233/3
CHEMISTRY
PAPER 3
PRACTICAL
JULY / AUGUST 2014

MWALA DISTRICT FORM 4 JOINT EXAMINATION 2014
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 3

CONFIDENTIAL

Each student requires:

- Spatula.
- 2.0g solid P
- 6 test tubes.
- Litmus paper.
- Wooden splint.
- 2.0g solid R.
- 2.0g solid G.
- 2.0g solid M
- 2 boiling tube.
- 10.0cm^3 liquid S.
- 2.0g sodium hydrogen carbonate.
- 4.5g of solid A in a boiling tube.
- 150cm^3 solution B, 0.06M acidified potassium manganate (VI).
- One burette.
- One pipette.
- Thermometer (-10 – 110^{0}C)
- Test tube holder.
- Distilled water
- 250 ml volumetric flask.
- Label.

This paper consists of 2 printed pages

Turn Over

ACCESS TO:-

- Source of heat
- Acidified potassium chromate (VI)
- 0.5M barium nitrate
- 2.0M hydrochloric acid.
- Wire gauge.
- Tripod stand

NOTES:-

- Solid P is lead (II) nitrate.
- Solid R is ammonium carbonate.
- Solid G is ammonium chloride.
- Solid M is sodium sulphate.
- Liquid S is ethanol.
- Potassium chromate (VI) is prepared by dissolving 5.0g of solid potassium chromate (VI) in 500cm^3 of 1M sulphuric (VI) acid.
- All solutions should be supplied with droppers.
- Solution B , 0.06M acidified potassium manganate (VII) is prepared by dissolving 9.48g of potassium manganate (VII) crystals in 400.0cm^3 of 2.0M H_2SO_4 and diluting with distilled water to a litre.
- Solid A is oxalic acid.

Name _____ Index No. _____

Candidate's Signature _____

Date _____

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2 ¼ HOURS

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INSTRUCTIONS TO CANDIDATES

- Answer all the questions in the spaces provided in this question paper.
- 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.
- All working MUST be clearly shown where necessary
- Mathematical table may be used.
- Electrical calculators may be used.

FOR EXAMINER'SUSE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1	22	
2	12	
3	6	
TOTAL SCORE	**40**	

This paper consists of 7 printed pages

Turn Over

1. You are provided with:
   - 4.5g of solid A in a boiling tube.
   - Solution B, 0.06M acidified potassium manganate (VII).

   You are required to determine:-
   1) The solubility of solid A at different temperature.
   2) The number of moles of water of crystallization in solid A.

Procedure

(a) Using a burette, add 4cm^3 of distilled water to solid A in the boiling tube. Heat the mixture while stirring with the thermometer to about 70^0C. When all the solid has dissolved allow the solution to cool while stirring with the thermometer. Note the temperature at which crystals of solid A first appear. Record this temperature in table I.

(b) Using the burette, add 2.0cm^3 of distilled water to the contents of the boiling tube. Warm the mixture while stirring with the thermometer until all solid dissolves. Allow the mixture to cool while stirring. Note and record the temperature at which crystals of solid A first appear.

(c) Repeat procedure (b) two more times and record the temperatures in the table I. **Retain the contents of the boiling tube for use in procedure (e)**

(d) (i) Complete table I by calculating the solubility of solid A at different temperatures. The solubility of a substance is the mass of that substance that dissolves in 100cm^3 (100g) of water at a particular temperature.

Table I

Volume of water in the boiling tube (cm^3)	Temperature at which crystals of solid A first appear	Solubility of solid A (g/100g water)
4		
6		
8		
10		

(6 marks)

(ii) On the grid provided, plot a graph of solubility of solid A against temperature (3 marks)

(iii) Using your graph

I) Determine the temperature at which 100g of solid A would dissolve in $100cm^3$ of water. (1 mark)

II) Calculate the mass of solid A that will crystallize out when a hot solution at 60^0C cooled to 40^0C. (1 mark)

(e) (i) Transfer the contents of the boiling tube into 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 A. Fill burette with solution B. Using a pipette and pipette filler, place $25.0cm^3$ of solution A into a conical flask. Warm the mixture to about 60^0C. Titrate the hot solution A with solution B until a permanent pink colour persists. Record your readings in table 2. Repeat the titration two more times and complete table 2.

Table 2

	I	II	III
Final Burette reading			
Initial Burette reading			
Volume of solution B used (cm^3)			

(4 marks)

Calculations:-

I) Average volume of solution B used. (1 mark)

II) Number of moles of potassium manganate (VI)) used. (1 mark)

III) Number of moles of A in 25.0cm^3 of solution A given that 2 moles of potassium manganate (VII) react completely with 5 moles of A. (1 mark)

IV) Relative formula mass of A. (2 marks)

(ii) The formula of A has the form D. XH_2O. Determine the value of X in the formula given that the relative formula mass of D is 90 and atomic mass of oxygen and hydrogen are 16.0 and 1.0g respectively. (2 marks)

2. (a) (i) Place a spatula half-full of solid P in a clean dry test tube. Strongly heat the test tube – together with its contents. Test for any gases produced.

