Name:	Class:	Class Register Number:

CHUNG CHENG HIGH SCHOOL (MAIN)

PRELIMINARY EXAMINATION 2024
SECONDARY 4

CHEMISTRY 6092/03

Paper 3 Practical

August 2024

1 hour 50 minutes

Candidates answer on the Question Paper.
Additional Materials: As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number clearly in the spaces provided at the top of this page.
Give details of the practical shift and laboratory where appropriate, in the boxes provided.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in the spaces provided on the Question Paper.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.
Qualitative Analysis Notes are printed on page 10.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Shift
Laboratory

For Examiner's Use	
1	
2	
3	
Total	/ 40

This document consists of **10** printed pages and **2** blank pages.

1 Magnesium oxide is often used to treat heartburn. To determine the percentage purity of a sample of magnesium oxide, a method known as back titration is used.

Procedure

1) Dissolve a sample of magnesium oxide in a known volume and concentration of hydrochloric acid, which is used in excess.

$$MgO + 2HCl \rightarrow MgCl_2 + H_2O$$

2) Determine the amount of unreacted acid by titrating the solution with aqueous sodium hydroxide.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

3) From the amount of unreacted acid, determine the amount of hydrochloric acid that has reacted with magnesium oxide.

4) Determine the amount of magnesium oxide that has reacted and hence its mass.

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

P is aqueous 0.200 mol/dm^3 sodium hydroxide.

Q is a solution made by dissolving 1.20 g of magnesium oxide in 100 cm^3 of 1.00 mol/dm^3 dilute hydrochloric acid and the solution made up to 250 cm^3 with distilled water.

R is methyl orange indicator.

(a) (i) Put **P** into the burette.

Pipette 25.0 cm^3 of **Q** into a conical flask.

Add a few drops of **R** to the flask.

Add **P** from the burette to the flask until the solution changes colour.

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

Results

[5]

(ii) Calculate the average volume of **P** used.

average volume of **P** = **……...** [1]

(b) **(i)** Calculate the amount, in moles, of hydrochloric acid that has reacted with **P**.

amount of hydrochloric acid = **……...** mol [1]

(ii) Calculate the amount, in moles, of hydrochloric acid in **Q**.

amount of hydrochloric acid = **……...** mol [1]

(c) **(i)** Calculate the amount, in moles, of magnesium oxide that has reacted with hydrochloric acid.

amount of magnesium oxide = **……...** mol [2]

(ii) Calculate the mass of magnesium oxide in the sample.

[A_r: O = 16, Mg = 24]

mass of magnesium oxide = **……...** g [1]

(iii) Calculate the percentage purity of the magnesium oxide sample.

percentage purity = **……...** % [1]

[Turn over

(d) State an assumption made when determining the percentage purity of magnesium oxide by titration.

……

……[1]

(e) A student used a wet burette without rinsing it with aqueous sodium hydroxide first. Explain how this would affect the titration results.

……

……

……[2]

[Total: 15]

2 You are provided with a solution **X**, that contains two ionic compounds.

Read all the instructions below carefully before starting the experiment in Question 2.

Instructions

Carry out the following experiments and test and identify any gases evolved. Carefully record your observations.

The volumes given below, unless referring to drops of solution, are approximate and should be estimated rather than measured.

	Tests	observations
(a)	Place 3 cm depth of solution **X** in a clean test tube. Add an equal volume of dilute hydrochloric acid.	[3]
(b)	Place 2 cm depth of solution **X** in a clean test tube. Add aqueous sodium hydroxide until no further change is seen. Warm the mixture gently.	[3]
(c)	Place 2 cm depth of solution **X** in a clean test tube. Add a few drops of aqueous silver nitrate followed by excess dilute nitric acid.	[2]
(d)	Place 2 depth of solution **X** in a clean test tube. Add a few drops of aqueous barium nitrate followed by excess dilute nitric acid.	[2]

[Turn over

(e) Consider the results of your experiment.

Identify the ions present in solution **X**. Give evidence to support each of your choices.

