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COMBINED SCIENCE **0653/62**

Paper 6 Alternative to Practical **February/March 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 relationship between the length of a leaf and the width of a leaf.

Fig. 1.1 shows the outline of a leaf.

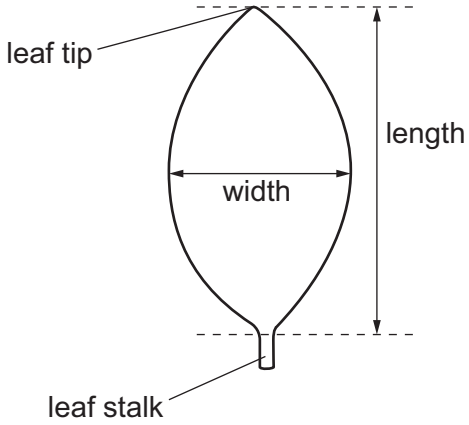


Fig. 1.1

- The length of a leaf is from the tip of the leaf to the leaf stalk.
- The width of a leaf is the widest part of the leaf.

(a) The student has five leaves, **A**, **B**, **C**, **D** and **E**, as shown in Fig. 1.2.

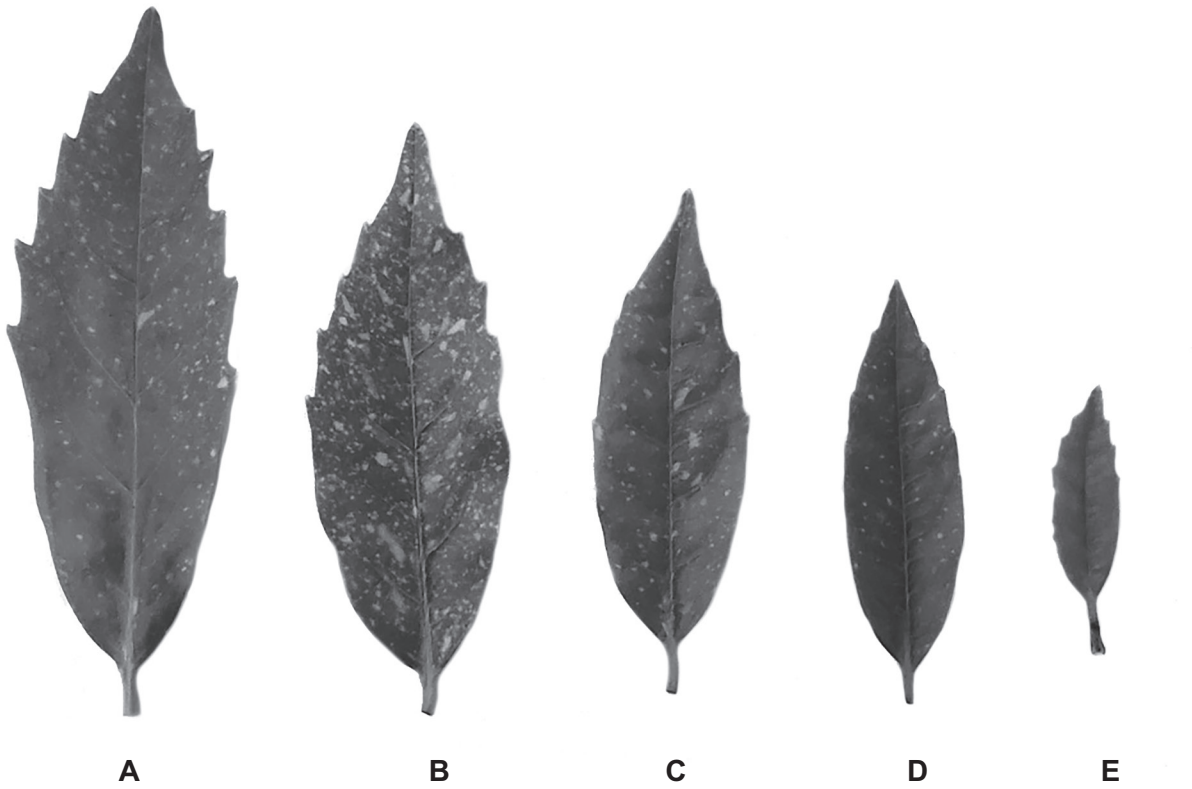


Fig. 1.2

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(i) Measure the length and width of each leaf in Fig. 1.2.

In Table 1.1, record your measurements to the nearest mm.

