PROPOSED MARKING GUIDE

Candidate's Name.....

School:.....

P525/3
CHEMISTRY
(PRACTICAL)
Paper 3
July/Aug. 2022
3 ¼ hours

UGANDA TEACHERS' EDUCATION CONSULT (UTEC)

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. text books, books on qualitative analysis, etc) should **not** *be used.*

Candidates are **not** *allowed to start working with 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.*

1. **You are provided with the following;**

FA1, which is 0.4M hydrochloric acid

FA2, which is sodium hydroxide solution

Solid Q which in impure acid

You are required to

- *standardize FA2*
- *Determine the percentage purity of acid* ***Q***

PART A

Procedure

Measure accurately 20 cm^3 of **FA1** into a 50 cm^3 measuring cylinder. Add distilled water carefully to make 50 cm^3 of the total solution. Transfer the solution into a clean beaker and label it **FA3.**

Questions:

(a) Calculate the,

(i) number of moles of the acid in 20 cm^3 of **FA1.** ***(1 ½ marks)***

1000cm^3 of FA1 Contain 0.4 Moles of HCl.

20cm^3 of FA1 Contain $\left(\frac{0.4 \times 20}{1000}\right)$ moles ✓

$= 0.008$ moles ✓

(ii) The molarity of hydrochloric acid in **FA3.** ***(02 marks)***

50cm^3 of FA3 Contain 0.008 moles

1000cm^3 of FA3 Contain $\left(\frac{0.008}{50} \times 1000\right)$ ✓

$= 0.16$ M ✓

3½

PART B

Procedure

Pipette 20.0 or 25.0 cm^3 of **FA3** into a clean conical flask add 2-3 drops of phenolphthalein indicator. Titrate with **FA2** from the burette until the end point. Repeat the titration to obtain consistent results. Record your results in the Table **1** below.

Results:

Volume of pipette used..... 20.0 ✓ ..... cm^3 . *(½ mark)*

	1	2	3
Final burette reading (cm^3)	32.40	32.10	32.10
Initial burette reading (cm^3)	0.00	0.00	0.00
Volume of **FA2** used (cm^3)	32.40 ✓	32.10 ✓	32.10 ✓

(4 ½ marks)

Titre values used to calculate average volume of **FA2** used *(½ marks)*

..... 32.10, 32.10 ✓ .....

Average volume of **FA2 used** ..... 32.10 ..... cm^3. *(2½ marks)*

±0.1 ✓
±0.2 ✓
±0.3 ✓
±0.4 ✓
±0.5 ✓

Questions

(a). Calculate the molar concentration of sodium hydroxide in **FA2.** *(5 marks)*

Moles of HCl that reacted = $\frac{0.16 \times 20}{1000}$ = 0.0032 Moles ✓

$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$ ✓

Reaction ratio NaOH : HCl is 1 : 1 ✓✓

Moles of NaOH = Moles of HCl = 0.0032 Moles ✓

$32.10\ cm^3$ of FA2 Contain 0.0032 Moles of NaOH

$1000\ cm^3$ of FA2 Contain $\left(\frac{0.0032 \times 1000}{32.10}\right)$ moles ✓

= 0.0997 M ✓

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PART C

Procedure

Weigh accurately about 1.6g of **Q** and place it in a beaker.

Add to it about 50 cm^3 of distilled water and stir to dissolve. Transfer the contents of the beaker into a 250 cm^3 volumetric flask. Add distilled water up to the mark. Label the resultant solution **FA4**.

Pipette 20.0 cm^3 (or 25.0 cm^3) of **FA4** into a conical flask. Add 2-3 drops of phenolphthalein indicator and titrate with **FA2** from the burette until the end point. Repeat the titration until you get consistent results. Record your results in Table **2**.

Results:

Mass of **Q** and the weighing bottle ..... 2.8 ✓t ..... g.

Mass of empty weighing bottle ..... 1.2 ✓ ..... g.

Mass of **Q** used ..... 1.6 ✓t ..... g.

