233/3
CHEMISTRY
PAPER 3
PRACTICAAL
JULY / AUGUST 2014

MAKUENI DISTRICT JOINT FORM 4 EXAMINATION 2014
Kenya Certificate of Secondary Education
CHEMISTRY

CONFIDENTIAL

Each candidate should have the following:

1. $120cm^3$ solution A, 0.1M sodium hydroxide label solution A.
2. $120cm^3$ solution B, 0.2M hydrochloric acid label solution B
3. Exactly 2.0g solid C – calcium hydroxide label solid B
4. Phenolpthalein indicator.
5. Methyl orange indicator.
6. Distilled water $500cm^3$ in a wash bottle.
7. Solid Q- 1g mixture of barium chloride and calcium hydroxide in the ratio of 2 : 1.
8. Solid P – 2g hydrated ammonium iron (II) sulphate ($FeSO_4 (NH_4)_2 SO_4. 6H_2O$)
9. Red and blue litmus paper. 2 pieces each.
10. Filter paper – 2 pieces
11. Labels – 2 pieces

APPARATUS

100ml measuring cylinder.

10ml – measuring cylinder.

Burette (0 – 50ml) on a stand and clamp

Pipette and pipette filler.

Stop watch

1 boiling tube

Test-tubes on a rack – 6 pieces.

Test-tube holder

Spatula.

Filter funnel.

3 conical flasks.

This paper consists of 2 printed pages

Turn Over

ACCESS TO:

1. Bunsen burner (Source of heat)
2. 2M sodium hydroxide.
3. Aqueous ammonia 0.1M
4. 0.5M sodium sulphate
5. 2M nitric acid
6. Barium nitrate solution (0.1M)
7. 2M hydrochloric acid

PREPARATIONS

1. Solution A is prepared by dissolving 4.0g of sodium hydroxide in 600cm^3 of distilled water and diluting it to one litre solution.
2. Solution B is prepared by dissolving 17.2cm^3 of concentrated hydrochloric acid of density 1.19g/cm^3 in 400cm^3 of distilled water and diluting to one litre solution.
3. Solid C is 2.0 g calcium hydroxide.
4. Solid Q is 1g mixture of barium chloride and calcium hydroxide in the ratio 2 : 1.
5. Solid P is 2g hydrated ammonium iron (II) sulphate.
6. 2M sodium hydroxide is prepared by dissolving 80g of sodium hydroxide into 1 litre solution.
7. 0.1M aqueous ammonia is prepared by dissolving 5.6cm^3 Analar grade Ammonia which contains 30 – 35% and make upto 1 litre mark.
8. 0.1M barium nitrate is prepared by dissolving 26.0g in water and making upto 1 litre
9. 2M dilute nitric acid is prepared by adding 128cm^3 of con. Acid to water and make upto 1 litre.
10. 2M hydrochloric acid is prepared by adding 172cm^3 of conc. Acid to water and make upto 1 litre
11. 0.5M sodium sulphate is prepared by dissolving 71.0g in water and make upto 1 litre.

Name _____ Index No. _____

Candidate's Signature _____

Date _____

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2 ¼ HOURS

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INSTRUCTIONS TO CANDIDATES

(f) Write your name and index number in the spaces provided above.
(g) Answer all the questions in the spaces provided.
(h) Mathematical tables and silent electronic calculators many be used.
(i) All working must be clearly shown where necessary.
(j) Candidates should answer the questions in English.

FOR EXAMINER'SUSE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1	19	
2	11	
3	10	
TOTAL SCORE	**40**	

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Turn Over

1. You are provided with:-
   - Solution A containing 4.0g sodium hydroxide per litre solution.
   - Aqueous hydrochloric acid solution.
   - Calcium hydroxide – Solid C.

You are required to standardize hydrochloric acid solution B using solution A and hence determine the solubility of solid C in 100g of water at room temperature.

