

Marking guide

Name..... Index No.....
School..... Sign.....
Class..... Stream.....
Date.....

MIRROR JET 2

Kenya Certificate of Secondary Education

233/3 - CHEMISTRY

(PRACTICAL)

JUNE. 2024 - 2 $\frac{1}{4}$ Hours

INSTRUCTIONS TO THE CANDIDATES:

- Write your name, Index number, Admission number and date of examination in the spaces provided at the top of the page.
- Answer all the questions in the spaces provide below each question.
- Mathematical tables and electronic calculators may be used.
- All working MUST be clearly shown where necessary.
- You are NOT allowed to start working with the apparatus for the first 15 minutes of the 2 $\frac{1}{4}$ hours allowed for this paper. This time is to enable you to read the question paper and make sure you have all the apparatus and chemicals that you may need.

For examiner's use only

Question	Max. score	Candidate's score
1	22	22
2	12	12
3	06	06
Total score	40	40

This paper consists of 6 printed pages excluding the cover page. Check to ascertain that all pages are printed as indicated and that no questions are missing.

1. You are provided with the following

- 4g of solid P – an organic acid, $\text{H}_2\text{C}_2\text{O}_4 \cdot \text{nH}_2\text{O}$
- 0.2M sodium hydroxide solution Q

You are required to determine

- The solubility of solid P
- The value of n in the formula $\text{H}_2\text{C}_2\text{O}_4 \cdot \text{nH}_2\text{O}$

Procedure I

- Fill in the burette with distilled water
- Transfer all the solid P in a clean dry boiling tube and add to it 4cm³ of distilled water from the burette. Heat the mixture while stirring with the thermometer until all the solid dissolves. When all the solid has dissolved, allow the solution to cool while stirring with the thermometer. Note the temperature at which crystals **just** start forming and record it in **table 1**.
- Add 2cm³ of distilled water to the contents of the boiling tube. Warm the mixture while stirring with the thermometer until all the solid dissolves, allow the mixture to cool while stirring with the thermometer and record the temperature at which crystals of solid P first appear.
- Repeat procedure (iii) above three more times each time adding 2cm³ of distilled water.

Retain the contents of the boiling tube for use in procedure II

- Complete **table 1** by calculating the solubility of solid P at the different temperature

