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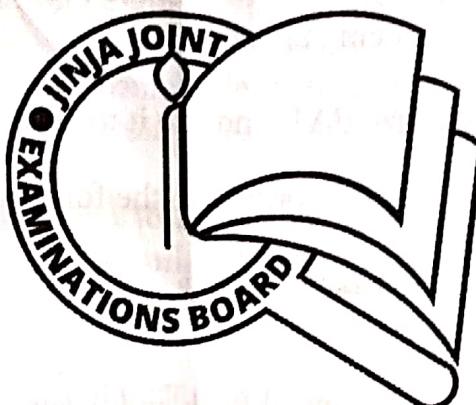
P525/3

CHEMISTRY

Paper 3

August, 2022

3½ hours



JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS –AUGUST, 2022

CHEMISTRY

PRACTICAL

Paper 3

3 hours 15 minutes

Gu108

INSTRUCTIONS TO CANDIDATES

- Answer all questions.
- Answers are to be written in the spaces provided.
- You are not allowed to use any reference books.
- Mathematical tables, slide rulers and non-programmable silent electronic calculators may be used.
- Candidates are not allowed to start working with the apparatus for the first 15 minutes. This time is to ensure that they have all the chemicals and apparatus they may need.
- Atomic masses: C=12, O=16, H=1, N=14, Cl=35.5

For Examiner's Use Only

Q1	Q2	Q3	TOTAL

1. You are provided with the following;

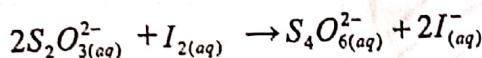
FA1; which is a solution containing iodine.

FA2; which is a 0.1M sodium thiosulphate solution.

Solid T, which is a reducing agent.

You are required to standardize FA1, and use it to determine the molar mass of T

Iodine reacts with thiosulphate according to the following equation:



A. Standardizing FA1

- a) Pipette 10cm³ of FA1 into a conical flask and titrate with FA2 using starch as the indicator.
- b) Repeat the titration until you obtain consistent readings.
- i) Record your results in the table below.
- ii) Record the volume of pipette used = 10 cm³

Table I

Final burette reading (cm ³)	12.00 ✓	21.00 ✓	31.80 ✓
Initial burette reading (cm ³)	2.00 ✓	12.00 ✓	21.00 ✓
Volume of FA2 used (cm ³)	10.00 ✓	9.90 ✓	9.90 ✓

Titre values used to calculate average volume of FA2

used 9.90, 9.90 cm³

∴ average volume of FA2 used $\frac{9.90 + 9.90}{2} = 9.90 \pm 0.1$ cm³ DR

Questions;

Calculate the concentration of iodine in moles per litre in FA1.

$$\begin{aligned} 1000 \text{ cm}^3 \text{ of } S_2O_3^{2-} &\text{ contain } 0.1 \text{ moles} \\ 9.90 \text{ cm}^3 \text{ of } S_2O_3^{2-} &\text{ contain } 0.1 \times 9.90 = 9.90 \times 10^{-4} \\ \text{moles of } I_2 &= 9.90 \times 10^{-4} \\ 1000 \text{ cm}^3 &= 1 \times 10^{-3} \text{ m}^3 \\ 9.90 \times 10^{-4} &= 4.95 \times 10^{-4} \times 1000 \\ &= 0.0495 \text{ M} \end{aligned}$$

B. Determining the molar mass of T

Procedure;

- a) Weigh accurately about 1.6g of T into a 250cm³ volumetric flask. Add some distilled water shake to dissolve. Make the solution to the mark by adding distilled water. Label the solution FA3.
- b) Pipette 10cm³ of FA3 into a conical flask. Add 20cm³ of FA1 using a measuring cylinder, followed by two spatula end-full of solid sodium hydrogen carbonate and shake the mixture well.
- c) Titrate the excess iodine in the mixture with FA2 using starch solution as the indicator. Repeat the titration until you obtain consistent readings.
- i) Record your results in table two below.

Results:

Mass of weighing container + T = 2.90 g
 Mass of weighing container alone = 1.30 g
 Mass of T used alone = 1.60 g
 Volume of pipette used = 10 cm³

Table II

Final burette reading (cm ³)	10.80	20.20	29.60
Initial burette reading (cm ³)	1.00	10.80	20.20
Volume of FA2 used (cm ³)	9.80	9.40	9.40

(6.40 - 1.2) Titre values used to calculate average volume of FA2 used 9.40 cm³

∴ Average volume of FA2 used $\frac{9.40 + 9.40}{2} = 9.40$ cm³

Questions:

- a) Calculate the number of moles of :

