Cambridge Assessment International Education

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COMBINED SCIENCE **0653/63**

Paper 6 Alternative to Practical **May/June 2025**

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 [ ].
- Notes for use in qualitative analysis are provided in the question paper.

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

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1 A student investigates the effect of oxygen concentration on the germination of pea seeds.

Fig. 1.1 shows a germinated pea seed.

Fig. 1.1

(a) Procedure

The student:

- assembles the apparatus as shown in Fig. 1.2 and leaves the five flasks for three days
- records in Table 1.1 the number of pea seeds that germinate.

Each flask contains a different percentage concentration of oxygen.

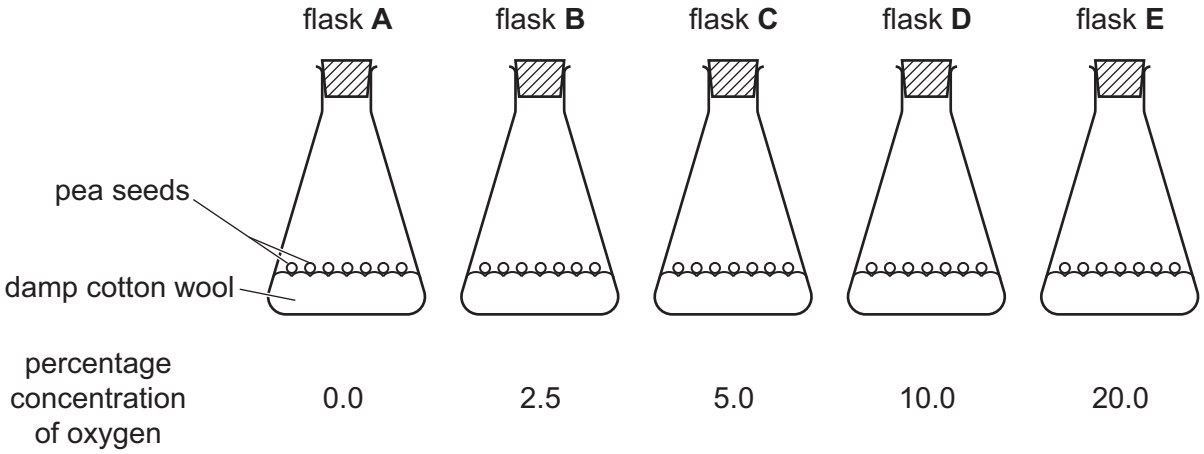


Fig. 1.2

(i) Fig. 1.3 shows the pea seeds from flask **B**.

