b) (i) Place the remaining solid in a boiling tube. Add about 6 $cm^3$ of distilled water and shake to dissolve. **Keep all** the product for the tests below;

| Observations | Inferences |
|---|---|
| The solid dissolves to form a colourless solution (1 mk) | Polar organic compound present. (1 mk) |

(ii) To about 2 $cm^3$ of the solution in a test tube , add 3 drops of acidified potassium manganate (vii)

| Observations | Inferences |
|---|---|
| The purple acidified potassium manganate (VII) turns colourless (1 mk) | $-C=C-$ , $-C\equiv C-$ present (1 mk) |

) To another 2 $cm^3$ of the solution in a test-tube , add half a spatula of sodium hydrogencarbonate.

| Observations | Inferences |
|---|---|
| Effervescence (1 mk) | $H^+$, $R-COOH$ present. (1 mk) |

(iii) To another 2 $cm^3$ of the product in a test tube, add sodium hydroxide dropwise till in excess

| Observations | Inferences |
|---|---|
| white precipitate soluble in excess sodium hydroxide solution ✓1 (1 mk) | $Al^{3+}$, $Pb^{2+}$, $Zn^{2+}$ present. ✓1 (1 mk) |

(iv) To another 2 $cm^3$ of sample of the product in a test tube, add dilute ammonia solution.

| Observations | Inferences |
|---|---|
| white precipitate soluble in excess ammonia solution ✓1 (1 mk) | ✓1 $Zn^{2+}$ present. (1 mk) |

**QUESTION 3.**

You are provided with solid U to use in this question. Carry out the tests outlined below, record the observations and inferences.

a) Place half the solid in a clean metallic spatula and burn it over a non-luminous flame.

| Observations | Inferences |
|---|---|
| Solid U burns with a yellow sooty flame ✓1. (1 mk) | ✓1 `C=C` and -C≡C- present. (1 mk) |

**QUESTION 2.**

You are provided with solid T and other reagents to use in this question. You are required to perform the tests below, record the observations and inferences. Test for any gases produced.

a) Place half of the solid in a clean dry test-tube. Heat the solid gently and then strongly.

| Observations | Inferences |
|---|---|
| - colourless liquid forms on the cooler parts of the test-tube ✓½<br>- moist blue litmus paper turns red while moist red litmus paper remains red. ✓½ (1 mk) | - water of crystallisation or hydrated salt present ✓1<br>- acidic gas produced. ✓1 (2 mks) |

b) (i) Place the remaining solid in a boiling tube. Add about 8 $cm^3$ of distilled water and shake for about 3 minutes. **KEEP** the product for use in the questions that follow.

| Observations | Inferences |
|---|---|
| solid T dissolves in water to form a colourless solution ✓1 (1 mk) | soluble salt present ✓1 (1 mk) |

(ii) To a 2 $cm^3$ sample of the product in a test-tube, add 2-3 drops of barium nitrate followed by 2 $cm^3$ 2 M nitric acid.

| Observations | Inferences |
|---|---|
| white precipitate insoluble in nitric(V) acid ✓1 (1 mk) | $SO_4^{2-}$ present ✓1 (1 mk) |

**QUESTION 2.**

You are provided with solid T and other reagents to use in this question. You are required to perform the tests below, record the observations and inferences. Test for any gases produced.

a) Place half of the solid in a clean dry test-tube. Heat the solid gently and then strongly.

| Observations | Inferences |
|---|---|
| - colourless liquid forms on the cooler parts of the test-tube ✓½<br>- moist blue litmus paper turns red while moist red litmus paper remains red. ✓½ (1 mk) | - water of crystallisation or hydrated salt present ✓1<br>- acidic gas produced. ✓1 (2 mks) |

b) (i) Place the remaining solid in a boiling tube. Add about 8 $cm^3$ of distilled water and shake for about 3 minutes. **KEEP** the product for use in the questions that follow.

| Observations | Inferences |
|---|---|
| Solid T dissolves in water to form a colourless solution ✓1 (1 mk) | Soluble salt present ✓1 (1 mk) |

(ii) To a 2 $cm^3$ sample of the product in a test-tube, add 2-3 drops of barium nitrate followed by 2 $cm^3$ 2 M nitric acid.

| Observations | Inferences |
|---|---|
| white precipitate insoluble in nitric(V) acid ✓1 (1 mk) | $SO_4^{2-}$ present ✓1 (1 mk) |

