Cambridge Assessment International Education

# Cambridge IGCSE™

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*7373763899*

**CHEMISTRY** **0620/52**

Paper 5 Practical Test **May/June 2023**

**1 hour 15 minutes**

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions
Insert (enclosed)

**INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

**INFORMATION**

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].
- Notes for use in qualitative analysis are provided in the question paper.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| Total | |

This document has **12** pages. Any blank pages are indicated.


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**1** You are going to investigate how the rate of the reaction between aqueous iron(III) nitrate and aqueous sodium thiosulfate changes with temperature.

**Read all of the instructions carefully before starting the experiments.**

**Instructions**
You are going to do five experiments using the apparatus shown in Fig. 1.1.

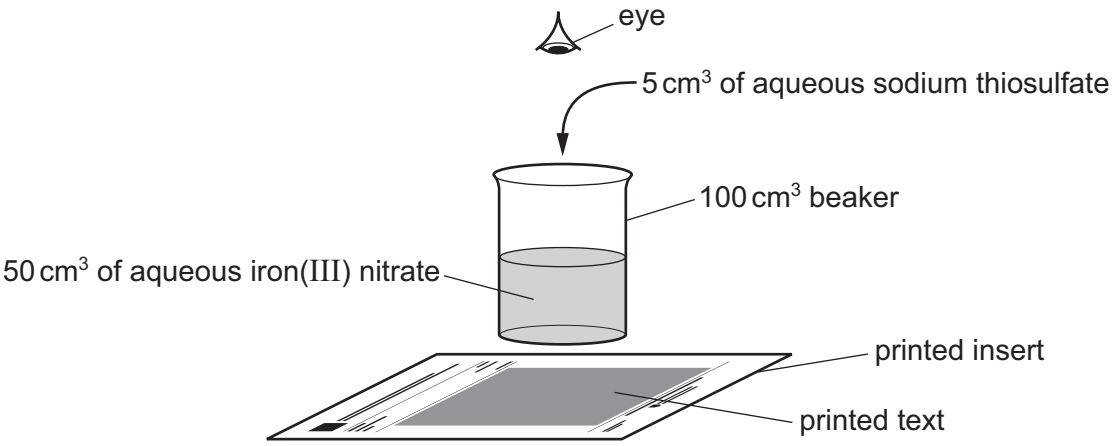



**Fig. 1.1**

**(a) You must not heat any solution to a temperature of above 55 °C in these experiments.**

Experiment 1

- Use a 50 cm³ measuring cylinder to pour 50 cm³ of aqueous iron(III) nitrate into a 100 cm³ beaker.
- Stand the beaker on the printed insert as shown in Fig. 1.1.
- Use a 10 cm³ measuring cylinder to pour 5 cm³ of aqueous sodium thiosulfate into the beaker. At the same time start a timer.
- Use a thermometer to stir the contents of the beaker.
- Look down from above the beaker. When the text on the printed insert becomes visible, stop the timer and record the time in seconds to the nearest whole number in Table 1.1.
- Use the thermometer to measure the temperature of the solution in the beaker when the text becomes visible. Record the temperature in Table 1.1.
- Rinse the beaker and thermometer with water.

Experiment 2

- Use the 50 cm³ measuring cylinder to pour 50 cm³ of aqueous iron(III) nitrate into the 100 cm³ beaker.
- Heat the beaker on a gauze over a Bunsen burner. Use the thermometer to measure the temperature of the aqueous iron(III) nitrate. Stop heating when the temperature has increased by about 5 °C.
- Stand the beaker on the printed insert.
- Use the 10 cm³ measuring cylinder to pour 5 cm³ of aqueous sodium thiosulfate into the beaker. At the same time start the timer.
- Use the thermometer to stir the contents of the beaker.
- Look down from above the beaker. When the text on the printed insert becomes visible, stop the timer and record the time in seconds to the nearest whole number in Table 1.1.
- Use the thermometer to measure the temperature of the solution when the text becomes visible. Record the temperature in Table 1.1.
- Rinse the beaker and thermometer with water.

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**[Turn over**

Experiment 3

- Repeat Experiment 2, this time heating the aqueous iron(III) nitrate until the temperature has increased by about 10 °C.

Experiment 4

- Repeat Experiment 2, this time heating the aqueous iron(III) nitrate until the temperature has increased by about 15 °C.

Experiment 5

- Repeat Experiment 2, this time heating the aqueous iron(III) nitrate until the temperature has increased by about 20 °C.

