Cambridge Assessment International Education

Cambridge IGCSE™

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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.

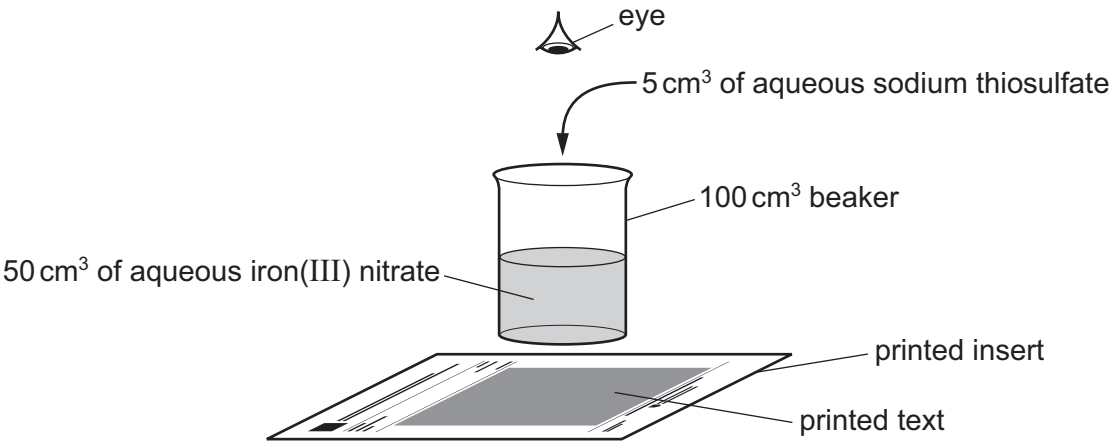

Fig. 1.1

(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.

View solution

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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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]

View solution

(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.

View solution

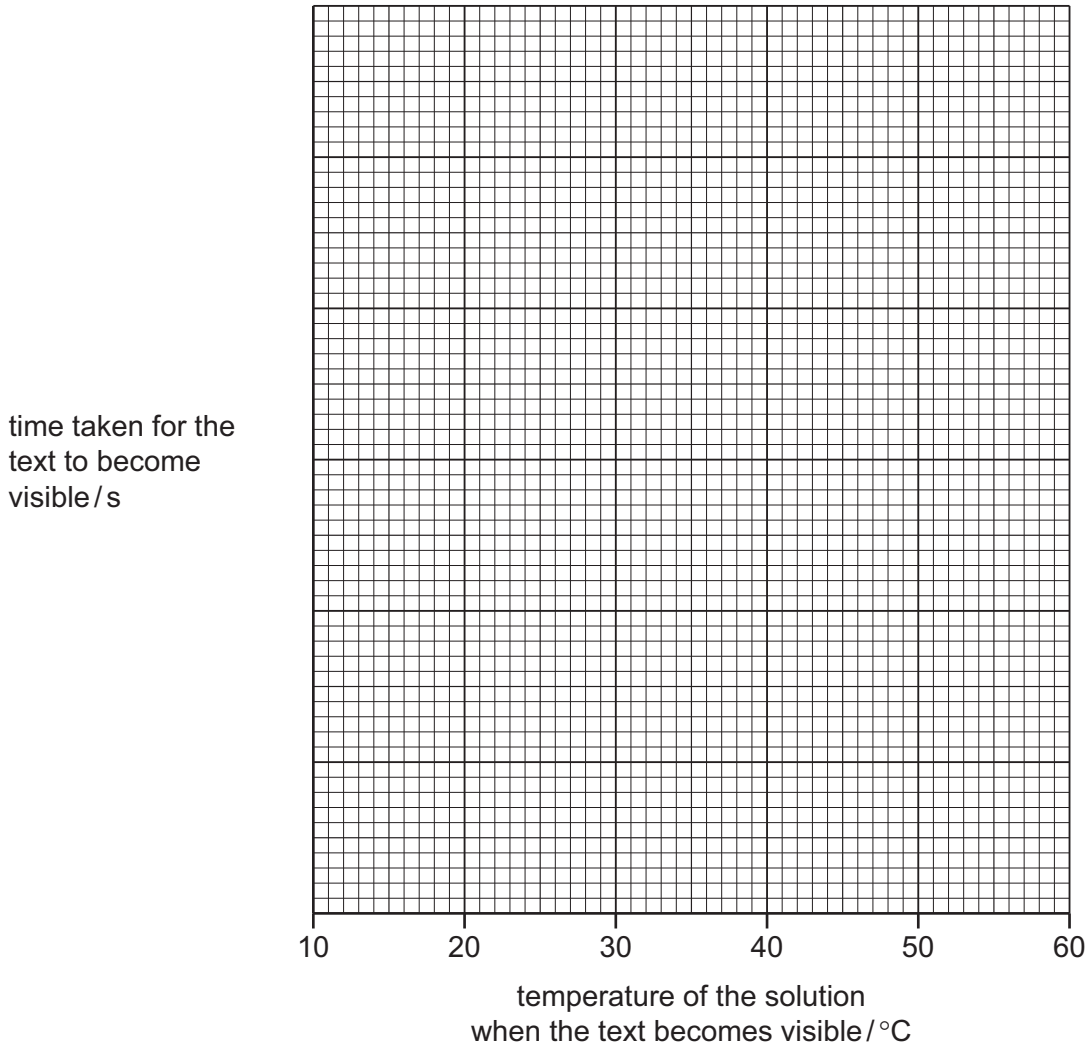

Fig. 1.2

[4]

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

View solution

..... [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]

View solution

(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.

View solution

change in results .....

explanation .....

.....

[2]

[Total: 19]

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**.

View solution

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.

View solution

Record your observations.

.....

..... [2]

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

View solution

..... [1]

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

View solution

Record your observations.

.....

..... [1]

(d) Identify solution **F**.

View solution

.....

..... [2]

Tests on solid G

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

View solution

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.

View solution

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.

View solution

To this solution, add excess aqueous sodium hydroxide.

Record your observations.

.....

..... [1]

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

View solution

.....

.....

..... [2]

[Total: 15]

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

View solution

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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