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CHEMISTRY **0620/53**

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

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	
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1 You are going to investigate the temperature change when solid **P** dissolves in water.

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do two experiments.

(a) Experiment 1

- Use the 25 cm^3 measuring cylinder to pour 20 cm^3 of distilled water into a boiling tube.
- Use the thermometer to measure the temperature of the distilled water. Record this temperature in Table 1.1 at time = 0 seconds.
- Add a 5 g sample of solid **P** to the distilled water in the boiling tube. At the same time start the stop-watch.
- Continually stir the contents of the boiling tube using the thermometer.
- Measure the temperature of the mixture in the boiling tube every 20 seconds for 120 seconds. Record each temperature measured in Table 1.1.
- Rinse the boiling tube with distilled water.

Complete Table 1.1 by calculating the temperature decreases from the temperature at 0 seconds.

For example, at 60 seconds:

temperature decrease = temperature at 0 s – temperature at 60 s

Table 1.1

time / s	0	20	40	60	80	100	120
temperature / °C							
temperature decrease / °C	0.0						

Experiment 2

- Repeat Experiment 1 using 10 cm^3 of distilled water instead of the 20 cm^3 of distilled water.
- Record your results for Experiment 2 in Table 1.2.

Complete Table 1.2 by calculating the temperature decreases from the temperature at 0 seconds.

Table 1.2

time / s	0	20	40	60	80	100	120
temperature / °C							
temperature decrease / °C	0.0						

[5]

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(b) Complete a suitable scale on the *y*-axis and plot your results from Experiment 1 and Experiment 2 on Fig. 1.1.
Draw **two** lines of best fit. Both of your lines of best fit **must** go to (0,0). Label both lines.