- i) excess iodine in FA1 that reacted with the thiosulphate ions in FA2

$$\begin{aligned} & \text{1000 cm}^3 \text{ of } S_2O_3^{2-} \text{ reacted with excess I}^- = 0.1 \text{ moles} \\ & 9.40 \text{ cm}^3 \text{ of } S_2O_3^{2-} \text{ reacted } \frac{0.1 \times 9.40}{1000} = 9.4 \times 10^{-5} \\ & \text{Moles of I}^- \text{ that reacted } \frac{1}{2} \times 9.4 \times 10^{-5} \\ & = 4.7 \times 10^{-5} \end{aligned}$$

- ii) iodine that reacted with T

$$\begin{aligned} & \text{Moles of I}_2 \text{ in } 20 \text{ cm}^3 \text{ of FA1} = 20 \times 0.049 \times 10^{-4} \\ & = 9.9 \times 10^{-5} \text{ moles} \end{aligned}$$

b) Determine the molar mass of T

(1 moles of iodine reacts with 1 mole of T)

Moles of I₂ that reacted with T

$$= (9.9 \times 10^{-4}) - (4.7 \times 10^{-4})$$

$$= 5.2 \times 10^{-4} \text{ moles}$$

$$\text{Moles of I in } 10 \text{ cm}^3 \text{ of FA}_3 = 5.2 \times 10^{-4} \text{ moles}$$

$$10 \text{ cm}^3 \text{ of FA}_3 \text{ contains } \frac{5.2 \times 10^{-4} \times 250}{70} \text{ moles}$$

$$= 0.013 \text{ moles}$$

$$0.013 \text{ moles of I weigh } 1.65 \text{ g}$$

$$\text{Therefore T weighs } \frac{1.6}{0.013} \text{ g}$$

$$= 123 \text{ g}$$

Molar mass of T is 123 g/mol

128

2. You are provided with substance X which contains two Cations and two anions. You are required to identify the Cations and anions in X. Carry out the tests below and record your observations and deductions in the table below. Where a gas (es) is evolved, it must be identified.

TESTS	OBSERVATIONS	DEDUCTIONS
(a) Heat a spatula end-ful of X in a hard glass test tube first gently and then strongly until there is no further change.	Colourless Condense that turns Anhydrous Copper(II) nitrate from white to blue Colourless gas that turns blue litmus paper red and lime water milky Residue yellow when hot and white when cold.	Hydrated Salt ✓ $\therefore \text{CO}_3^{2-} / \text{C}_2\text{O}_4^{2-}$ $\text{ZnO} \text{ or } \text{Zn}^{2+}$ Max 10 45
(b) To two spatula endfuls of X, add half a spatula end ful of Manganese (IV) oxide followed by 4 – 5 drops of concentrated sulphuric acid and heat gently	Effervescence ✓ purple vapour/gas/ fumes turns blue litmus red.	$\text{T}^{2+} \text{ or } \text{I}^-$ O ₂
(c) Put three spatula endfuls of X in a test tube. Add dilute nitric acid drop-wise until there is no further change. Warm gently.	Effervescence of carbon dioxide fumes blue litmus red and lime water milky. Colorless solution	$\text{CO}_2(\text{g})$ $\therefore \text{CO}_3^{2-}$ Confirmed Probably non-transition metal
(d) To the resultant solution in (c), add dilute ammonia solution drop-wise until in excess. Shake and filter. Keep both the filtrate and residue.	-white ppt insoluble in excess -white residue ✓ -colorless filtrate ✓	$\text{Ba}^{2+} \text{ or } \text{Mg}^{2+} \text{ or } \text{Al}^{3+}$ or $\text{Sn}^{2+} \text{ or } \text{Sn}^{4+}$ Zn^{2+} ✓ Pb ²⁺ Zn ²⁺ O ₃

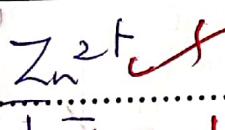
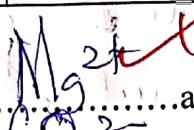
<p>(e) To the filtrate from (d), add dilute nitric acid drop-wise until the solution is just acidic</p>	<p>white Precipitate Soluble in acidic acid</p>	<p>Zn^{2+}</p>
<p>Divide the acidic filtrate into five portions.</p> <p>(i) To the first portion of the acidified filtrate, add sodium hydroxide drop-wise until in excess.</p>	<p>white ppt Soluble in excess giving a colourless solution</p>	<p>Zn^{2+}</p>
<p>(ii) To the second portion of the acidified filtrate, add ammonia solution drop-wise until in excess.</p>	<p>white Precipitate Soluble in excess in excess giving a colourless solution</p>	<p>Zn^{2+}</p>
<p>(iii) Use the third portion of the acidified filtrate to carry out a test of your own to confirm one of the cations in X. Record tests and observations.</p> <p>TESTS</p>	<p>Add solid $Ni(HCO_3)_2$ + Na_2HPO_4 soluble + excess ammonia Sulphuric acid Anhydrite ppt Soluble in excess</p>	<p>Zn^{2+}</p>
<p>(f) Wash the residue and dissolve it in dilute sulphuric acid. Divide the acidic solution into three portions.</p>	<p>Colourless solution</p>	<p>Mg^{2+}, Al^{3+}, Sn^{2+} or Sn^{4+}</p> <p>Reject (Ba^{2+}, Pb^{2+}) (Ca^{2+}, Zn^{2+})</p>

