**SWISS COTTAGE SECONDARY SCHOOL**
SECONDARY FOUR
PRELIMINARY EXAMINATION

**O**

| Name | | Academic Class | 4 | A | |
|---|---|---|---|---|---|
| | | Form Class | 4 | S | |

Form Class Register Number

# CHEMISTRY

**6092/03**

Paper 3 Practical

**Monday 9 September 2024**

Additional Materials: As listed in the Confidential Instructions

**1 hour 50 minutes**

**READ THESE INSTRUCTIONS FIRST**

Write your class, register number and name 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 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 12.

At the end of the examination, fasten all your work in both parts separately.
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 | |
| Question 2 | |
| Question 3 | |
| Total | |

This document consists of **11** printed pages and **1** blank page.

**[Turn over**

**1** The reaction of magnesium and dilute hydrochloric acid is exothermic.

You are going to investigate the temperature change when magnesium is added to dilute hydrochloric acid of different concentrations.

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

**Instructions**

You are going to carry out five experiments.

**P** is 1.000 mol/dm$^3$ hydrochloric acid.

You are provided with five vials of magnesium. Each vial contains two pieces of magnesium ribbons each measuring 1 cm in length.

**(a)** *Experiment 1*

Using a 10 cm$^3$ measuring cylinder, pour 10 cm$^3$ of **P** into a boiling tube.
Measure the initial temperature of **P** in the boiling tube and record the value in the table.

Transfer the magnesium ribbons from one of the vials to **P** in the boiling tube. Stir the mixture gently with the thermometer.

Measure the highest temperature reached and record it in the table.

Wash the thermometer and boiling tube with water.

*Experiments 2 to 5*

Repeat Experiment 1, using different volumes of **P** and water given in the table.
For example, in Experiment 2 measure 8 cm$^3$ of **P** into the measuring cylinder and then add water to **P** until the total volume in the measuring cylinder is 10 cm$^3$.

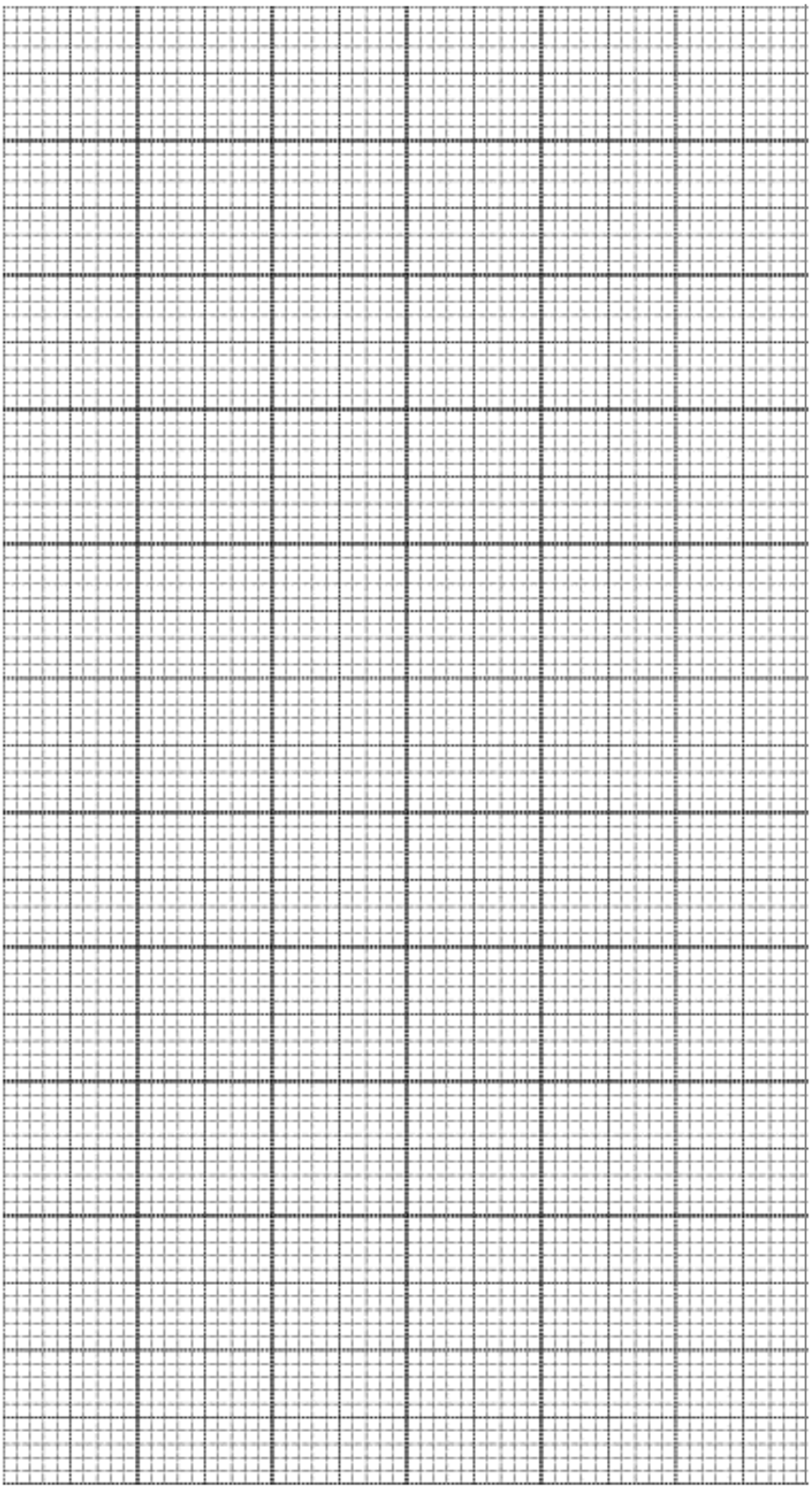
Complete the table by calculating the change in temperature for each experiment.