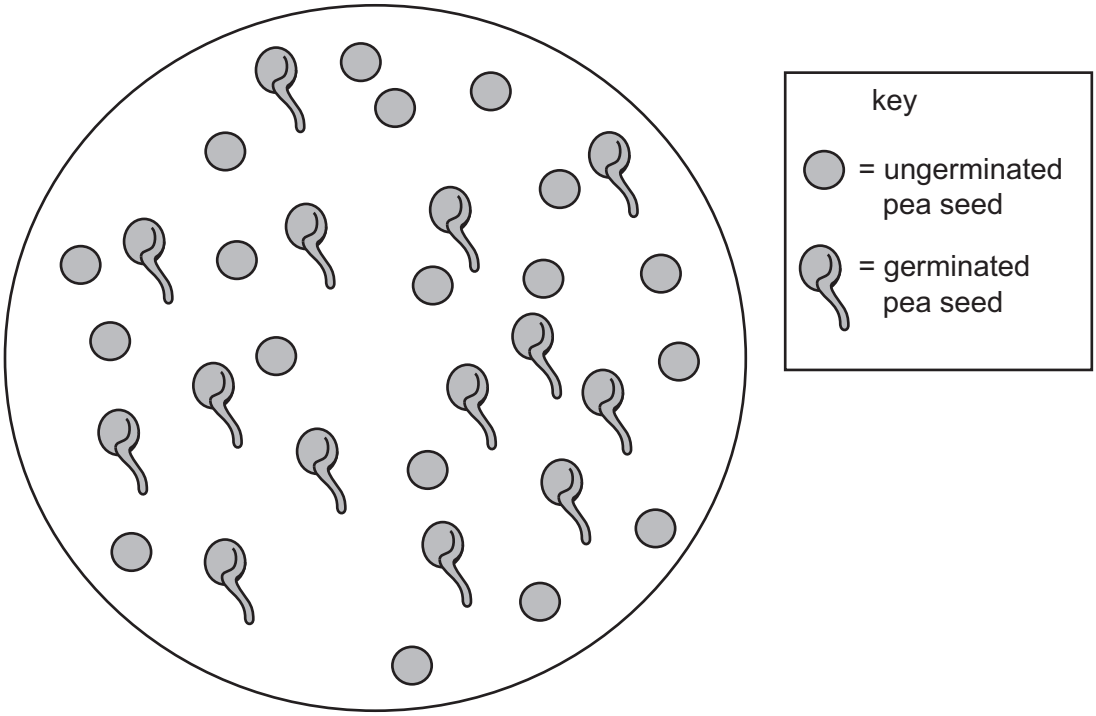


Fig. 1.3

Count the number of ungerminated pea seeds and the number of germinated pea seeds in Fig. 1.3.

Record these values in Table 1.1.

Table 1.1

flask	percentage concentration of oxygen	number of ungerminated pea seeds	number of germinated pea seeds	total number of pea seeds in flask	percentage of pea seeds that germinate
A	0.0	32	0	32	0
B	2.5			32	
C	5.0	6	25	31	81
D	10.0	2	28	30	93
E	20.0	0	34	34	100

[2]

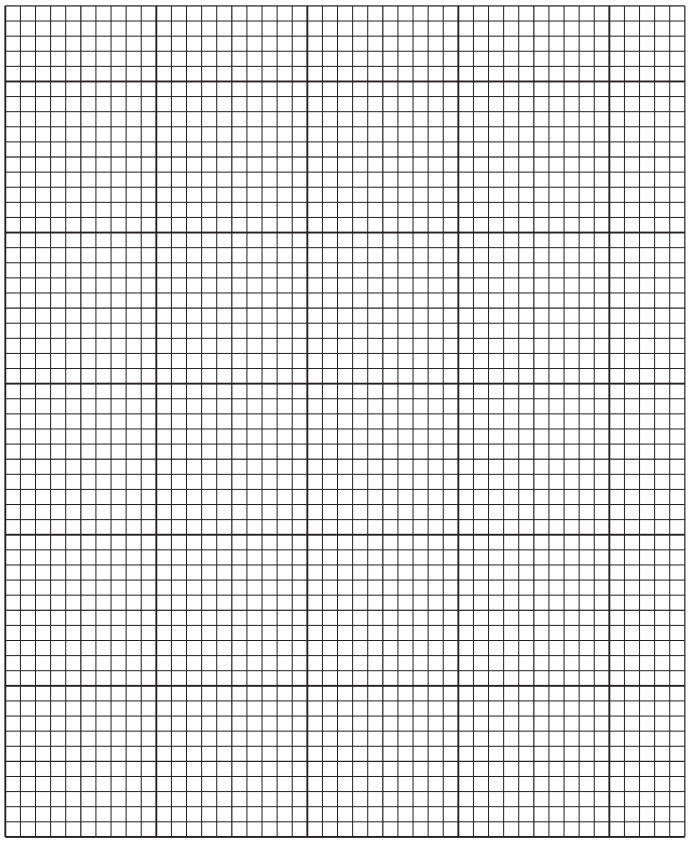
(ii) Calculate the percentage of pea seeds that germinate in flask **B**.

Use the equation shown.

$$\text{percentage of pea seeds that germinate} = \frac{\text{number of germinated pea seeds}}{\text{total number of pea seeds in flask}} \times 100$$

Record this value in Table 1.1. [1]

(iii) On the grid, plot the percentage of pea seeds that germinate (vertical axis) against the percentage concentration of oxygen.



[3]

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

(v) Describe the relationship between the percentage concentration of oxygen and the percentage of pea seeds that germinate.

.....

..... [1]

(vi) Explain why the percentage of pea seeds that germinate is plotted and **not** the number of pea seeds that germinate.

.....

..... [1]

(vii) The student observes that the pea seeds produce heat when they germinate.

This means that the investigation is **not** a fair test.

Explain why.

.....

.....

.....

..... [2]

(viii) State **one** factor that is kept constant for all five flasks in this investigation.

.....

..... [1]

(b) As seeds germinate they produce reducing sugars.

State the reagent used to confirm the presence of reducing sugars.

..... [1]

[Total: 13]

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2 A student investigates a white solid **H**.

