FORM 4 ENTRANCE EXAMS 2024

NAME…… ADM. NO……CLASS……..

233/3
CHEMISTRY
Paper 3
PRACTICAL
Time: $2^{1}/_{4}$ hours

Candidate's Signature ……

Index Number ……

Kenya Certificate of Secondary Education
233/3
CHEMISTRY
Paper 3
PRACTICAL
Time: $2^{1}/_{4}$ hours

Instructions to Candidates

a) *Write your name and ADMISSION numbers in the spaces provided above.*
b) *Sign and write the date of examination in the spaces provided above.*
c) *Answer **ALL** the questions in the spaces provided in the question paper.*
d) *Mathematical tables and silent electronic calculators may be used.*
e) *All working **MUST** be clearly shown where necessary.*
f) *Candidates should check the question paper to ascertain that **all** pages are printed as indicated and that no questions are missing.*

For Examiner's Use Only

Question	Maximum Score	Candidate's Score
1	20	
2	10	

3	**10**	
TOTAL SCORE	**40**	

This paper consists of 7 printed pages.

1. **(20 marks)** You are provided with:
   - Solution **P**, hydrochloric acid
   - Solution **Q,** containing 8.8g per litre of sodium hydroxide.
   - 0.6g of an impure carbonate, solid **B**

   You are required to determine the:

   a) Concentration of solution **P** in moles per litre.

   b) Percentage purity of the carbonate, solid **B**.

   Procedure I

   Fill the burette with sodium hydroxide, solution **Q**. Pipette 25.0cm^3 of hydrochloric acid, solution **P** into a conical flask. Add 2 – 3 drops of methyl orange indicator and titrate. (The colour of the indicator changes from pink to yellow). Record your results in table 1 below. Repeat the titration two more times and complete the table.

   Table I

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

(4 marks)

   a) What is the average volume of solution **Q** used? (1 mark)

   b) Determine the:

   (i) Concentration of solution **Q** in moles per litre. (Na = 23.0; O = 16.0, H = 1.0) (1 mark)

   (ii) Concentration of solution **P** in mole per litre (2 marks)

Procedure II

Using a 100ml measuring cylinder, measure out 100cm^3 of solution **P** into a 250cm^3 beaker.

Add all of solid **B** into the beaker containing solution **P**. Swirl the mixture and allow the reaction to proceed for about 4 minutes.

Label the solution obtained here as solution **K**.

Fill the burette with sodium hydroxide, solution **Q**. Pipette 25.0cm^3 of solution **K** into a conical flask. Add 2- 3 drops of methyl orange indicator and titrate. Record your results in table II below. Repeat the titration two more times and complete the table.

Table II

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution **Q** (cm^3)			

(4 marks)

c) What is the average volume of solution **Q** used? (1 mark)

d) Calculate the :

i. Moles of hydrochloric acid in 25.0cm^3 of solution **K**. (1 mark)

ii. Moles of hydrochloric acid in 100cm^3 of solution **K**. (1 mark)

iii. Moles of hydrochloric acid in $100cm^3$ of the original hydrochloric acid solution **P**. (1 mark)

iv. Moles of hydrochloric acid that were used up in the reaction with solid **B**. (1 mark)

v. Moles of the carbonate that reacted with hydrochloric acid. (1 mark)

e) Given that the relative formula mass of the carbonate is 72, calculate the:

i. Mass of the carbonate that reacted. (1 mark)

ii. Percentage purity of the carbonate, solid **B**. (1 mark)

2. (10marks) You are provided with solid **M**. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Place **all** of solid **M** in a boiling tube and add about $10cm^3$ distilled water and shake.

Observations	**Inferences**

(½mark) (½ mark)

b) Divide the solution into five portions of about $2cm^3$ each.

i. To the first portion, add aqueous sodium hydroxide dropwise until in excess.

Observations	Inferences
(1mark)	(1mark)

ii. To the second portion, add aqueous ammonia dropwise until in excess.

Observations	Inferences
(1mark)	(1mark)

iii. Dip a glass rod in the third portion and heat it on a burnsen burner flame, identify the colour of the flame produced.