<p>(i) To the first portion of the acidic solution add dilute sodium hydroxide solution drop wise until in excess</p>	<p>white precipitate insoluble in excess</p>	<p>Mg^{2+} present Rejected (Ba^{2+})</p>
<p>(ii) To the second portion of the acidic solution, add ammonia solution drop wise until in excess</p>	<p>white precipitate insoluble</p>	<p>Mg^{2+} present</p>
<p>(iii) To the third portion of the acidic solution carry out a test of your own to confirm the second cation in X. Record test and observations</p> <p>Test: Add solid Na_2HPO_4 and ammonia</p>	<p>white precipitate insoluble Excess Ammonia</p>	<p>Mg^{2+} present</p>
<p>(g) To two spatula end ful of X in a test tube, add 4cm^3 of water, shake vigorously and filter. Then divide the filtrate into 3 parts</p>	<p>Partly soluble white residue Colourless filtrate</p>	<p>(Mg^{2+}, Zn^{2+}) present Insoluble material long present in bottom of test tube and residue</p>
<p>(i) To the first portion of the filtrate, add 3 – 4 drops of Silver nitrate solution followed by ammonia solution dropwise until in excess.</p>	<p>Pale yellow precipitate insoluble Excess ammonia</p>	<p>T^- or Br^- present</p>

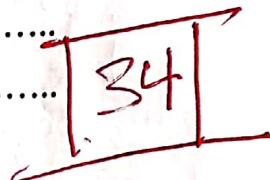
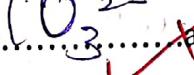
(ii) To the second portion of the filtrate, add 1 – 2 drops of concentrated nitric acid followed by sodium thiosulphate solution dropwise until in excess.	Colorless solution turns brown brown solution was colorless on addition of Sodium Thiosulphate	I^- oxidised to I_2 $\therefore \text{I}^-$ present
(iii) To the third portion of the filtrate, add 4 – 5 drops of Lead (II) nitrate solution	Yellow precipitate	I^- Confirmed

(h) Identify the

(i) cations in X.....and.....



(ii) anions in X.....and.....



3. You are provided with an organic substance P. You are required to determine the nature of P. Carry out the following tests on P and record your observations and deductions in the table below.

TESTS	OBSERVATIONS	DEDUCTIONS
(a) Burn a small amount of P on a spatula end or in a porcelain dish.	Colourless liquid burns with a blue flame	Aromatic, Saturated Compound with low Carbon Content.
(b) To 1cm^3 of P, add about 2cm^3 of water. Shake, add test the mixture with litmus paper. Divide the mixture into three parts.	Miscible with water forming a colourless solution that has no effect on litmus	- Polar compound - less acidic - Neutral compound. - probably Glycerol alcohol . ester etc

(i) To the first part of the mixture, add 2 – 3 drops of Brady's reagent.	No yellow / orange Precipitate	Carboxyl carb absent.
(ii) To the second part of mixture, add 2 – 3 drops of neutral Iron (III) chloride solution.	No purple Coloration or No observable change or No violet Coloration	Phenol absent ✓
(c) To the third part of the mixture from (b) above, add 4 – 5 drops of acidified potassium manganate (VII) solution. Heat the mixture gently for about 2 minutes. Allow to cool and divide the solution into three parts.	Purple acidified KMnO ₄ turns colourless	Primary or Secondary alcohol <u>reject aldehyde</u>
(i) To the first part of the solution, add 4 – 5 drops of Brady's reagent.	Yellow / orange Rpt	Primary or Secondary alcohol oxidised to Carboxyl compound
(ii) To the second part of the solution, add 2 – 3 drops of Acidified potassium	Orange acidified K ₂ C ₂ O ₇ turns green	Aldehyde formed from a primary alcohol

dichromate (I)
solution and heat
gently

- (iii) To the third part of the solution add 4 – 5 drops of Fehling solution and heat to boiling

Redish brown
PPT ✓

~~Aldehyde
from a Primary
alcohol~~

- (d) To about 0.5cm³ of P, add 2 – 3 drops of Lucas reagent.

No change
solution

~~Primary alcohol~~

- (e) To about 0.5cm³ of P, add 2 – 3 drops of sodium hydroxide solution followed by iodine solution until the solution is pale yellow. Warm the mixture and allow to stand.

Yellow ppt

~~CH₃ formed from
Primary alcohol
of S (see form
CH₃CH₂)~~ ✓

- (f) Comment on the nature of P

~~Aliphatic Primary alcohol with
CH₃CH₂ structure.~~

18