Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/52**

Paper 5 Practical Test **May/June 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	
1	
2	
3	
4	
Total	

This document has **16** pages. Any blank pages are indicated.

DC (CJ/SG) 329577/4

1 You are going to investigate the effect of enzyme concentration on the breakdown of a substance.

Catalase is an enzyme found in peas that breaks down hydrogen peroxide into water and oxygen gas. The word equation for the reaction is shown.

$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water + oxygen}$$

When peas are added to a solution of hydrogen peroxide and detergent, the oxygen gas causes a frothy layer of bubbles to form on top.

The rate of this reaction can be estimated by measuring the height of the layer of bubbles formed. This is shown as *h* in Fig. 1.1.

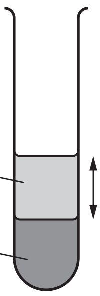


Fig. 1.1

You are provided with peas soaked in distilled water.

(a) Procedure

Step 1 Label five boiling tubes **0**, **1**, **2**, **4** and **8**.

Step 2 Use the 10 cm^3 syringe to add 10.0 cm^3 of hydrogen peroxide to each labelled boiling tube.

Step 3 Use the 1 cm^3 syringe to add 1.0 cm^3 of detergent to the five boiling tubes and stir gently to mix.

Step 4 Add the number of peas shown in Table 1.1 to the five labelled boiling tubes.

Table 1.1

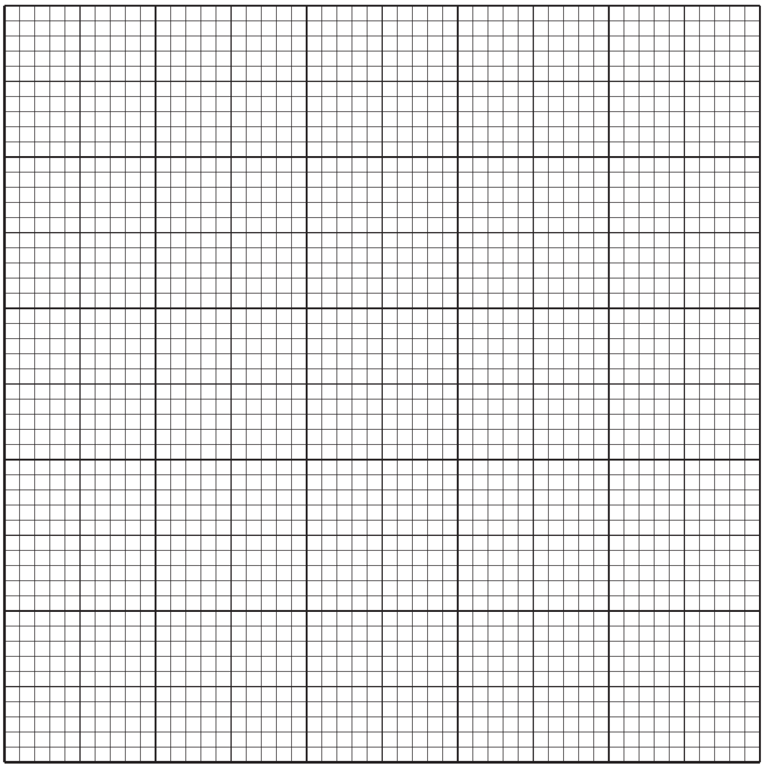
boiling tube	number of peas added	height *h* / mm
0	0	
1	1	
2	2	
4	4	
8	8	

Step 5 Start the stop-clock and wait for 5 minutes.

Step 6 At 5 minutes, measure the height *h* of the layer of bubbles formed.

(i) Record in Table 1.1 the value of *h* in each of the five boiling tubes. [3]

(ii) On the grid, plot a graph of height *h* (vertical axis) against the number of peas added.



[3]

(iii) Draw the line of best fit. [1]

(iv) Use your graph to estimate the height *h* when **six** peas are used.

Show on the graph how you obtain your value.

height *h* = ... mm [2]

(v) Describe the relationship between height *h* and the number of peas added.

....

.... [1]

(vi) Use your answer to **(a)(v)** to determine the relationship between the concentration of catalase and the rate of breakdown of hydrogen peroxide.

....

.... [1]

(b) Identify **one** source of error when measuring height *h* in **step 6**.

....

.... [1]

(c) A student does the same investigation. The student repeats the procedure several times for each boiling tube.

Suggest how repeating the procedure allows the student to evaluate the quality of the data.

....

.... [1]

[Total: 13]

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2 You are going to investigate the identity of unknown solution **X**.

(a) Procedure

- Pour approximately 2 cm depth of solution **X** into test-tubes **1** to **4**.
- Place a clean wooden splint into test-tube **4** and leave it to soak.
- Do each test as described in Table 2.1.
- Record your observations in Table 2.1.

Table 2.1

test-tube	test	observations
1	Add approximately 2 cm depth of aqueous sodium carbonate to solution **X**. Leave for one minute.	
2	Add approximately 2 cm depth of dilute nitric acid followed by a further 2 cm depth of aqueous barium nitrate to solution **X**. Leave for one minute.	
3	Add approximately 2 cm depth of dilute nitric acid followed by five drops of aqueous silver nitrate to solution **X**. Leave for one minute.	
4	Take the splint soaking in solution **X** and place it into a blue Bunsen burner flame. Record the immediate colour seen. If you do not see any colour, dip the splint in the solution and replace into the flame.	

