CAMBRIDGE
International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **5129/32**

Paper 3 Experimental Skills and Investigations **May/June 2026**

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. Do **not** use correction fluid or tape.
- 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 **20** pages. Any blank pages are indicated.

1 Catalase is an enzyme produced in most cells.

Catalase acts on hydrogen peroxide to produce water and oxygen.

A student compares the volume of oxygen produced by the action of catalase from two different plants.

She uses catalase from a potato plant and catalase from a celery plant.

procedure

The student:

- measures 50 cm^3 of dilute hydrogen peroxide into a conical flask
- adds 50 g of crushed potato tissue to the hydrogen peroxide
- measures the volume of oxygen produced in 5 minutes using the apparatus shown in Figure 1.1
- repeats the procedure with 50 g of crushed celery tissue.

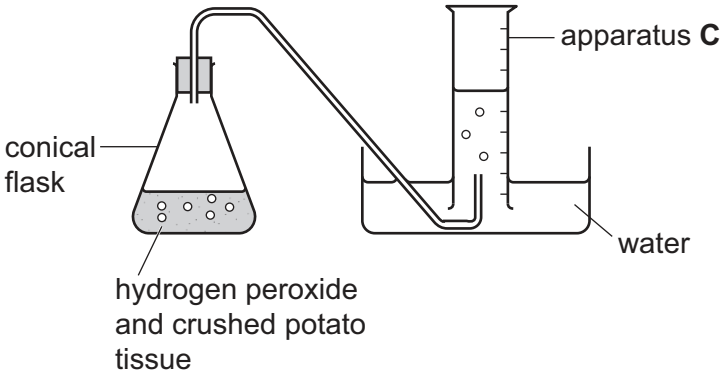


Figure 1.1

The student's results are shown in Figure 1.2.

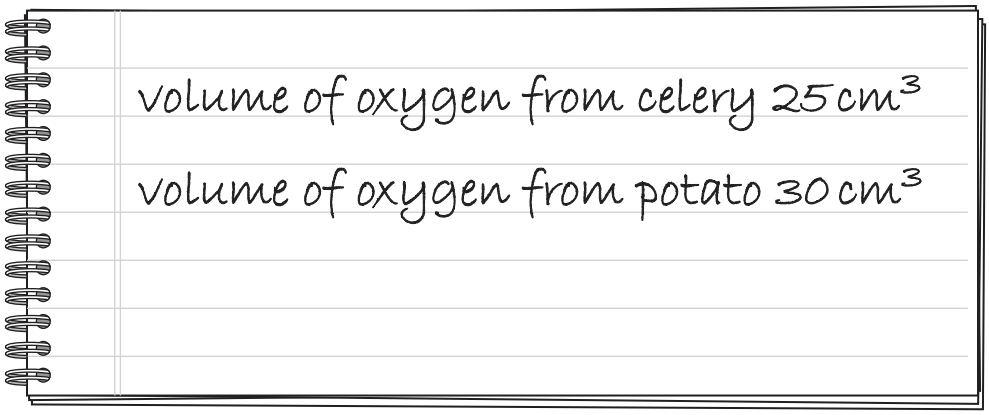


Figure 1.2

(a) (i) Record the results from Figure 1.2 in Table 1.1.

Table 1.1

type of tissue	volume of oxygen produced in 5 minutes /	average volume of oxygen produced in 1 minute / .....
celery	.....	.....
potato	.....	.....

[1]

(ii) Calculate the average volume of oxygen produced in 1 minute for each type of tissue. Record your answers in Table 1.1.

[1]

(iii) Write the units in the column headings in Table 1.1. [1]

(iv) State the name of the piece of apparatus, labelled **C** on Figure 1.1, that the student uses to measure the volume of the oxygen produced.

..... [1]

(v) It is important that the contents of the conical flask are kept at the same constant temperature for both tissues.

Describe how the contents of the conical flask are kept at the same constant temperature for both tissues.

.....

.....

..... [1]

(vi) The student concludes that potato contains more catalase per gram of tissue than celery.

Suggest **one** improvement to the procedure that will give the student more confidence in the conclusion.

.....

..... [1]

(b) The student tests catalase to show that it is a protein.

State the name and the initial colour of the chemical used to test for protein, and state the final colour that shows that catalase is a protein.

name of chemical .....

initial colour .....

final colour .....

[2]

(c) **(i)** Figure 1.3 shows some stems of celery with a single celery stem to one side.

