SUGGESTED MARKING GUIDE

Candidate's Name: ...Joseph Jobs Kayiwa.....

Signature: .....

Random No.						Personal No.		

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

545/3
CHEMISTRY
(PRACTICAL)
Oct./Nov. 2022
2 hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Certificate of Education

CHEMISTRY PRACTICAL

Paper 3

2 hours

INSTRUCTIONS TO CANDIDATES:

*Answer **both** questions. Answers are to be written in the spaces provided in this booklet. All your work **must** be in **blue** or **black** ink. Any work done in **pencil** **except** drawings will **not** be marked.*

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

All working must be clearly shown.

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

For Examiners' Use Only		
Q.1	25	
Q.2	25	
Total	50	

Turn Over

1 decimal place of pipette reading ✓
No decimal place for burette readings — Award 0.
Acc 1dp

1. You are provided with the following:

BA1, which is a 0.05 M solution of a salt, **G**. (*formula mass of* **G** *=261.32*)
BA2, which is a solution of an alkaline compound, **E**.
BA3, which is a 0.15 M solution of an acid, **W**.

You are required to determine the percentage by mass of **G** that is precipitated by **E**.

Initial burette reading 2dp ✓
FBR(2dp) ✓
Correct subtraction ✓
Range ±5 ✓

Procedure:

Pipette 25.0 cm³ (or 20.0 cm³) of **BA2** into a conical flask.

Using a measuring cylinder, transfer 30.0 cm³ of **BA1**, into a conical flask containing **BA2**, which you pipetted. Shake the flask well for the two solutions to mix, and add 4-5 drops of methyl orange indicator.

Titrate the resultant mixture with **BA3** from the burette until the precipitate just dissolves and the solution turns pale orange in colour.

Repeat the procedure until you obtain consistent results.
Record your results in the table **1**.

No FBR indicated? Award −FBR
Deny: −Accuracy −Subtraction

Acc 1 or 2 dps.

Table 1

Volume of pipette used ..... 25.0 ✓ ..... cm³ (½ mark) (01 mk)

Titration number	1	2	3
Final burette reading (cm³)	16.60 ✓	Ignore these columns even when filled	
Initial burette reading (cm³)	0.00 ✓		
Volume of **BA3** used (cm³)	16.60 ✓		

(6 marks) (7½ marks)

(a) (i) State the volumes of **BA3** used to calculate the average volume. (½ mark)

Award only one of the 3 values, ignore the others.

16.60 ✓ ..... Ignore this step: two values, (01 mk)

(ii) Calculate the average volume of **BA3** used. (2½ marks)

.....

16.60 ✓✓ ..... cm³

For 20cm³ pipette, 2

Average volume = 13.30 cm³

±0.00 ✓
±0.20 ✓
±0.30 ✓
±0.40 ✓
±0.50 ✓
±0.60 ✓

(b) Calculate the number of moles of

(i) acid **W** that reacted. *(02 marks)*

1000 cm^3 of BA3 contain 0.15 moles of W.

reject (cm^3 / cm^2) 16.0 cm^3 of BA3 contain $\left(\frac{16 \times 0.15}{1000}\right)$

reject = Average from table. for contains reacts with

= 0.0024 moles

Atleast 3 dps. (2)

(ii) the alkaline compound, **E**, that reacted. *(02 marks)*
(*1mole of* **E** *reacts with 2 moles of* **W**)

2 moles of W react with 1 mole of E

0.0024 moles of W react with $\left(\frac{0.0024 \times 1}{2}\right)$

= 0.0012 moles

Atleast 3 dps (2)

(c) Determine the

(i) number of moles of **G** that reacted with **E**. *(01mark)*
(**G** *reacts with* **E** *in mole ratio of 1:1*)

1 mole of E reacts with 1 mole of G. (1)

0.0012 moles react with (0.0012 x 1)

= 0.0012 moles

Atleast 3dps

(ii) mass of **G** that reacted with **E**. *(03 marks)*

1 mole of G weighs 261.32 g

0.0012 moles weigh $\left(\frac{0.0012 \times 261.32}{1}\right)$

= 0.313554 g.

(d) Calculate the

(i) number of moles of **G** in 30 cm^3 of **BA1** that was used. *(02 marks)*

1000 cm^3 of BA1 contain 0.05 moles of G

30 cm^3 of BA1 contain $\left(\frac{30 \times 0.05}{1000}\right)$

Atleast = 0.0015 moles.