Observations	Inferences
(½mark)	(½mark)

iv. To the fouth portion,add about $1cm^3$ of lead (II) nitrate solution.

Observations	Inferences

(1mark) (1mark)

v. To the fifth portion, add about 1cm^3 of dilute sodium hydroxide followed by a small piece of aluminium foil. Warm the mixture gently and carefully. Test any gas produced using blue and red litmus papers.

Observations	Inferences

(1mark) (1mark)

3. (10marks) You are provided with solid **W**. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Place about one third of solid **W** on a **metallic** spatula and burn it using a Bunsen burner.

Observations	Inferences

(1mark) (1mark)

b) Place the remaining solid **W** into a boiling tube. Add 10cm^3 of distilled water and shake well. Use 2cm^3 portions of the mixture for each of the following reactions.

(i) To the first portion, add 2 drops of acidified potassium manganate (VII) and shake well.

Observations	Inferences

(1mark) (1mark)

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

Observations	Inferences
(1mark)	(1mark)

(iii) To the third portion put universal indicator paper.

Observations	Inferences
(1mark)	(1mark)

(iv) To the fourth portion add a little solid **Y**, sodium hydrogen carbonate.

Observations	Inferences
(½mark)	(½mark)

(v) To the fifth portion add about $2cm^3$ of ethanol and warm the mixture.

Observations	Inferences

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CHEMISTRY PRACTICAL
MARKING SCHEME

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2.

Table I

	I	II	III
Final burette reading	***23.9***	***24.0***	***24.1***
Initial burette reading	***0.0***	***0.0***	***0.0***
Volume of solution **Q** used (cm^3)	***23.9***	***24.0***	***24.1***

CT=1
Dec = 1
Acc = 1
PA = 1
FA = 1
5 Marks

d) What is the average volume of solution **Q** used?

$$\frac{\mathbf{23.9 + 24.0 + 24.1}}{\mathbf{3}} = \mathbf{24.0}\boldsymbol{cm^3}$$

e) Determine the:

(iii) Concentration of solution **Q** in moles per litre. (Na = 23.0; O = 16.0, H = 1.0)

(1mark)

$$\frac{\mathbf{8.8}}{\mathbf{40}} = \mathbf{0.22}\boldsymbol{M}$$

(iv) Concentration of solution **P** in mole per litre

(2marks)

$$\frac{\boldsymbol{M_1V_1}}{\boldsymbol{M_2V_2}} = \frac{\mathbf{1}}{\mathbf{1}}$$

$$\frac{\boldsymbol{M_1} \times \mathbf{25}}{\mathbf{0.22 \times 24}} = \frac{\mathbf{1}}{\mathbf{1}}$$

$$\boldsymbol{M_1} = \frac{\mathbf{0.22 \times 24}}{\mathbf{25}}$$

$$= \mathbf{0.2112}\boldsymbol{M}$$

Table II

	I	II	III
Final burette reading	***12.4***	***12.5***	***12.6***
Initial burette reading	***0.0***	***0.0***	***0.0***
Volume of solution **Q** (cm^3)	***12.4***	***12.5***	***12.6***

CT=1
Dec = 1
Acc = 1
PA = 1
FA = 1
5 Marks

f) What is the average volume of solution **Q** used?

$$\frac{12.4 + 12.5 + 12.6}{3} = 12.5cm^3$$

e) Calculate the :

vi. Moles of hydrochloric acid in 25.0cm^3 of solution **K**.
(1mark)

$$Moles\ of\ HCl\ in\ 25cm^3 of\ A = moles\ of\ NaOH\ in\ 12.5cm^3\ of\ J$$

$$\frac{0.22 \times 12.5}{1000}$$

$$= 0.00275moles$$

vii. Moles of hydrochloric acid in 100cm^3 of solution **K**.
(1mark)

$$\frac{0.00275 \times 100}{25}$$

$$= 0.011moles$$

viii. Moles of hydrochloric acid in 100cm^3 of the original hydrochloric acid solution **P**.
(1mark)

$$\frac{0.2112 \times 100}{1000}$$

$$= 0.02112moles$$

ix. Moles of hydrochloric acid that were used up in the reaction with solid **B**.
(1mark)

