1. The description of the reagents and chemicals specified below does not necessarily correspond with the description in the question paper. Candidates must not be informed of the difference.

2. Candidates are **not** allowed to use reference books (i.e. textbooks, booklets on qualitative analysis etc.) during the examination.

3. On addition to the common reagents and apparatus used in chemistry laboratory, each student should have the following.
   - 1 burette
   - 1 pipette (20 cm^3 or 25 cm^3)
   - 1 measuring cylinder (50 or 100 cm^3)
   - 1 measuring cylinder (10 cm^3)
   - 1 plastic beaker
   - 1 Volumetric flask (250 cm^3)
   - 1 Thermometer
   - Phenolphthalein indicator
   - 2 filter papers
   - 8 test tubes
   - 10 cm^3 of **M**
   - 200 cm^3 of **GA_1**
   - 100 cm^3 of **GA_2**
   - 2.0 g of solid **W**
   - 3.0 g of solid ***X***
   - 2 conical flasks.

Easy access to:

- Heat source
- Reagents for identify cations, anions and gases

N.B

- Solid **W** is hydrated oxalic acid $H_2C_2O_4.2H_2O$
- Solid ***X*** is a uniform mixture of;
  zinc carbonate + copper(II) oxide + potassium iodide in a ratio of **2:1:1** respectively.
- **GA_1** is a 2M sodium hydroxide solution
- **GA_2** is a 2M sulphuric acid solution
- Liquid **M** is ethanal, CH_3CHO

END

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School ..... Signature .....

P525/3
CHEMISTRY
(PRACTICAL)
Paper 3
July/August 2024
$3^1/_4$ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY
PRACTICAL

Paper 3

3 hours 15 minutes

Instructions to Candidates:

- *Answer* **all** *questions.*
- *Record your answers on this question paper in the spaces provided.*
- *Mathematical tables and silent non-programmable calculators may be used.*
- *Reference books (i.e, textbooks, books on qualitative analysis etc.) should* **not** *be used.*
- *Candidates are* **not** *allowed to start working with the apparatus for the first 15 minutes. This time is to enable candidates to read the question paper and make sure they have all apparatus and chemicals that they may need.*
- *Where necessary use* (H = 1, O = 16, C = 12, Na = 23)

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

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1. You are provided with the following;

GA_1 which is a solution of sodium hydroxide of unknown concentration
GA_2 which is 2M solution of an acid HyT
Solid **W** which is an oxalic acid $H_2C_2O_4\ 2H_2O$
You are required to determine the;

(i) concentration of sodium hydroxide in GA_1 in moles per litre.
(ii) Value of y in the acid HyT
(iii) Molar enthalpy of neutralization of acid HyT by sodium hydroxide.

Theory

Sodium hydroxide reacts with acid and with acid HyT according to the equations.

$$2NaOH(aq) + H_2C_2O_4(aq) \rightarrow Na_2C_2O_4(aq) + 2H_2O(L)$$

Part I

Procedure

Weigh accurately 1.6 g of solid W into a clean beaker. Add 100 cm^3 of distilled water and stir to dissolve. Transfer the solution into a 250 cm^3 volumetric flask and make up to the mark with distilled water. Label solution **GA_3.**

Measure 6 cm^3 of **GA_1** into a clean beaker. Add 100 cm^3 of distilled water and stir to mix Transfer the solution into 250 cm^3 volumetric flask and make up to the mark with distilled water. Label the solution **GA_4.**

Pipette 20 or 25 cm^3 of GA_4 into a clean conical flask. Add 2 to 3 drops of phenolphthalein indicator and titrate with **GA_3** from the burette until the end point is reached. Repeat the titrations until you obtain consistent results. Record your results in the table below.

Volume of pipette used _____ cm^3 (½ mark)

Table I

Experiment Number	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of **GA_3** used (cm^3)			

(4 ½ marks)

Values used to calculate average volume of **GA_3** (½ mark)

_____

_____

Average volume of GA_3 used (2½ marks)

_____

_____

_____

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Questions

(a) Calculate the number of moles of;

(i) oxalic acid in **GA_3** that reacted with sodium hydroxide in **GA_4**. (2½ marks)
(H = 1, C = 12, O = 16)

(ii) Sodium hydroxide in 250 cm^3 of **GA_4**. (2 marks)

(b) Determine the concentration of sodium hydroxide in **GA_1** in moles per litre. (1 mark)

Part II

Procedure

(i) Using a measuring cylinder, measure and transfer 24 cm^3 of GA_1 into a clean plastic beaker.

(ii) Using a thermometer, measure and record the initial temperature T, of the solution **GA_1** in the table below, in experiment number 1.

(iii) Using a burette, titrate 4 cm^3 of **GA_2** into solution of **GA_1** in the plastic beaker. Stir the mixture with a thermometer and record the highest temperature T, reached by the mixture in the table in experiment number 2.

