CHEMISTRY PRACTICALS,

233/3,

TIME: $2\frac{1}{4}$ HOURS

NAME:…… SIGN:……..

CLASS…… ADM NO: ……. DATE:…….

Instructions to candidates:

(a) Answer all questions in the spaces provided in the question paper.

(b) KNEC mathematical tables and electronic calculators may be used for calculations.

(c) All working MUST be clearly shown where necessary.

(d) Candidates should answer the questions in English.

FOR EXAMINERS USE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1	21	
2	11	
3	08	
TOTAL	40	

1. You are provided with:

   Solid P – 3.6 g of hydrated oxalic acid with the formula $H_2C_2O_4$. X H_2O.

   Solution W – 0.2 M sodium hydroxide solution.

   You are required to determine:

   (i) Solubility of solid P.

   (ii) The value of X in $H_2C_2O_4$. X H_2O.

Procedure I:

(i) Fill the burette with distilled water.

(ii) Transfer 4 cm^3 of distilled water from the burette in to a boiling tube containing solid P.

(iii) Heat the mixture while stirring carefully with a thermometer until all the solid dissolves.

(iv) Cool the mixture by dipping it in cold water contained in a beaker while stirring with the thermometer. Record the temperature at which crystals start to form in table 1 below.

(v) Add a further 2 cm^3 of distilled water from a burette to the mixture. Repeat step (iii) and (iv) above and record the crystallization temperature. Complete table 1 below.

(RETAIN THE CONTENTS OF THE BOILING TUBE FOR USE IN PROCEDURE II)

(a) **Table 1**

Volume of distilled water in boiling tube.	Crystallization temperature.	Solubility of solid A in g/100g of water.
4		
6		
8		

10		
12		

(5marks)

10×½ = 5 mks

Complete table: (1 Mark)

Conditions:

5 readings (1 mark)

3-4 readings (½mark)

Less than 3 readings (0mark)

Penalties:

Penalize **½** mark **once** for unrealistic temperature readings of above 100^0C and below 10^0C.

Decimals (1 mark)

Accept temperature readings given as whole numbers, **1** d.p (**.0** or **.5**) or **2** d.p of **.00**, **.25, .50**, **.75**

Trend (1 mark).

Accept only a decreasing trend of temperature, otherwise penalize fully.

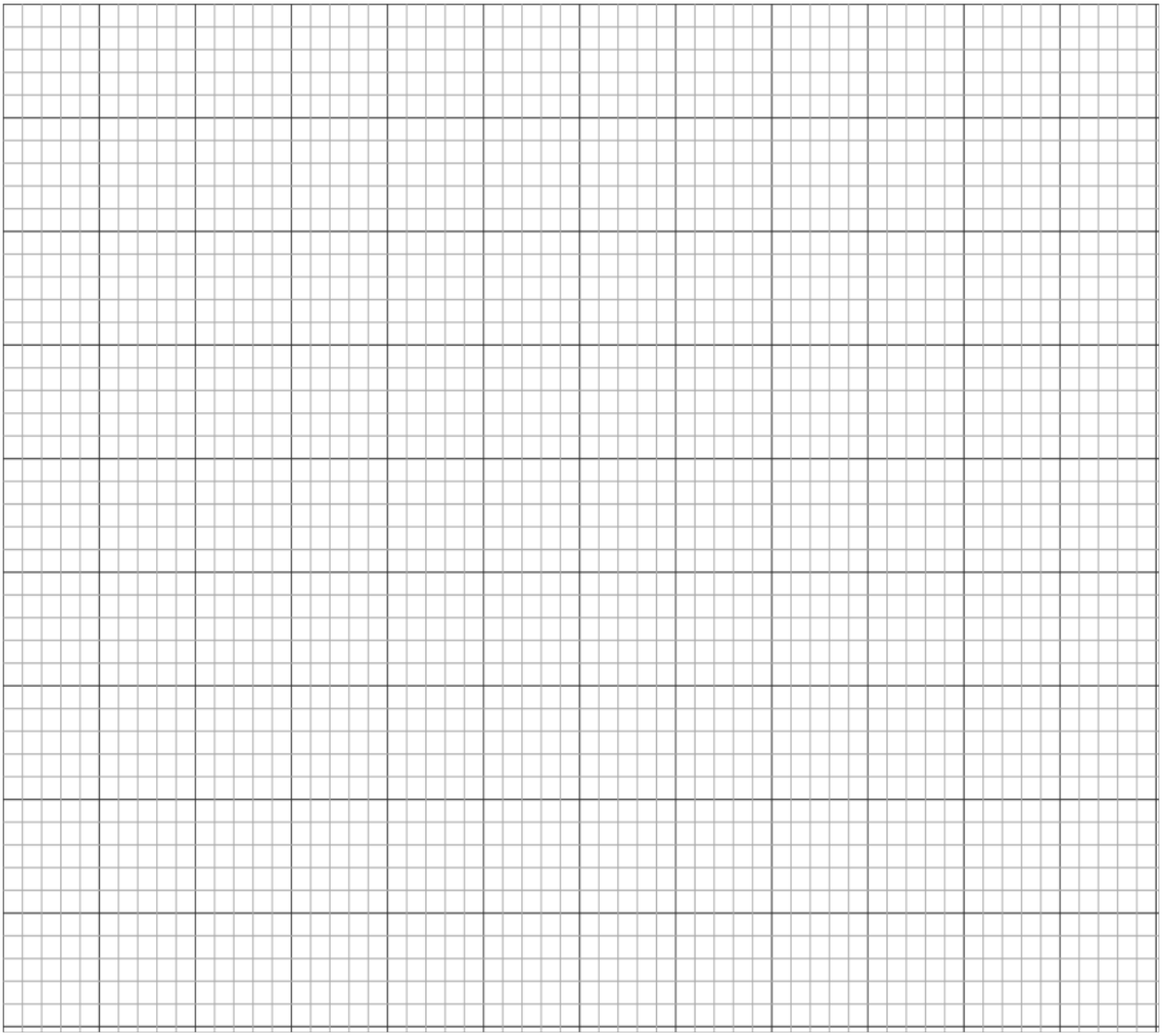
Solubility calculations in column II (2 marks):

