Candidate's Name:.....

Random No.					Personal No.		

Signature: .....

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

P525/3
CHEMISTRY
Paper 3
(Practical)
Nov./Dec. 2024
3¼ hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 3
(Practical)

3 hours 15 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of **three** *questions.*

All *questions are* **compulsory**. *Use* **blue** *or* **black** *ink. Any work done in pencil* **except** *drawings, will* **not** *be marked.*

Write your answers in the spaces provided. **No** *additional sheet(s) of paper should be inserted in this booklet.*

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

Reference books (i.e. text books, booklets on qualitative analysis etc.) should **not** *be used.*

You are **not** *allowed to start working with the apparatus for the first* **15 minutes**. *This time is to enable you to read the question paper and make sure you have all the apparatus and chemicals that you require.*

For Examiners' Use Only			
Q.1	**Q.2**	**Q.3**	**Total**

Turn Over

1. You are provided with the following:

FA1, which is approximately 0.1 M sodium thiosulphate solution.

FA2, which is 2 M sulphuric acid.

FA3, which is 10 % potassium iodide solution.

FA4, which is a solution made by dissolving 1.2 g of potassium iodate in 250 cm^3 of distilled water.

Solid **W**, which is impure copper(II) oxide.

Starch solution.

You are required to determine the;

(i) molarity of **FA1**.

(ii) percentage purity of **W**.

Theory:

In acidic solution, potassium iodate reacts with potassium iodide according to the following equation:

$$IO_3^-{}_{(aq)} + 5I^-{}_{(aq)} + 6H^+{}_{(aq)} \longrightarrow 3I_{2(aq)} + 3H_2O_{(l)}$$

Copper(II) sulphate reacts with potassium iodide solution according to the following equation:

$$2Cu^{2+}{}_{(aq)} + 4I^-{}_{(aq)} \longrightarrow Cu_2I_{2(s)} + I_{2(aq)}$$

Iodine reacts with sodium thiosulphate solution according to the following equation.

$$I_{2(aq)} + 2S_2O_3^{2-}{}_{(aq)} \longrightarrow S_4O_6^{2-}{}_{(aq)} + 2I^-{}_{(aq)}$$

PART I

Procedure

Pipette 25.0 cm^3 (or 20.0 cm^3) of **FA4** into a clean conical flask, add 10 cm^3 of **FA3** followed by 20 cm^3 of **FA2**.

Titrate the resultant solution with **FA1** from the burette using starch indicator.

Repeat the above procedure to obtain consistent results.

Record your results in Table **1**.

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

Table 1

Titration Number	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of **FA1** used (cm^3)			

(4½ marks)

(a) (i) Record the volume of **FA1** used for calculating the average volume. *(½ mark)*

.....cm^3

(ii) Calculate the average volume of **FA1** used. *(2½ marks)*

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..... cm^3

(b) Calculate the number of moles of;

(i) **FA4** that reacted. *(02 marks)*

(*K* =39, *O* = 16, *I* = 127)

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(ii) **FA1** that was reacted. *(02 marks)*

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(c) Determine the molarity of **FA1**. *(1½ marks)*

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PART II

Procedure

Weigh accurately 2.0 g of **W** and add it to 100 cm^3 of **FA2**. Warm the mixture while stirring to dissolve, cool and transfer the resultant solution to a 250 cm^3 volumetric flask and make up the solution to the mark using distilled water. Label the solution **FA5**.

Results:

Mass of weighing bottle + **W** .....g *(½ mark)*

Mass of empty weighing bottle .....g *(½ mark)*

Mass of **W** weighed .....g *(½ mark)*

PART III

Procedure

Pipette 25.0 cm^3 (or 20.0 cm^3) of **FA5** into a clean conical flask, add 10 cm^3 of **FA3** followed by 10 cm^3 of **FA2**.

Titrate the liberated iodine with **FA1** from the burette using starch indicator.

Repeat the titration to obtain consistent results.

Record your results in Table **2**.