……

……

……

……

……

……

……

……[4]

[Total: 14]

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3 Aqueous hydrogen peroxide decomposes at room temperature in the presence of a catalyst to form water and oxygen.

$$2H_2O_2\ (aq) \rightarrow 2H_2O\ (l) + O_2\ (g)$$

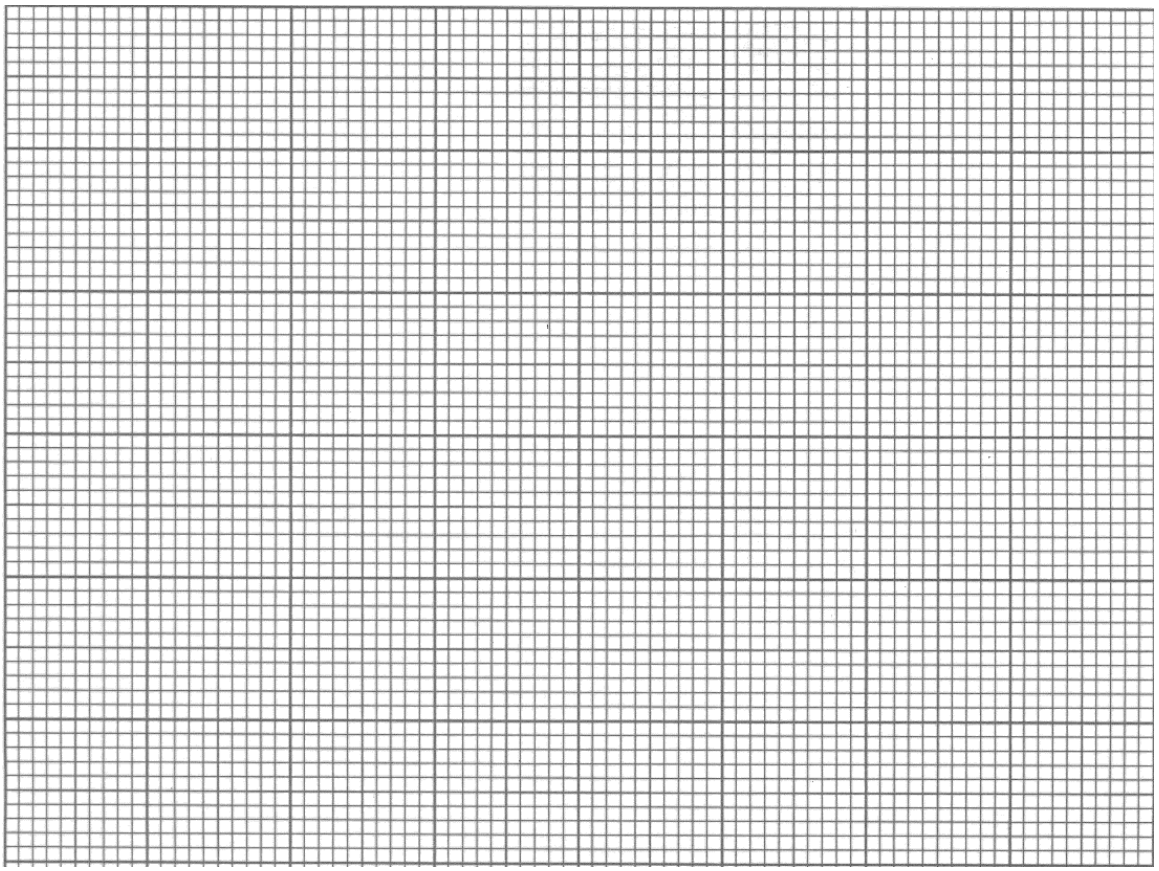
A student investigates the rate of decomposition of hydrogen peroxide. The results are shown in the table.

time / s	total volume of oxygen / cm^3
0	0
20	19
40	30
60	38
80	44
100	48
120	50
140	50

(a) Name the two pieces of apparatus used to make the recorded measurements in the table above.

.....[2]

(b) Plot a graph of total volume of oxygen against time using the results in the table. Draw a line of best fit through the points.



[3]

(c) What is the total mass of oxygen produced?

…… [1]

(d) From the **graph**, calculate the average rate of oxygen produced

in the first 50 seconds, ...

in the second 50 seconds ..... [2]

[Turn over

(e) **(i)** Instead of measuring the volume of oxygen gas produced, describe a different method to investigate the rate of decomposition of hydrogen peroxide.

……

……

……

……[2]

(ii) Suggest one source of error, other than reaction time, that affects the accuracy of the experiment described in **(e)(i)**.

……

……[1]

[Total: 11]

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QUALITATIVE ANALYSIS NOTES

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	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.

Tests 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 warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt.
copper(II) (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 lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns aqueous acidified potassium manganate(VII) from purple to colourless