all Nitric (V) acid provided in a test tube labeled Z. Divide the resulting mixture into two portion.

(I) To the first portion in test tube add ammonia solution dropwise to excess.

Observations	Inferences
(½ Mark)	(1 Mark)

(II) To the second portion in a test tube add two drops of potassium iodide.

Observation(s)	Inferences
(½ Mark)	(½ Mark)

(iii) (I) To $2cm^3$ of the filtrate, add three drops of dilute Nitric (V) acid.

Observations	Inferences
(½ Mark)	(½ Mark)

(II) To $2cm^3$ of the filtrate add 3 drops of Lead (II) Nitrate solution.

Observations	Inferences
(½ Mark)	(½ Mark)

(b) You are provided with solid T. Carry out the tests in (a) and (b) and write your observations and inferences in the spaces provided.
Describe the method used in part (c)
(i) Place about a third of solid T on a metallic spatula and burn it in a Bunsen burner flame

Observations	Inferences
(1 Mark)	(1 Mark)

(ii) Place the rest of solid T in a boiling tube. Add about 8cm3 of distilled water. Shake the mixture well. Retain the mixture to use in the tests in (ii) I to IV.

Observations	Inferences
(½ Mark)	

(I) To $2cm^3$ of the mixture in a test tube add the remaining magnesium metal.

Observations	Inferences
(½ Mark)	(½ Mark)

II. To $2cm^3$ of the mixture in a test tube add about $1cm^3$ of acidified potassium dichromate (VI) solution and warm.

Observations	Inferences
(½ Mark)	(½ Mark)

III. To $2cm^3$ of the mixture in a test tube add 2 drops of bromine water.

Observations	Inferences
(½ Mark)	(½ Mark)

IV. Determine the pH of the mixture obtained in (b)

Method used	Inferences
(½ Mark)	(½ Mark)

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CHEMISTRY

PAPER 3

1. Procedure II

Table 1……. 3 marks

(a) – Complete table (C.T) ✓1 Mark

Conditions

(i) Complete table with 3 titrations – 1 Mark

(ii) Incomplete table with 2 titrations – ½ Mark

(iii) Incomplete table with 1 titration – zero mark

Penalties:- Penalise ½ mark each

(i) Wrong arithmetic

(ii) Inverted table

(iii) Burette reading beyond 50cm (unless explained)

(iv) Unrealistic titre values i.e. $1cm^3$ or 100

(b) **Use of decimals (** tied to 1st and 2nd rows only)

Conditions (½ mark)

(i) Accept 1 or 2 decimal points used consistently, if not penalise fully.

(ii) Where 2 decimal points used the 2nd decimal point should be "0" or "5" if not penalise fully.

(iii) Accept consistency in use of zero as initial burette reading i.e. 0, 0.0, 0.00

(c) Acuracy (Tied to correct titre value)…… (1 mk)

(i) Atleast one of candidate's values is within ± 0.1 of s.v (1mk)

(ii) If non of candidates' value is within ± 0.2 of s.v (0 mark)

(iii) If one of the candidates value is within ± 0.2 of the s.v (½ mark)

(d) Principles of Averaging …… 1 mark

Conditions

(i) - 3 consistent values averaged
- If 3 titrations done but only are consistent and averaged } 1 mark
- If 2 titrations done and are consistent and averaged

Penalties

- Wrong arithmetic error is outside ± 0.2 units in d.p. ½ mark
- No working shown but answer is given correctly ½ mark
- Wrong workings with correct answer 0 mark

(e) Final accuracy (Tied to correct average titre)(1 mark)

Compare candidate's average titre with the s.v

i) If the candidates value is in ± 0.1of the s.v. – (1 mark)

ii) If the candidate's value is in ± 0.2 of the s.v. – (½ mark)

iii) If the candidate's value is beyond ± 0.2 – (0 mark)

beyond ± 0.2 0 mark

(ii) number of moles of the acid used

$n = \frac{MV}{1000} = \left\{0.15x \ \frac{Ans.in\ a\ (i)}{1000}\right\}$ = Ans _____ mole ½ mark

e.g. $0.15 \times \frac{20.35}{1000} = 0.003053$ mole

(b) Equation

$2HA_{(aq)} + M_2CO_3.xH_2O \longrightarrow 2MA_{(aq)} + CO_{2(g)} + (x + 1)\ H_2O_{(l)}$ ✓ 1 Mark

States wrong/missing or letters joined ✓ ½ Mark

(c) (i) No. of moles of metallic carbonate in $25cm^3$ of Md.

