233/3
CHEMISTRY
PAPER 3
PRACTICAL
JULY / AUGUST 2014

KATHONZWENI SUB-COUNTY FORM IV PRE-TRIAL EXAMINATION
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 3

CONFIDENTIAL

Requirements for candidates.
In addition to the fittings and apparatus that are commonly in a chemistry laboratory, each candidate requires:

1. 50ml burette.
2. 25 ml pipette.
3. 2 conical flasks.
4. Solution C_1 – about 100cm^3.
5. Solution C_2 – about 100cm^3.
6. White tile.
7. Stand and clamp.
8. Solid K – 5g exactly.
9. 10ml measuring cylinder.
10. One 250 ml glass beaker.
11. 2 boiling tubes.
12. Thermometer.
13. Means of heating.
14. Distilled water in a wash bottle.
15. Solid F – About 3g.
16. Solid P – about 3g
17. Metallic spatula.
18. Filter paper.
19. Filter funnel.
20. Stirring rod.

This paper consists of 2 printed pages

Turn Over

21. 6 test tubes.
22. About 1g sodium hydrogen carbonate.
23. Test tube holder.

ACCESS TO:

- 2M NaOH
- 2M NH_4OH
- 0.25M Pb $(NO_3)_2$
- 0.25M $BaCl_2$
- 2M HCl
- Phenolphthalein indicator.
- Access to conc. H_2SO_4
- Access to acidified $KMnO_4$.
- Access to ethanol

} All supplied with droppers

PREPARATION OF SOLUTIONS / SOLIDS

- Solid K
- Solid K – Potassium chlorate (V).
- Solution C_1 is prepared by dissolving 10.08g of oxalic acid in about 500cm^3 and making to one litre.
- Solution C_2 is prepared by dissolving 8g of NaOH pellets in about 500cm^3 of distilled water and making to 1 litre of solution.
- Solid F is a mixture of $CuCO_3$ and $ZnSO_4$ in the ratio 4 : 3 by mass respectively
- Solid P is oxalic acid.

Name _____ Index No. _____

Candidate's Signature _____

Date _____

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2 ¼ HOURS

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INSTRUCTIONS TO CANDIDATES

(a) Write your name and index number in the spaces provided above.

(b) Answer all the questions in the spaces provided.

(c) Mathematical tables and silent electronic calculators many be used.

(d) All working must be clearly shown where necessary.

FOR EXAMINER'SUSE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1	15	
2	12	
3	13	
TOTAL SCORE	**40**	

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1. You are provided with"
- Solution C_1 which is a solution of a dibasic acid, $H_2C_2O_4.XH_2O$ containing 5.04g in $500cm^3$ of solution.
- Solution C_2 which is a 0.2M solution of sodium hydroxide.

You are required to:-
- Determine the value of X in the formula $H_2C_2O_4.XH_2O$ (H =1, C = 12, O = 16)

Procedure

Fill the burette with solution C_1. Pipette $25cm^3$ of solution C_2 into a clean dry conical flask. Add 2 drops of phenolphthalein indicator and titrate against C_1 until the indicator just turns colourless.
Repeat the procedure two more times and complete the table below.

(4 marks)

Titration	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution C_1 used (cm^3)			

(a) Calculate the average volume of C_1 used. (1 mark)

(b) Calculate the moles of the acid, C_1 reacting. (3 marks)

(c) Calculate the concentration of the acid, C_1 in moles / litre. (2 marks)

(d) Calculate the relative formula mass of the acid. (3 marks)

(e) Hence determine the value of X in $H_2C_2O_4.XH_2O$. (2 marks)

2. You are provided with:
- 5g of solid K
- Distilled water

You are required to determine solubility of solid K at different temperatures.

