Name .....Adm No. .....

Class..... School.....

233/3

Date.....

CHEMISTRY

Paper 3

JUNE 2022

Time: 2¼ Hours

MARKING SCHEME

SUKELLEMO

FORM 4

CHEMISTRY PRACTICAL

INSTRUCTIONS

* Write your **name** and the indicated details in the spaces provided on this page.
* Answer **ALL** questions in the spaces provided in the question paper.
* You are **NOT** allowed to start working with the apparatus for the ***first 15 minutes*** of the 2¼ hours allowed for this paper. This time is to enable you to read the question paper and make sure you have all the chemicals and apparatus you may need.
* Mathematical tables and silent electronic calculators may be used.
* All working must be clearly shown where necessary.

For Examiner's Use Only

Question	Maximum score	Candidate's score
1	21	
2	10	
3	9	
Total score	**40**	

This paper has 8 printed pages. Candidates should check the question paper to ascertain that ALL pages are printed as indicated and that no questions are missing.

QUESTION 1

You are provided with:

- 6.0g of an alkanoic acid labelled **solid P** in a boiling tube.
- 2M sodium hydroxide solution labelled **solution Q**.

You are required to:

(a) Determine the solubility of **solid P** at different temperatures.
(b) Determine the number of moles of water of crystallization in **solid P**.
(c) Find the molar mass of the alkanoic acid.

Procedure I

i) Using a burette add $10cm^3$ of distilled water to the **solid P** in the boiling tube. Heat the mixture while stirring with a thermometer to about 70°C. When the entire solid has dissolved allow the solution to cool while stirring with the thermometer. Note the temperature at which crystals of **solid P** first appear. Record this temperature in the Table 1 below.

ii) Using the burette add $2cm^3$ 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. Note the temperature at which the crystals of **solid P** first appear.

iii) Repeat the procedure (ii) two more times and record the temperatures in Table I. **Retain the contents of the boiling tube for use in procedure II.**

TABLE I

Volume of water in the boiling tube (cm^3)	**Temperature at which crystals of solid P first appear (°C)**	**Solubility of Solid P ($g/100gH_2O$)**
10	55	$\frac{6 \times 100}{10} = 60$ ✓
12	50	$\frac{6 \times 100}{12} = 50$ ✓
14	45	$\frac{6 \times 100}{14} = 42.9$ ✓
16	40	$\frac{6 \times 100}{16} = 37.5$ ✓

a) i) Complete **Table 1** by calculating the solubility of **solid P** at different temperatures (6 mks)

- Complete table – 1mk
- Decimal point (whole number throughout for 1dp) – 1mk
- Calculation – 2mk
- School value ± 2°C – 1mk (whole school value is 1st reading) – 1mk
- Trend (decrease in temperature) – 1mk