Table 1.1

leaf	length /mm	width /mm
A		
B		
C		
D		
E		

[2]

(ii) Calculate the average **length** of the five leaves.

average length = ... mm [1]

(iii) Suggest why the length of the leaf stalk is **not** included in the measurement of the length of the leaf.

.....

..... [1]

(iv) State **one** reason why it is difficult to measure the length or width of a leaf accurately.

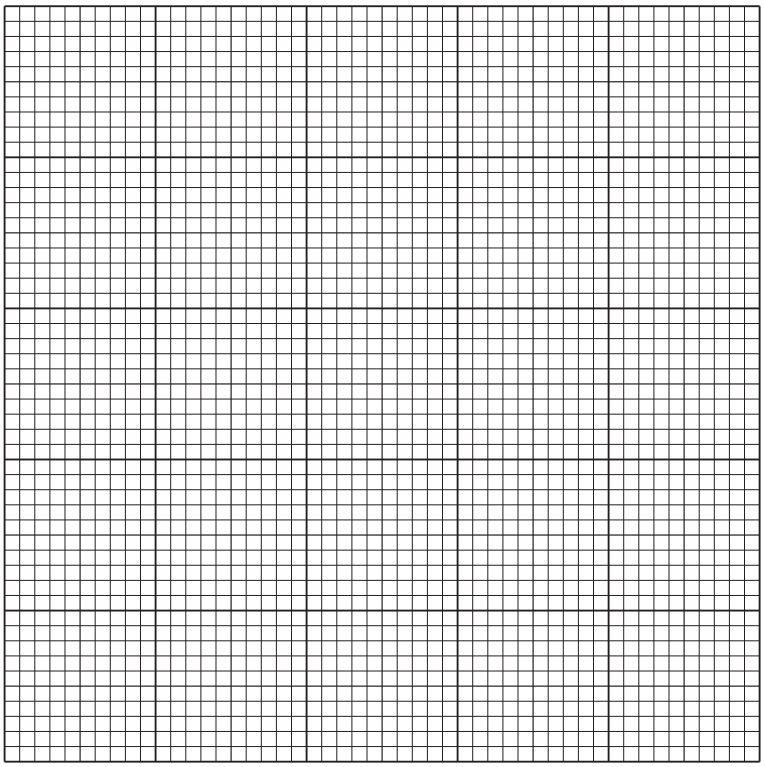
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(v) On the grid, plot the width of each leaf (vertical axis) against the length of each leaf.



[3]

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

(vii) Describe the relationship between the width of the leaves and the length of the leaves.

.....

..... [1]

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(b) Fig. 1.3 shows leaf **B**.



Fig. 1.3

In the box, make a large pencil drawing of leaf **B**.

[3]

[Total: 13]

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2 A student investigates four aqueous solutions, **H**, **J**, **K** and **L**.

Aqueous **H** is blue.

Aqueous **J**, **K** and **L** are colourless.

(a) The student mixes equal volumes of aqueous **H** and aqueous **L** and observes a white precipitate.

The student mixes equal volumes of aqueous **J** and aqueous **K** and observes effervescence.

Record these tests and observations in a results table.

[2]

(b) The student adds four drops of universal indicator into separate samples of each of the four solutions, **H**, **J**, **K** and **L**.

The student records in Table 2.1 the colour observed for each solution.

A pH colour chart is shown in Fig. 2.1.

pH	0–3	4	5	6	7	8	9	10	11–14
colour	red	orange	yellow	green-yellow	green	green-blue	blue	blue-purple	purple

Fig. 2.1

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Use the information in Fig. 2.1 to complete Table 2.1.

Table 2.1

aqueous solution	colour observed	pH of solution
H	green-blue	
J	blue	
K		1
L		7

[2]

(c) Explain why it is difficult to see the actual colour of the universal indicator in aqueous **H**.

..... [1]

(d) Acids have a pH that is less than 7.

State which **one** of the aqueous solutions is an acid, **H**, **J**, **K** or **L**.

..... [1]

(e) Determine which solution, **H**, **J**, **K** or **L**, is a carbonate.

Explain your answer.

solution .....

explanation .....

.....

[1]

[Total: 7]

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3 When a detergent is shaken with water it forms a layer of bubbles called foam.

Plan an investigation to determine the relationship between the temperature of water and the amount of foam produced when detergent is shaken with water.

You are provided with the apparatus shown in Fig. 3.1.

