THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2A **CHEMISTRY 2A**

(ACTUAL PRACTICAL A)

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2024**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. A sample of 500 cm^3 of vinegar solution consists 3 g of organic acid with a general formula R–COOH where R is an alkyl group. The amount of the acid in vinegar is determined through titration with a standard solution of a base made by dissolving 1.2 g of NaOH with distilled water to make 500 cm^3 solution. Use phenolphthalein (POP) indicator to carry out the experiment using the given procedure, then answer the questions that follow.

(a) Calculate:
(i) the concentration of the base in mol/dm^3.

The mass of NaOH used was 1.2 g
The molar mass of NaOH was 40 g/mol
The number of moles of NaOH was 1.2 divided by 40 which gave 0.03 mol
The volume of solution was 500 cm^3 = 0.5 dm^3
The concentration of the base was 0.03 divided by 0.5 which gave 0.06 mol/dm^3

(ii) the molarity of the organic acid.

The average volume of NaOH used during titration was 25.0 cm^3 = 0.025 dm^3
The balanced equation was: $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$
The mole ratio was 1 to 1
The moles of NaOH used were 0.06 multiplied by 0.025 which gave 0.0015 mol
Therefore, 0.0015 mol of acid reacted with NaOH in 25 cm^3
In 500 cm^3: (0.0015 × 500) divided by 25 = 0.03 mol
Molarity = 0.03 divided by 0.5 = 0.06 mol/dm^3

(iii) the molecular mass of the organic acid.

The mass of the acid used was 3 g
The number of moles was 0.03 mol
The molecular mass was 3 divided by 0.03 which gave 100 g/mol

(b) If R in the acid is represented by C_nH_{2n+1}, find the value of n in the formula unit.

The molecular mass of the acid was 100
The –COOH group had a mass of 45
So the alkyl group R had a mass of 100 minus 45 which was 55
Let R = C_nH_{2n+1}
Mass = 12n + (2n + 1) = 14n + 1
14n + 1 = 55
14n = 54
n = 54 divided by 14 = 3.86 which was approximately 4

(c) Write the structural formula of the acid and give its IUPAC name.

R = C_4H_9
The structural formula was $CH_3CH_2CH_2CH_2COOH$
The IUPAC name was pentanoic acid

(d) Write the reaction between the organic acid and ethanol in the presence of H_2SO_4.

$C_4H_9COOH + C_2H_5OH$ ----> $C_4H_9COOC_2H_5 + H_2O$
Pentanoic acid reacted with ethanol to form ethyl pentanoate and water
(e) Give two natural sources of the organic acid present in vinegar.

Apples
Grapes

2. Sample PP contained one cation and one anion. Systematic qualitative analysis was carried out to identify the ions. The experiments, observations, and inferences were recorded as shown in the table below:

S/N	Experiment	Observation	Inference
1	Performed flame test	Gave brick-red flame	Calcium ion (Ca^{2+}) was present
2	Added dilute HCl, then $BaCl_2$	Formed white precipitate	Sulfate ion (SO_4^{2-}) was present
3	Added NaOH and warmed	Did not evolve ammonia	Ammonium ion (NH_4^+) was absent
4	Added Na_2CO_3	Did not effervesce	No acidic hydrogen was present

(a) The cation and anion in the sample were:
Cation: Ca^{2+}
Anion: SO_4^{2-}

(b) The molecular formula of the sample was:
$CaSO_4$

(c) Two properties of the cation identified were:
It gave a brick-red flame during the flame test
It formed a white precipitate with sulfate ions that was insoluble in dilute acids