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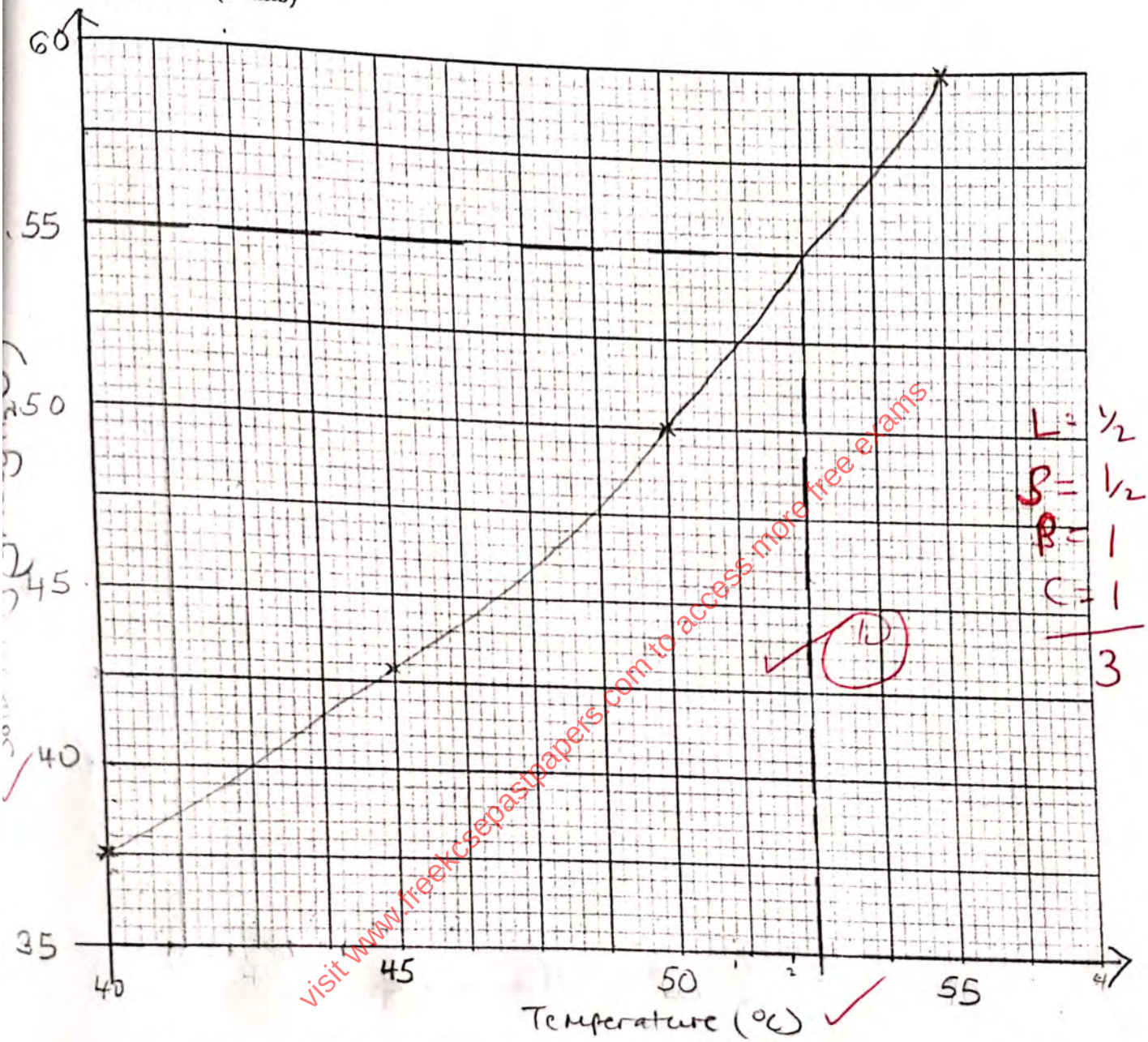
ii) On the grid provided, plot a graph of the solubility of solid P (vertical axis) against temperature. (3 mks)



iii) Using the graph determine the temperature at which 55g of solid P would dissolve in 100cm^3 of water. (1 mk)

52·5°C ✓ 10

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Procedure II

i) Transfer the contents of the boiling tube in **Procedure I** into a 250 ml volumetric flask. ***Rinse both the boiling tube and the thermometer with distilled water and add to the volumetric flask.*** Add more distilled water to make up to the mark. Transfer the solution to a 250 ml beaker, Label this **solution R. Wash the volumetric flask then rinse it with distilled water ready for use in Step(ii).**

ii) Using a measuring cylinder place 25.0 cm^3 of solution Q into a 250 ml volumetric flask. Add about 200cm^3 of distilled water. Shake well. Add more distilled water to the make up to the mark. Label this **solution T.**

iii) Fill a burette with **solution R**. Using a pipette and pipette filler, place 25 cm^3 of **solution T** into a 250 ml conical flask. Add 2-3 drops of phenolphthalein indicator and titrate with **solution R**. Record your results in table II. Repeat the titration two more times and complete the table.

TABLE II

CT-1
DP-1
ACC-1
PA-1
FA-1

Titre	1	2	3
Final burette reading (cm^3)	13.2	27.2	13.2
Initial burette reading (cm^3)	0.0	14.0	0.0
Volume of solution **R** used (cm^3)	13.2	13.2	13.2

(4 marks)

Values Averaged must be within ± 0.2 of each other

DETERMINE:

a) The average volume of **solution R** used (1 mk)

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b) The concentration of **solution T** in moles per litre. (1 mk)

$1000cm^3 \Rightarrow 2$ moles

$25cm^3 \Rightarrow \frac{25}{1000} \times 2 = 0.05$ moles

0.05 moles $\Rightarrow 250cm^3$

$\Rightarrow 1000cm^3$

$\frac{1000}{250} \times 0.05 = 0.2M$

(1)