Table 1

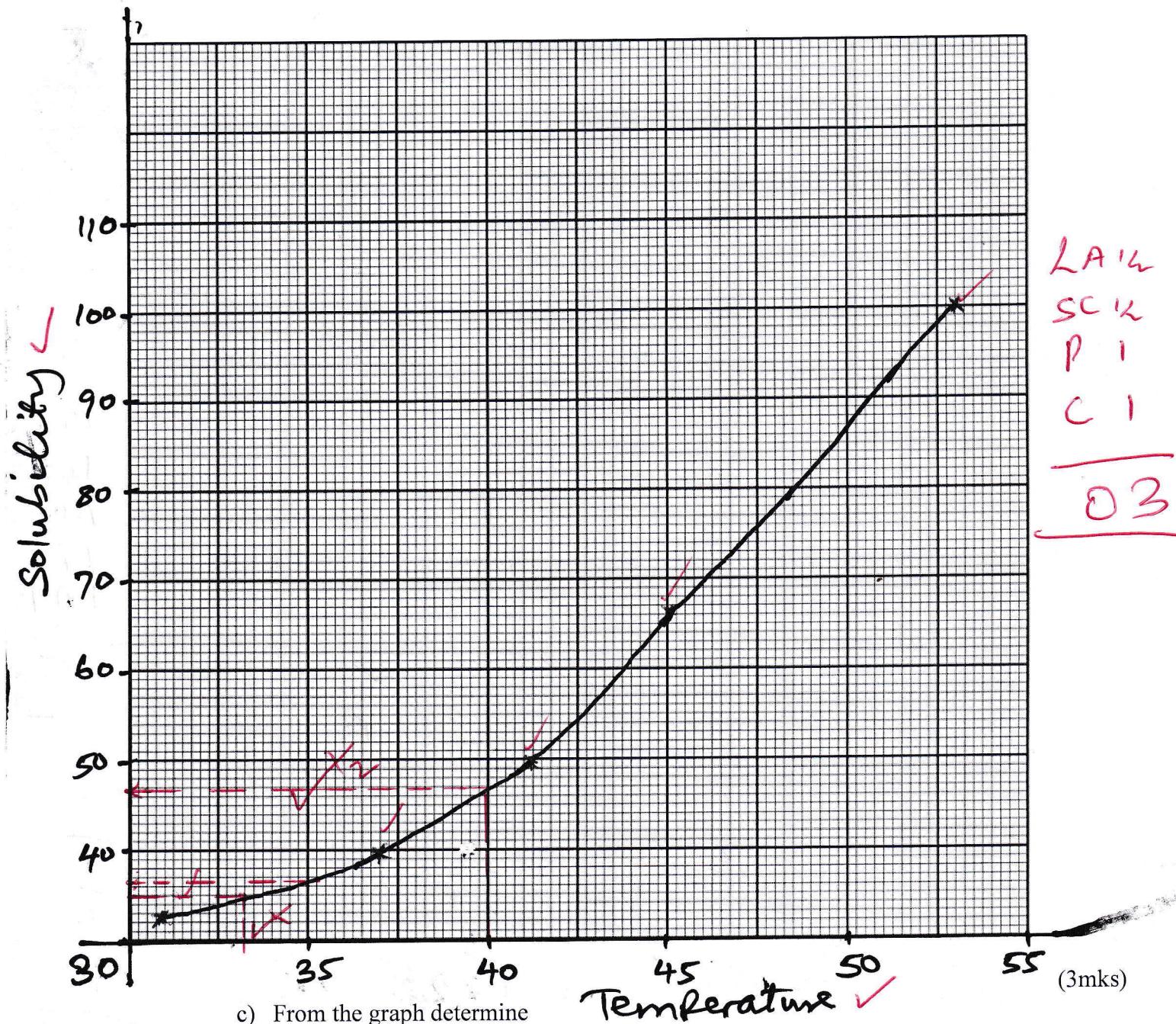
Experiment	1	2	3	4	5
Volume of water (cm ³)	4	6	8	10	12
Temperature at which crystals first appear (°C)	53	45	41	37	31
Solubility of P in g/100g of H ₂ O	100	66.7	50	40	33.3

(5mks)

CT3
DP14
AC12
TR1
—
05

- On the grid provided plot a graph of solubility of P in g/100g of water (vertical axis) against temperature

- Note
- Accuracy is tried to the first temp reading and should be within ± 2 units.
 - Penalise $\frac{1}{2}$ mks for each wrong or missing solubility to a max of $2\frac{1}{2}$ mks on complete table.



c) From the graph determine

i) The solubility of solid P at 40°C

(1mk)

~~47.9~~ ✓ ~~100g of H₂O~~ ✓ ~~Correct reading~~ ✓ I

ii) The temperature at which 35g of solid P will dissolve in 100g of water

(1mk)

~~33.5°C~~ ✓ ~~Showing~~ ✓ ~~Reading~~ ✓ I

iii) From the graph determine the mass of solid P which will be deposited if solid in 100g of water at 50°C is cooled to ~~35°C~~

(2mks)

~~Solubility at 35°C = 37.0 g~~ ✓ ~~Showing~~ ✓ I

~~mass deposited = 45 - 37~~ ✓ ~~2~~ ✓ I

~~= 8 g~~ ✓ ~~2~~ ✓ I

Procedure II

- i) Transfer the solution from procedure I above into 250ml volumetric flask. Rinse both boiling tube and thermometer with distilled water and add to the volumetric flask. Add distilled water to the flask up to the mark. Label it as solution P
- ii) Pipette 25cm³ of solution Q into 250cm³ conical flask. Add 2 – 3 drops of phenolphthalein indicator.
- iii) Fill the burette with solution P and titrate against solution Q.
- iv) Record the results in the table below
- v) Repeat the titration two more times and complete table 2

