Name: Marking Scheme ..... Index No: .....

School: ..... Venue ..... Adm no: ..... Class: .....

Candidate's Signature: .....

Date: .....

233/3
CHEMISTRY PRACTICAL
Paper 3
2021
TIME: 2 ¼ HOURS

KASSUJET JOINT EXAMINATIONS 2021

Kenya Certificate of Secondary Education (K.C.S.E)
233/3
Chemistry Practical
Paper 3
2 ¼ Hours

INSTRUCTIONS TO CANDIDATES:

- Answer all the questions in the spaces provided in the question paper.
- You are **NOT** allowed to start working within the first 15 minutes of the 2 ¼ hours allowed for this paper. This time is to enable you read the question paper and make sure you have all the chemicals and apparatus that you may need.
- All working **MUST** be clearly shown.
- Mathematical tables and silent scientific calculators may be used.
- This paper consists of **7 printed** pages.
- Candidates should check to ascertain that all papers are printed as indicated and that no questions are Missing

For Examiner's Use Only:

Question	Maximum score	Candidate's score	Examiner's initials
1	22	22	
2	11	11	
3	7	7	
Total score	40	40	

1. You are provided with:

- ***5.0g*** *of* ***solid X*** *in a boiling tube*
- ***Solution Y,*** *which is acidified Potassium manganate (VII) containing* ***9.0g*** *of Potassium manganate (VII),* $KMnO_4$*, in 1000cm³ of solution.*

You are required to determine:

(i) The solubility of solid X at different temperatures

(ii) The number of moles of water of crystallization in solid **X**

Procedure

i).Using a 10 cm³ measuring cylinder add 4cm³ of distilled water to solid **X** in the boiling tube. Heat the mixture while stirring with the thermometer to **about 85°C**.When **all** the solid has dissolved allow the solution to cool while stirring with the thermometer.(You can occasionally immerse the boiling tube in a beaker of tap water).Note the temperature at which crystals of solid **X** first appear. Record this temperature in table 1.

ii) 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. Note and record the temperature at which crystals of solid **X** first appear.

iii)Repeat procedure (ii) ***three*** more times and record the temperature in the table 1. **Retain the contents of the boiling tube** for use in the procedure (v).

iv).a).Complete table 1 by calculating the solubility of solid **X** at different temperatures.

Table 1

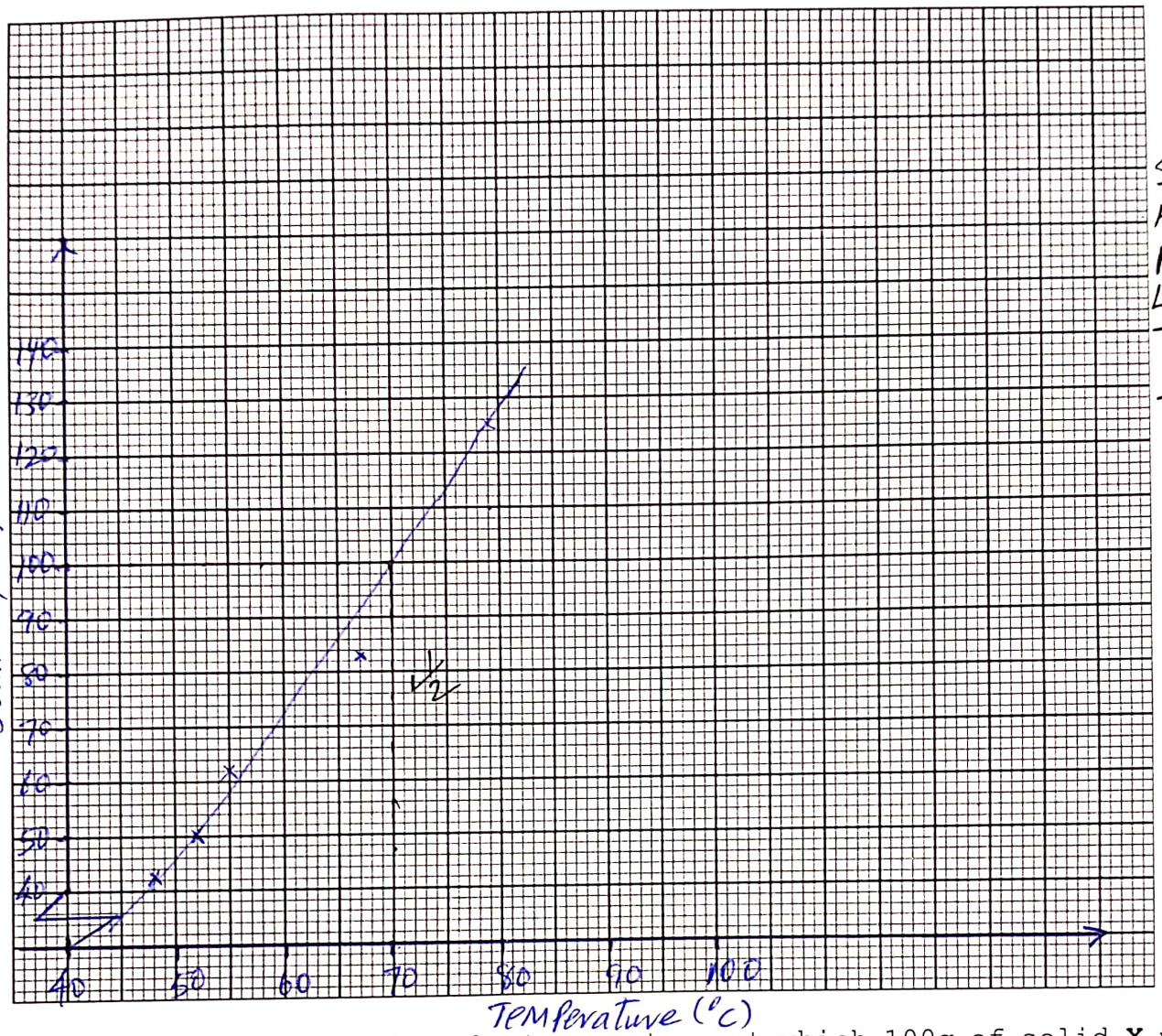
Volume of water (cm³)	**Temperature at which crystals (°C)**	**Solubility of solid X (g/100g of water)**
4	79	125.000 ½
6	67	83.333 ½
8	55	62.500 ½
10	52	50.000 ½
12	48	41.667 ½