= (Answer in a (ii) above x $\frac{1}{2}$)

= Answer _____ mole ✓ ½ Mark

e.g. $0.003053 \times \frac{1}{2} = 0.00153$ mole

(ii) No. of moles of the metallic carbonate in 50.00 cm^3 of solution Mc ✓ 1 Mark
$50cm^3$ of Mc has same No. of moles of carbonate as $250cm^3$ of Md.
but $25cm^3$ of Md ⟶ Answer in c (i) above.
$\therefore$ 250cm3 of Md has Ans. c (i) x $\frac{250cm^3}{25cm^3}$
= Ans. _____ mole ✓ ½ Mark
e.g. $\left(0.00153\ x\ \frac{250}{25}\right)$ = 0.0153 mole

(iii) Molar mass of the metallic carbonate
$50cm^3$ of Mc ⟶ Ans. c (ii)
$80cm^3$ of Mc ⟶ ?
$\therefore$ Moles in $80cm^3$ of Mc = $\left(Ans.c\ (ii)\ x\ \frac{80}{50}\right)$ moles
but $80cm^3$ of Mc has 7.0g
$\Rightarrow \left\{Ans\ c\ (ii) x\ \frac{80}{50}\right\}$ mole = 7.0g
1 mole - ?
So molar mass = $\left\langle\frac{1\ x\ 70}{Ans\ c(ii) x\ \frac{80}{50}}\right\rangle$
= Ans _____ g ½ mark
e.g = $\frac{7.0\ x\ 1}{\left(0.0153\ x \frac{80}{50}\right)} = \frac{7.0}{0.02448}$ = 285.5477g

(iv) Value of x in $M_2CO_3.xH_2O$
Let molar mass = (23 x 12) + 12 + (16 x 3) + x (2 + 16)
= 106 + 18x
But molar mass = Ans. c (iii)
$\therefore$ 106 + 18x = Ans. c (iii)
x = $\left\{\frac{Ans.C\ (iii) - 106}{18}\right\}$ ✓ ½ mark
= Ans _____ ½ mark
e.g. 106 + 18x = 285.5477
x = $\frac{285.5477-106}{18}$
= 9.9749 ≈ 10

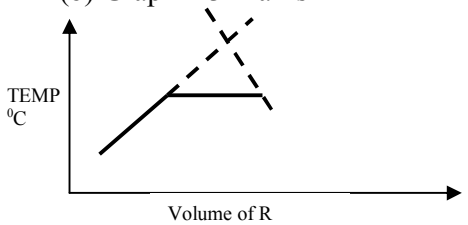
2. (a) Table ……✓3 ½ marks
1. Complete table ✓1 Mark

Conditions

i. Complete table with 7 readings ✓1 Mark
Incomplete table with 5 – 6 readings ✓ ½ Mark
Incomplete table less than 5 readings 0 mark
ii. Treat initial value above 40^0C and below 10^0C as unrealistic and penalize ½ mark tied to t = 0
iii. Penalise ½ mark for each reading greater than 50^0C from t = 30 seconds to a maximum of ½ mark.
iv. Penalize fully if all readings are constant.

2. Use of decimals ✓1 Mark
Accept whole numbers or readings with .0 or .5 used consistently, otherwise penalize fully.
3. Accuracy ½ mark
Compare the candidate's initial temperature (at time = 0) with the school value: If within ± 0.2 award 1 mark otherwise penalize fully
4. Trend ✓1 Mark
Award the first ½ mark for a continuous rise in temperature upto a maximum or constant values followed by a drop.

(b) Graph ✓3 Marks



Trend

(i) Labeling (both axis) ✓ ½ Mark

Penalize fully for – inverted axes

- wrong units

Accept if units are omitted

(ii) Scale ½ mark

Area covered by the plots should be at least ¾ of the plotting area: otherwise penalize fully.

(iii) Plotting ✓1 Mark

- Award ✓1 mark for at least 7 points correctly plotted
- Award ½ mark for 5 – 6 points correctly plotted otherwise award zero.
- Award fully for plots if the axes are inverted but the plotting is correct.

(iv) Shape 1 mark

- Award ½ mark for a straight line showing progressive increase in temperature.
- Award the other ½ mark for an extrapolated straight line showing a drop.

(c) (i) ½ mark - shown on the graph

(ii) ½ mark - value

(d) Heat change 1 ½ marks

$\Delta H = Mc\Delta T$

e.g. $\frac{42.5}{1000}$ x 4.2 x 4.5 = -0.8033Kj

- Penalize ½ mark for wrong or absence of units
- Penalize ½ mark for the absence of the –ve sign on the answer

(e) Moles of NaOH = $\frac{25\ x\ 0.6}{1000}$ = 0.015mol ✓ ½ Mark

Molar enthalpy

0.015 ⟶ -8033

1 mole ⟶ ?

= $\frac{1}{0.015}$ x .8033 = - 53.5533 kJ mol^{-1} ✓ ½ Mark

2. (II)

1. (a) Complete table ✓5 Marks

(i) Complete table with 10 readings 2 ½ marks

- Penalize ½ mark for each space not filled
- Penalize ½ mark for any time reading less than or greater than 220 seconds.
- If the candidate enters some readings in fractions and others in decimals award accordingly (each value is worth ½ mark)

(ii) Use of decimals ½ mark

Accept whole numbers or 1dpl – 2dpl used consistently throughout: otherwise penalize fully.