Table 2

Titration	I	II	III
Final burette reading (cm ³)	19.5	19.6	19.7
Initial burette reading (cm ³)	0.0	0.0	0.0
Volume of solution P used (cm ³)	19.5	19.6	19.7

(4mks)

Calculate

i) Average volume of solution P used $\frac{19.5 + 19.6 + 19.7}{3} = 19.6$ (1mk)

ii) Number of moles of solution Q used $\frac{0.2 \times 25}{1000} = 0.005$ (1mk)

iii) Number of moles of solution P used $\frac{\text{Ans (ii)}}{2} = \frac{0.005}{2} = 0.0025$ (1mk)

iv) Molarity of solution P $\frac{\text{Ans (iii)} \times 1000}{19.6} = 0.1276$ (1mk)

v) Determine the value of n
 $\text{Molar mass} = \frac{16}{0.1276} \approx 125.4$
 $n = \frac{35.4}{18} \approx 2$
 $1 \times 2 + 12 \times 2 + 16 \times 4 + 18n = 125.4$
 $90 + 18n = 125.4$

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2.

- a) You are provided with mixture K. Carry out the following tests and record the observations inferences in the spaces provided.
- i) Put all of the solid K in a boiling tube and add about 10cm³ of distilled water. Shake well and filter the mixture into a boiling tube. Retain the filtrate.

Observations	Inferences
<ul style="list-style-type: none"> - Colourless \checkmark - White residue \checkmark 	<ul style="list-style-type: none"> - A mixture of Soluble and Insoluble substances \checkmark - Coloured ions absent \checkmark

- ii) Put the residue in a test tube and add about 5cm³ of dilute nitric (V) acid

Observations	Inferences
<ul style="list-style-type: none"> - NO effervescence \checkmark - Dissolves into a colourless solution \checkmark 	$\text{SO}_3^{2-}, \text{CO}_3^{2-}$ absent \checkmark Zn^{2+} present \checkmark

- iii) To about 2cm³ of the solution in (ii) above , add ammonia drop – wise until excess

Observations	Inferences
White ppt soluble in excess \checkmark	Zn^{2+} present \checkmark

b)

- i) Divide the filtrate into 3 portions. To the 1st portion, add sodium hydroxide dropwise until in excess

Observations	Inferences
NO white ppt \checkmark	$\text{Ca}^{2+}, \text{Mg}^{2+}, \text{Ba}^{2+}, \text{Zn}^{2+}, \text{Al}^{3+}, \text{Pb}^{2+}$ absent \checkmark

- ii) To the 2nd portion, dip a clean glass rod and heat it in a non – luminous flame

Observations	Inferences
Bright yellow flame \checkmark	Na^+ present \checkmark

iii) To the 3rd portion, add 3 drops of acidified barium nitrate solution

Observations	Inferences
White \checkmark ppt (1mk)	SO_4^{2-} present (1mk) 12

3. You are provided with solid L. carry out the tests below and write your observations and inferences in the spaces provided.

i) Take a half – spatula full of solid L and burn it in a non – luminous flame

Observations	Inferences
Sooty / Smokey flame (1mk)	$\text{:C}=\text{C:} / -\text{C}\equiv\text{C}-$ present. (1mk) 2

ii) Put the rest of solid L in a boiling tube and add about 6cm³ of distilled water. Shake well and divide the solution into three portions

I. To the first portion, add 4 drops of acidified potassium Manganate (VII)

Observations	Inferences
Purple KMnO_4 is decolourised (1mk)	$\text{:C}=\text{C:} / -\text{C}\equiv\text{C}-$, R-OH present (1mk) 2

II. To the second portion, add 4 drops of bromine water

Observations	Inferences
Orange bromine water is decolourised (1mk)	$\text{:C}=\text{C:} / -\text{C}\equiv\text{C}-$ present. (1mk) 2

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