Name: _____ ( ) Class: _____

2024 PRELIMINARY EXAMINATION
GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL

CHEMISTRY 6092/03

Paper 3 Practical

6 August 2024
1h 50 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, register number, and class on all the work you hand in.
Give details of the practical shift and laboratory where appropriate, in the boxes provided.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use highlighters, glue, correction fluid or correction tape.

Answer **all** questions.
The use of a scientific calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

Qualitative Analysis Notes are printed on page 10.
The number of marks is given in brackets [ ] at the end of each question or part question.

Shift
Laboratory

For Examiner's Use	
Question 1 (15)	
Question 2 (11)	
Question 3 (9)	
Question 4 (5)	
Total (40)	

This document consists of **10** printed pages.

1 Citric acid is a carboxylic acid found in lemon juice. The equation for the reaction between citric acid, $H_3C_6H_5O_7$, and potassium hydroxide, KOH, is shown below.

$$3KOH + H_3C_6H_5O_7 \rightarrow K_3C_6H_5O_7 + 3H_2O$$

The mass of citric acid dissolved in 500 cm^3 of an aqueous solution can be determined by titration with aqueous potassium hydroxide.
Methyl orange is used to determine the end-point of the titration.

Read all the instructions below carefully before starting the experiment in Question 1.

P is 0.100 mol/dm^3 aqueous potassium hydroxide.
Q is aqueous citric acid.

(a) Fill the burette with **P**.

Use the pipette to transfer 25.0 cm^3 of **Q** into a conical flask.

Add a few drops of the methyl orange to the solution in the conical flask.

Add **P** from the burette, swirling the flask consistently.

Record your titration results in the space provided. Repeat the titration as many times as you consider necessary to achieve consistent results.

Results

[5]

(b) Use your titration results to obtain the average volume of **P** used. Show clearly how you obtained this volume.

average volume of **P** …….[1]

(c) Use your results from **(b)** to calculate the number of moles of aqueous potassium hydroxide in the average volume of **P** used.

moles of aqueous potassium hydroxide ……..[1]

(d) Calculate the number of moles of citric acid in 25.0 cm^3 of **Q**.

moles of citric acid in 25.0 cm^3 of **Q** is ……[1]

(e) Calculate the concentration of citric acid in **Q** in mol/dm^3.

concentration of citric acid in **Q** ..... [1]

(f) Calculate the mass of citric acid in 500 cm^3 of **Q**.
[A_r : H, 1; C,12; O,16]

mass of citric acid in 500 cm^3 of **Q** ..... [3]

(g) If **Q** was replaced by ethanoic acid of the same concentration during the titration, what would be the expected volume of **P** required to completely neutralise 25.0 cm^3 of **Q**? Explain your answer.

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……..[3]

[Total: 15 marks]

2 Read all the instructions carefully before starting the experiments in Question 2.

You are provided with three compounds of manganese: solid **D**, solutions **S** and **T**.

Instructions

(a) Carry out the following tests on each substance and record your observations in the table. You should test and name any gas evolved.

The volumes given below are approximate and should be estimated rather than measured.

test	observations
Test 1 Put about 1 cm depth of aqueous hydrogen peroxide in a clean test tube. Add an equal volume of dilute sulfuric acid. Then add 1 cm^3 of **T** with shaking. You do not need to test any gas evolved in Test 1.	
Test 2 Put about 1 cm depth of hydrogen peroxide in a clean test tube. Use a spatula to carefully add a small amount of **D**.	
Test 3 Put about 1 cm depth of dilute sulfuric acid in a clean test tube. Add an equal volume of aqueous potassium iodide. Use a spatula to carefully add a small amount of **D**.	
Test 4 Put about 1 cm depth of **S** in a clean test tube. Add aqueous sodium hydroxide until a change is seen. Add excess aqueous sodium hydroxide to the mixture and allow to stand for a few minutes.	

Test 5 Put about 1 cm depth of **S** in a clean test tube. Add an equal volume of aqueous barium nitrate then add an equal volume of dilute nitric acid.	
Test 6 Put about 1 cm depth of **T** in a clean test tube. Add an equal volume of **S**.	

[9]

(b) Deduce the role of **D** in **Test 3**. Explain your answer.

…….

…….....[2]

[Total: 11 marks]

3 A student carried out a titration to determine the mole ratio for the reaction between acidified hydrogen peroxide and acidified iron(II) sulfate.

She followed the procedure below using different volumes of acidified iron(II) sulfate and acidified hydrogen peroxide as shown in Table 3.

(i) Put aqueous potassium manganate(VII) into the burette.
Titrate 50 cm^3 of 0.050 mol/dm^3 acidified iron(II) sulfate with 0.020 mol/dm^3 aqueous potassium manganate(VII) until one drop of aqueous potassium manganate(VII) produces a pink colour that does not disappear on swirling.

(ii) Empty the flask and rinse with water.

(iii) Measure 40 cm^3 of acidified iron(II) sulfate and 10 cm^3 of 0.030 mol/dm^3 acidified hydrogen peroxide, using separate measuring cylinders.
Pour both solutions into a flask, mix and titrate with aqueous potassium manganate(VII).