Procedure

Transfer solid K into a boiling tube. Using a 10ml measuring cylinder, measure $10cm^3$ of water into the boiling tube. Heat the mixture while stirring with the thermometer to about 90^0C. When all the solid has dissolved, allow the solution to cool while stirring with the thermometer. (Cooling of the solution can be speeded up by dipping the boiling tube in cold water in a glass beaker for a few seconds.)
Record the temperature at which the crystals of solid K first appear. In the table below.
Retain the boiling tube and its contents for further experiments.
Measure $5cm^3$ of distilled water and add to the mixture in the boiling tube. Heat until the crystals dissolve, then cool while stirring with a thermometer.
Record the temperature at which the crystals again start to reappear.
Repeat this procedure, each time adding more $5cm^3$ of distilled water, heating, cooling and recording the crystallization temperature until the table is completely filled.

Total volume of water added to 5g of solid K (cm^3)	10	15	20	25	30	35
Temperature at which crystals appear (^0C)						
Solubility of K in g/100g of water						

(a) Complete the table and calculate the solubility of solid K in g/100g of water at different temperatures. (6 marks)

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

(c) From the graph determine:-

(i) The solubility of K at 25^0C. (1 mark)

(ii) The temperature when the solution will contain 22g of K. (1 mark)

(d) From your results calculate the mass of K that will crystallize out when a hot solution at 52^0C is cooled to 37^0C. (1 mark)

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

(a) Using a clean spatula heat the solid F in a Bunsen burner flame.

Observations	Inferences
(½ mark)	(½ mark)

(b) Place the remaining portion of the solid F in a boiling tube. Add about $10cm^3$ of distilled water. Stir and filter. Keep the residue for further tests. Divide the filtrate into four portions.

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

Observations	Inferences
(1mark)	(1 mark)

(ii) To the second portion, add ammonium hydroxide solution till in excess.

Observations	Inferences
(1 mark)	(½ mark)

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

Observations	Inferences
(1 mark)	(½ mark)

(iv) To the fourth portion, add barium chloride solution followed by hydrochloric acid.

Observations	Inferences
(½ mark)	(½ mark)

(c) Dissolve the residue into about $5cm^3$ of 2M hydrochloric acid and record your observation and make inferences.

Observations	Inferences
(½ mark)	(½ mark)

(d) Carry out the following tests on P.

(i) Using a clean metallic spatula heat solid P in a Bunsen burner flame.

Observations	Inferences
(½ mark)	(½ mark)

(ii) Put two spatulafuls of P in a boiling tube. Add $10cm^3$ of distilled water. Warm the mixture to dissolve and divide the solution into three portions.

I) To the first portion, add sodium hydrogen carbonate.

Observations	Inferences
(½ mark)	(½ mark)

II) To the second portion add 3 drops of conc. H_2SO_4. Shake well and add $1cm^3$ of ethanol and warm the mixture.

Observations	Inferences
(½ mark)	(½ mark)

III) To the third portion, add 1-2 drops of acidified potassium manganate (VII) solution.

Observations	Inferences
(1 mark)	(1 mark)

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MARKING SCHEME

1.

Titration	I	II	III
Final burette reading (cm^3)	30.1	30.1	30.1
Initial burette reading (cm^3)	0.0	0.0	0.0
Volume of solution C1 used (cm^3)	30.1	30.1	30.1

CT – 1
D – 1
A – 1
AV -1
FA – 1
05

(a) - Complete table 1 mark
- Consistent use of decimal 1 mark
- Penalise fully for mixed decimal
- Accuracy
  If ± 0.1 SV 1 mark
  ± 0.2 SV ½ mark
- Principles of averaging

$$\frac{30.1 + 30.1 + 30.1}{3}$$ √ ½ mark = 30.1 cm^3 √ ½

- Final answer 1 mark
  Rounded to atleast 2 dp
  Penalise fully if rounded to less than 2 dp
- If average titre within ± 0.1 of S.V 1 mark

(b) Number of moles of the acid, C_1 that reacted

Moles of NaOH reacting
If $1000cm^3$ ⟶ 0.2 moles
$25cm^3$ ⟶ ? √ ½ mark

$$= \frac{25}{1000} \times 0.2$$ √ ½ mark
= 0.005 moles

- Since the acid is dibasic, mole ratio of acid : base is 1 : 2 i.e $H_2C_2O_4.XH_2O$: NaOH
  1 : 2 √ ½ mark

This paper consists of 5 printed pages

Turn Over

Thus 2 moles of NaOH react with one mole of acid

2 moles of NaOH ⟶ 1 mole of acid √ ½ mark

0.005 moles ⟶ ?

