Name:	Class:	Class Register Number:

CHUNG CHENG HIGH SCHOOL (MAIN)

PRELIMINARY EXAMINATION 2026
SECONDARY 4

CHEMISTRY 6092/03

Paper 3 Practical

21 August 2026

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, correction fluid or highlighters.

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.

1 In acidic conditions, potassium manganate(VII) reacts with potassium iodide to produce iodine. The iodine liberated can be titrated with aqueous sodium thiosulfate.

From the titration results, the concentration of the potassium manganate(VII) can be calculated.

In this experiment, you will determine the concentration of potassium manganate(VII).

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

Instructions

P is potassium manganate(VII) of unknown concentration.

Q is 0.1 mol/dm^3 sodium thiosulfate.

(a) (i)

- Fill the burette with **Q**.
- Use the pipette to transfer 25.0 cm^3 of **P** into the conical flask.
- Use the measuring cylinder to measure 10.0 cm^3 of dilute sulfuric acid and add it into the conical flask.
- Use the same measuring cylinder to measure 10.0 cm^3 of aqueous potassium iodide and add it into the conical flask.
- Swirl the conical flask gently to mix the solutions thoroughly. The solution should turn red-brown.
- **Do not add the starch indicator solution at this stage.**
- Add **Q** from the burette to the conical flask until the red-brown colour fades to a pale yellow, then add a few drops of the starch indicator solution.

  This will give a deep blue solution.
- Continue adding **Q** slowly from the burette, until one drop of **Q** causes the blue colour to disappear, leaving a colourless solution.
- Record your results in an appropriate format in the space provided. Repeat the titration as many times as you consider to be necessary to achieve consistent results.

Results (Titres : 25.80 cm^3; 25.50 cm^3; 25.30 cm^3

[5]

(ii) From your titration results, calculate the average volume of **Q** required to reach the end-point of the titration. Show clearly how you obtained this volume.

average volume of **Q** = ... cm^3 [1]

(b) **Q** is 0.1 mol/dm^3 sodium thiosulfate.

(i) Use your answer to **(a)(ii)** to calculate the amount of sodium thiosulfate, in moles, used to react with the iodine produced by the reaction of potassium manganate(VII) and potassium iodide.

amount of sodium thiosulfate = ……. mol [1]

(ii) Two moles of sodium thiosulfate react with one mole of iodine.

Use your answer to **(b)(i)** to calculate the amount of iodine, in moles, produced by the reaction of potassium manganate(VII) and potassium iodide.

amount of iodine = ……. mol [1]

(iii) Five moles of iodine are produced by the reaction of two moles of potassium manganate(VII) with potassium iodide.

Use your answer to **(b)(ii)** to calculate the amount, in moles, of potassium manganate(VII) used in the reaction.

amount of potassium manganate(VII) = …….. mol [1]

(iv) Use your answer to **(b)(iii)** to calculate the concentration, in mol/dm^3, of the potassium manganate(VII), $KMnO_4$, in 25.0 cm^3 of solution **P**.

concentration of $KMnO_4$ in 25.0 cm^3 of **P** = …….mol/dm^3 [2]

[Turn over

(c) In this experiment, aqueous potassium iodide is added in excess.

A student repeated the experiment but accidentally used insufficient aqueous potassium iodide.

State and explain the effect, if any, that this would have on the volume of **Q** required to reach the end-point of the titration and the calculated concentration of potassium manganate(VII).

……...……..

……...……..

……...……..

……..……..[2]

(d) Aqueous iron(II) sulfate also reacts with solution **P**. During the reaction, the purple colour of solution **P** disappears.

Describe an experiment to investigate how the concentration of solution **P** affects the rate of its reaction with aqueous iron(II) sulfate. Use two different concentrations of solution **P** in your experiment.

Your description should include:

- the apparatus you would use,
- the measurements you would take, and
- how you would use your results to determine the effect of concentration on the rate of reaction.

You may assume that all the apparatus and reagents normally found in a school laboratory are available.

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….[6]

[Total: 19]

2 **(a)** **R** is an aqueous mixture of two cations and one anion. **(R is a mixture of copper(II) sulfate and acidified iron(II) sulfate)**

All the ions in **R** are listed in the qualitative analysis notes on page 10.

Follow the instructions in Table 2.1 to carry out tests on **R**.

You should test any gases involved. The volumes given below are approximate and should be estimated rather than measured.

Record your observations in Table 2.1. If there are no observable changes, write '**no observable change**'.

