Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

COMBINED SCIENCE **0653/62**

Paper 6 Alternative to Practical **May/June 2024**

1 hour

You must answer on the question paper.

No additional materials are needed.

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 [ ].

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

DC (PB/CT) 330921/4

1 A student investigates 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, 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.

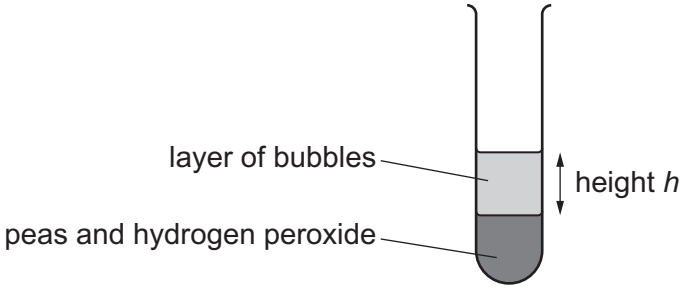


Fig. 1.1

(a) Procedure

The student:

Step 1 adds 10 cm^3 of hydrogen peroxide to each of five boiling tubes, **A**, **B**, **C**, **D** and **E**

Step 2 adds different numbers of peas to each boiling tube

Step 3 waits 5 minutes and then measures the height *h* in each boiling tube.

Fig. 1.2 shows the boiling tubes at the end of 5 minutes. These are drawn to scale.

