MARKING SCHEME, PRACTICAL TERM 1 2024

233/3

CHEMISTRY PAPER

3 (Practical)

2¼ Hours

INSTRUCTIONS:

(i) Write your name and index Number in the spaces provided.

(ii) Answer *All* questions in the spaces provided in the question paper.

(iii) You are *NOT* allowed to start working with the apparatus for the first *15 minutes of the 2 ¼ 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 that you may need.

(iv) All working *MUST* be clearly shown where necessary.

(v) Mathematical tables and electronic calculators may be used.

FORM EXAMINER'S USE ONLY

Question	Max. Score	Score
1	20	
2	14	
3	06	
Total Score	40	

QUESTION 1

You are provided with:

- Solid Z ; 5.0 g of $(COOH)_2 .X H_2O$
- Solution Y ; 0.125658 M $KMnO_4$

You are required to :

a) Determine the solubility of Z at different temperatures.

b) Determine the number of moles of water of crystallization in solid Z.

PROCEDURE 1

a) Using a burette, add $4cm^3$ of distilled water to solid Z in a boiling tube.

- Heat the mixture while stirring with the thermometer to about 80^0C.

- When the whole solid dissolves, allow the solution to cool while stirring with the thermometer

- Note the temperature at which crystals first appear and record this temperature in the table 1 below.

b) Using a burette add $2cm^3$more distilled water into the content of the boiling tube and warm until the solid dissolve.

- Remove from the flame and allow the solution to cool in air while stirring.

- Record the temperature at which crystal first appears in table 1.

- Repeat procedure (b) 3 more times and complete table 1 below.

- Retain the content of the boiling tube for procedure II

Table I.....,..…… 6mks

Volume of water in the boiling tube (cm^3)	Temperature at which crystals of solid A appear (^0C)	Solubility of solid Z (g/100g of water)

4 6 8 10 12		

I). COMPLETE TABLE…….. 3MKS

-all temp 2mk, 4 temp readings 1 ½ mk, 3 temp readings 1mk, 2 temp ½ mk

- all solubility well calculated 1mk, 3-4 solubility calculated well ½ mk

- penalize ½ mk ONCE for temp reading above 80 and below 30

- award a max 1 ½ mk for constant temp readings

II. DECIMALS… 1mk

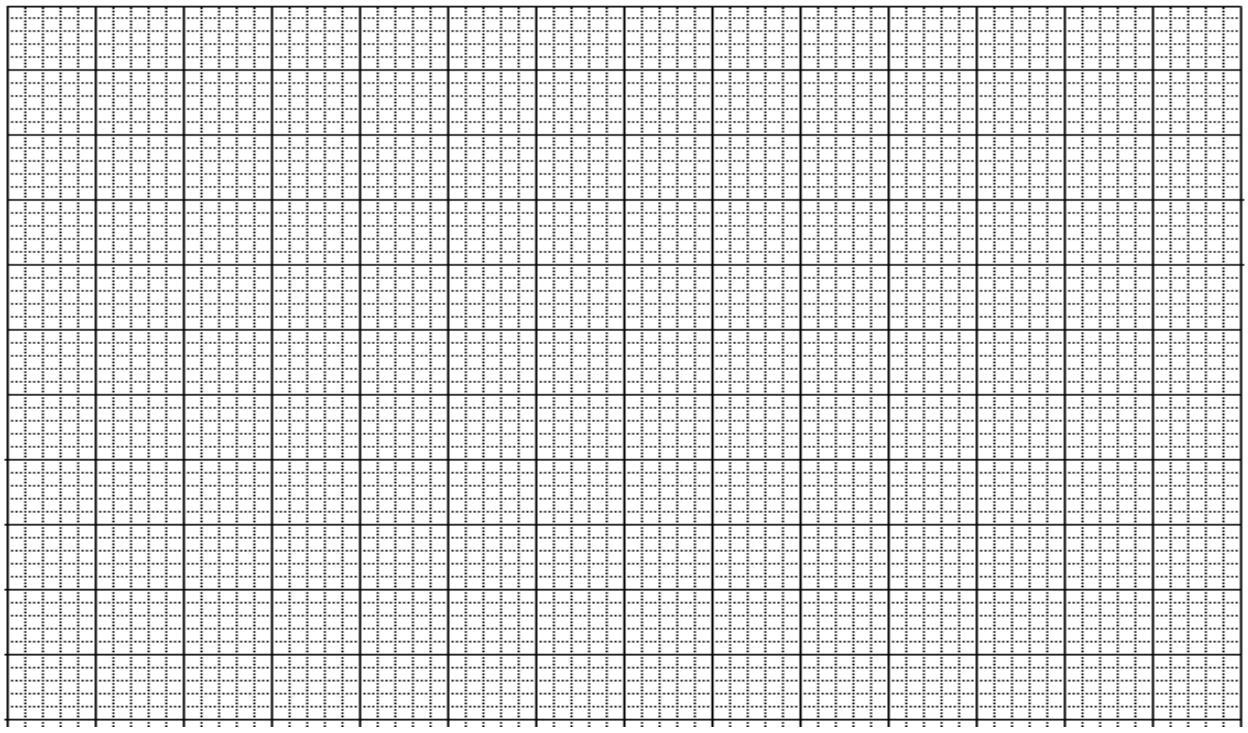
- TIED to all temperatures either constant or 1 dp of .0 or .5
  Otherwise award 0 mk

