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CHEMISTRY **0620/52**

Paper 5 Practical Test **October/November 2024**

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 the rate of the reaction between aqueous iron(III) nitrate and aqueous sodium thiosulfate.

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.

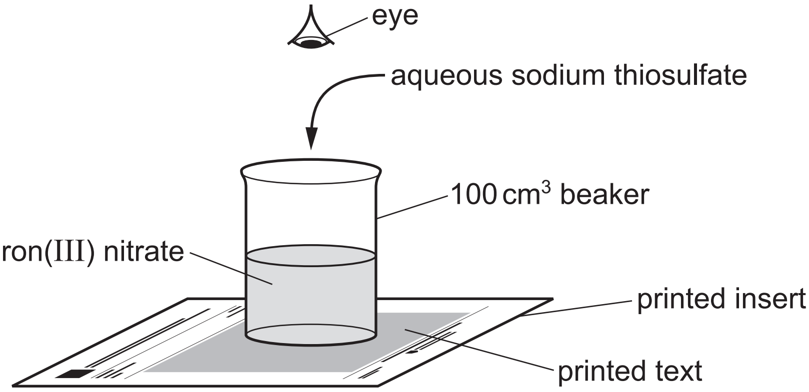

Fig. 1.1

(a) Experiment 1

- Use the 50 cm^3 measuring cylinder to pour 50 cm^3 of aqueous iron(III) nitrate into the 100 cm^3 beaker.
- Stand the beaker on the printed text of the insert as shown in Fig. 1.1.
- Use the 25 cm^3 measuring cylinder to pour 15.0 cm^3 of aqueous sodium thiosulfate into the beaker. At the same time start the stop-watch.
- Stir the contents of the beaker.
- Look down from above the beaker. When the printed text on the insert becomes visible, stop the stop-watch and record the time in seconds to the nearest whole number in Table 1.1.
- Rinse the beaker with distilled water.

Experiment 2

- Use the 50 cm^3 measuring cylinder to pour 50 cm^3 of aqueous iron(III) nitrate into the 100 cm^3 beaker.
- Stand the beaker on the printed text of the insert as shown in Fig. 1.1.
- Use the 10 cm^3 measuring cylinder to pour 10.0 cm^3 of aqueous sodium thiosulfate into the beaker. At the same time start the stop-watch.
- Stir the contents of the beaker.
- Look down from above the beaker. When the printed text on the insert becomes visible, stop the stop-watch and record the time in seconds to the nearest whole number in Table 1.1.
- Rinse the beaker with distilled water.

Experiment 3

- Repeat Experiment 2, using 7.0 cm^3 of aqueous sodium thiosulfate instead of 10.0 cm^3.

Experiment 4

- Repeat Experiment 2, using 6.0 cm^3 of aqueous sodium thiosulfate instead of 10.0 cm^3.

Experiment 5

- Repeat Experiment 2, using 5.0 cm^3 of aqueous sodium thiosulfate instead of 10.0 cm^3.

Table 1.1

experiment	1	2	3	4	5
volume of aqueous sodium thiosulfate / cm^3					
time taken for text to become visible / s					

[4]

(b) 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.