$$Ans\ a(iii) - a(ii)$$

$$= 0.02112 - 0.011$$

$$= 0.01012moles$$

x. Moles of the carbonate that reacted with hydrochloric acid.
(1mark)

$$CO_3^{2-}{}_{(aq)} + 2H^+{}_{(aq)} \longrightarrow CO_{2(g)} + H_2O_{(l)}$$

$$\frac{0.01012 \times 1}{2} = 0.00506moles$$

f) Given that the relative formula mass of the carbonate is 72, calculate the:

iii. Mass of the carbonate that reacted. (1mark)

$$\frac{0.00506 \times 72}{1} = 0.36432g$$

iv. Percentage purity of the carbonate, solid **B**. (1mark)

$$Percentage\ purity = \frac{0.36432}{0.6} \times 100$$

3. (10marks)

c) Place **all** of solid **M** in a boiling tube and add about 10cm^3 distilled water and shake.

Observations	**Inferences**
• ***Colourless solution (½mk)***	• ***Cu^{2+}, Fe^{2+}, Fe^{3+} absent (½mk)***

d) Divide the solution into five portions of about $2cm^3$ each.

vi. To the first portion, add aqueous sodium hydroxide dropwise until in excess.

Observations	Inferences
• ***White ppt (½mk) insoluble in excess½mk***	***Ca^{2+}, Mg^{2+}, Ba^{2+}present*** ***- All three/any two correct ions given 1 mk.*** ***- Only one correct ion given ½ mk.***

vii. To the second portion, add aqueous ammonia dropwise until in excess.

Observations	Inferences
• ***White ppt (½mk) insoluble in excess½mk***	***Mg^{2+}, Ba^{2+}present*** ***- All two correct ions given 1 mk.*** ***- Only one correct ion given ½ mk.***

viii. Dip a glass rod in the third portion and heat it on a burnsen burner flame, identify the colour of the flame produced.

Observations	Inferences
• ***Green flame (½mk)***	***Ba^{2+}present (½mk)***

ix. To the fourth portion,add about $1cm^3$ of lead (II) nitrate solution.

Observations	Inferences
• ***No white ppt 1mk*** ***NOTE*** ***- Accept "No ppt"/"colourless solution retained"/ "No observable change" for½mk but accept CORRECT inference and credit accordingly*** ***- REJECT Colourless solution formed/No colour change/ No white substance/ No reaction/ No observation***	***SO_4^{2-}, CO_3^{2-}, SO_3^{2-}absent*** ***- All 3 ions given 2mks*** ***- 2 ions given 1mk*** ***- 1 ion given ½ mk*** ***NOTE:*** ***- Where there is a contradictory ion mark out of 1½ mks and penalise ½ mk for EACH contradictory ion given to a maximum of 1½ mks.*** ***- Accept correct ion(s) written in words for ½mk***

x. To the fifth portion, add about 1cm[illegible] small piece of aluminium foil. Warm[illegible] gas produced using blue and red litmus papers.

Observations	Inferences
Colourless gas (½mk) the turns red litmus blue and blue litmus remains blue (½mk)	***NO_3^- present (1mk)***

4. (10marks)

c) Place about one third of solid **W** on a **metallic** spatula and burn it using a Bunsen burner.

Observations	Inferences
• ***Solid melts and burns with a yellow(½mk)/ luminous and sooty(½mk)/***	***C = C / –C ≡ C – present (1mk)*** ***NOTE*** ***Accept either of the following given in words in place of the above structures for FULL credit.***

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d) Place the remaining solid **W** into a boiling tube. Add $10cm^3$ of distilled water and shake well. Use $2cm^3$ portions of the mixture for each of the following reactions.

(vi) To the first portion, add 2 drops of acidified potassium manganate (VII) and shake well.

Observations	**Inferences**
• *Acidified potassium manganate (VII) solution is decolourised OR Purple colour of acidified potassium manganate (VII) changes to colourless OR purple colour of acidified $KMnO_4$ solution turns colourless.*	*C = C / –C ≡ C – (½mk), R – OH (½mk) present* ***NOTE*** ***In absence of the above structures, accept the CORRECT inference given in words for FULL credit as "unsaturated organic compound and alcohol / alkanol present".***

(vii) To the second portion, add three drops of bromine water

Observations	**Inferences**
• *Yellow/ orange bromine is decolourised. (1mk)*	*C = C / –C ≡ C – present*

(viii) To the third portion put universal indicator paper.