**Table 1.1**

| experiment | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| time taken for the text to become visible / s | | | | | |
| temperature of the solution when the text becomes visible / °C | | | | | |

[4]

**(b)** State the **sudden** colour change seen immediately aqueous sodium thiosulfate is added to aqueous iron(III) nitrate.

start colour .....

end colour .....

[1]

**(c)** Write a suitable scale on the *y*-axis and plot your results from Experiments 1 to 5 on Fig. 1.2. Draw a smooth curve of best fit.

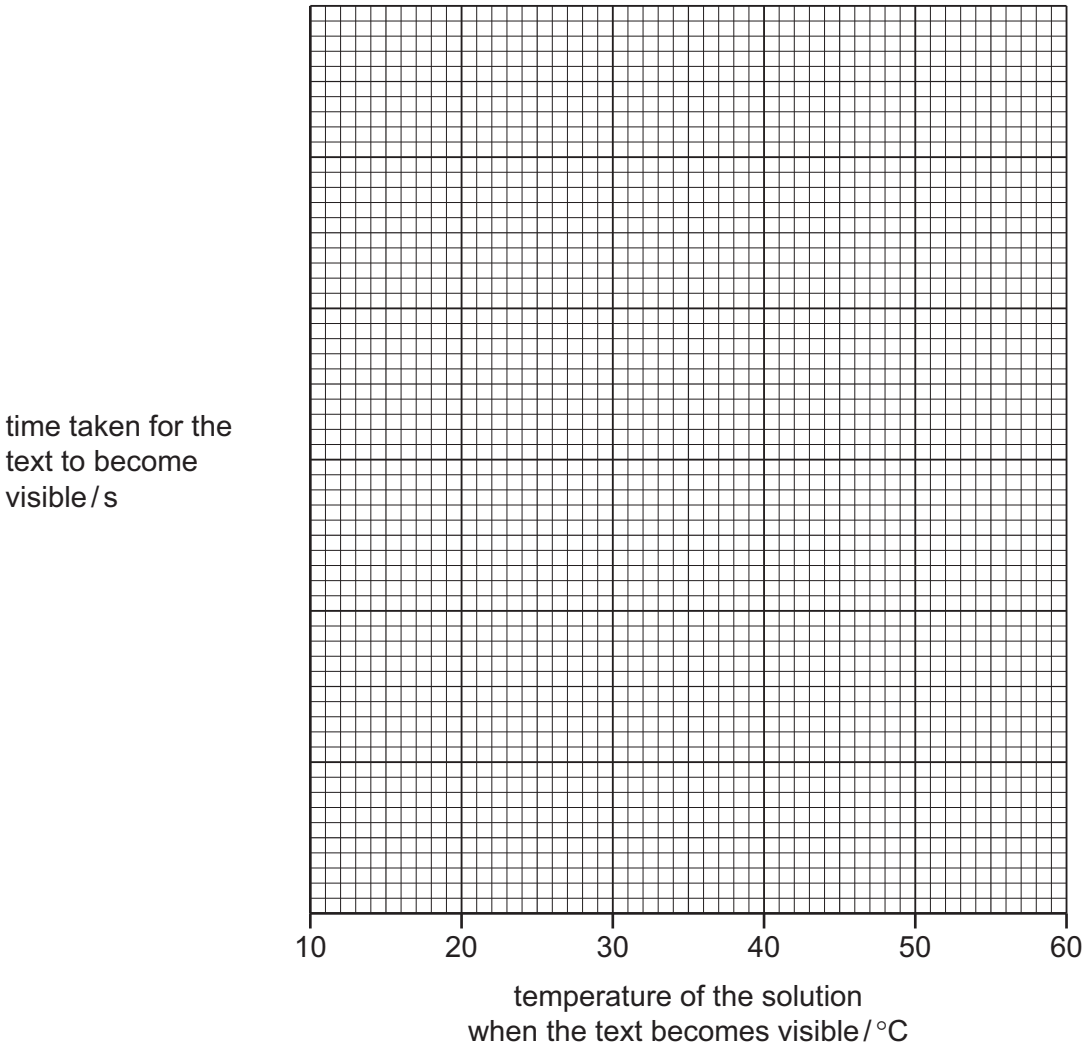



**Fig. 1.2**

[4]

**(d)** Deduce the experiment in which the rate of reaction is fastest.

..... [1]

**(e)** Use your graph to predict the temperature of the solution when the text becomes visible after 65 seconds.
Show your working on Fig. 1.2.

temperature = ..... °C [2]

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**[Turn over**

**(f)** Explain why wrapping the beaker in cotton wool after it has been heated will improve the accuracy of the results obtained.

.....