(6 marks)

- Accuracy $(79 \pm 2^{\circ}C) - 1$
- Decimal – 1
- Trend – ½
- Complete table – 1
- Calculations (solubility column) – 2·5

Total = 6.

b). On the grid provided, plot a graph of solubility of solid X (vertical axis) against temperature. (3 marks)



S-½
A-½
P-1
L-1
03

c).Using your graph, determine the temperature at which 100g of solid **X** would dissolve in 100cm³ of water. (1 mark)

70°c ½ Must be shown on graph.

Procedure II

v) a).Transfer the contents of the boiling tube into a 250ml 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. Label this solution **X**. Fill a burette with solution **Y**.
Using the pipette and pipette filler, place 25.0cm³ of solution **X** into a conical flask. Warm the mixture to about 60°C. Titrate the hot solution **X** with solution **Y** until a permanent pink colour persists. Continuously shake the mixture during the titration. Record your readings in table 2.
Repeat the titration two more times and complete the table2.

Table 2

Titration	I	II	III
Final burette reading (cm^3)	27.4	27.4	27.4
Initial burette reading (cm^3)	0.0	0.0	0.0
Volume of solution Y used (cm^3)	27.4	27.4	27.4.

CT-1
D-1
Ac-1
PA-1
FA-1
5

(4 marks)

b). Calculate the:

I. average volume of solution Y used (1 mark)

$\frac{I+II+III}{3}$ = Ans. 6 I. eg. $\frac{27.4+27.4+27.4}{3} = 27.4$.

II. Number of moles of Solution Y, Potassium manganate (VII) used (K=39, Mn=55, O=16) (2 marks)

$KMnO_4 = 158$

Molarity = $\frac{9}{158}$ ½

$= 0.057M$ ½

Moles = (Ans 6 I × 0.057) ÷ 1000 ½

= Ans. 6 II. ½

eg. $\frac{27.4}{1000} \times 0.057 = 0.001561$ Mol.

2

III. Number of moles of X in $25cm^3$ of solution X given that 2 moles of potassium manganate (VII) react completely with 5 moles of X (1 mark)

$MnO_4^- : X = 2:5$

Moles of X in $25cm^3$ = $\frac{5}{2}$ × Ans 6 II. ½

= Ans 6 III ½

eg. $\frac{5}{2} \times 0.001561$ ½

$= 0.003902$ ½

1

IV. Number of moles of X in $250cm^3$ of solution (1 mark)

$\frac{250}{25}$ × Ans 6 III ½

= Ans 6 (IV) ½

eg. $\frac{250}{25} \times 0.003902$ ½

$= 0.03902$ ½

1

V Relative formula mass of X, (1 mark)