(iv) Repeat the procedure (i) to (iii) for volume of **GA_2** added equal to 8, 12, 16, 20 and 24 cm^3 for experiment numbers, 3, 4, 5, 6 and 7

(v) Record your results in the table.

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Experiment number	1	2	3	4	5	6	7
Volume of **GA_2** added ($cm^{3)}$	0	4	8	12	16	20	24
Highest temperature, T of the mixture (^0C)							

(7 marks)

(c) Plot a graph of the highest temperature against the volume of GA_2 added. (6 marks)

(d) Use the graph to determine the;

(i) Highest temperature reached at the neutralization point (1 mark)

_____

(ii) Temperature change at the neutralization point. (1 mark)

_____

(iii) Volume of acid H_yT required to neutralize sodium hydroxide solution. (1 mark)

_____

(e) Calculate the number of moles of;

(i) Sodium hydroxide in **GA₁** that reacted with acid in **GA₂**. (1 mark)

_____

(ii) Acid HyT in GA_2 that reacted with sodium hydroxide in **GA₁**. (1 mark)

_____

_____

_____

_____

(f) Calculate the value of **y** in the acid **Hy**T and write an actual equation for the reaction between acid HyT and sodium hydroxide. (4½ marks)

_____

_____

_____

_____

_____

_____

_____

_____

(g) Calculate the molar enthaply of neutralization of the acid HyT by sodium hydroxide in GA_1 (Density of solution = 1 g/cm^3, specific heat capacity of solution = 4.2 $Jg^{-1}\ {}^0C^{-1}$) (4½ marks)

_____

_____

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2. You are provided with substance ***X*** which contains two cations and two anions. Carry out the following tests on ***X*** to identify the cations and anions present. Identify any gases evolved.

(31 marks)

Test	Observation	Deduction
(a) To two spatula end full of ***X*** in a boiling tube, add 6 drops of concentrated sulphuric acid and heat strongly.		
(b) To three spatula end full of ***X*** add 7 cm^3 of water and shake strongly. Filter and keep both the residue and the filtrate. Divide the filtrate into **three** parts.		
(i) To the first part, add 1 cm^3 of lead(II) nitrate solution.		
(ii) To the second part, add 1 cm^3 of dilute hydrogen peroxide solution followed by 7 drops of concentrated sulphuric acid and shake and then add starch indicator.		

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(iii) Use the third part to carry out a test of your own choice to confirm the anion in the filtrate. **Test:** _____ _____ _____ _____		
(c) Wash the residue with distilled water, add 5 cm^3 of dilute nitric acid drop wise to the washed residue and warm. Allow to cool and decant it to obtain the clear upper solution to be used in part (d)		
(d) To 4 cm^3 of the solution obtained in (c) above add 5 cm^3 of sodium hydroxide solution drop wise and shake. Filter and keep both the residue and the filtrate.		
(e) To the filtrate obtained, add dilute nitric acid drop wise until it is just acidic. Divide the resultant solution into **four** parts.		
(i) To the first part, add sodium hydroxide solution drop wise until excess.		

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(ii) To the second part, add 1 cm^3 of dilute sulphuric acid.		
(iii) To the third part, add ammonium hydroxide solution drop wise until excess.		
(iv) Use the fourth part to carry out a test of your own choice to confirm the cation in the filtrate. Test: _____ _____ _____ _____		
(f) Wash residue with sodium hydroxide solution and dissolve it in dilute nitric acid. Divide the resultant solution into **three** parts.		
(i) To the first part add sodium hydroxide solution drop wise until excess.		

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(ii) To the second part add ammonium hydroxide solution drop wise until in excess.		
(iii) Use the third part to carry out a test of your own choice to confirm the cation in the residue. Test: _____ _____ _____ _____		

(g) Identify the

(i) Cations in T ..... and .....

(ii) Anions in T..... and .....

3. You are provided with substance **M** which is an organic compound. Carry out the following tests on **M** to identify its nature and functional group. (14 marks)

Test	Observation	Deduction
(a) Burn a small amount of **M** on a spatula or a crucible lid.		
(b) To 4 cm^3 of **M**, add 2 cm^3 of distilled water and shake. Test the resultant solution with litmus paper. Divide the solution into **four** parts.		

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(i) To the first part, add little solid sodium carbonate.		
(ii) To the second part, add 1 cm^3 of neutral iron(III) chloride solution.		
(iii) To the third part, add acidified solution of potassium manganate (VII) and heat.		
(iv) To the fourth part, add 1 cm^3 of 2,4 - dinitrophenyl hydrazine.		
(c) To 1 cm^3 of **M** in a test tube, add 1 cm^3 of fehlings solution and heat.		

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(d) To 1 cm^3 of **M**, add 2 cm^3 of Iodine solution followed by sodium hydroxide solution drop by drop until the solution turns pale yellow. Warm the solution and then cool under running water.		

(e) Comment on M

_____

_____

_____

END

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