(a) The student adds a sample of **H** to aqueous sodium hydroxide in a boiling tube.

The student carefully warms the boiling tube.

The student concludes that **H** contains the ammonium ion.

Describe the observations the student makes to form this conclusion.

.....

..... [1]

(b) The student adds a sample of **H** to dilute hydrochloric acid.

The student concludes that **H** contains the carbonate ion.

Describe the observations the student makes to form this conclusion.

.....

..... [1]

(c) Solid **H** reacts when it is heated.

Procedure

The student:

- puts some **H** into a test-tube
- uses a balance to measure the mass of the test-tube and **H**
- heats the test-tube for two minutes with a blue Bunsen burner flame
- allows the test-tube to cool down
- uses a balance to measure the mass of the test-tube and its contents.

(i) Explain why the student uses a blue Bunsen burner flame rather than a yellow flame.

.....

..... [1]

(ii) The total mass of the test-tube and **H** before heating is 15.7 g.

Fig. 2.1 shows the reading on the balance after heating for two minutes.

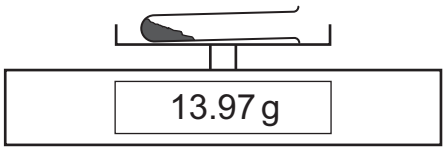


Fig. 2.1

State the total mass of the test-tube and its contents after heating for two minutes.

Give your answer to **one** decimal place.

mass after heating = ... g [1]

(iii) Suggest why the student lets the test-tube and its contents cool down before measuring the mass.

.....

..... [1]

(iv) Suggest why the total mass of the test-tube and its contents decreases during the heating.

.....

..... [1]

(v) The student thinks that some of the sample of **H** in the test-tube has **not** reacted.

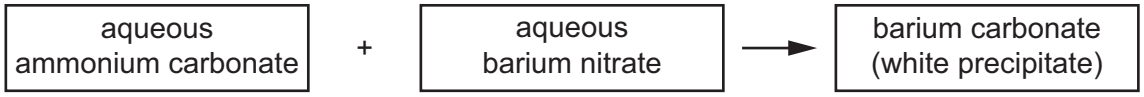
Explain how the student changes the procedure to ensure that all of **H** reacts.

.....

..... [1]

[Total: 7]

3 Aqueous ammonium carbonate reacts with aqueous barium nitrate to form a white precipitate of barium carbonate.



The white precipitate is separated from the reaction mixture by filtration.

Plan an investigation to determine the relationship between the volume of aqueous ammonium carbonate used and the mass of barium carbonate made.

You are provided with:

- aqueous ammonium carbonate
- aqueous barium nitrate.

You may use any common laboratory apparatus in your plan.

In your plan include:

- any apparatus you will use
- a brief description of the method
- what you will measure and which variables you will control
- a table to record the results (you are **not** required to enter any readings in the table)
- how you will process your results to form a conclusion.

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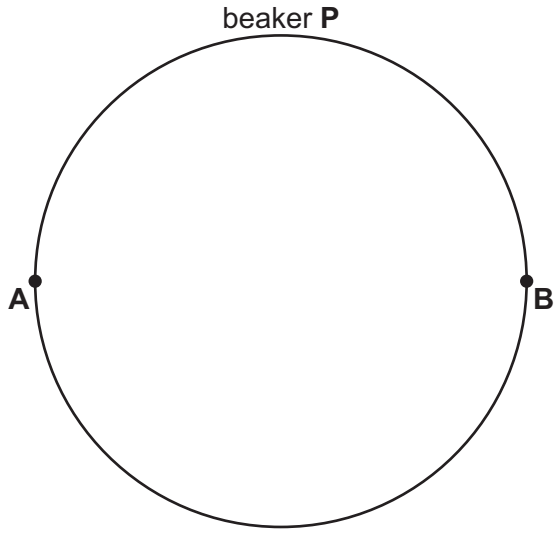
..... [7]

4 A student investigates the rate of cooling of hot water in two glass beakers **P** and **Q**.

(a) Each beaker has a circular open top with a different diameter.

Fig. 4.1 shows the water in beaker **P** as seen from above.



drawn to scale

Fig. 4.1

(i) Measure the diameter **AB**.

Record this value to the nearest 0.1 cm.

diameter = ... cm [1]

(ii) Calculate the surface area of the top of the water in beaker **P**.

