Name: MARKING GUIDE Index No: .....

Signature: .....

P525/3

Chemistry Practical

3¼ hours.

UACE ACEITEKA MOCK EXAMINATION 2023

Chemistry Practical

Paper 3

3 hours 15minutes

INSTRUCTIONS TO CANDIDATES

All questions are compulsory

Answers are to be written in the spaces provided in the booklet.

All your work must be in blue or black ink.

Any work done in pencil will not be marked.

You are not allowed to work with the apparatus for the first 15 minutes. Use this time to read through the paper and check whether you have all the chemicals and apparatus

You are not allowed to use any reference books.

All working must be clearly shown.

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

For Examiner's Use ONLY		
Q.1	30	
Q.2	33	
Q.3	17	
Total	80	

1. You are provided with the following:
GA1 which is 1M hydrochloric acid.
GA2 which is sodium hydroxide solution
GA3 which is 0.1M sulphuric acid
Solid P, which is a dibasic acid, H_2Y

You are required to;
(a) Standardise GA2 using GA1.
(b) Determine the value of Y in H_2Y

Procedure

Part A

(a) Pipette 20 or 25cm³ of GA2 into a clean conical flask. Add 2-3 drops of phenolphthalein indicator and titrate with GA1 from the burette. Repeat the titration 2-3 times to obtain consistent results. Record your results in the table below.

Results:

Volume of pipette used 25·00/25·0/25 ✓✗ cm³ (0½)

	1	2	3
Final burette reading (cm³)	26.00	26.90	27.90
Initial burette reading (cm³)	1.00	2.00	3.00
Volume of GA1 used (cm³)	25.00 ✓✗	24.90 ✓✗	24.90 ✓✗

(4½)

Titre Range = ±3

Volumes of GA1 used to calculate average volume

24.90 and 24.90 agree ±0.1 ✓ (0½)

Average volume 24.90 ±0.1 ✓✓ cm³ (2½)

±0.2
±0.3
±0.4
±0.5

Questions:

(b) Calculate the molar concentration of sodium hydroxide solution in GA2.

1000cm³ of GA1 Contain 1 mole of HCl
24.90cm³ of GA1 Contain $\frac{1 \times 24.9}{1000} = 2.49 \times 10^{-2}$ (07)

Ratio of NaOH : HCl is 1 : 1 ✓

Moles of NaOH reacted $= 1 \times 2.49 \times 10^{-2}$

$= 2.49 \times 10^{-2}$

$\Rightarrow 25cm^3$ of GA2 Contain 2.49×10^{-2} moles of NaOH

$\therefore 1000cm^3$ of GA2 Contain $2.49 \times 10^{-2} \times \frac{1000}{25}$

$= 0.996$ moles of NaOH

Molar Concentration of NaOH is 0.996M

Part B

(c) Weigh accurately 1.6g of P and transfer it into a beaker. Then add $50cm^3$ of GA2 and carefully stir to dissolve.
Transfer the contents of the beaker into a $250cm^3$ volumetric flask, and add water up to the mark with distilled water. Label the resultant solution GA4.

(d) Pipette 20 or $25cm^3$ of GA4 into a clean conical flask followed 2-3 drops of phenolphthalein indicator. Titrate with GA3 from the burette until the end point. Repeat the procedure 2-3 times to obtain consistent results. Record your results in the table below.

Results:

Mass of weighing vessel + P = 2.60 ✓ g

Mass of weighing vessel = 1.00 ✓ g

Mass of weighing P = 1.60 ✓ g (02)

Volume of pipette used 25.00/25.0/25 ✓ cm^3

	1	2	3
Final burette reading (cm^3)	12.50	14.30	13.30
Initial burette reading (cm^3)	0.00	2.00	1.00
Volume of GA3 used (cm^3)	12.50	12.30	12.30 (04)

Titre range ±3

Volumes of GA3 used to calculate average volume ✓✓✓

12.30 and 12.30 agree ±0.1 ✓ (01)

Average volume 12.30±0.1 ✓✓ cm^3 (02)

±0.2
±0.3
±0.4
±0.5

Questions:

(e) Calculate the number of moles of:

(i). sulphuric acid in GA3 that reacted with sodium hydroxide in GA4

1000 cm^3 of GA3 Contain 0.1 moles of H_2SO_4

12.30 cm^3 of GA3 Contain $\frac{0.1 \times 12.30}{1000}$ ✓

$= 1.23 \times 10^{-3}$ moles of H_2SO_4 (01½)

