THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
DIPLOMA IN SECONDARY EDUCATTION EXAMINATION

732/2C   **CHEMISTRY 2C**

Time: 3 Hours   **ANSWERS**   **Year: 2022**

Instructions.

1. This paper consists of three questions.

2. Answer **all** questions.

3. Cellular phones are **note** allowed in the examination room.

4. Write your **examination Number** on every page of your answer booklet(s).

1. Titration: Oxalic Acid (TT) vs Sodium Hydroxide (PP)

Given:

- TT = 6.3 g/dm³ oxalic acid

- PP = Sodium hydroxide (unknown concentration)

- Phenolphthalein indicator

(a)(i) What is the volume of the pipette used?

Answer: 20.00 cm³

(ii) Tabular Form for Titration

Titration	Final Burette Reading (cm³)	Initial Burette Reading (cm³)	Volume Used (cm³)
Rough	20.20	0.00	20.20
1st	40.20	20.20	20.00
2nd	60.20	40.20	20.00
3rd	80.20	60.20	20.00

(b) Why is oxalic acid considered a primary standard substance?

Because it is stable, pure, non-hygroscopic, has a known formula, a definite molar mass, and it can be weighed accurately and dissolved to prepare a standard solution.

(c) In which part of the meniscus will you read the solution TT in the burette? Explain.

Answer: Lower meniscus.
Reason: Oxalic acid solution is colorless and transparent; hence, readings are taken at the bottom of the meniscus for accuracy.

(d) Why is it not advised to hold the pipette from its bulb?

Holding from the bulb transfers heat from your hand to the solution, potentially causing expansion and affecting the volume measurement.

(e) What is the colour change of phenolphthalein in this reaction?

- In sodium hydroxide: **Pink**

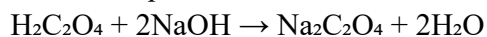- At endpoint (after reaction with oxalic acid): **Colourless**

(f) Calculate the concentration of solution TT in mol/dm³

Molar mass of oxalic acid ($H_2C_2O_4 \cdot 2H_2O$) = 126 g/mol

Concentration = 6.3 g / 126 g/mol = **0.05 mol/dm³**

(g) Calculate the concentration of PP in mol/dm³

Reaction equation:
$H_2C_2O_4 + 2NaOH \rightarrow Na_2C_2O_4 + 2H_2O$

Mole ratio: $H_2C_2O_4$: NaOH = 1 : 2

$C_1V_1 = C_2V_2$

$0.05 \times 20.00 = C_2 \times 20.00 / 2$

$1.00 = 0.5 \times C_2 \times 20$

$C_2 = 1 / 10 =$ **0.1 mol/dm³**

2. Heat of Solution Experiment

Given:

- D1: Ammonium nitrate

- D2: Calcium chloride

- Volume of water = 50 cm³ (50 g)

- Specific heat capacity (c) = 4.2 J/g°C

- Mass of salt = 2.0 g

(a) Tabulated Results

Experiment	Salt	Initial Temp (°C)	Final Temp (°C)
1	Ammonium nitrate (D1)	25	23
2	Calcium chloride (D2)	25	27

(b) Calculate heat of solution

Formula:
$Q = mc\Delta T$

For D1:
$\Delta T = 23 - 25 = -2°C$
$Q = 50 \times 4.2 \times (-2) = \textbf{-420 J}$

For D2:
$\Delta T = 27 - 25 = 2°C$
$Q = 50 \times 4.2 \times 2 = \textbf{420 J}$

(c) State whether each process is endothermic or exothermic.

- **D1 (Ammonium nitrate):** Endothermic (temperature decreased)

  Reason: Heat is absorbed from water to dissolve the salt.

- **D2 (Calcium chloride):** Exothermic (temperature increased)

  Reason: Heat is released as the salt dissolves.

3. Qualitative Analysis — Sample Q (Sodium Chloride)

(a) Analysis Table

Test	Observation	Inference
(i) Appearance	White crystalline solid	Possible chloride salt
(ii) Action of heat	No visible change	Thermally stable
(iii) Dilute H_2SO_4 on solid	No reaction	Absence of carbonate or nitrate
(iv) Concentrated H_2SO_4 on solid	Steamy fumes (HCl gas) with pungent smell	Presence of chloride ion (Cl^-)
(v) Flame test	Yellow flame	Presence of sodium (Na^+)
(vi) Solubility in water	Soluble	Ionic salt
(vii) Confirmatory test for chloride ($AgNO_3$)	White precipitate, soluble in dilute NH_3	Confirm chloride (Cl^-) ion
(viii) Confirmatory test for sodium (Flame test)	Yellow flame	Confirms Na^+

(b) What are the cation and anion present in the sample?

Cation: Na^+

Anion: Cl^-

(c) Reaction equation for test (iv)

$NaCl(s) + H_2SO_4(conc) \rightarrow NaHSO_4(s) + HCl(g)$