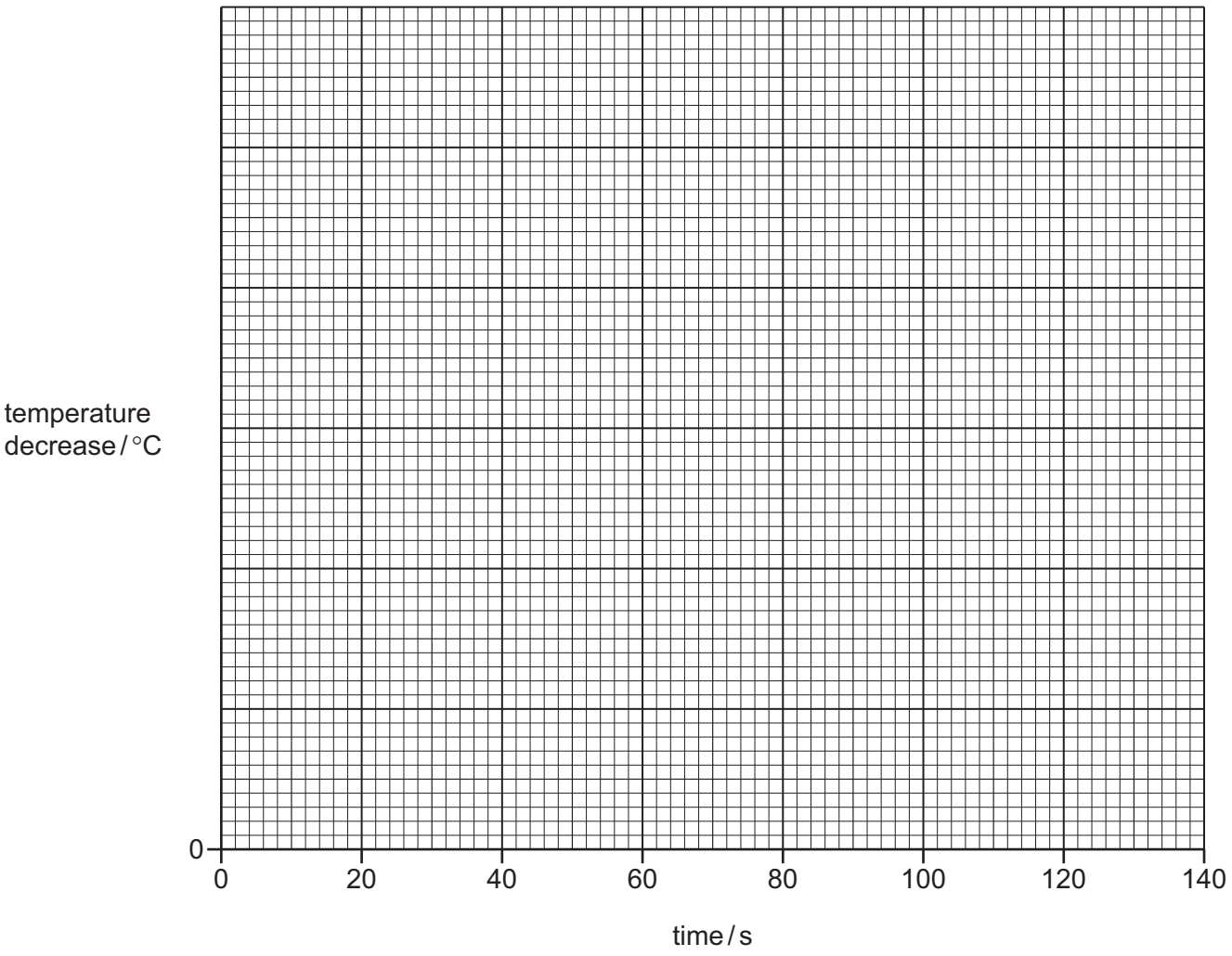

Fig. 1.1

[4]

(c) State whether the energy change in Experiment 1 is exothermic or endothermic.
Explain your answer.

.....

..... [1]

(d) Compare the maximum temperature decrease in Experiment 1 with the maximum temperature decrease in Experiment 2.

.....

.....

..... [2]

(e) **From your graph in Fig. 1.1**, deduce the temperature decrease in Experiment 2 after 45 seconds.
Show clearly **on Fig. 1.1** how you worked out your answer.

temperature decrease = ... °C [2]

(f) The average rate of temperature decrease in each experiment can be calculated using the equation shown.

$$\text{average rate of temperature decrease} = \frac{\text{temperature decrease}}{\text{time}}$$

Calculate the average rate of temperature decrease in Experiment 1 for 120 seconds.
Give units for the average rate you have calculated.

average rate of temperature decrease = ...

units = ...
[2]

(g) State **two** possible sources of error in these experiments.
For each source of error, suggest an improvement which reduces the error.

source of error 1 .....

improvement 1 .....

.....

source of error 2 .....

improvement 2 .....

.....
[4]

[Total: 20]

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2 You are provided with two solids: solid **R** and solid **S**.
Do the following tests on solid **R** and solid **S**, recording all of your observations at each stage.

Tests on solid R

(a) Transfer about half of solid **R** to a boiling tube. **Gently** heat the solid for about 30 seconds.

Record your observations.

.....

..... [2]

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

(b) To the first portion of solution **R** in a boiling tube, add aqueous sodium hydroxide dropwise and then in excess.

Record your observations.

.....

..... [2]

(c) To the second portion of solution **R** in a boiling tube, add aqueous ammonia dropwise and then in excess.

Record your observations.

.....

..... [2]

(d) To the third portion of solution **R** in the test-tube, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Record your observations.

.....

..... [1]

(e) Identify the **two** ions in solid **R**.

.....

..... [2]

Tests on solid S

(f) Carry out a flame test on solid **S**.

Record your observations.

..... [1]

Transfer the remaining solid **S** to a boiling tube. Add about 4 cm depth of distilled water to the boiling tube and place a stopper in the boiling tube. Shake the boiling tube to dissolve solid **S** and form solution **S**. Divide solution **S** into two approximately equal portions in two test-tubes.

(g) To the first portion of solution **S**, add about 2 cm depth of aqueous sodium hydroxide.

Record your observations.

..... [1]

(h) To the second portion of solution **S**, add a few drops of acidified aqueous potassium manganate(VII).

Record your observations.

..... [1]

(i) Identify solid **S**.

.....

..... [2]

[Total: 14]

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3 A mixture contains three solid compounds:

- aluminium oxide
- calcium carbonate
- calcium chloride.

Table 3.1 gives some information about the three compounds in the mixture.

Table 3.1

name of compound	solubility in water	effect of adding aqueous sodium hydroxide
aluminium oxide	insoluble	reacts to form a soluble compound
calcium carbonate	insoluble	no effect
calcium chloride	soluble	reacts to form an insoluble compound

Plan an experiment to find the percentage by mass of calcium carbonate in the mixture. Your plan must include how you will calculate the percentage by mass of calcium carbonate in the mixture.

You are provided with a sample of the mixture, distilled water, aqueous sodium hydroxide and common laboratory apparatus.

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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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