Table 2.1

Test	instructions	observations
1	To 1 cm depth of **R** in a clean test-tube, add 3 drops of aqueous barium nitrate. Keep the test-tube and its contents for **Test 2**.	
2	To the test-tube and its contents from **Test 1**, add 4 cm depth of aqueous ammonia.	
	Allow the test-tube to stand for a few minutes.	
3	To 1 cm depth of **R** in a clean test-tube, add 3 drops of aqueous silver nitrate.	
4	To 1 cm depth of **R** in a clean test-tube, add an equal volume of aqueous hydrogen peroxide. Keep the test-tube and its contents for **Test 5**.	
5	To the test-tube and its contents from **Test 4**, add 4 cm depth of aqueous ammonia.	There is no need to record observations for this step.
	Allow the test-tube to stand for a few minutes.	

[8]

(b) **(i)** Use your observations from Table 2.1 to deduce the anion in **R**. Explain your answer.

anion ……...

explanation …….

……..
[1]

(ii) **R** contains two cations.

Use your observations from Table 2.1 to deduce one of the two cations in **R**. Explain your answer.

cation ……..……

explanation …….

……..
[1]

(c) Suggest the role of aqueous hydrogen peroxide in **Test 4**. Explain your answer.

…….

…….

…….[2]

[Total: 12]

3 Magnesium reacts with copper(II) sulfate solution as shown.

$$Mg + CuSO_4 \rightarrow MgSO_4 + Cu$$

A student reacts different masses of magnesium with 50.0 cm³ of copper(II) sulfate solution and measures the temperature rise.

By plotting a graph of temperature rise against mass of magnesium, the student can determine the mass of magnesium required to react completely with the copper(II) sulfate present.

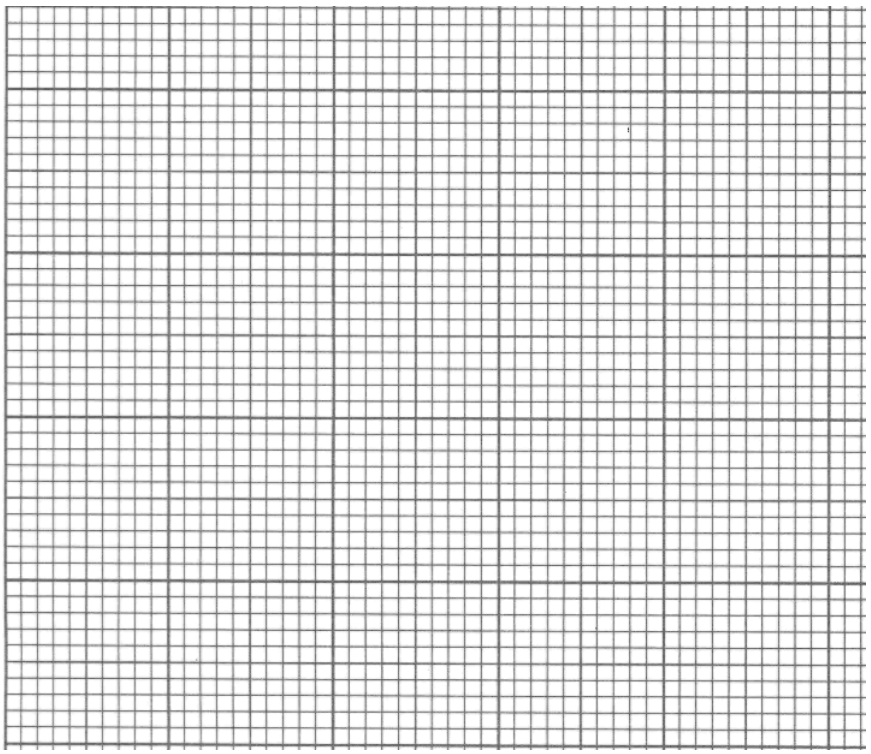
He recorded his measurements as shown in the table below.

mass of magnesium / g	initial temperature of aqueous copper(II) sulfate / °C	highest temperature of mixture / °C	temperature rise / °C
0.20	30.0	32.5	
0.40	30.0	35.5	
0.60	30.0	37.0	
0.80	30.0	37.5	
1.00	30.0	37.5	

(a) Calculate the temperature rise and complete the table above. [1]

(b) Plot a graph of temperature rise against mass of magnesium on the grid below.

Use these points to draw two intersecting straight lines of best fit.



[3]

(c) **(i)** Use your graph to find the maximum temperature produced when 0.5 g of magnesium is added to the aqueous copper(II) sulfate.

temperature …..……°C [1]

(ii) Deduce from your graph the mass of magnesium required to react completely with 50 cm^3 of aqueous copper(II) sulfate.

mass of magnesium …….. g [1]

(iii) Using your answers to **(c)(ii)**, calculate the concentration of the aqueous copper(II) sulfate used in the experiment.
[A_r: Mg, 24]

concentration …….. mol/dm^3 [2]

(d) Suggest one way to determine more accurately the mass of magnesium required to react completely with 50.0 cm^3 of copper(II) sulfate solution.

…….

…….[1]

[Total: 9]

[Turn over

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