Observations	**Inferences**
• *pH=4 (1mk)* • *Accept pH = 5 or 6* *Reject pH given as a range*	• *Weakly acidic (1mk)* *Reject* *Weak acid/weak alone*

(ix) To the fourth portion add a little solid **Y**, sodium hydrogen carbonate.

Observations	Inferences
Effervescence / Bubbles of a colourless gas / fizzing (½mk) ***NOTE*** ***Reject: hissing / fizzling / sizzling / "colourless gas" on its own***	***R – COOH present (½mk)*** ***NOTE*** ***Accept either of the following if given in place of the above structures for*** • ***carboxylic / alkanoic acid present*** • ***solution is acidic*** • ***H_3O^+ / H^+ present***

(x) To the fifth portion add about $2cm^3$ of ethanol and warm the mixture.

Observations	Inferences
Fruity / Pleasant smell (½mk) ***Reject*** *:* *Sweet smell*	***R-COOH, -COOH present (½mk)*** *(**Accept** for above in words for ½mk)* *Ester formed if R-COOH is not mentioned).* ***N/B:*** *Penalize fully for any contradictory functional group.*

233/3 CONFIDENTIAL INFORMATION FOR THE CHEMISTRY TEACHER ONLY

In addition to the fittings and apparatus found in chemistry laboratory, each student will require the following.

1. $200cm^3$ of hydrochloric acid, solution **P**.
2. $150cm^3$ of sodium hydroxide, solution **Q**.
3. 0.50g of solid **B** weighed accurately.
4. About 0.2g of solid **Y**.
5. About 0.5g of solid **M**.
6. About 0.5g of solid **W**.
7. Burette 0-50 cm^3.
8. Pipette 25 cm^3.
9. One pipette filler
10. Means of labeling (one label).
11. 100 cm^3 measuring cylinder.
12. 10ml measuring cylinder
13. 250 cm^3 beaker.
14. Two conical flasks.
15. Six dry test-tubes.
16. About 1cm by 3cm aluminium foil
17. 1 red and 1 blue litmus papers.
18. Universal indicator paper
19. About $2cm^3$ ethanol placed in a test tube
20. 2 boiling tubes.
21. Metallic spatula
22. Funnel.
23. A test-tube holder.
24. Stop clock (wall clock)

BENCH REAGENTS/ ACCESS REAGENTS

1. Methyl orange indicator – supplied with dropper
2. Distilled water in a 500ml wash bottle

3. 2M sodium hydroxide – supplied with dropper
4. 2M aqueous ammonia – supplied with dropper
5. 0.5M lead (II) nitrate solution – supplied with dropper
6. Source of heat
7. Universal indicator solution supplied with a dropper
8. pH chart
9. Acidified potassium manganate (VII) – supplied with a dropper
10. Bromine water – supplied with a dropper

NOTES

1. Solution **P** is prepared by adding 18.0cm^3 (density=1.18g/cm^3) of concentrated hydrochloric acid into 600cm^3 of distilled water contained in a one litre volumetric flask and diluting to one litre of solution.
2. Solution **Q** is prepared by dissolving 8.80g of sodium hydroxide in 600cm^3 of distilled water contained in a one litre volumetric flask and diluting to one litre of solution. (**0.22M**)
3. Acidified potassium manganate (VII) is prepared by dissolving 2.0g of potassium manganate (VII) provided in about 100cm^3 of 2M sulphuric (VI) acid, adding 800cm^3 of distilled water and diluting to one litre of solution. Label this as acidified potassium manganate (VII).
4. Bromine water is prepared by adding 2ml of liquid bromine to 100cm^3 of distilled water and the mixture stirred well in a fume cupboard.
5. Solids :

- **B** is **Na_2CO_3**
- **M** is **$Ba(NO_3)_2$**
- **W** is **Maleic acid**
- **Y** is **$NaHCO_3$**