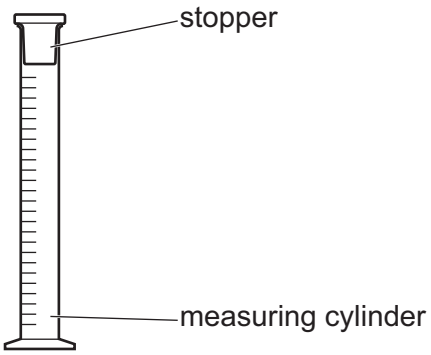


Fig. 3.1

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

In your plan include:

- any additional apparatus you will use
- a brief description of the method
- what you will measure
- which variables you will control
- how you will process your results to form a conclusion.

You may include a results table (you are **not** required to enter any readings in the table).

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4 A student determines the pressure exerted on a table by a wooden block.

(a) Fig. 4.1 shows the wooden block (**not** drawn to scale).

The three faces **X**, **Y** and **Z** have different areas. Face **X** has the smallest area.

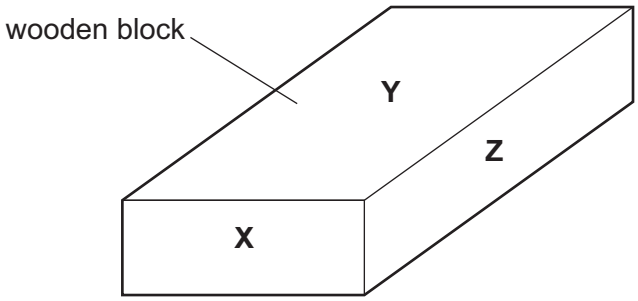


Fig. 4.1 (not to scale)

(i) Fig. 4.2 shows the **actual** size of face **X** of the wooden block.

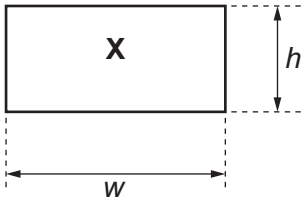


Fig. 4.2 (actual size)

Use a ruler to measure the height *h* and the width *w* of face **X** in Fig. 4.2.

Record each measurement to the nearest 0.1 cm.

h = ... cm

w = ... cm
[2]

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(ii) The measurements in **(a)(i)** are recorded to the nearest 0.1 cm.

Suggest why the measurements are **not** recorded to the nearest 0.01 cm.

.....

..... [1]

(iii) Calculate the area A of face **X** of the block.

Use your answers in **(a)(i)** and the equation shown.

$$A = h \times w$$

A = ... cm^2 [1]

(b) The student places the block on a balance with face **X** on the balance.

The student measures the mass of the block.

Fig. 4.3 shows the balance reading.



Fig. 4.3

Record the mass m of the wooden block to the nearest 0.01 g.

m = ... g [1]

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(c) **(i)** Calculate the force F exerted by the wooden block on the table.

Use your answer in **(b)** and the equation shown.

$$F = \frac{m \times 9.8}{1000}$$

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

F = ... N [2]

(ii) State the name of a piece of apparatus that measures F directly.

..... [1]

(d) Calculate the pressure P exerted by the wooden block on the table when standing on face **X**.

Use your answers in **(a)(iii)** and **(c)(i)** and the equation shown.

$$P = \frac{F}{A}$$

State the unit of your answer.

P = ...

unit = ...
[2]

(e) Face **Y** is placed on the table instead of face **X**.

Predict how this affects the value of P.

Explain your answer.

.....

..... [1]

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(f) A student wants to determine the volume of another block.

The student:

- puts 200 cm^3 of water in a large measuring cylinder
- puts the block in the measuring cylinder as shown in Fig. 4.4

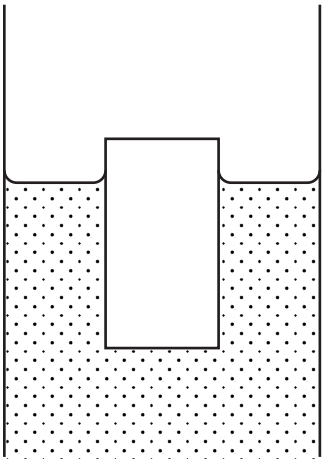


Fig. 4.4

- measures the new level *V* of the water.

(i) Fig. 4.5 shows the reading on the measuring cylinder after the block is added.

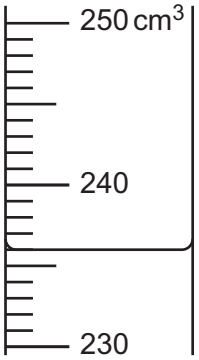


Fig. 4.5

Record the new level *V* of the water in the measuring cylinder.

V = ... cm^3 [1]

(ii) Suggest why calculating *V* – 200 does **not** give the volume of the block.

.....

..... [1]

[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, 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

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