Volume of pipette used ..... 20.0 ✓t ..... cm^3 *(½ mark)*

	1	2	3
Final burette reading (cm^3)	20.20	40.20	40.50
Initial burette reading (cm^3)	0.00	20.20	20.50
Volume of **FA2** used (cm^3)	20.20 ✓t	20.00 ✓t	20.00 ✓t

(4 ½ marks)

Titre values used to calculate average volume of **FA2** used *(1 ½ marks)*

20.00, 20.00 ✓t

Average volume of **FA2 used** ..... 20.00 ±0.1 ✓t ..... cm^3 *(2 ½ marks)*

±0.2
±0.3
±0.4
±0.5

Question

(a) Calculate the number of moles of;

(i) Sodium hydroxide that reacted *(2 marks)*

$1000 cm^3$ of FA2 Contain 0.0997 Moles of NaOH

$20.0 cm^3$ of FA2 Contain $\left(\frac{0.0997 \times 20}{1000}\right)$ Moles ✓

$= 0.001994$ Moles ✓

(ii) Acid Q that reacted *(2 ½ marks)*

(1 mole of Q reacts with 2 moles of sodium hydroxide)

2 Moles of ~~NaOH react~~ of NaOH react with 1 Mole of Q.

0.001994 Moles of NaOH react with $\left(\frac{1 \times 0.001994}{2}\right)$ Moles ✓

$= 0.000997$ Moles ✓

(b) Determine the concentration of **Q** in FA4

(i) In $moldm^{-3}$ *(2 marks)*

$20.00 cm^3$ of FA4 Contain 0.000997 Moles of Q

$1000 cm^3$ of FA4 Contain $\left(\frac{0.000997 \times 1000}{20}\right)$ Moles

$= 0.0499$ M ✓.

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(ii) In grams per liter *(1 ½ marks)*

(1 mole of Q weigh 90 g)

90g of Q ~~W~~ contain 1mole

1mole of Q weigh 90g

0.0499 moles of Q weigh $\frac{90}{1} \times 0.0499$

$= 4.491/l$

(c) Calculate the percentage purity of **Q**. *(1 ½ marks)*

250cm³ of FA4 Contain 1.6g of Q.

1000cm³ of FA4 Contain $\frac{1.6 \times 1000}{250}$

$= 6.4 g/l$

Percentage Purity $= \left(\frac{4.49 \times 100}{6.4}\right)$

$= 70.2\%$

C3

2. You are provided with substance **W** which contains **two** cations and **two** anions. Carry out the following tests on **W** to identify the cations and anion. Identify any gas (es) evolved. Record your observations and deductions in the Table **3.** *(30 marks)* Total 35 marks

TESTS	OBSERVATIONS	DEDUCTIONS
(a) Heat **two** spatula ends full of **W** strongly until there is no further change.	Pale/light green/solid	Ni^{2+}/Fe^{2+}, Cr^{3+}, Cu^{2+}
	Colourless liquid Condensate turned ~~White~~ anhydrous Copper(II) Sulphate blue	Hydrate salt/ Water of Crystallisation
	White fumes with a sweet Smell ~~turned~~ formed yellow ppt with Brady's reagent.	Propanone vapour
	Colourless gas turned lime water milky and moist blue litmus red	Acidic gas, CO_2, CH_3COO^-/CO_3^{2-} May be present
	Black residue	NiO/CuO
(b) To one spatula ends full of **W** in a dry test tube add drops of concentrated sulphuric acid and warm	Colourless vapour with a sour smell of vinegar turns moist blue litmus red.	Ethanoic acid vapour CH_3COO^- present.

