Candidates Name: ……..

Signature: ……...

Random No.					Personal No.		

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

545/2
CHEMISTRY
Paper 2
2025
2 Hours

CRACKING CHEMISTRY PRACTICAL SERIES SET-4

Uganda Certificate of Education

CHEMISTRY

Paper 2
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.*

Item 1

Otim, a farmer in northern Uganda, uses limewater to reduce soil acidity in his vegetable garden. He has bought limewater from two different suppliers (A and B) but is unsure which one is more effective.

A local agriculture officer explains that the limewater sample with higher alkalinity (better at neutralising acid) will require *a larger volume of dilute hydrochloric acid in a titration test to reach neutralisation.*

The agriculture club at your school has been asked to help Otim by *pipetting fixed volumes of each limewater sample separately and titrating them with dilute hydrochloric acid solution using phenolphthalein indicator.* They have approached you for guidance.

You have been provided with the following:

- **BA1**: Dilute hydrochloric acid solution (to simulate acid in soil)
- **BA2**: Limewater from supplier A
- **BA3**: Limewater from supplier B
- Phenolphthalein indicator

Task: As a chemistry learner:

(a) Design an experiment you will carry out to help Otim. (*Your design should include; aim, variables, hypothesis, apparatus and materials, procedure, risks and their mitigations*)

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(b) carryout the experiment and record your results. (*A minimum of three readings required*.)

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(c) analyse your results and inform Otim accordingly.

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END

SUGGESTED RESPONSE

Aim:

To determine which limewater sample, BA2 or BA3, requires the larger volume of dilute hydrochloric acid to reach neutralisation using phenolphthalein indicator.

A=05
2A=05
1A=03

Alternatively

- To compare the volumes of dilute hydrochloric acid needed to neutralise fixed volumes of limewater from two different suppliers.
- To find out which limewater sample requires more amount of acid for neutralisation using phenolphthalein indicator.
- To measure and compare the volume of acid needed to neutralise equal amounts of limewater from suppliers A and B.
- To establish which limewater sample neutralises more acid based on the volume of acid used in titration

Variables

V=06

- **Independent:** Source of limewater / BA2 and BA3/ type of lime water sample/ nature of lime water sample
- **Dependent:** Volume of BA1 required to reach the end-point.
- **Controlled:** Volume of limewater samples pipetted (25.0 cm³), number of drops of indicator used,

3V=06
2V=05
1V=04

Hypothesis:

H=06

The limewater sample that requires a larger volume of dilute hydrochloric acid to reach the end-point is more effective at neutralising acidic soil.

2H=06
1H=05

Alternatively

- Limewater sample BA2 requires a larger volume of acid to reach neutralisation than BA3, showing that BA2 is more effective.
- Supplier A's limewater will neutralise more acid than supplier B's limewater, so it will need a greater volume of acid in titration.
- The volume of acid needed to neutralise supplier A's limewater is greater than that for supplier B's, indicating supplier A's limewater is stronger.
- Between the two samples, the limewater requiring the larger volume of acid is the more effective neutraliser of acidic soil.
- Supplier A's limewater will require more amount of acid to reach the end-point compared to supplier B's limewater, showing higher neutralising power.

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Apparatus & materials: *25.0 cm³ pipette, 250 cm³ conical flasks, 50 cm³ burette and stand, white tile, distilled water, beakers, funnel, dropper*

Procedure:

a) *25.0 cm³ of BA2 was pipetted into a clean conical flask.* ~ Pm ~ Pm $(Pm \, 7/3)$ $P=05$

b) *Two drops of phenolphthalein indicator were added to the flask and the mixture was swirled gently.* Pm $Pm + Pr + Pc = 3P = 05$

c) *The burette was filled with dilute hydrochloric acid (BA1)* $Pm + Pr = 2P = 04$

d) *The initial burette reading was recorded.*

e) *Acid from the burette was added slowly to the conical flask while swirling until the pink colour just disappeared, indicating the end-point.* $Pm = 1 \, P = 01$

f) *The final burette reading was recorded*

g) *Steps a) to f) were repeated until at least three consistent and reliable readings were obtained for sample BA2.*

h) *The apparatus was cleaned, and the same titration procedure was repeated for BA3 instead of BA2.*

Risks & mitigations

Risk	Mitigation
Contact with hydrochloric acid which is corrosive	Wear safety goggles, gloves, and laboratory coat;
Spillage of BA1, BA2, or BA3 on the body	Clean spills immediately with plenty of water; clean with a cloth
Broken glassware that may cause cuts to the skin	Broken glass with a brush, not hands.

$R = 03$

(b) Results

Sample BA2 (Supplier A)

Volume of BA2 used 25.0cm³

$D = 05$

$2D = 05$
$1D = 04$

Experiment number	1	2	3
Final burette reading (BA2) (cm³)	22.10	32.20	22.20
Initial burette reading (BA2) (cm³)	0.00	10.00	0.00
Volume of acid used (BA2) (cm³)	22.10	22.20	22.20

$Dr = 05$

$2Dr = 05$
$1Dr = 04$

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Sample BA3 (Supplier B)

Note: Allow joint table for BA 2 and BA3
- Award D and Dr after considering both BA2 and BA3
Score guide attached

Volume of BA3 used <u>25.0cm³</u>

Experiment number	1	2	3
Final burette reading (BA3) (cm³)	18.50	28.60	18.50
Initial burette reading (BA3) (cm³)	0.00	10.00	0.00
Volume of acid used (BA3) (cm³)	18.50	18.60	18.50

(c) Analysis

For Supplier A (BA2):

→ Allow for only 2 values picked also

Volumes of acid used (cm³): 22.10, 22.20, 22.20

$$Mean/Average\ volume = \frac{22.10 + 22.20 + 22.20}{3} = \frac{66.50}{3} = 22.17\ cm^3$$

Im

For Supplier B (BA3):

Volumes of acid used (cm³): 18.50, 18.60, 18.50

$$Mean/Average\ volume = \frac{18.50 + 18.60 + 18.50}{3} = \frac{55.60}{3} = 18.53\ cm^3$$

Im

Im = 2

Interpretation

The limewater from Supplier A (BA2) required *an average* of **22.17 cm³** of dilute hydrochloric acid to reach the neutralisation end-point, while limewater from Supplier B (BA3) required only **18.53 cm³**. Since the same fixed volume of limewater was used for both samples, the limewater needing the larger volume of acid contains more base and is thus more effective at neutralising acidity.

Ia

2Im + Ia = 06
2Im = 05

Conclusion

Supplier A's limewater is more effective at neutralising acidic soil compared to Supplier B's limewater because it required a larger volume of acid to reach the end-point in the titration.

C = 06

Note: award C only if I is correct

Recommendation

2c = 06

Otim should use limewater from Supplier A for his vegetable garden as it has a higher neutralising ability and will better reduce soil acidity, promoting healthier crop growth.

IC = 05