III. ACCURACY….. 1mk

Tied to the 1st temp reading , if within + or – 2^0 of the school value ,award 1 mk, otherwise award 0 mk

IV. TREND……. 1mk continuous drop in temperature, otherwise award 0 mk

I. a) Draw a graph of solubility of solid Z (vertical axis) against temperature (3mks)



- LABELLING……. ½ mk
  both axes labelled for ½ mk. penalize fully for inverted axes. penalize fully for wrong units otherwise ignore if units are not given
- SCALE……..1/2 mk (check the space for the actual plots and if ½ of the boxes are used in both axes, award fully), the scale should accomodateball plots, the spacing must be consistent.
- PLOTTING…. … 1 mk (5 plots correctly plotted…….1MK, 3-4 correctly plotted ½ mk)
- CURVE…… …….. 1mk (a smooth curve passing through at least 3 plots which include the 1st plot , the last plot and any other one plot). The curve should not be extrapolated

b) From your graph determine the solubility of solid Z at 60^0C
(1mk)

- correct reading from your graph

PROCEDURE II

a) – Transfer the contents of the boiling tube into a 250ml volumetric flask.

- Add distilled water up to the mark

- Label this solution Z

b) – Using a clean pipette and a pipette filler, transfer 25ml of solution Z into a conical flask.

- Warm the mixture up to 60^0C
- Fill a burette with solution Y
- Titrate Y against the hot solution Z until a permanent pink colour persist
- Record your results in Table 2 below

c) Repeat (b) 2 more times are record your results in the table 2 below.

TABLE 2

	I	II	III
FINAL BURETTE READING			
INITIAL BURETTE READING			
VOLUME OF SOLUTION Y USED (cm^3)			

(4mk)

TABLE 2

Complete table ----------1mk

(i)Complete the table with 3 titrations done –(1mk)

(ii) Incomplete table with 2 titrations done ---(1/2mk)

(iii)Incomplete table with 1 titration done –(0mk)

Penalties

I.Wrong arithmetic
II.Inverted table
III.Unrealistic value

Penalize ½ mark for each to a maximum of $1/_2$mk

Decimals ----------1mk

(Tied to the first and second row only)

Conditions

Accept either 1or 2 decimals points used consistently

If the 2 nd decimal point is used . can only be o or 5

Accuracy -------1mk

Compare any correct titre value in the 3rd row with the school value (sv)

Conditions

I. If within ±0.1cm^3 of sv ---1mk
II. If not within ±0.1cm^3 but within ±0.2cm^3 of sv ---1/$_2$ mk
III. Beyond ±0.2cm^3 of sv -----omk

NB/ if there is wrong arithmetic in the table compare the sv with the correct value and credit accordingly.

Principle of averaging ----1mk

Value average must be shown and must be within ±0.2 cm^3 of each other; conditions.