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c) The concentration of alkanoic acid **solution R** in moles per litre (1 mole of acid reacts with 2 moles of the base) (2 mks)

Moles of base in 25cm³ ⇒ $\frac{0.2 \times 25}{1000} = 0.005$ moles (1)

Mole ratio of Acid : Base
1 : 2
: 0.005 mole (1)

$\frac{0.005}{2} \times 1 = 0.0025$ moles acid

Acid
0.0025 moles ⇒ Av volume

1000cm³

$= \frac{1000cm^3}{Av.volume} \times 0.0025$ (1)

Correct ans (1)

Penalize −½ Mk for wrong or missing units

d) The relative formula mass of the alkanoic acid, **solid P** (2 mks)

Ans in (c) above $\times \frac{250}{1000}$ (1) = correct ans (1)

$\left[\frac{6}{\text{Ans in (c) above} \times \frac{250}{1000}}\right]$ OR $\frac{6}{\text{Ans above}}$ (1) = correct ans. (1)

e) The formula of **P** has the form $\mathbf{M.xH_2O}$. Determine the value of x in the formula. (The relative formula mass of M is 90; O=16;H = 1) (1mk)

RFM of P is $M.xH_2O$ = Ans in (d) above.

$x = \frac{\text{Ans in (d) above} - 90}{18}$ (1)

= Correct ans. (1)

Penalize −½ Mk if the value of x is a fraction.

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QUESTION 2

You are provided with **solid Y**. Use it to carry out the tests indicated below and record your observations and inferences in the spaces provided.

a) Put half a spatula of **solid Y** in a boiling tube. Add about 5 cm^3 of distilled water and shake. Divide the resultant mixture into four portions of 1 cm^3 each.

Observations	Inferences
Solid dissolves to form a colourless solution (1 mk)	- Soluble salt. (½) Colored ions absent (Cu^{2+} Fe^{2+}, Fe^{3+}) (½) (1 mk)

(1)

i) To the first portion add aqueous sodium hydroxide dropwise till in excess.

Observations	Inferences
white precipitate dissolves in excess to form a colourless solution (1 mk)	Zn^{2+}, Al^{3+}, Pb^{2+} present (1) (1 mk)

ii) to the second portion add aqueous ammonia dropwise till in excess

Observations	Inferences
white precipitate dissolves in excess to form a colourless solution (1) (1 mk)	Zn^{2+} present (1) (1 mk)

iii) To the third portion add lead (II) nitrate solution and warm.

Observations	Inferences
white precipitate does not dissolve on warming (½) (1 mk)	SO_4^{2-}, SO_3^{2-}, CO_3^{2-} (½) present; Cl^- absent (½) (1 mk)

tied to correct observation

iv) To the fourth portion add dilute nitric (V) acid followed by Barium nitrate solution.

Observations	Inferences
- No effervescence ½ - white precipitate ½ (1 mk)	SO_4^{2-} present 1 (1 mk)

QUESTION 3

You are provided with **solid M** and **solid F**.

Carry out the tests below and write the observations and inference in the spaces below:

a) Using a metallic spatula, ignite about one half of **solid M** in a Bunsen burner flame.

Observations	Inferences
Solid melts and burns with a yellow sooty flame. 1 (1 mk)	>C=C< present ; -C≡C- 1 (1 mk)

b) Place the other half of **solid M** in a boiling tube. Add 15cm^3 of distilled water and shake well. Label this **solution M**. Use this solution for the following tests.

i) Place 2cm^3 of **solution M** in test tube and determine pH.

Observations	Inferences
pH = 3 1 Accept any value within (1-3) not the range. (½ mk)	Strongly acidic 1 (½ mk)

ii) To about 2 cm^3 of the **solution M** obtained in (b) above add 3 drops of acidified potassium manganate (VII)

Observations	Inferences
Purple $KMnO_4$ (aq) changes to colourless 1 (1 mk)	>C=C< ½ ; -C≡C- present ; ROH 1½ (1 mk)

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iii) To about 2 cm^3 of the **solution M** obtained in (b) above add 2 drops of bromine water. and warm

Observations	Inferences
Yellow bromine water changes colourless (½ mk)	$-C=C-$ present (½ mk)

iv) To the remaining **solution M** in the boiling tube, add half of **solid ~~N~~ F**

Observations	Inferences
Effervescence (½ mk)	$R-C(=O)-OH$ present RCOOH $-COOH$ (½ mk)

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