(ii) mass of **G** in 30 cm^3 of **BA1**. 3dps *(02 marks)*

1 mole of G weighs 261.32g.

0.0015 mole of G weigh (0.0015×261.32) g

Atleast 2dps = 0.39198 g.

(iii) percentage of **G** that formed a precipitate with **E**. *(02 marks)*

Percentage of G precipitated $= \frac{0.313584}{0.39198} \times 100$

Range (75 – 85)% = 80%.

2. You are provided with substance **Q**, which contains **two** cations and **one** anion.

Carry out the following tests in table **2** to identify the cations and the anion in **Q**.

Identify any gas(es) evolved.

Record your observations and deductions in table **2**. *(25 marks)*

25

Table 2

TESTS	OBSERVATIONS	DEDUCTIONS
(a) Heat a spatula end-ful of **Q** strongly in a dry test tube.	White solid/powder. Ignore Colourless gas turns damp/moist blue litmus paper red and limewater milky.	CO_2 / CO_3^{2-} or HCO_3^-
	Droplets of a colourless liquid turns white anhydrous $CuSO_4$ blue	H_2O of crystallization
	Reddish brown residue when hot yellow on cooling.	PbO / Pb^{2+}

Ignore

Accept orange, brown (hot)

Accept → vigorous effervescence

TESTS	OBSERVATIONS	DEDUCTIONS
(b) To **two** spatula end-fuls of **Q**, add dilute nitric acid drop-wise until there is no further change. Add dilute sodium hydroxide solution drop-wise until the alkali is in excess. Filter and keep both the filtrate and residue.	Bubbles of a colourless gas turns moist blue litmus paper red and limewater milky Dissolves to form colourless solution White ppt insoluble or White residue Colourless filtrate	CO_2 / CO_3^{2-} confirmed Zn^{2+}, Al^{3+}, Pb^{2+}, Mg^{2+}, Ca^{2+} Mg^{2+}, Ca^{2+} Mg^{2+}, Ca^{2+} Zn^{2+}, Al^{3+}, Pb^{2+}. any correct 2 (6)
(c) To the filtrate, add dilute nitric acid drop-wise until the solution is just acidic. Divide the acidified solution into **four** parts and test as follows:	White ppt soluble to form colourless solution	Zn^{2+}, Al^{3+}, Pb^{2+}. any correct 2 (1mk) (2)
(i) To the **first** part of the acidified solution, add dilute sodium hydroxide solution drop-wise until in excess.	White ppt soluble to form colourless solution.	Zn^{2+}, Al^{3+}, Pb^{2+}. any correct 2 (1mk) (2½)
(ii) To the **second** part of the acidified solution, add dilute ammonia solution drop-wise until in excess.	White ppt insoluble	Al^{3+}, Pb^{2+}. (2)
(iii) To the **third** part of the acidified solution, add 4–5 drops of dilute sulphuric acid and warm.	White ppt insoluble on warming	Pb^{2+}. ↑ award even when insoluble on warming is missing. reject if Al^{3+} also is included. (1½)

TESTS	OBSERVATIONS	DEDUCTIONS
(iv) Use the **forth** part of the acidified solution, to carry out a test of your own choice in order to confirm one of the cations in **Q**. **Test:** Add 2–3 drops of potassium iodide solution Acc add KI(aq)	Yellow ppt Shd be emphasised. Accept test under observation.	Pb^{2+} confirmed. (½)
(d) Wash the residue **twice** with dilute sodium hydroxide solution and dissolve it in dilute nitric acid. Divide the resultant solution into **two** parts and test as follows:	Dissolves to a colourless solution	Mg^{2+}, Ca^{2+} Both (1)
(i) To the **first** part, add dilute sodium hydroxide solution drop-wise until in excess.	White ppt insoluble	Mg^{2+} Ca^{2+} Both (½)
(ii) To the **second** part, add dilute ammonia solution drop-wise until in excess.	White ppt insoluble	Mg^{2+} confirmed. (½)

(e) (i) The cations in **Q** are ..... Pb^{2+} confirmed in C(iv) and ..... Mg^{2+} confirmed in d(ii)

(ii) The anion in **Q** is..... CO_3^{2-} confirmed in (b) (½)

Total 25

END