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

Table 2

Titration Number	**1**	**2**	**3**
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of **FA1** used (cm^3)			

(*4½ marks*)

(a) (i) Record the volume of **FA1** used for calculating the average volume. (*½ mark*)

.....cm^3

(ii) Calculate the average volume of **FA1** used. (*2½ marks*)

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..... cm^3

(b) Calculate the number of moles of;

(i) iodine liberated by **FA5**. (*02 marks*)

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(ii) Copper(II) ions in 250 cm^3 of **FA5**. (*02 marks*)

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(c) Determine the;

(i) mass of pure copper(II) oxide in **W**. *(02 marks)*
(Cu = 63.5; O = 16)

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(ii) percentage purity of **W**. *(01 mark)*

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2. You are provided with substance **Q** which contains **two** cations and **two** anions. Carry out the tests in Table **3** to identify the cations and anions present in **Q**. Identify any gas(es) evolved.

Record your observations and deductions in the table. *(30 marks)*

Table 3

	TESTS	OBSERVATIONS	DEDUCTIONS
(a)	Heat a spatula end-ful of **Q** in a dry test tube strongly until there is no further change.		
(b)	To three spatula end-fuls of **Q** in a boiling tube, add about 8 cm^3 of distilled water and shake thoroughly. Filter, keep both the filtrate and the residue. Divide the filtrate into **seven** portions.		
(i)	To the **first** portion, add dilute sodium hydroxide solution drop-wise until in excess.		

	TESTS	OBSERVATIONS	DEDUCTIONS
(ii)	To the **second** portion, add dilute ammonia solution drop-wise until in excess.		
(iii)	To the **third** portion, add 2-3 drops of dilute sulphuric acid.		
(iv)	Use the **fourth** portion to carry out a test of your own choice to confirm one of the cations in **Q**. **Test:** …… …… …… …… …… ……		
(v)	To the **fifth** portion, add copper turnings followed by 3-4 drops of concentrated sulphuric acid and warm.		
(vi)	To the **sixth** portion, add 3-4 drops of lead(II) nitrate and heat.		

TESTS	OBSERVATIONS	DEDUCTIONS
(vii) To the **seventh** portion, add 3-4 drops of silver nitrate solution followed by ammonia solution drop-wise until in excess.		
(c) Wash the residue with water and dissolve it in about 5 cm^3 of dilute hydrochloric acid. Divide the solution into **four** portions.		
(i) To the **first** portion, add dilute sodium hydroxide solution drop-wise until in excess.		
(ii) To the **second** portion, add dilute ammonia solution drop-wise until in excess.		
(iii) To the **third** portion add ammonium oxalate solution.		
(iv) To the **fourth** portion, add half a spatula of solid ammonium chloride and shake to dissolve. Then add 3-4 drops of disodium hydrogen phosphate solution followed by dilute ammonia solution drop-wise until in excess.		

(d) (i) The cations in **Q** are .....and .....

(ii) The anions in **Q** are .....and .....

Turn Over

3. You are provided with substance **Z** which is an organic compound. Carry out the tests in Table **4** to determine the nature of **Z**.

Record your observations and deductions in the table. *(20 marks)*

Table 4

	TESTS	OBSERVATIONS	DEDUCTIONS
(a)	Burn a small amount of **Z** on a spatula end or on a porcelain dish.		
(b)	To 0.5 cm^3 of **Z** in a test tube, add about an equal volume of water, shake and test the mixture with litmus paper. Divide the resultant mixture into **three** portions.		
(i)	To the **first** portion of the mixture, add a half a spatula end-ful of sodium carbonate.		
(ii)	To the **second** portion of the mixture, add 2-3 drops of neutral iron(III) chloride solution.		

TESTS	OBSERVATIONS	DEDUCTIONS
(iii) To the **third** portion of the mixture, add 2 cm^3 of 2,4-dinitro phenylhydrazine solution (Brady's reagent). Shake and leave to stand.		
(c) To 0.5 cm^3 of **Z**, add 1-2 drops of acidified potassium dichromate solution.		
(d) To 0.5 cm^3 of **Z**, add about an equal volume of ethanoic acid followed by 2-3 drops of concentrated sulphuric acid and heat the mixture.		
(e) To 3 cm^3 of silver nitrate solution in a clean test tube, add 3 drops of sodium hydroxide solution then dilute ammonia solution drop-wise until the precipitate just dissolves, finally add 3 drops of **Z** and warm gently while shaking.		

	TESTS	OBSERVATIONS	DEDUCTIONS
(f)	To 0.5 cm^3 of **Z**, add 2 cm^3 of sodium hydroxide solution followed by aqueous iodine drop-wise until in excess. Warm the mixture and leave it to stand.		

(g) Describe the nature of **Z**.

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END