5 correctly worked out solubility values (2 marks)

3-4 correctly worked out solubility values (1 mark)

Less than 3 correctly worked out solubility values (0mark)

(b) On the grid provided, plot a graph of solubility of solid P against crystallization temperature.
(3marks)



Graph (3 marks)

(i) Axis (2 correctly labelled) = ½ mk.

Only one axis labelled or axes completely unlabeled = 0 mk.

(ii) Scale (½mk)

Penalize fully for nonlinear / inconsistent interval on any of the axis.

Penalize fully if plotting is on less than half of the grid space provided.

(iii) Plotting (1 mark)

All five points correctly plotted = 1 mark.

3 – 4 correctly plotted points = ½mk

Less than 3 correctly plotted points = 0 mks

(iv) Curve (1 mark).

Accept a smooth curve passing through atleast 3 correctly plotted points, otherwise penalize fully.

(c) From the graph, determine:

(i) The solubility of solid P at 60^0C. (1mark)

- **Award 1 mark for correctly read solubility value.**

(ii) The temperature at which 40 g of solid P would dissolve in 50 g of water. (2marks)

40 g dissolve in 50 g of water

? dissolve in 100g of water.

$$\frac{40 \times 100}{50} = 80 \text{ g}$$ *✓1mark*

- Then read the temperature that gives a solubility of 80g/100g of water. *✓1mark*

Procedure II:

Transfer all the contents of the boiling tube in procedure I into a clean 250 ml volumetric flask. Rinse the boiling tube and the thermometer with distilled water and add the contents into the volumetric flask. Add 100 cm^3 of distilled water to the volumetric flask; shake until all the solid dissolves. Add more distilled water to the mark. Label this as solution Q. Drain the burette of any distilled water and then fill it with solution Q. Pipette 25 cm^3 of solution W into a clean conical flask, add 3 drops of phenolphthalein indicator. Titrate solution Q against solution W. Record your reading in table 2 below. Repeat the titration two more times and complete the table below.

Table 2

(a)

	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution Q used (cm^3).			

(4marks)

I. **Complete table = 1 mark.**

Complete table with three titrations = 1 mark.

Incomplete table with two titrations = ½mark.

Incomplete table with one titration = 0 mark.

Penalties.

(i) Wrong arithmetic.

(ii) Inverted table.

(iii) Burette readings beyond 50 ml and below 1.0 ml.

- For any of the above penalties, penalize **½mark** each upto a maximum of **½mark.**

II. **Use of decimals = 1 mark**

(i) 1 d.p used consistently.

(ii) If 2 decimal places are used, the second decimal place MUST be a 0 or 5.

- Penalize FULLY for any other use of decimal place.

III. **Accuracy = 1 mark.**

- Compare any of the candidates reading with the school value.
  - ➤ If atleast one titre value is within ±0.1 cm^3 of the school value = 1 mark.
  - ➤ If none is within ±0.1 cm^3 of s.v but within ±0.2 cm^3 of s.v = ½mark.
  - ➤ If none is within ±0.2 cm^3 of the s.v, award 0 mark.
- In case of wrong arithmetic in the table, cored the correct titre with the s.v and award accordingly.

IV. **Principles of averaging = 1 mark.**

- 3 consistent values averaged = 1 mark.
- 3 titrations done, only two consistent and averaged = 1 mark.
- Only two titrations done, are consistent and averaged = ½mark.

V. **Final answer = 1 mark.**

- Compare the school value with the candidate's averaged titre.
  - If within ± 0.1 cm^3 of the s.v award 1 mark.
  - If not within ± 0.1 cm^3 but within ±0.2 cm^3 of the s.v award ½mark.
  - If beyond, ±0.2 cm^3 award 0 mark.