C7

C2

(c) Dissolve three spatula ends full of **W** in about 5 cm^3 of water to make a solution	Dissolved forming Pale green solution	Cu^{2+} Fe^{2+}, Ni^{2+} Cr^{3+}	
(i) To 1 cm^3 of solution add iron (ii) chloride solution and heat.	Brown precipitate / Brown Solution	CH_3COO^- Confirmed Present	02
(ii) To the remaining solution of **W** add sodium hydroxide solution drop wise until there is no further change. Filter and keep both the filtrate and the residue.	Green precipitate Insoluble Green residue / Colourless Filtrate	Ni^{2+}, Fe^{2+} Zn^{2+}, Al^{3+}, Pb^{2+} Sn^{2+}	03½
(d) Add dilute hydrochloric acid to the filtrate until the solution is just acidic. Divide the solution into four portions.	White precipitate Soluble in excess acid	Zn^{2+}, Al^{3+}, Pb^{2+}, Sn^{2+}	1½
(i) To the first portion of the acidic solution add sodium hydroxide solution drop wise until in excess.	White precipitate Soluble in excess forming Colourless Solution	Zn^{2+}, Al^{3+}, Pb^{2+}, Sn^{2+}	02
(ii) To the second portion, add potassium iodide solution	No observable change	Zn^{2+}, Al^{3+}, Sn^{2+}	01
(iii) To the third portion of acidic filtrate add 5 drops of litmus solution followed by dilute ammonia drop wise until in excess	Blue precipitate Soluble to form a blue lake solution	Al^{3+} Confirmed	02
(iv) To the fifth portion of acidic filtrate add 2-3 drops Barium nitrate solution	White precipitate	SO_4^{2-} Confirmed.	01
(e) Wash the residue and dissolve it in minimum dilute sulphuric. Divide the resultant solution into 3 portions	Dissolves forming pale green Solution	Ni^{2+}, Fe^{2+}	01

i)	To the **first** portion add sodium hydroxide solution drop wise until in excess.	Green precipitate insoluble ✓	Ni^{2+} ✓
ii)	To the third portion add ammonia solution drop wise until in excess.	Green precipitate soluble forming blue solution ✓	Ni^{2+} ✓
iii)	Use the third portion to carry out a test of your own choice to confirm one of the anions. Add dimethylglyoxime solution Or Add KCN(aq) Until in excess	Red precipitate ✓ Yellow-green ppt Soluble in excess forming yellow solution	Ni^{2+} ✓

(e) (i) the cations in **W**: Al^{3+} ✓ ..... and ..... Ni^{2+} ✓ .....

(ii) The anions in **W**: CH_3COO^- ✓ ..... and ..... SO_4^{2-} ✓ .....

3. You are provided with organic substance **T**. You are required to determine the nature of **T**. Carry out the following tests on W and record your observations and deductions in Table 4 below.

(18 marks)

TESTS	OBSERVATIONS	DEDUCTIONS
(a) Burn a small amount of **T** on a spatula end or on crucible lid.	White solid / crystals Melts forming colourless liquid which burns with yellow sooty flame	Aromatic / aliphatic unsaturated compound or Aliphatic compound with high C:H ratio
(b) Add half spatula end full of **T** to about 3 cm^3 of dilute sodium hydroxide and shake.	Readily soluble to form colourless solution	Acidic compound Aromatic carboxylic acid or Phenol suspected
(c) To a spatula end-ful of **T** in a test tube add 5 cm^3 of water. Shake vigorously and warm. Test the solution with litmus paper. Divide into three equal portions.	Slightly / Partially soluble in cold water, soluble / dissolves on warming forming colourless solution, turned blue litmus red.	Phenol; aromatic carboxylic acid suspected

(i) To the first portion of the solution add 2-3 drops of 2,4- dinitrophenyl hydrazine.	No observable change or No yellow / orange PPt formed	Carbonyl Compound absent. OR Ketone, aldehyde absent 1½
(ii) To the second portion of the solution add 2-3 drops of neutral Iron(iii) chloride solution.	Violet / purple Colouration	Phenol absent 02 ½
(iii) To the 2 cm^3 of ethanol add a spatula end-ful of **T** and shake to desolve. Add 3-4 drops of conc sulphuric acid and warm the mixture.	Sweet-fruity smelling Product OR Sweet fruity Smell	Ester formed Esterification occured 02 ½ Carboxylic acid Confirmed

(b) Comment on the nature **T.**

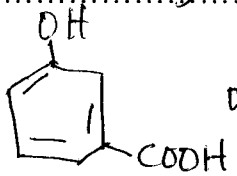
Aromatic compound with a hydroxyl group attached to benzene ring, also contains the -COOH (carboxylic acid group) 1½

OR

Ar. Phenol with a carboxylic acid group 1S

OR

Compound with Structure



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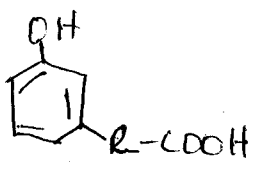

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