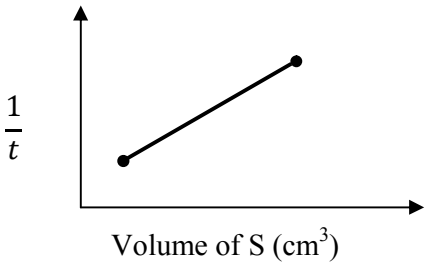
(iii) Accuracy ½ mark

Compare the candidate's first reading and the school value. If within ±2 seconds award ½ mark: otherwise penalize fully.

(iv) Trend ½ mark

Award ½ mark if time increasing throughout: otherwise penalize fully.

(b) The graph



(i) Scale ½ mark

Area covered to be ¾ of the space provided. Scale should accommodate 4 plots, otherwise penalize fully.

(ii) Labeling of axes ½ mark

- Penalize fully for wrong units of volume

- Penalize fully for inverted axes
- Accept if no units are shown on labelling

(iii) Plotting ✓ 1 mark

Accept 4 -5 correctly plotted otherwise penalize fully if 3 plots are correctly plotted award ½ mark if less than 2 plots are correctly plotted award 0 mark. Accept rounding off if consistently used.

(c) Time taken 1cm long magnesium ribbon to react with $5cm^3$ of solution S.

Showing on the graph – ½ mark

Stating correct reading ½ mark

Conditions

- ✓ Penalize fully if not shown on the graph.
- ✓ Award 1 mark if shown on the graph but not stated
- ✓ Accept the answer to at least 1 dpl unless it works out exactly to a whole number. Otherwise penalize fully.
- ✓ Award zero if not shown on the graph and the stated value is wrong.
- ✓ If value shown of the graph is stated wrongly penalize fully.

3. (a)

(i)

Observations	Inferences
– Brown fumes ✓ ½ mark – Colour of moist blue litmus turns red ✓ ½ mark – Colour of moist red litmus remains red.	NO^3 present ✓ ½ mark
Colour of white solid becomes orange (when hot) ✓ ½ mark but yellow when cold ✓ 1 mark	PbO formed ✓ ½ mark

(ii)

I	Observations	Inferences
	White ppt formed insoluble in excess ✓ ½ mark	Pb^{2+}, Al^{3+} present ✓ 1 mark Accept Zn^{2+} absent ✓ 1 mark
II	Yellow ppt formed ✓ ½ mark	Pb^{2+} present ✓ ½ mark

(iii)

I	Observations	Inferences
	No effervescence of colourless gas ✓ ½ mark	SO_4^{2-} likely present or CO_3^{2-} and SO_3^{2-} ✓ ½ mark
II	No white ppt formed ✓ ½ mark	Cl^-, SO_4^{2-} absent Accept NO_3^- likely to be present ✓ ½ mark

(b)

(i)	Observations	Inferences
	- Melts into a colourless liquid ✓ ½ mark - Burns with a sooty / smocky/ luminous / yellow flame ✓ ½ mark	C = C or –C ≡ C - ✓ present 1 mark Accept:- organic cpd in high C:H ratio - Long chain organic cpd - Aromatic cpd - Unsaturated organic cpd - Carbon – carbon double of triple bonds (in words) Rej: C ≡ C or C = C - Alkene, alkyne - Long chain hydrocarbon ✓ 1 mark
(ii)	Partially dissolves ✓ ½ mark to form colourless solution ✓ ½ mark	

I	Observations	Inferences

	Slow effervescence✓ 1 mark/ fizzing formation of bubbles of colourless gas Accept: Slow production of colourless gas Rej: "hissing" ½ mark	- H^+/H_30^+/-COOH/R – OH ✓ 1 mark - Carboxylic group in words - Solution is acidic Rej: Solution is an acid ½ mark
II	- Orange colour of $H^+/K_2Cr_2O_7$ persists/is retained Rej:Colour of $H^+/K_2Cr_2O_7$ retained ½ mark	Absence of R – OH ½ mark
III	Red/orange/yellow bromine water decolourised ✓ 1 mark Rej: Bromine water turns colourless /dicoloured ✓ ½ mark	$>C = C<$ or –C ≡ C - ✓ 1 mark Accept: Unsaturated organic compound Penalise fully for any contradictory functional group ✓ ½ mark
IV	Method - Place $1cm^3$ of solution T in a test tube - Add 1 – 3 drops of universal indicator solution - Match the colour obtained with the pH chart pH value 4 Rej: pH range of 4 – 5 ✓ ½ mark	Solution is weakly acidic Rej: Weak acid ✓ ½ mark