[4]

(b) Explain why it is difficult to identify the positive ion (cation) present in solution **X** using the procedure for test-tube **4**.

....

.... [1]

(c) Identify the negative ion (anion) present in solution **X**.

State which test you use to make this identification.

negative ion is ....

test ....
[2]

[Total: 7]

3 When an aqueous salt solution is left in an open container, the mass of the solution decreases. This is because some of the water evaporates.

Plan an investigation to determine the relationship between the concentration of salt solution and the rate of evaporation of water from the salt solution.

You are provided with:

- distilled water
- solid salt.

You may use any other common laboratory apparatus in your plan.

You are not required to do this investigation.

In your plan, include:

- the apparatus you will use
- a brief description of the method
- what you will measure
- which variables you will keep constant
- how you will process your results to draw a conclusion.

You may include a labelled diagram if you wish.

You may include a table that can be used to record the results if you wish.
You do **not** need to include any results in the table.

....

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....

....

....

....

....

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....

....

....

.... [7]

4 You are going to compare the rate at which hot water cools in a beaker with and without a lid.

You have a cardboard disc with a small circular hole in the centre to use as a lid.
Arrange the equipment as shown in Fig. 4.1.

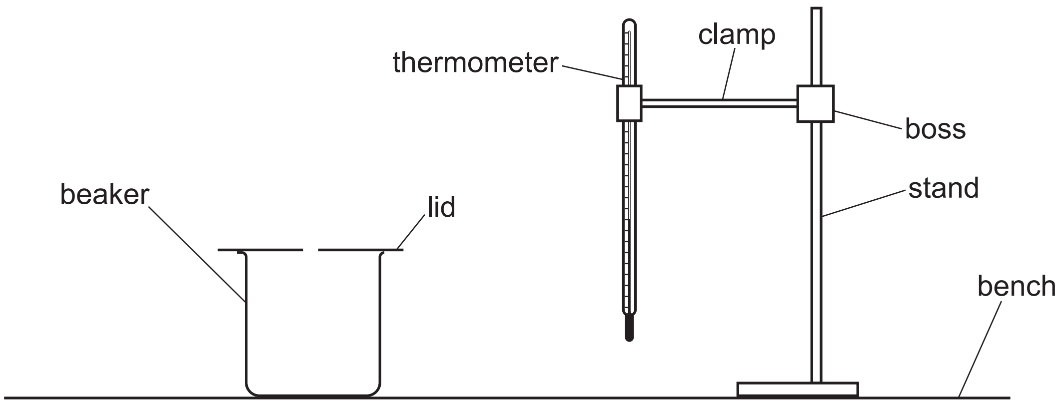

Fig. 4.1

(a) (i) Procedure

- Remove the lid from the beaker and carefully add 100 cm^3 of hot water to the empty beaker.
- Put the cardboard lid on top of the beaker.
- Put the thermometer through the hole in the lid into the hot water in the beaker.
- Wait for 30 s after placing the thermometer in the hot water.
- Record in Table 4.1 the temperature on the thermometer θ_A at time t = 0 to one decimal place.
- Start the stop-clock.
- Measure θ_A every 30 s for 180 s and record the results in Table 4.1.
- Move the clamp and thermometer away from the beaker.

Table 4.1

time t / s	temperature θ_A (with a lid) / °C	temperature θ_B (without a lid) / °C
0		
30		
60		
90		
120		
150		
180		

[2]

(ii) Repeat the procedure in **(a)(i)** but without using the lid.

Record in Table 4.1 the temperatures θ_B for the beaker without the lid. [2]

(b) **(i)** Calculate the total change in temperature between $t = 0$ and $t = 180\,s$ for the beaker with a lid $\Delta\theta_A$ and for the beaker without a lid $\Delta\theta_B$.

$\Delta\theta_A$ = ... °C

$\Delta\theta_B$ = ... °C

[1]

(ii) Calculate the average rate of cooling R of the water for each experiment.

Use the equation shown.

$$R = \frac{\Delta\theta}{\Delta t} \qquad \text{where } \Delta t = 180\,\text{s}$$

Give your answers to **two** significant figures.

Determine the unit for the rate of cooling.

R_A = ...

R_B = ...

unit = ...

[3]

(iii) Two results are equal within the limits of experimental accuracy if the values are within 10% of each other.

Use your answers to **(b)(ii)** to state whether the rate of cooling R_A in the beaker with a lid is equal to the rate of cooling R_B in the beaker without a lid.

Support your answer with a calculation.

calculation

statement ....

....

.... [2]

(c) (i) State how to avoid parallax (line of sight) error when reading the thermometer.

....

.... [1]

(ii) Suggest **two** improvements to the procedure described in **(a)**.

1 ....

....

2 ....

.... [2]

[Total: 13]

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NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests 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.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt. or very slight white 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

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

Flame tests for metal ions

metal ion	flame colour
lithium (Li^+)	red
sodium (Na^+)	yellow
potassium (K^+)	lilac
copper(II) (Cu^{2+})	blue-green