| experiment | volume of **P** / cm$^3$ | volume of water / cm$^3$ | initial temperature / °C | highest temperature / °C | change in temperature / °C |
|---|---|---|---|---|---|
| 1 | 10 | 0 | | | |
| 2 | 8 | 2 | | | |
| 3 | 6 | 4 | | | |
| 4 | 4 | 6 | | | |
| 5 | 2 | 8 | | | |

[4]

**(b)** Use the results you have obtained in **(a)** to plot a graph of change in temperature against volume of **P**.

Draw a line of best fit, taking into account all of your plotted points.



[4]

**(c)** Describe and explain the trend shown by your graph in **(b)**.

.....

.....

..... [2]

**(d)** Determine the expected change in temperature if the experiment was repeated with 0.0065 mol of dilute hydrochloric acid in the 10 $cm^3$ solution.

Show clearly **on the graph** how you obtained your answer.

..... [2]

**(e)** A student wanted to repeat the experiment using 10 $cm^3$ of solution **P** and four pieces of magnesium ribbons of 1 cm length. He predicted that the temperature change would be twice that of Experiment 1.

Explain if his prediction was correct. What was the assumption made in his prediction?

.....

.....

.....

.....

.....

..... [2]

**(f)** Give **two** observations, other than temperature change, made when magnesium reacts with dilute hydrochloric acid and explain each observation.

observation 1 .....

explanation .....

observation 2 .....

explanation .....

[4]

**(g)** State one source of error, **other than heat loss**, in the results obtained in Experiments 1 to 5. Suggest one improvement you could make to the experiment to reduce this error.

error .....

.....

improvement .....

.....

..... [2]

[Total: 20]

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## CHEMISTRY

Paper 3 Practical

**6092/03**
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**2** Part 1

You are provided with a bleach solution **Q**, which contains an oxidising agent, the chlorate(I) ion. This ion liberates iodine from acidified aqueous potassium iodide. The iodine liberated can be titrated with aqueous sodium thiosulfate. From the titration results, the concentration of the bleach solution can be calculated.

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

**Instructions**

You are going to carry out a titration experiment.

**Q** has been prepared by diluting a sample of 100 $cm^3$ of commercial bleach to 1.00 $dm^3$ by adding deionised water.

**R** is 0.0500 mol/$dm^3$ sodium thiosulfate.

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

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

Add about a test-tubeful of aqueous potassium iodide and about a test-tubeful of dilute sulfuric acid into this flask. The solution should turn brown. **Do not add the starch indicator at this stage.**

Add **R** from the burette until the brown colour fades to a pale yellow, then add a few drops of starch solution. This will give a dark blue solution.

Continue adding **R** slowly from the burette, until one drop of **R** causes the blue colour to disappear, leaving a colourless solution.

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)** From your titration results, obtain an average volume of **R** to be used in your calculations.
Show clearly how you obtained this volume

average volume of **R** = ..... [1]

**(b) (i)** **R** is 0.0500 mol/$dm^3$ aqueous sodium thiosulfate.

Using your answer from **(a)(ii)**, calculate the number of moles of aqueous sodium thiosulfate used in the titration.

number of moles of sodium thiosulfate = ..... [1]

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

Using your answer from **(b)(i)**, calculate the number of moles of iodine liberated in the reaction.

number of moles of iodine = ..... [1]

**(iii)** One mole of iodine is liberated by one mole of chlorate(I) ions.

Using your answer from **(b)(ii)**, calculate the number of moles of chlorate(I) ions contained in 25.0 $cm^3$ of solution **Q**.

number of moles of chlorate(I) ions = ..... [1]

**(iv)** Using your answer to **(b)(iii)**, calculate the concentration, in mol/$dm^3$, of the chlorate(I) ions in the commercial bleach used to prepare solution **Q**.

concentration of chlorate(I) ions in commercial bleach = ..... [4]

Part 2

**(c)** Solution **T** is used in the removal of stains. You are going to determine the nature of solution **T** by carrying out the following test on solution **T**. You should test and identify any gas evolved.

**(i)** Put 1 cm depth of aqueous potassium iodide in a clean test tube. Add an equal volume of solution **T** with shaking.

Record your observations.

.....

.....

..... [2]

**(ii)** What can you deduce about the nature of solution **T**?

..... [1]

[Total: 16]

**3** You are provided with two solids which are Group 2 carbonates, **X**$CO_3$ and **Y**$CO_3$.

Group 2 carbonates decompose on heating to form metal oxide and carbon dioxide.

metal carbonate $\rightarrow$ metal oxide + carbon dioxide

Given 1 g of each carbonate, outline a method involving the reaction above, to determine which of the two metals, **X** or **Y**, has the higher relative atomic mass.

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

In your method you should include the measurements you would take and explain how you would use your results to determine which metal has the higher relative atomic mass.

[$A_r$: C, 12; O, 16]

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..... [4]

[Total: 4]

# NOTES FOR QUALITATIVE ANALYSIS

**Test 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. |

**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 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 |

**Test 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 |