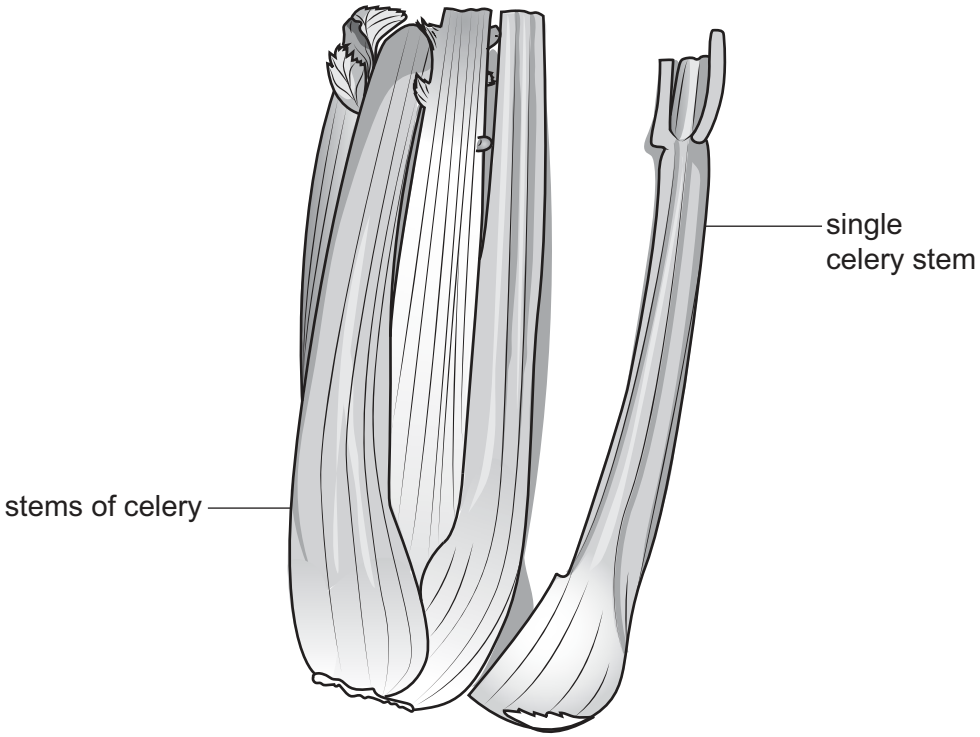


Figure 1.3

The student uses a scalpel to cut a section across the single celery stem.

State **one** safety precaution the student needs to take when making the cut.

.....

..... [1]

(ii) The student draws a large diagram of the section of celery stem.

The drawing is shown in Figure 1.4.

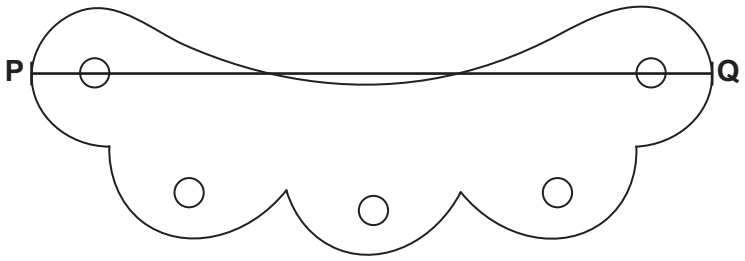


Figure 1.4

The width of the celery stem is shown by line **PQ**.

Measure and record the length of line **PQ**.

length of line **PQ** = ... mm [1]

(iii) The actual width of the celery stalk is 27 mm.

Calculate the magnification of the student's drawing using the equation shown.

$$\text{magnification} = \frac{\text{length of line } \mathbf{PQ}}{\text{actual width}}$$

Write your answer to 1 decimal place.

magnification = × ..... [1]

[Total: 11]