Observation	**Inferences**
(1 mark)	(1 mark)

(ii) Repeat the same procedure using solid R.

Observation	**Inferences**
(1 mark)	(1 mark)

(iii) Place a little of solid G in a dry test tube and heat strongly. Record your observations and inferences.

Observation	Inferences
(1 mark)	(1 mark)

(h) (i) Place all solid M in a boiling tube. Add distilled water while shaking until the boiling tube is full.

Observation	Inferences
(1 mark)	(1 mark)

(ii) Obtain two portions of about 2.0cm^3 of the resulting mixture above (h(i)

I) To the first portion add 2-3 drops of barium nitrate solution.

Observation	Inferences
(1 mark)	(1 mark)

II) To the second portion, add 2-3 drops of barium nitrate solution followed by a few drops of 2M hydrochloric acid.

Observation	Inferences
(1 mark)	(1 mark)

3. You are provided with liquid S. Carry out the following tests and record your observations and inferences in the spaces provided.

(i) Place four drops of liquid S on a clean dry watch glass and ignite it.

Observation	Inferences
(1 mark)	(1 mark)

(ii) Place about 2.0cm^3 of liquid S in a clean dry test tube, add all sodium hydrogen carbonate provided.

Observation	Inferences
(1 mark)	(1 mark)

(iii) Place about 2.0cm^3 of liquid S in a test tube, add about 1cm^3 of acidified potassium dichromate (VI) and warm the mixture.

Observation	Inferences
(1 mark)	(1 mark)

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MARKING SCHEME

1. Table 1 6 marks

Volume of water in the boiling tube (cm^3)	Temperature at which crystals of solid A first appear	Solubility of solid A (g/100g water)
4	66.0	112.5
6	58.0	75.0
8	52.0	56.25
10	45.0	45.0

Column 1 4 marks
Distributed as follows:

(i) Complete table 2 marks
- Complete table with 4 readings 2 marks
- Incomplete table with 3 readings 1 ½ marks
- Incomplete table with 2 readings 1 mark
- Incomplete table with 1 reading 0 mark

(ii) Use of decimals 1 mark
- Accept unit if all readings are recorded consistently either as whole numbers or to 1 d. place of 0.0 or 0.5, otherwise penalize fully.

(iii) Trend ½ mark
- Award ½ mark for a continuous drop in temperature readings in column I, otherwise penalize fully.

Column II 2 marks
- Award ½ mark for each value of solubility correctly calculated, otherwise penalize fully.
- Ignore units in grams if attached to correct answer, otherwise penalize if wrong units are attached.

(iv) Graph 3 marks
Distributed as follows:-

(i) Labelling of axes ½ mark
- Penallise fully for any inversion of axis.
-Penallise fully if wrong units are given or shown BUT ignore if not attached.
- Penalise fully if only one axis is labeled.

(ii) Scale 1 mark

- Area covered in units should be at least ¾ of the total big square of the grid, given on both vertical and horizontal axis, otherwise penalize fully.
- Scale intervals must be consistent, otherwise penallise fully.
- Scale chosen must accommodate all plots, otherwise penallise fully.

(iii) Plotting 1 mark

- Award 1mark for 3 or 4 points correctly plotted.
- If there are only 2 correctly plotted points, award ½ mark.
- Accept plots even when axis are interchanged.

(iv) Curve 1 mark

- Award 1 mark for a smooth rising curve joining at least 3 correctly plotted points of which one must be at 112.5 / 4.0cm^3 of water.
- Reject a curve obtained from wrong calculated values in column II.

d in (T) 1 mark

- Accept correct reading with or without showing on the graph.
- If shown on the graph but reading is wrongly read, or absent award ½ mark for showing.
- Penallise ½ mark for wrong units otherwise ignore if not shown.
- Reject any reading and showing from a wrong graph e.g exchange of axis, wrong plotting at volume of 4.0cm^3.

d in (J) 2 marks

Solubility at 50^0C = correct reading } √ ½
Solubility at 30^0C = correct reading }
Mass of crystals = correct ans √ ½

(e) (i) Table 2 5 marks

	I	II	III
Final burette reading	30.0	30.0	30.0
Initial burette reading	0.0	0.0	0.0
Volume of solution B used	30.0	30.0	30.0

Distributed as follows:-

(a) Complete table 1 mark

Conditions

(i) Complete table with 3 titrations 1 mark
(ii) Incomplete table with 2 titrations ½ mark
(iii) Incomplete table with 1 titration 0 mark

Penalties

- Wrong arithmetic
- Inverted tables.
- Values beyond 50.0cm^3 unless explained
- Unrealistic values i.e values below 1.0cm^3 and above hundreds

NB: Penalise ½ mark each to a maximum of ½ mark (penallise once)

(h) (i) Decimals 1 mark (Tied to 1st and 2nd rows only)

Conditions

- Accept 1 or 2 dp used consistently
- Accept 2 d.p only if the 2nd place of decimal is "0" or "5".
- Allow inconsistency of zeros i.e 0.0, 0.00 or 0 in the initial values

NB: Penallise fully if any of the conditions is not met.

c) Accuracy 1 mark

Compare any of the titre readings with school values (S.V) tick (√) the chosen value on the table.