$= \frac{0.005}{2} \times 1$ √ ½ mark

= 0.0025 moles √ ½ mark

(c) Concentration of the acid

If 30.1cm^3 ⟶ 0.0025 moles

1000cm^3 √ ½ mark

$= \frac{1000}{30.1} \times 0.0025$ √1 mark

=0.0831 moles / litre √ ½ mark

(d) RMM of acid

Molarity = $\frac{\text{g/litre}}{\text{RMM}}$

$\text{RMM} = \frac{\text{g/litre}}{\text{Molarity}}$

g/litre

500cm^3 contain 5.04g √ ½ mark

1000cm^3 ⟶ ?

$= \frac{1000}{500} \times 5.04$ √ 1 mark

= 10.08g √ ½

Thus RMM = $\frac{10.08}{0.0831}$ √ ½ mark

=121.3 √ ½ mark

= 121

(d) Value of X

$H_2C_2O_4 . XH_2O$ = 121 √ ½ mark

90 + 18x = 121

18x = 121 – 90 √ 1 mark

x = 1.7

x = 2 √ ½ mark

2. (a)

Total volume of water added to 5g of solid K (cm^3)	10	15	20	25	30	35
Temperature at which crystals appear (^0C)	86	67	57	48.5	42	39
Solubility of K in g/100g of water	50	33.3	25	20	16.7	14.3

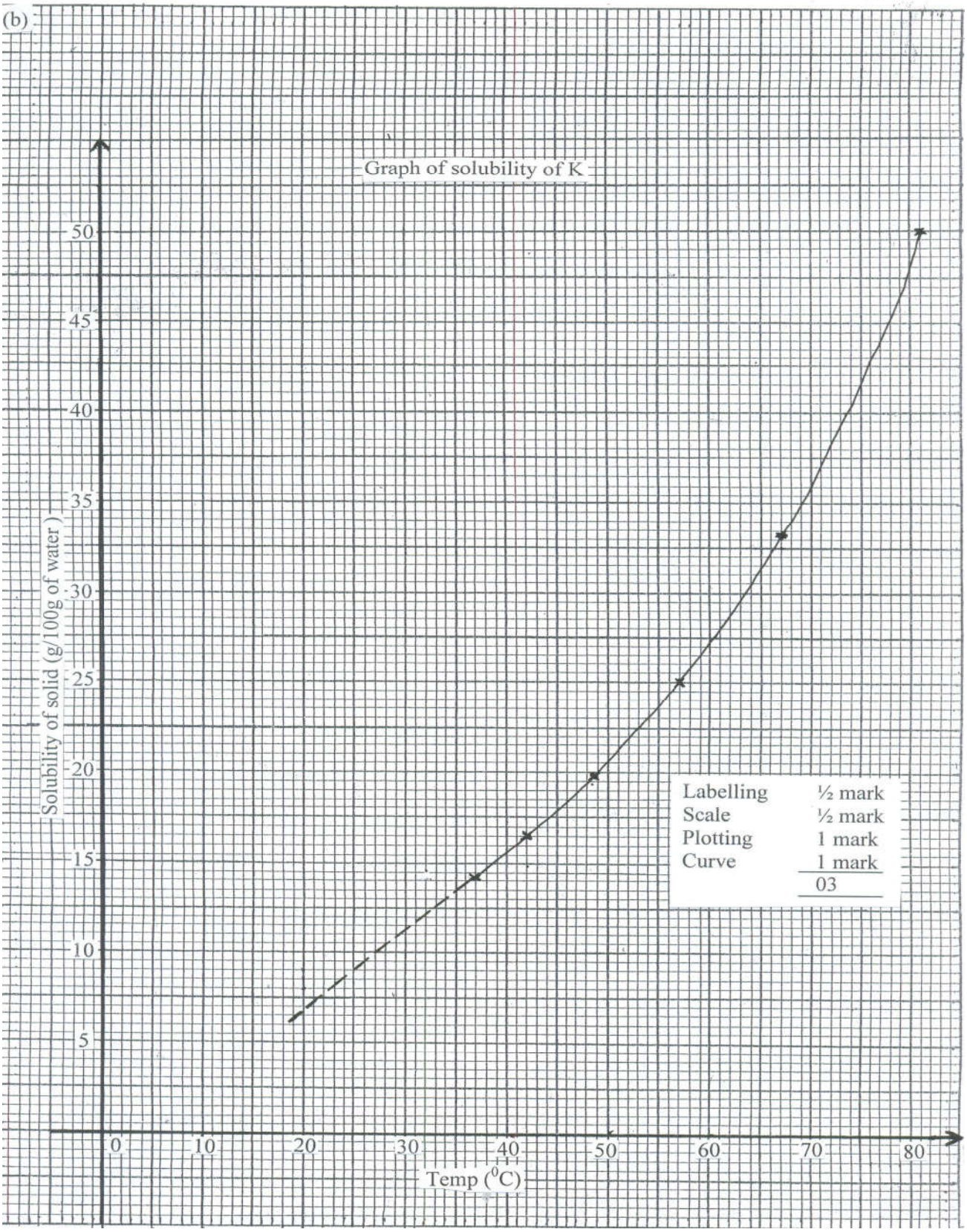
(i) Complete table (column I) 2 marks
Incomplete table with 5 readings 2 marks
Incomplete table with 4 readings 1 mark
3 and below readings 0 mark

