Candidate's Name: MUTESASIRA 0774767116 0752154941

Signature: .....

Random No.	Personal No.

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

545/4
CHEMISTRY
(PRACTICAL)
Oct./Nov. 2022
2 hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Certificate of Education

CHEMISTRY PRACTICAL

Paper 4

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	Mutesasira
Q.2	25	Mutesasira
Total	50	Mutesasira

Turn Over

1. You are provided with the following:

BA1, which is a solution made by dissolving 5.0 g of impure anhydrous sodium carbonate to make 1 dm^3 of solution.

BA2, which is a 0.1 M hydrochloric acid.

You are required to determine the percentage impurity of the sodium carbonate solution.

Procedure:

Pipette 25.0 cm^3 (or 20.0 cm^3) of **BA1** into a conical flask. Add 2-3 drops of methyl orange indicator and titrate the solution with **BA2** from the burette. Repeat the procedure until you obtain consistent results.
Record your results in the table **1**.

Table 1

Volume of pipette used ..... 25.0 ✓ 0½ cm^3 *(½ mark)*

Titration number	**1**	**2**	**3**
Final burette reading (cm^3)	16.60	33.10 ✓	49.60 ✓
Initial burette reading (cm^3)	0.00 ✓	16.60 ✓	33.10 ✓
Volume of **BA2** used (cm^3)	16.60 ✓	16.50 ✓	16.50 ✓ 07½

(7½ marks)

(a) (i) State the volumes of **BA2** used to calculate the average volume. *(½ mark)*

..... 16.50 cm^3 and 16.50 cm^3 ✓ ½ .....

(ii) Calculate the average volume of **BA2** used. *(2½ marks)*

..... $\frac{16.50 + 16.50}{2}$ ✓ ✓ = 16.50 cm^3 .....

..... ✓ 02½ .....cm^3

(b) Calculate the number of moles of:

(i) hydrochloric acid in **BA2** that reacted. *(03 marks)*

1000cm³ of BA2 contain 0.1 moles of acid

1cm³ of BA2 contains $\left(\frac{1}{1000} \times 0.1\right)$ moles of acid

∴ 16.50 cm³ of BA2 contain $\left(\frac{16.50 \times 0.1}{1000}\right)$ moles of acid (03)

$= 0.00165$ moles

(ii) sodium carbonate in **BA1** that reacted. *(02 marks)*
(1 mole of sodium carbonate reacts with 2 moles of hydrochloric acid)

2 moles of acid reacted with 1 mole of sodium carbonate

0.00165 moles of acid reacted with $\frac{1}{2} \times 0.00165$ moles of sodium carbonate (02)

$= 0.000825$ moles

(c) Determine the:

(i) concentration of sodium carbonate in mol dm^{-3} in **BA1**. *(03 marks)*

250 cm³ of BA1 contain 0.000825 moles

1000 cm³ of BA1 contain $\left(\frac{1000 \times 0.000825}{25.0}\right)$ moles (03)

$= 0.033$ moles

(ii) percentage impurity of the sodium carbonate. *(06 marks)*
(C = 12, O = 16, Na = 23)

Molar mass of $Na_2CO_3 = (2 \times Na) + (1 \times C) + (3 \times O)$

$(2 \times 23) + (1 \times 12) + 3 \times 16 = 106$g

1 mole of Na_2CO_3 weighs 106g

0.033 moles of Na_2CO_3 weighs $0.033 \times 106 = 3.498$g

Mass of Impure $Na_2CO_3 = (5.0 - 3.498) = 1.502$g

Percentage Impurity of $Na_2CO_3 = \frac{1.502}{5.0} \times 100$

$= 30.04\%$ (06)

2. You are provided with substance **L**, which contains **two** cations and **one** anion.
Carry out the following tests in table **2** to identify the cations and the anion in **L**.
Identify any gas(es) evolved.
Record your observations and deductions in table **2**.

Table 2 *(25 marks)*

TESTS	OBSERVATIONS	DEDUCTIONS
(a) Heat a spatula end-ful of **L** strongly in a dry test tube.	- Green powder turns black on heating and cooling - Colorless condensate turns anhydrous $CuSO_4$ blue - Colorless gas, turns blue litmus red, lime water milky	Cu^{2+} or Fe^{2+} CuO or FeO / Cu^{2+} or Fe^{2+} - H_2O of crystallisation from a hydrated salt - Acidic gas CO_2 / CO_3^{2-} or HCO_3^-
(b) To a spatula end-ful of **L**, add about 4 cm^3 of dilute nitric acid and warm to dissolve. Add dilute sodium hydroxide solution drop-wise until in excess. Filter and keep both the filtrate and residue.	- Green powder dissolves in acid with effervescence, bubbles of a colorless gas given off, turns blue litmus red, lime water milky - Blue solution - Pale blue precipitate insoluble in excess - Colorless filtrate - Pale blue residue	- CO_2 / CO_3^{2-} confirmed - Cu^{2+} - Cu^{2+} - Zn^{2+}, Al^{3+} or Pb^{2+} - Cu^{2+}
(c) To the filtrate, add dilute nitric acid drop-wise until it is just acidic. Divide the resultant solution into **three** parts and test as follows: (i) To the **first** part of the acidified solution, add dilute sodium hydroxide solution drop-wise until in excess.	- White precipitate soluble to form a colorless solution - White precipitate soluble in excess	- Zn^{2+}, Al^{3+} or Pb^{2+} (any two) - Zn^{2+}, Al^{3+} or Pb^{2+} (any two)

TESTS	OBSERVATIONS	DEDUCTIONS
(ii) To the **second** part of the acidified solution, add aqueous ammonia drop-wise until in excess.	- White ppt insoluble in excess	- Al^{3+} or Pb^{2+} Any one two
(iii) Use the **third** part of the acidified solution to carry out a test of your own choice to confirm one of the cations in **L**. Test: To the Third part was added 3 drops of potassium Iodide Solution	- Yellow ppt	Pb^{2+} Confirmed.
(d) Wash the residue and dissolve it in dilute nitric acid. Divide the solution into **two** parts and test as follows: (i) To the **first** part, add dilute sodium hydroxide solution drop-wise until in excess.	- Pale blue residue dissolves to form a blue solution - Pale blue ppt ppt insoluble in excess	- Cu^{2+} - Cu^{2+}
(ii) To the **second** part, add dilute ammonia solution drop-wise until in excess.	- Pale blue ppt soluble in excess to form a deep blue solution.	- Cu^{2+} confirmed

(e) (i) The cations in **L** are Pb^{2+} and Cu^{2+}

(ii) The anion in **L** is CO_3^{2-}

END