Condition

- If any value is within ± 0.1 1 mark
- If any value is within ± 0.2 ½ mark
- If not within ± 0.2 0 mark

NB: If there is a wrong arithmetic or subtraction compare the S.V with the worked out correct value and ward accordingly.

d) Principles of averaging 1 mark

Values averaged MUST be shown and must be within ± 0.2 of each other.

Conditions

- If 3 consistent values are averaged 1 mark
- If 3 titrations alone, only 2 possible and averaged 1 mark
- If 2 titrations alone, and are consistent and averaged 1 mark

NB: Award 0 mark if averaging involves.

- 3 consistent values but only 2 averaged
- 3 inconsistent values are averaged.
- 2 inconsistent values are averaged.

c) Final answer 1 mark (Tied to correctly averaged titre)

- If within ± 0.1 S.V 1 mark
- If within ± 0.2 S.V ½ mark
- If beyond ± 0.2 of S.V 0 marks

Calculations

II) Moles of $KMnO_4$ = $\frac{0.06 \times \text{titre}}{1000}$ √ ½

= correct answer √ ½

Conditions

(i) Penalise ½ mark for wrong transfer of titre, otherwise penallise fully for strange figure.

(ii) 0.06 must be transferred initial otherwise penalize fully.

III) Moles of A in $25.0cm^3$ = $\frac{\text{Ans in (II)} \times 5}{2}$

= correct ans

Conditions : As in II above

IV) RFM of A 2 marks

Moles in $250cm^3$ = $\frac{\text{an in III} \times 250}{25}$ √ ½

= correct ans

RFM = $\frac{4.5}{9}$ √1

= Correct answer √ ½

OR

Mass in $25cm^3$ = 0.45g √ ½

RFM = $\frac{0.45 \quad √1}{\text{Moles in part III}}$

= Correct answer √ ½

OR

Mass in $1000cm^3$ = 4.5 x 4 = 18g

Molarity of A = $\frac{1000 \text{ x ans III}}{25}$ √ ½

RFM = $\frac{18}{\text{Molarity}}$ √1

= correct ans √ ½

Penalties

(i) Penalise fully if 4.5 is not used intact

(ii) Reject if RFM is less than 108 and greater than 162.

(iii) Penallise ½ mark for any units used or attached to the final answer e.g g

(iii) Determining the value of X 2 marks

RFM of H_2O = 18 √ ½

18x = ans (IV) – 90

x = $\frac{\text{ans (IV)} - 90}{18}$ √

= correct answer √ ½

OR

RFM of H_2O = 18 √ ½

x = $\frac{\text{ans (IV)} - 90}{18}$ √1

= correct ans √ ½

OR

90 +18x √ ½ = ans (IV)

x = $\frac{\text{ans (IV)} - 90}{18}$ √1

= correct ans √ ½

OR

x = $\frac{\text{ans (IV)} - 90}{18}$

= correct ans

Penalties

- Penallise ½ mark if units given or attached to final answer.

NB: For all calculations, any working beyond the expected answer penalize fully.

3.

	Observations	Inferences
3. (a) (i)	- Red residue when hot. - Yellow residue when cold - Brown gas. - Cracking sound. - Blue litmus paper turns red. - Red litmus paper retains its colour. - Glowing splint relights. *NB: Award ½ mark each upto a maximum of 1 mark*	- NO_3^- present √ ½ - Acidic gas present √ ½
(ii)	- Blue litmus paper retains its colour. - Glowing splint goes off. - Colourless gas with a pungent smell. - Red litmus paper turns blue *NB: Award ½ mark each upto a maximum of 1 mark*	NH_4^+ present √1
(iii)	White sublimate formed on cooler part of the test tube √1	G sublimes √1
b) (i)	- M dissolves to form a colourless solution √1	- M is polar or - M is soluble in water √1
(ii) I)	White precipitate formed √1	CO_3^{2-}, SO_4^{2-} or SO_3^{2-} present 3 ions 1 mark 2 ions ½ mark 1 ion 0 mark
II)	White precipitate √ ½ , insoluble √ ½ (1 mark)	SO_4^{2-} present √1
c) (i)	Burns with a blue flame √1	- Saturated organic compound √1 or - Organic compound with low C : H ratio √1 or - Absence of unsaturated organic compound √ OR absent √1 OR —C ≡ C— absent √ Or present √1 REJECT (i) —C = C— or C ≡ C absent (ii) Carbon – carbon double bond or carbon – carbon triple bond

(ii)	- No effervescence / No bubbles / No fizzing √1 <u>Ignore</u> - Does not dissolve / No reaction. <u>Reject</u> No hissing on its own	- Absence + H^+ or R – COOH √1 <u>Accept</u> Is not acidic / liquid not cidic Ignore: Absence of H_3O^+
(iii)	$K_2Cr_2O_7$ changes colour from orange to green √1 Or Solution changes from orange to green. <u>Reject:</u> Solution turns green	R ─ OH present √1 <u>Reject</u> (i) Alcohol written in words (ii) ─ OH *NB: Penalise fully for any contradictory functional groups and structures.*