4

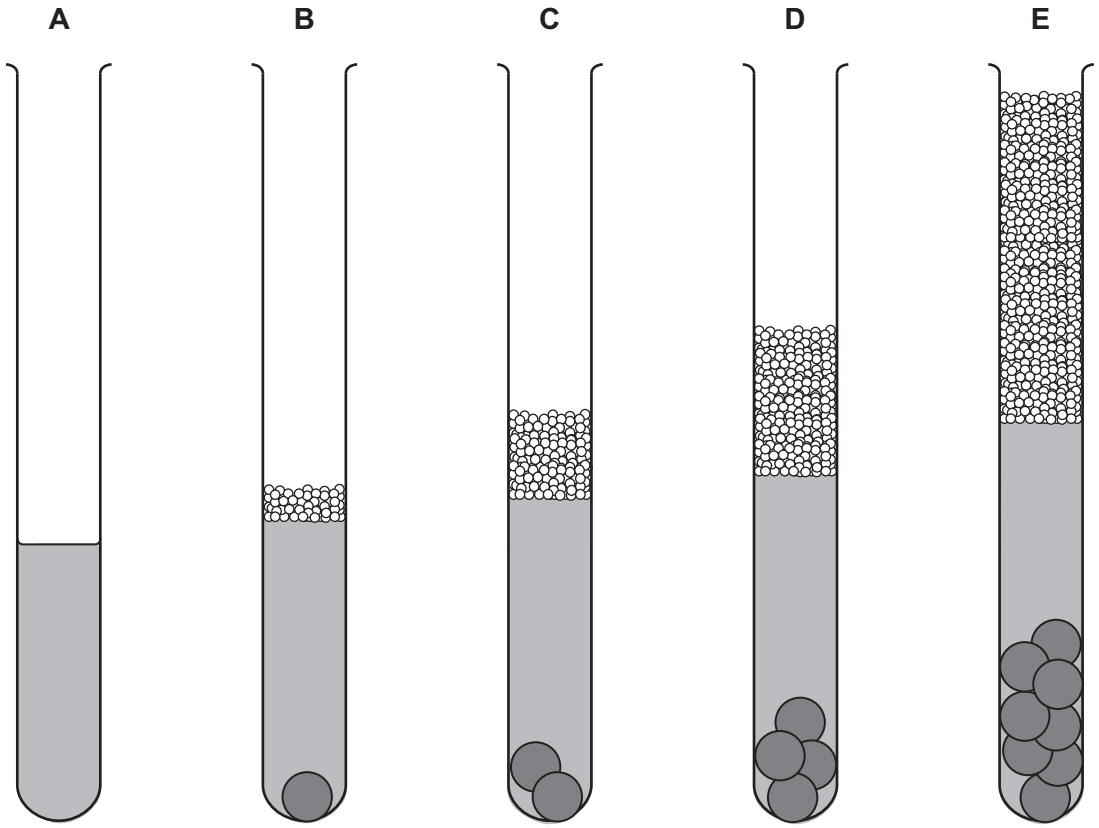


Fig. 1.2

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

Table 1.1

boiling tube	number of peas added	height *h*/mm
A	0	
B	1	
C	2	
D	4	
E	8	

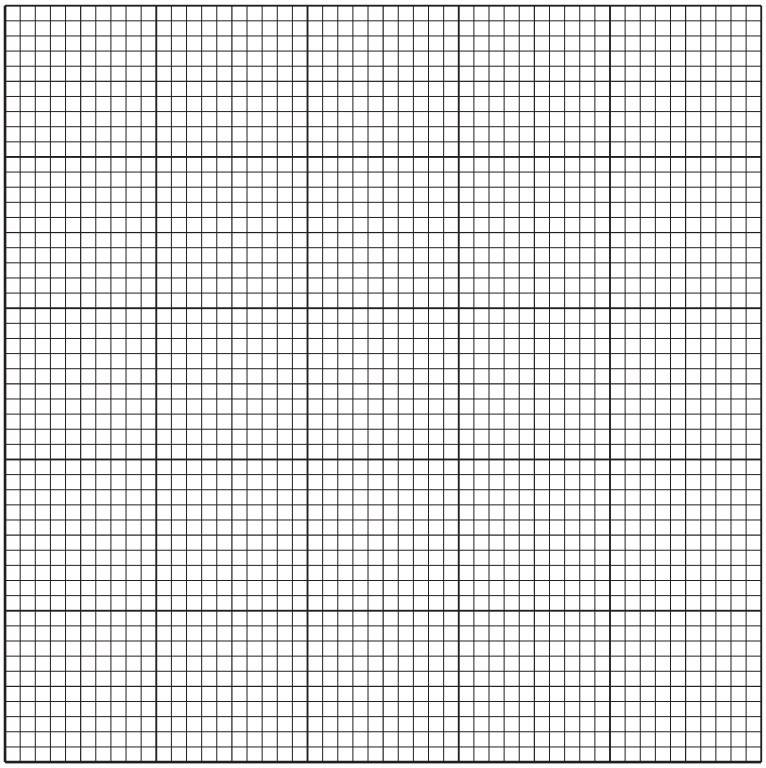
[2]

(ii) Explain why the height of the bubbles is measured from the top of the hydrogen peroxide rather than from the bottom of the test-tube.

.....

..... [1]

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



[3]

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

(v) 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]

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

.....

..... [1]

(vii) Use your answer to **(a)(vi)** 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 **(a)(i)**.

.....

..... [1]

(c) 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]

2 A student investigates the identity of unknown solution **X**.

Procedure

The student does each test described in Table 2.1 on separate samples of solution **X**.

The observations are shown in Table 2.1.

Table 2.1

test number	test	observations
1	Add aqueous sodium carbonate to solution **X**.	light blue precipitate
2	Add dilute nitric acid followed by aqueous barium nitrate to solution **X**.	remains a blue solution
3	Add dilute nitric acid followed by aqueous silver nitrate to solution **X**.	white precipitate in a blue solution
4	Soak a wooden splint in solution **X** and hold the splint in a blue Bunsen burner flame.	blue-green flame for a few seconds and then a yellow flame

(a) Test **4** is called the flame test.

(i) Explain why it is difficult to identify the positive ion (cation) present in solution **X** using the flame test in test **4**.

.....

..... [1]

(ii) Explain why the student does **not** use a yellow Bunsen burner flame for the flame test.

.....

..... [1]

(b) Solution **X** is blue.

In test **3**, the precipitate appears to be blue.

Describe what the student does to confirm the precipitate is white and not blue.

.....

..... [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]

(d) Solution **X** contains Cu^{2+} ions.

The student adds aqueous ammonia to solution **X** until the ammonia is in excess.

Describe the observations made by the student.

.....

..... [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.

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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..... [7]

4 A student compares the rate at which hot water cools in a beaker with and without a lid.

The apparatus used for the beaker without a lid is shown in Fig. 4.1.