(ii). Excess sodium hydroxide in 250cm^3 of GA4

Ratio NaOH : H_2SO_4 is 2 : 1 ✓

Moles of NaOH reacted $= 2 \times 1.23 \times 10^{-3}$

$= 2.46 \times 10^{-3}$ (03)

⇒ 25 cm^3 of GA4 Contain 2.46×10^{-3} moles of excess NaOH

∴ 250 cm^3 of GA4 Contain $2.46 \times 10^{-3} \times \frac{250}{25}$ ✓

$= 2.46 \times 10^{-2}$ moles of excess NaOH ✓

(e) Sodium hydroxide that reacted with P

Initially: $1000cm^3$ of GA2 Contain 0.996 moles of NaOH ✓

$50cm^3$ of GA2 Contain $\frac{0.996 \times 50}{1000}$ ✓

$= 0.0498$ moles of NaOH

Moles of NaOH reacted $= 0.0498 - 0.0246$ ✓ (02)

$= 0.0252$ ✓

(f) P that reacted with sodium hydroxide

Ratio of $NaOH : H_2Y$ is 2 : 1 ✓

Moles of H_2Y reacted $= \frac{1}{2} \times 0.0252$ (02)

$= 0.0126$ ✓

(f) Determine the formula mass of P in H_2Y (H=1)

0.0126 moles of H_2Y weigh 1.6g ✓

∴ 1 mole of H_2Y weigh $\frac{1.6 \times 1}{0.0126}$ ✓ (02)

$= 126.98$ ✓

2. You are provided with substance S which contains two cations and two anions. You are required to identify the cations and anions in S. Carry out the following tests on S and record your observations and deductions in the table below. Identify any gases evolved.

TESTS	OBSERVATIONS	DEDUCTIONS
(a). Heat two spatula endful of S in a hard glass test tube first gently and then more strongly until there is no further change	• Colourless condensate/liquid which turns white anhydrous $CuSO_4$ blue • Colourless gas which turns blue litmus red and limewater milky • Brown gas which turns blue litmus red. • Gas with sweet smell forms a yellow ppt with Brady's reagent. • Residue yellow (hot) and white (cold)	- Hydrated salt or water of crystallization $CO_{3(s)}^{2-}$ ∴ $CO_3^{2-}/HCO_3^-/C_2O_4^{2-}/CH_3COO^-$ $NO_{3(s)}^-$ ∴ NO_3^- CH_3CHO ∴ CH_3CHO ZnO
(b). To two spatula endfuls of S in a test tube, add 4 drops of concentrated sulphuric acid and warm gently	• Effervescence of misty fumes with a vinegar smell which turn blue litmus red	$CH_3COOH_{(g)}$ ∴ CH_3COO^-
(c). To three spatula endfuls of S in a test tube, add about 5cm³ of water and shake vigorously to dissolve.	• Colourless solution	Probably non transition metal ions present.
(d). To 1cm³ of the solution from (c) in a test tube, add 1cm³ of ethanol followed by 3-5 drops of concentrated sulphuric acid and heat gently. Pour the mixture into a beaker of cold water	• Sweet fruity smell	Ester/esterification ∴ CH_3COO^-

TESTS	OBSERVATIONS	DEDUCTIONS	
(e) To 1cm³ of the solution from (c) in a test tube, add sodium hydroxide solution dropwise until in excess. Then add half a spatula endful of Z in powder and warm gently.	· Effervescence of a colourless gas with a pungent smell that turns red litmus blue and form dense white fumes with Conc HCl	Gas is NH_3 ✓ ∴ NO_3^- ✓	03½
(f). To the remaining solution from (c) in a boiling tube, add ammonia solution dropwise until in excess. Shake and filter. Keep both the filtrate and the residue.	· White ppt insoluble White residue ✓ · Colourless filtrate ✓	Probably Al^{3+} ✓, Pb^{2+}, Sn^{2+}, Sn^{4+}, Mg^{2+}, Ba^{2+} · Probably Zn^{2+} ✓	02
(g). To the filtrate from (f), add dilute nitric acid drop wise until the solution just becomes acidic. Then divide the resultant solution into four portions.	· White ppt soluble in acid ✓	· Probably Zn^{2+} ✓	01
(i). To the first portion of the solution, add sodium hydroxide solution drop wise until in excess	· White ppt soluble in excess giving a colourless solution ✓	· Probably Zn^{2+} ✓	01
(ii). To the second portion of the solution, add 4 drops of sodium sulphate solution	· No white ppt ✓/ No observable change	Pb^{2+} absent ∴ Zn^{2+} ✓ present	1½
(iii). To the third portion of the solution, add ammonia solution drop wise until in excess	· White ppt soluble in excess giving a colourless solution ✓	Probably ✓ Zn^{2+} present.	1