$\frac{5}{\text{Ans 6 IV}}$ ½

= Ans 6 IV ½

eg. $\frac{5}{0.03902}$ ½

$= 128.1427$ ½

1

c). The formula of **X** has the form $X.nH_2O$. Determine the value of n in the formula given that the relative mass of **X** is 90.0 (O=16.0, H=1.0) (2 marks)

$X.nH_2O$ = Ans 6 (V) ½

n = (Ans 6 (V) − 90) ÷ 18 ½

= Ans (c) √1

eg. $90 + 18n = 128.1427$ ½

$18n = 128.1427 - 90$

$n = 38.1427 \div 18$ ½

$= 2.12 \simeq 2$. √1

2

$CaCl_2 + ZnCO_3$

2. You have been provided with **solid R**. Carry out the tests below

(a) Transfer all the solid R to a boiling tube. Add about $6cm^3$ of distilled water and shake the mixture thoroughly. Allow to settle then carefully filter into another boiling tube. **Retain the residue for part (b)**

Divide the filtrate into ***three*** portions

i) To the first portion of the **filtrate** in a test tube, add few drops of 2M lead (II) nitrate solution and warm

Observations	Inferences
White ppt ½ soluble ½ on warming (1 mark)	Cl^-, Br^- present. Any 1 × ½. Penalize fully for contradiction (1/2 mark)

1½

ii) To the second portion of the **filtrate** in a test tube, add 2M sodium hydroxide solution drop wise until in excess

Observations	Inferences
White ppt insoluble in excess (1 mark)	Mg^{2+} ½, Ca^{2+} ½ 2 – 1 mark, 1 – ½ mark, 0 – 0 mark. Penalize ½ Mark for each contradiction upto 1 Mark max. (1 mark)

1

(iii)

(I) Describe how you would carry out a **flame test** on the solution obtained.

Procedure	Expected observation
Dip a clean glass rod/nichrome wire/metallic spatula into the solution ½ Heat the part with solution on a non-luminous flame. ½ (1 mark)	Flame colour is Bright white or orange (1 mark)

2

(II) On the third portion of the **filtrate**, carry out the flame test described above

Observations	Inferences
Orange flame (1/2 mark)	Ca^{2+} (Must have appeared in 2 a(ii), Procedure in 2(iii) I MUST be correct. Penalize fully for any contradiction (1/2 mark)

I

6½

b). i).To the residue in a boiling tube add 2M hydrochloric acid provided drop wise until there is no more change. Test for any gas using a burning splint.
Divide the resultant solution into ***two*** portions

Observations	Inferences
Bubbles/effervescence of colourless gas ½ colourless solution formed ½ (1 marks)	CO_3^{2-} (reject HCO_3^-). Cu^{2+}, Fe^{2+}, Fe^{3+} absent. Any correct logged on correct observation (1/2 mark)

1½

ii). To the first portion, add 2M sodium hydroxide solution drop wise until in excess

Observations	Inferences
White ppt ½ Soluble ½ in excess (1 mark)	Zn^{2+}, Pb^{2+} present. 2 ions – ½ mrk. 1,0 – 0 mark. Penalize fully if: ion. : wrong symbol, wrong ion. (1/2 mark)

1½

iii). To the second portion, add 2M ammonium hydroxide solution until in excess

Observations	Inferences
White ppt Soluble in excess (1 mark)	Zn^{2+} present. Must have appeared in b(ii) above. Penalize fully for any contradiction to ½ mrk maximum. (1/2 mark)

1½

4½

- Maleic acid.

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

a). Using a clean metallic spatula, heat about one third of solid H in a Bunsen burner flame.

Observations	Inferences
Burns with yellow ✓1 smoky/sooty flame (1 mark)	;C=C< /-C≡C- / long chain hydrocarbon. (1 mark)

b). Dissolve the remaining portion of **solid H** by adding about $6cm^3$ of distilled water and divide the solution into **3 portions.**

i) To the first portion, add two drops of acidified potassium manganate (VII) solution

Observations	Inferences
Purple $H^+/KMnO_4$ ✓1 decolourised. ✓1 (1 mark)	;C=C< /-C≡C-, ROH ✓½ (1 mark)

ii) To the second portion, add two drops of bromine water

Observations	Inferences
Yellow/orange decolourised ✓1 (1 mark)	;C=C< /-C≡C- present ✓1 (1 mark)

iii) Determine the pH of the third portion using universal indicator paper

Observations	Inferences
pH = 1, 2, 3 ✓½ (1/2 mark)	Strongly acidic ✓½. (1/2 mark)