Procedure I

- Place all the solid C into a clean conical flask.
- Measure accurately 100cm^3 of distilled water using a measuring cylinder and add it to solid C.
- Shake thoroughly and leave it to stand for 12 minutes.
- Fill the burette with solution B.
- Pipette 25cm^3 of solution A into a clean conical flask.
- Add 3 drops of phenolpthalein indicator and titrate with solution B.
- Record the results in the table I below.
- Repeat the experiment to obtain three consistent readings

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

(4 marks)

(a) Determine the average volume of solution B used. (1 mark)

(b) Determine the molarity of solution A. (1 mark)

(c) Determine the molarity of solution B. (2 marks)

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   - Solution A containing 4.0g sodium hydroxide per litre solution.
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Initial burette reading (cm^3)			
Volume of solution B used (cm^3)			

(4 marks)

(a) Determine the average volume of solution B used. (1 mark)

(b) Determine the molarity of solution A. (1 mark)

(c) Determine the molarity of solution B. (2 marks)

PROCEDURE II

Filter the saturated solution of the mixture C and water into a clean conical flask and label this solution C.
Using pipette and filler, transfer 25cm^3 of the filtrate into a conical flask and titrate with hydrochloric acid solution B using methyl orange indicator.
Record the results in the table 2 below.
Repeat the titration to obtain consistent readings

Table 2

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

(4 marks)

(a) Determine the average volume of solution B used. (1 mark)

(b) Determine the number of moles of solution B used. (1mark)

(c) Calculate the number of moles of C in 25cm^3 of the filtrate. (2 marks)

(d) Calculate the number of moles of solid C in 100cm^3 of solution . (1 mark)

(e) Calculate the solubility of solid C per 100g of water
(Ca = 40.0, O = 16.0, H = 1.0) Density of water = 1 g/cm^3 (2 marks)

2. You are provided with solid Q. Carry out the test below. Write your observations and inferences in the spaces provided.

(a) Using a spatula place about one third of solid Q in a clean dry test-tube and heat it strongly.

Observation	Inferences
(1 mark)	(1 mark)

(b) Place the remaining solid Q in a boiling tube. Add about 10cm3 of distilled water. Shake the mixture thoroughly for about one minute. Filter and divide the filtrate into four portions.

Observation	Inferences
(1 mark)	(1 mark)

(c) To the first portion, add 2 drops of phenolphthalein indicator.

Observation	Inferences
(½ mark)	(1 mark)

(d) To the second portion, add $2cm^3$ of dilute hydrochloric acid.

Observation	Inferences
(½ mark)	(1 mark)

(e) To the third portion, add $5cm^3$ of aqueous sodium sulphate.

Observation	Inferences
(1 mark)	(1 mark)

(f) To the fourth portion, add dilute sodium hydroxide dropwise until in excess.

Observation	Inferences
(1 mark)	(1 mark)

3. You are provided with solid P. Carry out the tests below. Identify any gas (es) produced. Record your observations and inferences in the spaces provided.

(a) Place about half of the solid P in a dry test tube. Heat the solid gently.

Observation	Inferences
(1 mark)	(1 mark)

(b) Dissolve the remaining portion of solid P in $10cm^3$ of distilled water in a boiling tube.
Divide the solution into four portions
To the first portion, add sodium hydroxide dropwise till in excess.

Observation	Inferences
(1 mark)	(1 mark)

(c) To the second portion, add 3 drops of ammonia solution followed by $1cm^3$ of hydrogen peroxide.

Observation	Inferences
(1 mark)	(1 mark)

(d) To the third portion, add about $1cm^3$ of nitric acid solution.

Observation	Inferences
(1 mark)	(1 mark)

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

Observation	Inferences
(1 mark)	(1 mark)

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MARKING SCHEME

TABLE 1

Experiment number	I	II	III
Final burette reading (cm^3)	13.0	25.9	38.7
Initial burette reading (cm^3)	0.0	13.0	25.9
Volume of solution B used (cm^3)	13.0	12.9	12.8

Complete table 1
Decimal place 1
Accuracy (tied to school value 1
Arithmetic (correct) 1

(a) Average volume of solution B used

$$\frac{13.0 + 12.9 + 12.8}{3} \surd ½ = 12.9cm^3 \surd ½$$

(b) Molarity of solution A

$$\text{Molarity} = \frac{\text{mass / litre}}{\text{RMM}} = \frac{4.0}{40} = 0.1M \surd 1$$