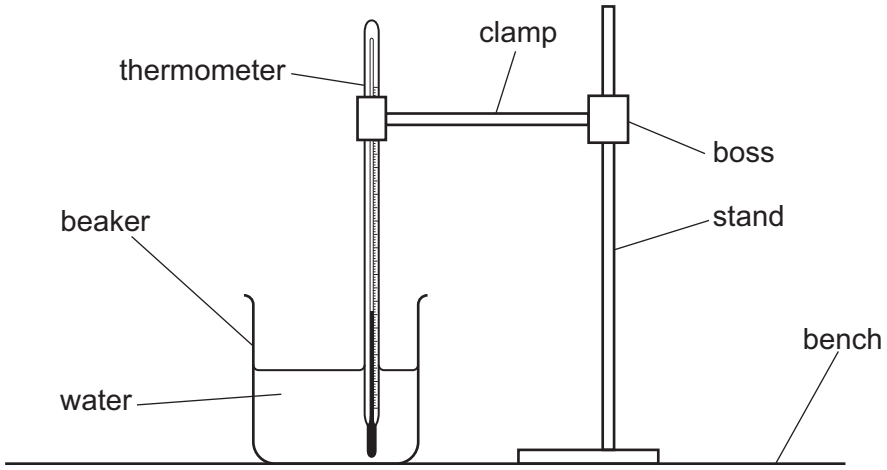

Fig. 4.1

(a) Procedure

The student:

- adds 100 cm^3 of hot water to a beaker
- places a thermometer in the hot water in the beaker
- waits for 30 s after placing the thermometer in the hot water
- measures the temperature θ_A on the thermometer at time t = 0 and immediately starts a stop-clock
- records θ_A at time t = 0 in Table 4.1
- measures and records θ_A every 30 s for 180 s
- empties the beaker.

The student repeats the procedure for the beaker with a cardboard lid on top, recording the temperatures as θ_B.

Fig. 4.2 shows the reading on the thermometer after 60 s in the beaker without a lid and after 60 s in the beaker with a lid.

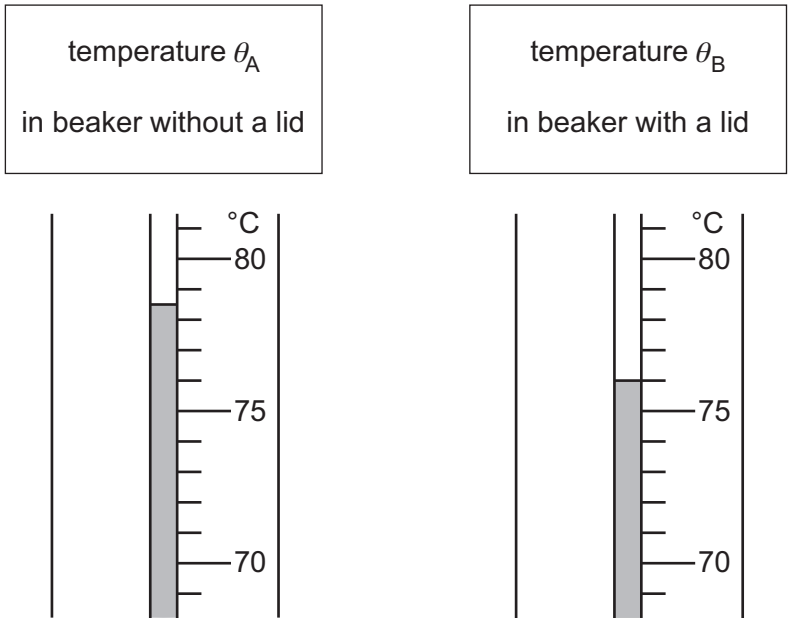

Fig. 4.2

(i) Record in Table 4.1 the two temperatures for time t = 60 s.

Table 4.1

time t /s	temperature θ_A (without a lid) / °C	temperature θ_B (with a lid) / °C
0	84.0	79.0
30	81.0	77.5
60		
90	75.5	74.0
120	73.0	77.0
150	71.0	71.5
180	69.0	70.0

[2]

(ii) Circle the anomalous result in Table 4.1. [1]

(b) (i) Calculate the total change in temperature between t = 0 and t = 180 s for the beaker without a lid $\Delta\theta_A$ and for the beaker with 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 without a lid is equal to the rate of cooling R_B in the beaker with 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) State the name of a piece of apparatus suitable for measuring the 100 cm^3 of hot water.

..... [1]

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

1 .....

.....

2 .....

..... [2]

[Total: 13]

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