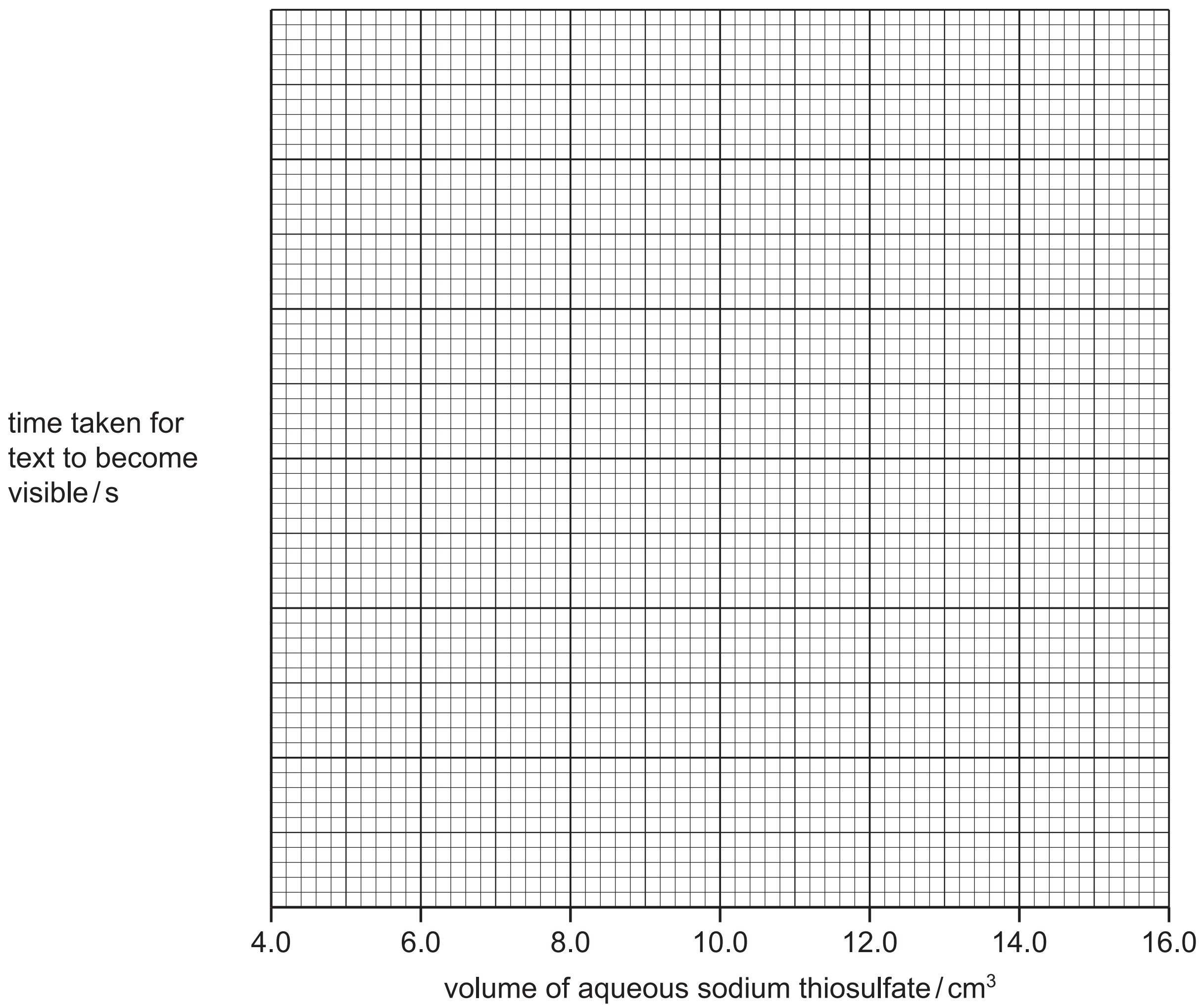

Fig. 1.2

[4]

(c) State why the contents of the beaker are stirred after adding the aqueous sodium thiosulfate to the aqueous iron(III) nitrate.

....

.... [1]

(d) Deduce which experiment has the highest rate of reaction.

.... [1]

(e) Use your graph in Fig. 1.2 to predict the time taken for the text to become visible if the volume of aqueous sodium thiosulfate is 12.5 cm^3.
Show your working on Fig. 1.2.

time = ... [3]

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

....

.... [1]

(ii) Explain why it is **not** possible to use a volumetric pipette to measure the volumes of the aqueous sodium thiosulfate used in the experiments.

....

.... [1]

(iii) Describe how the reliability of the results of this investigation can be checked.

....

.... [1]

(g) Describe how the results of the experiments would change if the experiments are repeated using a narrower and taller beaker.
Explain your answer.

change in results ....

explanation ....

....
[2]

(h) Describe additional measurements that must be taken to determine whether the reaction in this investigation is exothermic or endothermic.

....

.... [1]

[Total: 19]

2 You are provided with two solids: solid **M** and solid **N**.

Do the following tests on solid **M** and solid **N**. Record all of your observations at each stage.

Tests on solid M

(a) Carry out a flame test on solid **M**.

Record your observations.

.... [1]

Transfer the remaining solid **M** to a boiling tube. Add about 5 cm depth of distilled water to solid **M**, place a stopper in the boiling tube and shake the boiling tube to dissolve solid **M** and form solution **M**. Divide solution **M** into four approximately equal portions in one boiling tube and three test-tubes.

(b) To the first portion of solution **M** in the boiling tube, add aqueous sodium hydroxide dropwise until it is in excess.

Record your observations.

....

.... [2]

(c) To the second portion of solution **M** in a test-tube, add the piece of magnesium ribbon.

Record your observations.

....

.... [1]

(d) To the third portion of solution **M** in a test-tube, add about 2 cm depth of aqueous hydrogen peroxide.

Record your observations.

....

.... [2]

(e) To the fourth portion of solution **M** in a test-tube, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate. Leave the mixture to stand for about two minutes.

Record your observations.

....

.... [1]

(f) Identify the **three** ions in solid **M**.

....

....

.... [3]

Tests on solid N

(g) Transfer approximately half of solid **N** to a boiling tube. Add about 5 cm depth of dilute sulfuric acid to the boiling tube. Test any gas produced.

Record your observations.

....

.... [2]

(h) Add the remaining solid **N** to a boiling tube and add about 2 cm depth of distilled water.
Do **not** place a stopper in the boiling tube.
Shake the boiling tube carefully to dissolve solid **N** and form solution **N**.

To solution **N**, add about 2 cm depth of aqueous sodium hydroxide. Gently warm the mixture and test any gas given off.

Record your observations.

....

.... [1]

(i) Identify solid **N**.

....

.... [2]

[Total: 15]

3 Limes and lemons are citrus fruits which contain aqueous citric acid in their juice. Citric acid reacts with alkalis such as aqueous sodium hydroxide.

Plan an investigation to find which of lime juice and lemon juice contains the most concentrated aqueous citric acid. Assume that citric acid is the only acid present in the juices.

Your plan must include:

- the method to use
- how the results are used to determine which juice contains the most concentrated aqueous citric acid.

You are provided with lime juice, lemon juice, aqueous sodium hydroxide and common laboratory apparatus and chemicals.

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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