I. 3 values averaged and consistent -1mk
II. 3 values done and only 2 possible averaged –1mk
III. 2 titrations done and averaged -1mk
IV. 2 titrations done and inconsistent -0mk
V. 3 titrations done and consistent but only two averaged -0mr

Final accuracy -1mk

Compare correct student average titre with the (sv)

I. If within +_0.1 of sv-1mk
II. If within +_0.2 of sv -1/2mk
III. If beyond +_0.2 of sv -0mk

NB// If the candidate has averaged wrong values pick the correct value if any ,average and credit accordingly

II) a) Calculate the average volume of solution Y used (1mk)

Marked in the table

b) Calculate the number of moles of Y used 1mk

$\frac{aver\ volume}{1000}$ X 0.125658 ½ mk = corr ans ½ mk

c) Given 2 moles of $KMnO_4$ react with 5 moles of Z, calculate the number of moles of Z in 25cm^3 (1mk)

mole ratio 2 : 5

moles of A = $\frac{answer\ in\ b\ aboven}{2}$ X 5 ½ mk = corr ans ½ mk

d) Calculate the molarity of Z (1mk)

$= \frac{answ\ in\ c}{25}\ X\ 1000$ ½ mk = corr ans ½ mk

e) Determine the molar mass of Z (1mk)

$= \frac{5}{ans\ in\ d}$ ½ mk= corr ans ½ mk

f) Determine the value of X (C=12, O=16 H=1) (1mk)

90 + 18x =ans in e ½ mk

$X = \frac{ans\ in\ e - 90}{18}$ = corr ans ½ mk

2. You are provided with solid W. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Place solid W in a dry boiling tube. Add about $20cm^3$ distilled water and shake well. Filter to obtain the residue and the filtrate.

Observations (1mk)	Inferences (1mk)
- colourless filtrate ½ mk - white residue ½ mk	- is a mixture of a soluble and insoluble salt

b) Divide the filtrate into 3 portions.

i) To the first portion, add Ba $(NO_3)_2$, followed by 5 drops of dilute nitric (v) acid

Observations (1mk)	Inferences (½ mk)
- white ppt ½ mk insoluble in the acid ½ mk	SO_4^{2-}

ii) To the 2nd portion, add aqueous ammonia drop wise until in excess

Observations (1mk)	Inferences (1mk)
- white ppt ½ mk insoluble in excess ½ mk	-Mg^{2+} 1/2 mk, Al^{3+} present1/2 mk Penalize ½ mk for @ contradictory ion including Pb2+

iii)To the 3rd portion, add aqueous sodium hydroxide dropwise until in excess

Observations (1mk)	Inferences (½ mk)
- white ppt ½ mk insoluble ½ mk in excess	- Mg^{2+}

c) Wash the residue and put it in a test tube. Add about 15cm^3 of dilute nitric (v) acid. Test the gas produced with a burning splint. Divide the solution into 3 portions

Observations (1mk)	Inferences (1mk)
- bubbles ½ mk of a colourless gas - put off a burning splint ½ mk - residue dissolves ½ mk	CO_3^{2-} present 1mk

i)Add sodium hydroxide to the first portion dropwise until in excess to the 1st portion

Observations (1mk)	Inferences (1mk)
White ppt ½ mk soluble ½ mk	Zn^{2+} , Pb^{2+} , Al^{3+} present

ii)Add 2 drops of potassium iodide to the 2nd portion.

Observations (½ mk)	Inferences (½ mk)
Yellow ppt ½ mk	Pb^{2+}

iii)Add 2 cm^3 of solution R to the 3rd portion and wait for few seconds.

Observations (1mk)	Inferences (1mk)
White ppt 1mk	Soln R contains Cl^- ,SO_4^{2-} , SO_3^{2-}, CO_3^{2-}, or Br^- ions Any 4 ions 1mk Any 3 ions½ mk

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

a) Place a half spatula of solid V in a dry boiling tube. Add about $6cm^3$ distilled water and shake well.

Observations (1mk)	Inferences (½ mk)
- dissolves ½ to form a colourless solution ½	Polar organic compound 1mk

b) Divide into 3 portions

i) To the first portion, add ½ spatula of $NaHCO_3$

Observations (½ mk)	Inferences (1/2 mk)
No bubbles	RCOOH or H^+ absent

ii) To the 2nd portion, add 3 drops of acidified $K_2Cr_2O_7$ and warm

Observations (½ mk)	Inferences (½ mk)
- acidified $K_2Cr_2O_7$ remain orange	ROH absent

iii)To the 3rd portion, add 3 drops of acidified $KMnO_4$

Observations (1mk)	Inferences (½ mk)
Acidified $KMnO_4$ remain purple	=C=C= absent

b) Scoop the remaining with a spatula and heat it on a non luminous flame

Observations (½ mk)	Inferences (½ mk)
-yellow sooty flame	Long chain saturated organic cpd ½ mk -ignore mention of unsaturated organic compound present or =C=C= present