..... [2]

**(g) (i)** Explain why it would be an improvement to measure the volume of aqueous iron(III) nitrate in a burette rather than a measuring cylinder.

.....

..... [1]

**(ii)** Suggest why it would **not** be an improvement to add the aqueous sodium thiosulfate using a pipette.

.....

..... [1]

**(h)** Suggest why the aqueous sodium thiosulfate must be added after the aqueous iron(III) nitrate has been heated and **not** before it is heated.

.....

..... [1]

**(i)** Describe how the results of the experiment would change if the experiment is repeated using a 250 $cm^3$ beaker instead of the 100 $cm^3$ beaker.
Explain your answer.

change in results .....

explanation .....

.....
[2]

[Total: 19]

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**2** You are provided with two substances: solution **F** and solid **G**.
Do the following tests on the substances, recording all of your observations at each stage.

**Tests on solution F**

**(a)** Carry out a flame test on solution **F**.

Record your observations.

..... [1]

Divide the remaining solution **F** into two approximately equal portions in one boiling tube and one test-tube.

**(b) (i)** To the first portion of solution **F** in the boiling tube, add about 1 cm depth of aqueous sodium hydroxide and a piece of aluminium foil. Warm the mixture gently. Test any gas produced.

Record your observations.

.....

..... [2]

**(ii)** Identify the gas made in **(i)**.

..... [1]

**(c)** To the second portion of solution **F**, add a few drops of dilute sulfuric acid.

Record your observations.

.....

..... [1]

**(d)** Identify solution **F**.

.....

..... [2]

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**[Turn over**

**Tests on solid G**

**(e)** Place about half of solid **G** in a hard-glass test-tube. Heat the solid gently.

Record your observations.

.....

.....

.....

..... [2]

**(f)** Place the remaining solid **G** in a boiling tube.
Add about 10 $cm^3$ of dilute sulfuric acid to the boiling tube. Test any gas produced.

**Keep the solution formed for use in (g).**

Record your observations.

.....

.....

.....

..... [3]

**(g)** Leave the solution from **(f)** to settle for about three minutes. Carefully pour about 1 cm depth of the **solution** from **(f)** into another boiling tube.

To this solution, add excess aqueous sodium hydroxide.

Record your observations.

.....

..... [1]

**(h)** Identify the ions in solid **G**.

.....

.....

..... [2]

[Total: 15]

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**3** A metal polish is a mixture of four substances.
The properties of these substances are shown in Table 3.1.

**Table 3.1**

| name of substance | solubility in water | reaction with dilute nitric acid |
|---|---|---|
| propanol | soluble | dissolves |
| ethanoic acid | soluble | dissolves |
| iron(III) oxide | insoluble | reacts when warmed to form a soluble salt |
| silicon(IV) oxide | insoluble | no reaction |

Plan an experiment to find the percentage by mass of silicon(IV) oxide in the mixture. Your plan should include how you will calculate the percentage of silicon(IV) oxide in the mixture.

You are provided with a sample of the metal polish, dilute nitric acid and common laboratory apparatus.

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..... [6]

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## Notes for use in qualitative analysis

### Tests for anions

| anion | test | test result |
|---|---|---|
| carbonate, $CO_3^{2-}$ | add dilute acid, then test for carbon dioxide gas | effervescence, carbon dioxide produced |
| chloride, $Cl^-$ [in solution] | acidify with dilute nitric acid, then add aqueous silver nitrate | white ppt. |
| bromide, $Br^-$ [in solution] | acidify with dilute nitric acid, then add aqueous silver nitrate | cream 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. |
| sulfite, $SO_3^{2-}$ | add a small volume of acidified aqueous potassium manganate(VII) | the acidified aqueous potassium manganate(VII) changes colour from purple to colourless |

### 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. or very slight white ppt. |
| chromium(III), $Cr^{3+}$ | green ppt., soluble in excess | green ppt., insoluble in excess |
| 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, ppt. turns brown near surface on standing | green ppt., insoluble in excess, ppt. turns brown near surface on standing |
| 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 |

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## Tests for gases

| gas | test and test result |
|---|---|
| ammonia, $NH_3$ | turns damp red litmus paper blue |
| carbon dioxide, $CO_2$ | turns limewater milky |
| 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 acidified aqueous potassium manganate(VII) from purple to colourless |

## Flame tests for metal ions

| metal ion | flame colour |
|---|---|
| lithium, $Li^+$ | red |
| sodium, $Na^+$ | yellow |
| potassium, $K^+$ | lilac |
| calcium, $Ca^{2+}$ | orange-red |
| barium, $Ba^{2+}$ | light green |
| copper(II), $Cu^{2+}$ | blue-green |

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