(iii) the moles of hydrochloric acid in 100 $cm^3$ of solution P. (1 mk)

If 16.7 $cm^3$ of HCl acid → 0.01 moles ✓½

∴ 100 $cm^3$ of HCl acid → $\frac{100}{16.7}$ ✓½ × 0.01 = 0.0599 moles

e) (i) Calculate the moles of hydrochloric acid present in 50 $cm^3$ of solution N (1 mk)

∴ If 1000 $cm^3$ of HCl acid → 1.5 moles

∴ 50 $cm^3$ of HCl acid → $\frac{50}{1000}$ ✓½ × 1.5 ✓½

= 0.075 moles

(ii) Determine the moles of hydrochloric acid that reacted with 10 cm of magnesium ($1\frac{1}{2}$ mks)

0.075 − 0.0599 = 0.0151 moles of HCl acid ✓½ ✓1

(iii) Given that one mole of magnesium reacts with 2 moles of hydrochloric acid, determine;

I. Moles of magnesium in 10 cm length of magnesium (1 mk)

If 2 moles of HCl acid → 1 mole of Mg

∴ 0.0151 moles of HCl acid → $\frac{0.0151}{2}$ ✓½ × 1 ✓½

= 0.00756 moles of Mg

II. Moles per cm length of magnesium. (1 mk)

If 10 cm of Mg → 0.00756 moles

∴ 1 cm of Mg → $\frac{1}{10}$ ✓½ × 0.00756

= 0.000756 moles/cm ✓½

b) From the graph, determine the time taken for 3.5 cm piece of magnesium to react with the acid. ($1\frac{1}{2}$ mks)

$\frac{1}{t} = 2.16 \times 10^{-2}$ ✓½

$t = \frac{1}{2.16 \times 10^{-2}}$

$t = 46.29$ seconds ½

showing on the graph = ½ mk

**Procedure II**

Transfer **all** the products from procedure I into a 100 ml measuring cylinder. Add distilled water to the mixture upto the 100 ml mark. Transfer the solution into the beaker and stir to mix uniformly. Label the mixture as solution P.

Pipette 25.0 $cm^3$ of solution S and transfer into a clean conical flask. Fill the burette with solution P. Titrate solution S with solution P from the burette using 2-3 drops of phenolphthalein indicator. Record the initial and final burette readings in table II below. Repeat the titration two more times and complete the table.

**Table II**

CT = 1MK
DP = 1MK
ACC = 1MK
PA = 1MK
FA = 1MK

| Experiment Number | 1 | 2 | 3 |
|---|---|---|---|
| Final burette reading ($cm^3$) | 16.8 | 16.7 | 16.6 |
| Initial burette reading ($cm^3$) | 0.0 | 0.0 | 0.0 |
| Volume of solution P used ($cm^3$) | 16.8 | 16.7 | 16.6 |

(5 mks)

c) Determine the average volume of solution P used.

$\frac{16.8 + 16.7 + 16.6}{3} = 16.7\ cm^3$

d) Calculate:

(i) the moles of sodium hydroxide in 25.0 $cm^3$ of solution S (1 mk)

If 1000 $cm^3$ of NaOH → 0.4 moles ✓½

∴ 25 $cm^3$ of NaOH → $\frac{25}{1000} \times 0.4 = 0.01$ moles ✓½

(ii) the moles of hydrochloric acid in average volume of solution P. (1 mk)

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

Mole ratio of NaOH : HCl is 1 : 1 ✓½

If 1 mole of NaOH → 1 mole of HCl acid

∴ 0.01 mole of NaOH → $\frac{0.01}{1} \times 1 = 0.01$ moles of HCl acid ✓½

b) From the graph, determine the time taken for 3.5 cm piece of magnesium to react with the acid. ($1\frac{1}{2}$ mks)

$\frac{1}{t} = 2.16 \times 10^{-2}$ ✓½

$t = \frac{1}{2.16 \times 10^{-2}}$

$t = 46.29$ seconds ✓½

showing on the graph = ½ mk

**Procedure II**

Transfer **all** the products from procedure I into a 100 ml measuring cylinder. Add distilled water to the mixture upto the 100 ml mark. Transfer the solution into the beaker and stir to mix uniformly. Label the mixture as solution P.