(ii) Use of decimals 1 mark
Whole numbers or 1dp (applies to column I)

(iii) Accuracy ½ mark
± 2.0 of S.V ½ mark
If otherwise 0 mark

(iv) Trend ½ mark
½ mark for continuous drop in temperature readings in column I, otherwise penalize fully.
Column II 2 marks
- ½ mark for each value of solubility correctly calculated

(b)

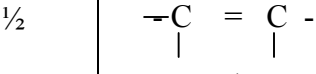
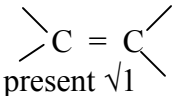

Graph of solubility of K
Solubility of solid (g/100g of water)
50
45
40
35
30
25
20
15
10
5
0
10
20
30
40
50
60
70
80
Temp (^{0}C)
Labelling ½ mark
Scale ½ mark
Plotting 1 mark
Curve 1 mark
03

(c) (i) Solubility at 25^0C 1 mark
(Shown in graph) Penalise ½ mark for wrong units
- From extrapolated graph = 8.5g / 100g pf H_2O

(ii) Temperature when solution will contain 22g
- Penalise ½ mark for wrong units.

(d) Mass of solid K (1 mark
At 52^0C = 21.5 g/100g of H_2O
At 37^0C = 14.0 g/100g of H_2O
21.5 – 14.0 = 7.5g

3.

	OBSERVATIONS	INFERENCES
(a)	Blue green flame √ ½	Cu^{2+} present √ ½
b) (i)	White ppt √ ½ soluble in excess √ ½	Zn^{2+}, Pb^{2+}, Al^{3+} present All 3 mentioned 1 mark 2 mentioned - ½ mark Only one – 0 mark
(ii)	White ppt formed √ ½ soluble in excess √ ½	Zn^{2+} present √ ½
(iii)	White ppt formed √ ½ Insoluble on warming √ ½	SO_4^{2-} present √ ½
(iv)	White ppt formed √ ½ insoluble on adding HCl	SO_4^{2-} present √ ½
c)	Effervescence / bubbles formed √ ½	CO^{2-}_3 present √ ½ (HCO_3^-, SO_3^{2-} present
d) (i)	Burns with a yellow sooty flame √ ½	 present √ ½
(ii) I)	Effervescence of a colourless gas √ ½	Acidic substance √ ½ Accept H^+ / H_3O^+ present / RCOOH present
II)	Sweet fruity smell √ ½	R – COOH present √ ½
III)	Purple colour of $KMnO_4$ turns colourless √1	 present √1 Named 3 – 1 mark Named 2 – ½ mark But no mark if R – OH only