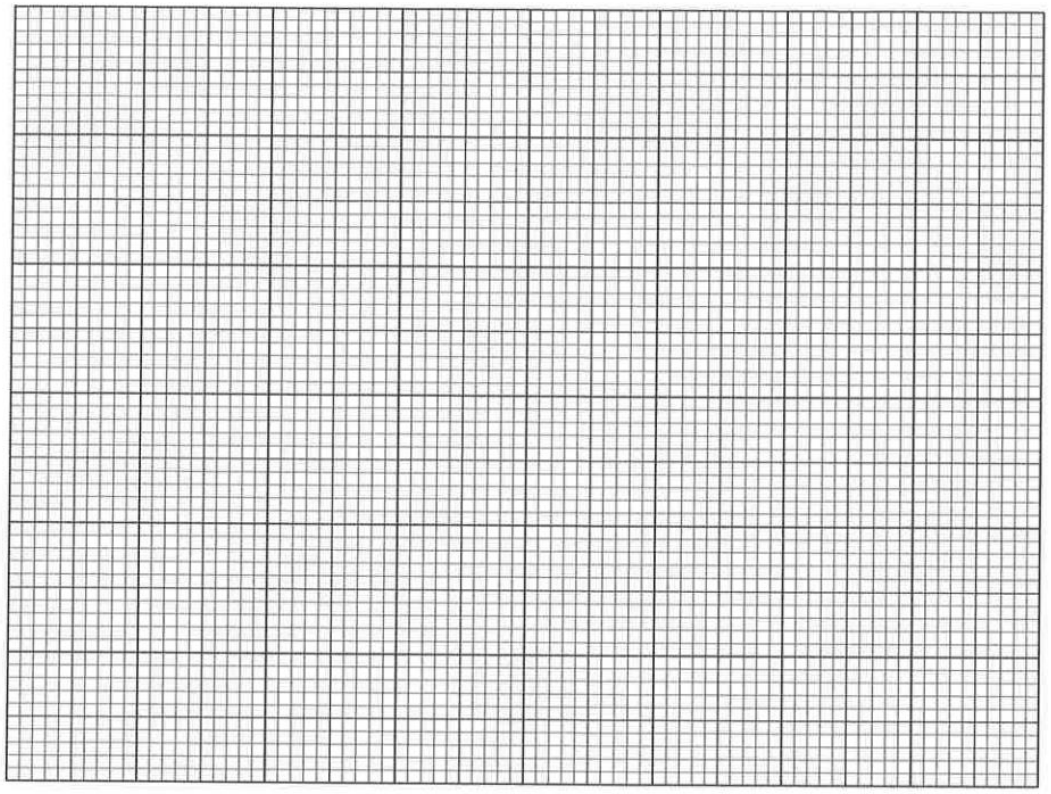
(iv) Repeat the procedure described in (i)-(iii) using the volumes of acidified iron(II) sulfate and acidified hydrogen peroxide.

The results are shown in Table 3.

Volume of acidified iron(II) sulfate /cm^3	Volume of acidified hydrogen peroxide /cm^3	Total volume/cm^3	Volume of aqueous potassium manganate(VII)/cm^3
50	0	50	24.40
40	10	50	13.60
30	20	50	2.80
20	30	50	8.00
10	40	50	18.80
0	50	50	29.60

Table 3

(a) Plot a graph of volume of aqueous potassium manganate(VII) against volume of acidified iron(II) sulfate on the grid on Page 7. Using these points, draw two straight lines of best fit. The lines should intersect each other.



[4]

(b) **(i)** From the graph, deduce the volume of acidified iron(II) sulfate when the lines intersect on the graph.

Volume of acidified iron(II) sulfate …… cm^3[1]

(ii) Calculate the volume of acidified hydrogen peroxide that has reacted with the volume of acidified iron(II) sulfate in **(b)(i)**, by using the formula 'volume of acidified hydrogen peroxide = 50 – volume of acidified iron(II) sulfate'.

Volume of acidified hydrogen peroxide …… cm^3 [1]

(c) **(i)** Calculate the number of moles of iron(II) sulfate in the volume of acidified iron(II) sulfate in **(b)(i)**

Number of moles of iron(II) sulfate = …….[1]

(ii) Calculate the number of moles of hydrogen peroxide in the volume of acidified hydrogen peroxide in **(b)(ii)**.

Number of moles of hydrogen peroxide= …….[1]

(d) Using your answer to **(c)**, complete the partial equation below.

_____ $FeSO_4$ + _____ H_2O_2 + sulfuric acid → iron(III) sulfate + water [1]

[Total: 9 marks]

4 **A** is magnesium oxide powder contaminated with zinc oxide. You are requested to plan and produce a procedure to purify **A** and determine the percentage purity of magnesium oxide. Zinc oxide is an amphoteric oxide.

You can assume the apparatus and reagents normally found in a school laboratory are available.

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……...[5]

[Total: 5 marks]

End of Paper

QUALITATIVE ANALYSIS NOTES

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Test for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on heating	-
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt.
copper (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron (II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron (III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

gas	*test and test result*
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	gives white ppt. with limewater (ppt. dissolves with excess CO_2)
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns aqueous acidified potassium manganate(VII) from purple to colourless