2 A student investigates the distillation of ink. The apparatus is assembled as shown in Figure 2.1.

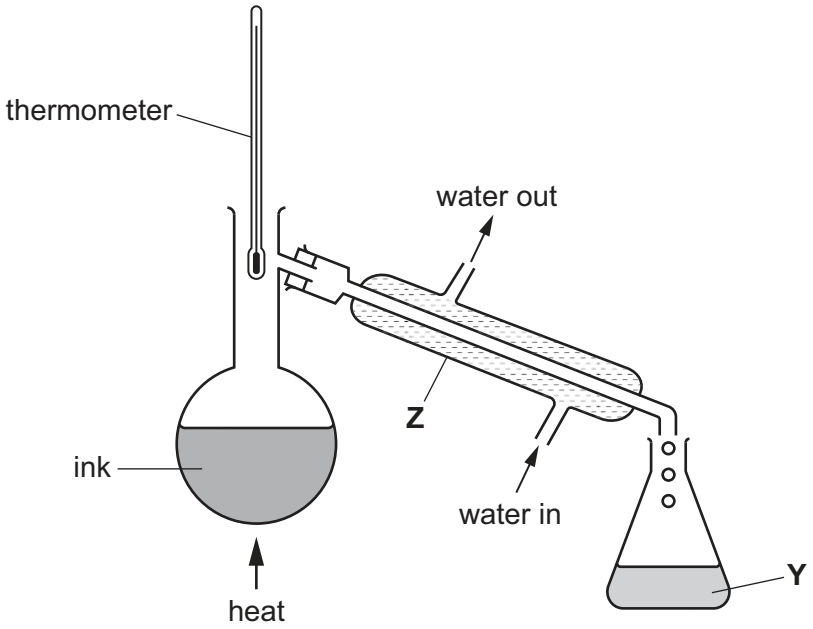


Figure 2.1

(a) (i) State the name of apparatus **Z**.

..... [1]

(ii) Explain the function of apparatus **Z**.

.....

..... [1]

(iii) The student has made an error when assembling the apparatus.

Identify the error, and state why this error prevents the experiment from working.

error .....

reason .....

.....

[2]

(iv) The student corrects the error in the apparatus and starts the distillation.

Figure 2.2 shows the thermometer before the flask is heated and when the highest temperature is reached.

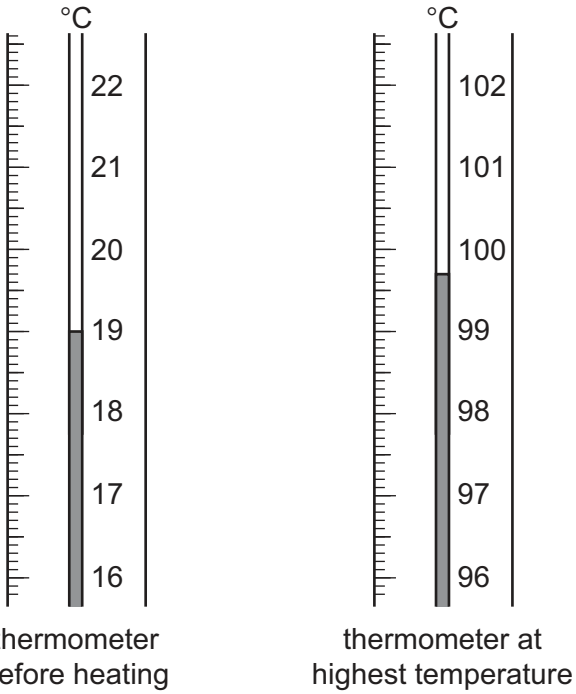


Figure 2.2

State the temperature before heating and the highest temperature.

temperature before heating = ... °C

highest temperature = ... °C
[2]

(v) Suggest the boiling point of liquid **Y** shown in Figure 2.1.

boiling point = ... °C [1]

(b) The student also uses chromatography to investigate the composition of the ink.

Figure 2.3 shows the apparatus the student uses.

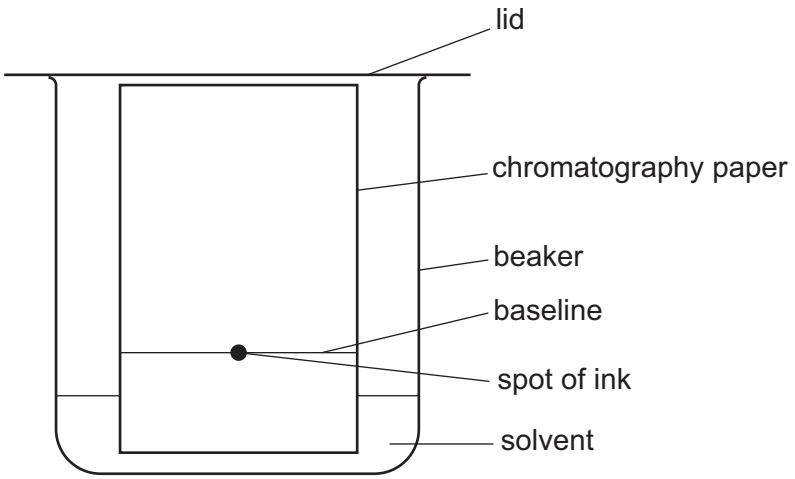


Figure 2.3

(i) The ink contains two different coloured compounds, both of which are soluble in the solvent. Each compound has a different solubility in the solvent.

On Figure 2.3, complete the diagram to show the results on the chromatography paper. [1]

(ii) Explain why a lid is placed on the beaker.

.....