Use the equation shown.

$$\text{surface area} = \frac{3.1 \times (\text{diameter})^2}{4}$$

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

surface area = ... cm^2 [2]

(b) Fig. 4.2 shows glass beakers **P** and **Q**.

The student adds 250 cm^3 of hot water into **P**.

A thermometer measures the temperature of the water.

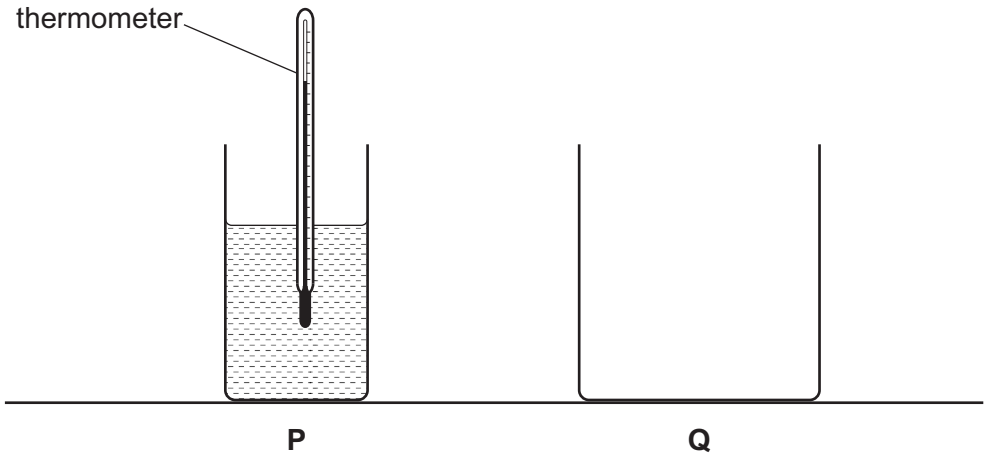


Fig. 4.2

(i) State the name of a piece of apparatus suitable for measuring 250 cm^3 of water.

..... [1]

(ii) Fig. 4.2 shows the water level and thermometer in **P**.

The student adds 250 cm^3 of hot water and a thermometer to **Q**.

Complete Fig. 4.2 by:

- drawing a line to estimate the level of water in **Q**
- drawing a thermometer to measure the temperature of the water in **Q**.

[2]

(c) The student:

- starts a stop-watch when the temperature of the water in **P** and **Q** is 80 °C
- records in Table 4.1 the temperature of the water in **P** and **Q** every 60 seconds for 5 minutes.

Table 4.1

time / s	temperature of water in **P** / °C	temperature of water in **Q** / °C	difference between the temperature of water in **P** and **Q** / °C
0	80.0	80.0	0.0
60	75.5	69.5	6.0
120	73.0	63.0	10.0
180	70.0	58.5	11.5
240			
300	65.5	52.5	13.0

(i) Fig. 4.3 shows the readings on each thermometer at 240 s.

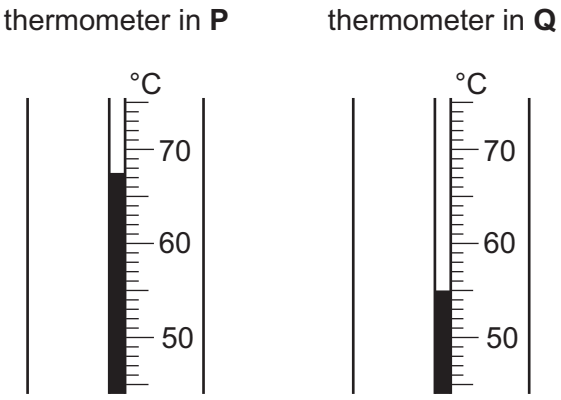


Fig. 4.3

Record in Table 4.1 these temperatures to the nearest 0.5 °C. [2]

(ii) Calculate the difference between the temperature of water in **P** and **Q** at 240 s.

Record your value in Table 4.1. [1]

(iii) The student stirs the water before measuring each temperature.

Explain why stirring is important.

.....

..... [1]

(d) Compare how the temperature of the water in **P** and in **Q** changes with time.

Use the data in Table 4.1 to help you.

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.....

..... [2]

(e) The student wants to investigate the rate of cooling from the open top of the beaker only.

Suggest **one** change the student makes to the apparatus in Fig. 4.2.

.....

..... [1]

[Total: 13]

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.
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, 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, 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

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