Pipette 25.0 $cm^3$ of solution S and transfer into a clean conical flask. Fill the burette with solution P. Titrate solution S with solution P from the burette using 2-3 drops of phenolphthalein indicator. Record the initial and final burette readings in table II below. Repeat the titration two more times and complete the table.

**Table II**

CJ = 1MK
DP = 1MK
ACC = 1MK
PA = 1MK
FA = 1MK

| Experiment Number | 1 | 2 | 3 |
|---|---|---|---|
| Final burette reading ($cm^3$) | 16.8 | 16.7 | 16.6 |
| Initial burette reading ($cm^3$) | 0.0 | 0.0 | 0.0 |
| Volume of solution P used ($cm^3$) | 16.8 | 16.7 | 16.6 |

(5 mks)

c) Determine the average volume of solution P used.

$$\frac{16.8 + 16.7 + 16.6}{3} = 16.7\ cm^3$$

d) Calculate:

(i) the moles of sodium hydroxide in 25.0 $cm^3$ of solution S (1 mk)

If 1000 $cm^3$ of NaOH → 0.4 moles ✓½

∴ 25 $cm^3$ of NaOH → $\frac{25}{1000} \times 0.4 = 0.01$ moles ✓½

(ii) the moles of hydrochloric acid in average volume of solution P. (1 mk)

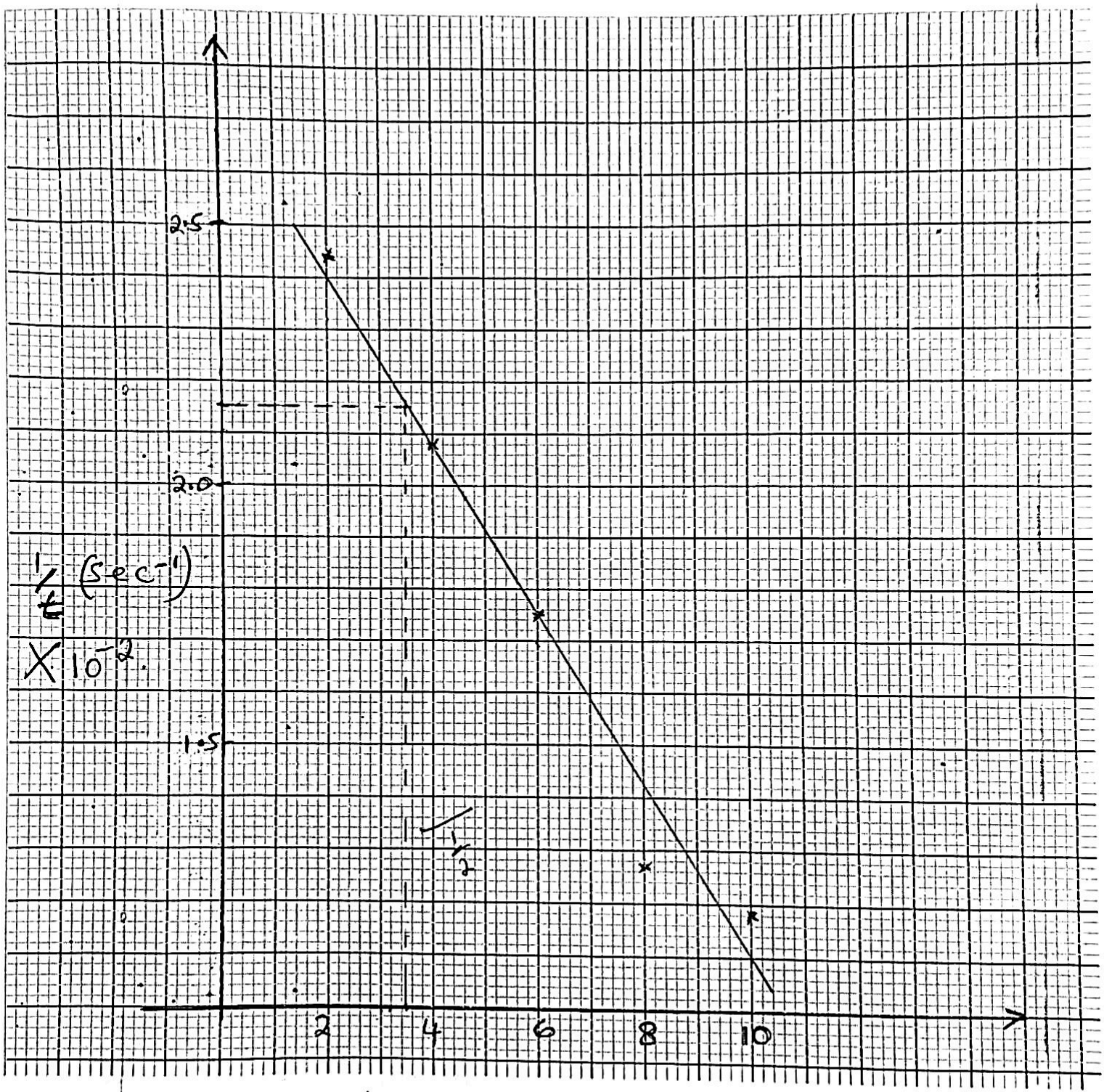
$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$ ✓½