(c) Molarity of solution B

$$HCl_{(aq)} + NaOH_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$$

Mole ratio 1 : 1
Moles of NaOH $= 0.1 \times {}^{25}/_{1000}$ $\surd ½$
$=0.0025$ moles $\surd ½$
Moles of HCl = moles of NaOH = 0.0025 moles

Molarity of HCl $= \frac{0.0025 \times 1{,}000}{12.9}$ $\surd ½$
$= 0.19379M$ $\surd ½$

TABLE 2

Experiment number	I	II	III
Final burette reading (cm^3)	5.0	10.0	15.0
Initial burette reading (cm^3)	0.0	5.0	10.0
Volume of solution B used (cm^3)	5.0	5.0	5.0

Complete table	1
Accuracy (tied to school value)	1
Decimal place	1
Arithmetic	1

(a) Average volume of ssolution B used

$\frac{5.0 + 5.0 + 5.0}{3}$ √ ½ = $5.0cm^3$ √ ½

(b) Moles of solution B used

Moles = M x $\frac{V}{1000}$

= 0.19379 x $\frac{5.0}{1000}$ √ ½ = 0.0096895 √ ½ moles

(c) Moles of C in $25cm^3$ of the filtrate

$Ca(OH)_{2\,(aq)} + 2HCl_{\,(aq)} \longrightarrow CaCl_{2\,(aq)} + 2H_2O_{\,(l)}$

Moles ratio 1 : 2 √ ½

Moles of HCl = 0.000968 √ ½

Moles of $Ca(OH)_2$ = $\frac{0.000968}{2}$ √ ½ = 0.000484 moles √ ½

(d) Moles in $100cm^3$

0.000484 moles → $5.0cm^3$

? → $100cm^3$

$\frac{0.00484 \times 100}{5}$ √ ½ = 0.00968 moles √ ½

(e) R.F.M $Ca(OH)_2$ = 40 + 32 + 2 = 74

Moles in $100cm^3$ = 0.00968

1 mole → 74g

0.00968 moles → ?

$\frac{0.00968 \times 74}{1}$ √ ½ = 0.71632g √ ½

0.71632 x 1 g/cm^3 √ ½ 0.71632 cm^3 √ ½

Solubility = 0.71632g / 100g of water

2

	Observation	Inference
2 (a)	- Colourless liquid formed on cooler part of the test-tube √ ½ - White residue or solid is left √ ½ (1 mark)	Hydrated salt √1 (1 mark) NB: Reject Tiny droplets or moisture or vapour or water condensed or colourless liquid condensed.
(b)	Colourless filtrate √ ½ White residue √ ½ (1 mark)	Compound is sparingly soluble √1 NB: Accept absence of coloured ions (1 mark)
(c)	Solution turns pink from colourless √ ½ (1 mark)	OH^-, HCO_3^- or co_3^{2-} present All 3- 1 mark Only 2 – ½ mark Only 1 – 0 mark NB: Accept basic for ½ mark
(d)	No effervescence √ ½ (1 mark)	OH^- present or CO_3^{2-} or HCO_3^- absent (1 mark)
(e)	White precipitate √1 (1 mark)	Ca^{2+} or Ba^{2+} ions present Accept Ca^{2+} only ½ Ba^{2+} only ½ (1 mark)
(f)	No white precipitate √1 (1 mark)	Ba^{2+} or Ca^{2+} ions present (1 mark)
3(a)	Colourless gas √ ½; turns red litmus paper to blue √ ½ (1 mark)	Basic gas or ammonium ions present √1 (1 mark)
(b)	Pale green precipitate √ ½ ; Insoluble in excess √ ½ (1 mark)	Fe^{2+} present √1 (1 mark)
(c)	Pale green precipitate √ ½ Insoluble in excess √ ½ (1 mark)	Fe^{2+} present √1 (1 mark)
(d)	Pale green solution. Turns to brown orange √	Fe^{2+} confirmed √
(e)	White precipitate √1 (1 mark)	SO_4^{2-} present √1 (1 mark)