TESTS	OBSERVATIONS	DEDUCTIONS	
(v) Use the fourth portion of the solution to carry out a test of your own to confirm one of the cations in S. Test $NH_4Cl_{(s)} + Na_2HPO_{4(aq)} + NH_3$ (excess)	- White ppt Soluble in excess ammonia.	Zn^{2+} ✓ Confirmed.	(1½)
(vi) Wash the residue and dissolve it in dilute nitric acid until no further change. Divide the resultant solution into four portions.	- Colourless Solution	Probably Al^{3+} ✓ or Pb^{2+} or Sn^{2+} or Sn^{4+} or Mg^{2+} or Ba^{2+} or Al^{3+}	(01)
(i) To the first portion of the solution, add sodium hydroxide solution drop wise until in excess	- White ppt Soluble in excess	Probably Pb^{2+} ✓ or Al^{3+} or Sn^{2+} or Sn^{4+}	(02)
(ii) To the second portion of the solution, add ammonia solution drop wise until in excess	- White ppt insoluble in excess	Probably Pb^{2+} ✓ or Al^{3+} or Sn^{2+} or Sn^{4+}	(02)
(iii) To the third portion of the solution add 3–4 drops of sodium sulphate solution.	- White ppt ✓	- Pb^{2+} present.	(01)

TESTS	OBSERVATIONS	DEDUCTIONS
(iv). Use the fourth portion of the solution to carry out a test of your own to confirm the second cation in S.		

Test

Add $KI_{(aq)}$ ✓ → Yellow ppt ✗ Pb^{2+} present ✓ 02

OR

$K_2CrO_{4(aq)}$ + $NaOH_{(aq)}$ → Yellow ppt Soluble

(i). (i) Cations in S Pb^{2+} h(iv) ✗ and Zn^{2+} ✓ s(iv) ✓ 02

(ii) Anions in S CH_3COO^- (d) ✓ ✗ and NO_3^- ✓ (e) ✓

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

TESTS	OBSERVATIONS	DEDUCTIONS	
(a). Burn a small amount of W on a spatula end or in a porcelain dish	Colourless liquid burns with a yellow sooty flame.	Aromatic Cpd or Aliphatic Unsaturated Cpd	(02)
(b). To 0.5cm³ of W, add about 3cm³ of water and test with litmus.	Immiscible/insoluble in water. No effect on both blue/red litmus	Non polar Cpd of high molecular mass Neutral Cpd probably alcohol or Carbonyl	(03)
(c). To 0.5cm³ of W, add an equal volume of methanol. Shake and divide the resultant mixture into two portions.	Soluble/mix Methanol	—	(0k)
(i). To the first portion, add 3-4 drops of sodium carbonate solution.	No effervescence	Carboxyl gp absent or Carboxylic acid absent	(01)
(ii). To the second portion, add 5 drops of neutral iron (iii) chloride solution.	No purple colouration	Phenol absent	(02)
(d). To 1cm³ of W, add 3-4 drops of Brady's reagent.	Yellow/orange ppt	Carbonyl Gpt Present	(02)

TESTS	OBSERVATIONS	DEDUCTIONS
(e). To 1cm³ of W, add an equal volume of Fehling's solution and heat the mixture.	No observable change or No reddish brown ppt	aldehyde absent ∴ Ketone present (02)
(f). Dissolve 1cm³ of W into about 1cm³ of methanol. To the solution add 4cm³ of iodine solution followed by sodium hydroxide solution dropwise until the solution is pale yellow. Heat the mixture and allow to stand.	Yellow ppt	Aromatic Ketone with $CH_3\overset{\overset{O}{\|}}{C}-$ Structure present (02)

(1½)

Comment on the nature of W (a) Aromatic Ketone (c) with $CH_3\overset{\overset{O}{\|}}{C}-$ (f) Structure present