Mole ratio of NaOH : HCl is 1 : 1 ✓½

If 1 mole of NaOH → 1 mole of HCl acid

∴ 0.01 mole of NaOH → $\frac{0.01}{1} \times 1 = 0.01$ moles of HCl acid ✓½

a) Plot a graph of reciprocal of time, $(\frac{1}{t})$ (y-axis) against length of magnesium used. (3 mks)




Scale - ½ mk

Labelling - ½

Plot - 1mk

Curve - 1mk

**QUESTION 1.**

You are provided with:-

- Solid M, magnesium ribbon.
- Solution N, 1.5 M hydrochloric acid.
- Solution S, 0.4 M sodium hydroxide

You are required to:-

- Determine the rate of reaction of different lengths of magnesium ribbon with hydrochloric acid of different concentrations.
- Draw a graph for the rate of reaction of magnesium ribbon with different lengths of magnesium and determine the time taken for 3.5cm length of the ribbon to react completely.
- Determine the moles per cm length of magnesium solid M.

**Procedure I**

Measure exactly 50.0 $cm^3$ of solution N in 100 ml measuring cylinder and transfer into a clean 100 ml beaker. Measure and cut 2 cm lengths of solid M using a scalpel blade. Drop a 2 cm piece of magnesium in solution N and start a stop-watch simultaneously. Swirl the beaker once and ensure the magnesium is in contact with the acid throughout. Stop the watch immediately the magnesium reacts completely and record in the table I below, the time t, taken for the 2 cm piece to react.

Drop another 2 cm piece of magnesium into the mixture and start a stop-watch simultaneously. Record the time t, taken for the 2 cm piece of magnesium to react. Repeat the procedure by dropping 2 cm piece of magnesium ribbon into the mixture and recording in table I below the time taken for complete reaction.

Calculate the reciprocal for time taken, $(\frac{1}{t})$ for each length and complete table I. **KEEP** the products for use in Procedure II.

**Table I**

| Length of solid M used (cm) | 2 | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| Time, t, taken for 2 cm piece to react (seconds) | 41 | 48 | 57 | 79 | 85 |
| Reciprocal of time, $\frac{1}{t}$ ($Sec^{-1}$) | 0.0244 | 0.0208 | 0.0175 | 0.0127 | 0.0118 |

Trend = 1mk = Tied to the row of time: time should increase
Sample Table (CT) = 1mk

(4 mks)

Accuracy (Acc) = 1mk ---- Tied to the first time recorded
Decimal Place (DP) = 1mk ---- Tide to the row of $\frac{1}{t}$, ~~shall~~ the values recorded should be to four D.P. consistently

NOTES: For Accuracy: allowed range is ± 5 seconds against the first recorded time.

Name MARKING SCHEME

Index No.....

School .....Candidate's Signature.....

Date: .....

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CHEMISTRY PRACTICALS

Paper 3

December, 2021

Time: 2¼ Hours

# MOMALICHE 4 CYCLE 8 JOINT EXAMINATION TESTS, DECEMBER, 2021

*Kenya Certificate of Secondary Education (K.C.S.E)*

## INSTRUCTION TO CANDIDATES

- Write your name, school and index number in the spaces provided.
- Sign and write the date in the spaces provided.
- Answer **all** the questions in the spaces provided.
- **Mathematical tables** and **electronic calculators** may be used.
- All working must be clearly shown.

**FOR EXAMINER'S USE ONLY**

| Question | Maximum Score | Candidate's Score |
|---|---|---|
| 1 | 21 | |
| 2 | 11 | |
| 3 | 8 | |
| **TOTAL** | **40** | |