(b) Calculate the average volume of solution Q used. (1mark)

- **Tied to (V) above.**

(c) Calculate the:

(i) Number of moles of solution W used. (1mark)

$\frac{0.2\times25}{1000}$ **√½mk**

= 0.005 moles. √½mk

- **The above expression MUST be given as it is, otherwise penalize fully for any strange value used.**

(ii) Number of moles of solution Q used given the equation below. (1mark)

$2NaOH_{(aq)} + H_2C_2O_4.\ X\ H_2O_{(aq)} \longrightarrow Na_2C_2O_4.XH_2O_{(aq)} + H_2O_{(l)}$

➤ **From the equation, mole ratio is 2:1**

$\frac{0.005}{2}$ **√½mark**

= 0.0025 moles. √½mark

(iii) Concentration of solution Q in moles per litre. (1mark)

$$\frac{\text{Answer in c(ii) above} \times 1000}{\text{Average titre.}}$$ **√½mark**

Correct answer **√½mark**

(d) Determine the value of X in the formula $H_2C_2O_4.\ X\ H_2O$. (C = 12, H = 1, O = 16).(2mks)

$$\text{Molarity} = \frac{\text{Concentration (g/l)}}{\text{RFM}}$$

$$\text{Conc in g/l} = 3.6 \times \frac{1000}{250}$$

= 14.4 g/l. √½mark

$$\text{RFM} = \frac{14.4\ (g/l)}{\text{Answer in c(iii)}}$$ **√½mark**

$$90 + 18X = \frac{14.4\ (g/l)}{\text{Answer in c(iii)}}$$ **√½mark**

$$X = \left(\frac{14.4}{\text{Answer in c(iii)}} - 90\right) \div 18$$ **√½mark**

2. You are provided with solid E. Carry out the tests below. Write your observations and inferences in the spaces provided. Place all solid E in a boiling tube. Add about 10 cm^3 of distilled water and shake until all the solid dissolves. Use about 2 cm^3 portions of the solution in a test tube for the tests below.

(a) To the first portion, add sodium hydroxide solution dropwise till in excess.

Observations	Inferences
White precipitate**√½mark** soluble in excess**√½mark** (1mk)	Pb^{2+}, Al^{3+}, Zn^{2+} present.**√1mark** All 3 mentioned = 1mk Any 2 correct mentioned = **√½**mk Only 1 correct mentioned = 0 mk. (1mk)

(b) To the second portion, add aqueous ammonia dropwise till in excess.

Observations	Inferences
White precipitate**√½**mark insoluble in excess**√½**mark (1mk)	Pb^{2+}, Al^{3+} present. • Penalize ½mk for any contradictory ion mentioned as present upto a maximum of 1 mark. (1mk)

(c) To the third portion, add 3 drops of sodium chloride solution.

Observations	Inferences
No white precipitate.√1mark (1mk)	Al^{3+} present.√1mark • Award ½mk for Pb^{2+} mentioned as absent. (1mk)

(d) To the fourth portion, add 3 drops of barium nitrate solution.

Observations	Inferences
White precipitate.√1mark (1mk)	SO_4^{2-}, SO_3^{2-}, CO_3^{2-} present. • All 3 mentioned = 2mks • Any 2 correct mentioned = 1mk • Only 1 correct mentioned = 0 mk. • Penalize ½mk for any contradictory ion mentioned as present upto a maximum of 2 marks. (2mks)

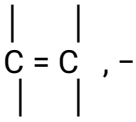
(e) To the fifth portion, add 3 drops of acidified lead (II) nitrate solution.

Observations	Inferences
White prepitate.√1mark (1mk)	SO_4^{2-} present.√1mark • Accept SO_3^{2-}, CO_3^{2-} mentioned as absent for ½mk. Penalize 1mk for any contradictory ion. (1mk)

NB: Penalize fully for any ion written with a wrong charge.

3. You are provided with solid F. Carry out the tests below. Write your observations and inferences in the spaces provided.

(a) Place half of solid F on a metallic spatula and ignite it over a Bunsen burner.

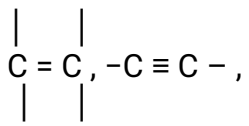
Observations	Inferences
Burns with a yellow / sooty flame. √1mark (1mk)	 √1mark (1mk)

(b) Place the remaining portion of solid F in a boiling tube. Add 5 cm^3 of distilled water and shake. Preserve the resulting mixture for test (i) and (ii) below.

Observations	Inferences
Solid F dissolves or is soluble. √1mark (1mk)	Polar compound or Q is polar. √1mark (1mk)

(i) To about 2 cm^3 of the solution in a test tube, add 3 drops of acidified potassium manganate (VII) solution.

Observations	Inferences

Purple colour is decolourised /changes from purple to colourles. √1mark (1mk)	 R-OH present √1mark. (1mk)

(ii) To another 2 cm^3 portion of the solution, add 3 drops of acidified potassium dichromate (VI) solution.

Observations	Inferences
Orange colour changes to green.√1mark (1mk)	R-OH present √1mark. (1mk)

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