..... [1]

(iii) The student has samples of three known compounds in addition to the sample of ink.

Describe how the experiment can be changed to show whether any of the three known compounds are present in the ink.

.....

.....

.....

..... [2]

[Total: 11]

Turn over

3 Figure 3.1 shows a model of a wind turbine.

The turbine is made from three rotor blades attached to a shaft.

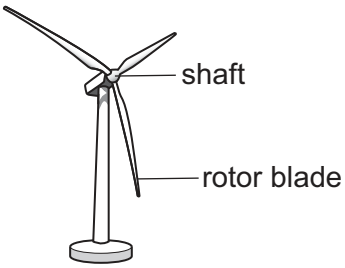


Figure 3.1

(a) Figure 3.2 shows one of the rotor blades drawn to scale.

The length *r* of the rotor blade is from the centre of the shaft to the tip of the blade.

Measure and record *r* in millimetres.

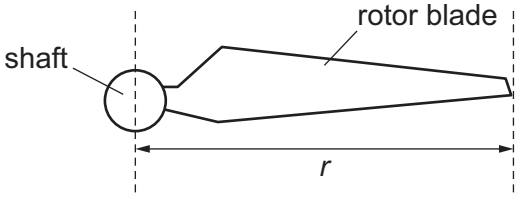


Figure 3.2

r = ... mm [1]

(b) The area covered by one rotation of the turbine blades is shown in Figure 3.3.

This is called the swept area.

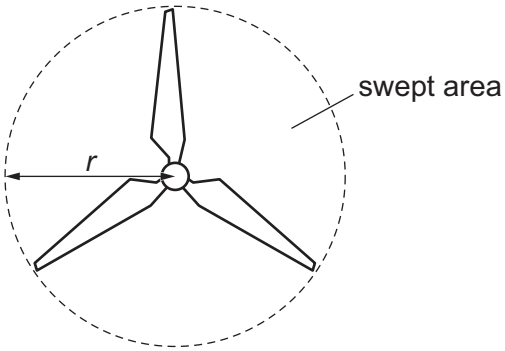


Figure 3.3

Calculate the swept area *A*.

Use the equation

$$A = 3.14r^2$$

where *r* is the length of the rotor blade recorded in **3(a)**.

A = ... mm^2 [1]

(c) Inside the model of the turbine, there is a circuit containing a generator.

A student investigates the effect of increasing the swept area *A* on the electrical power produced in the generator.

procedure

The student:

- connects the generator in the model turbine to an ammeter and a voltmeter
- takes a deep breath, and blows air through the turbine so that it spins
- records the maximum reading on the ammeter
- repeats to find the maximum reading on the voltmeter.

(i) Figure 3.4 shows the maximum reading I on the ammeter. This is the current generated when the turbine spins the fastest.

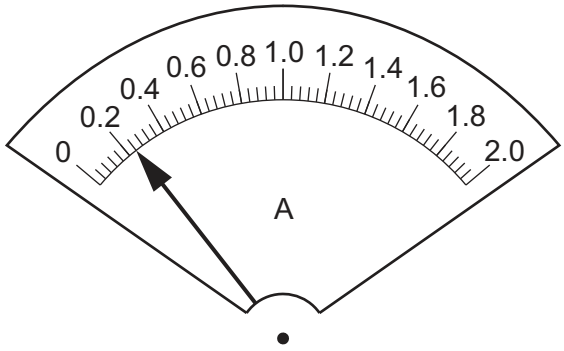


Figure 3.4

Record I.

I = ... A [1]

(ii) Figure 3.5 shows the maximum reading V on the voltmeter. This is the voltage generated when the turbine spins the fastest.

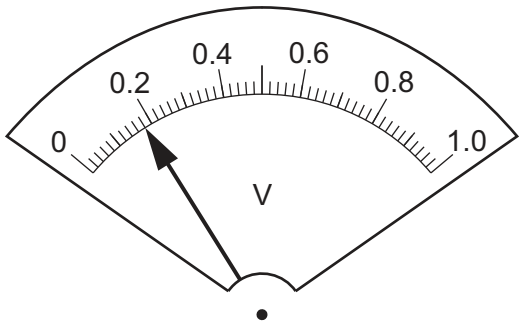


Figure 3.5

Record V.

V = ... V [1]

(iii) Calculate the maximum power P produced by the model turbine.

Use your readings of I and V from **3(c)(i)** and **3(c)(ii)** and the equation shown.

$$P = VI$$

P = ... W [1]

(d) The student increases the swept area *A* by increasing the length of the rotor blades, and repeats the procedure to calculate new values of maximum power *P*.

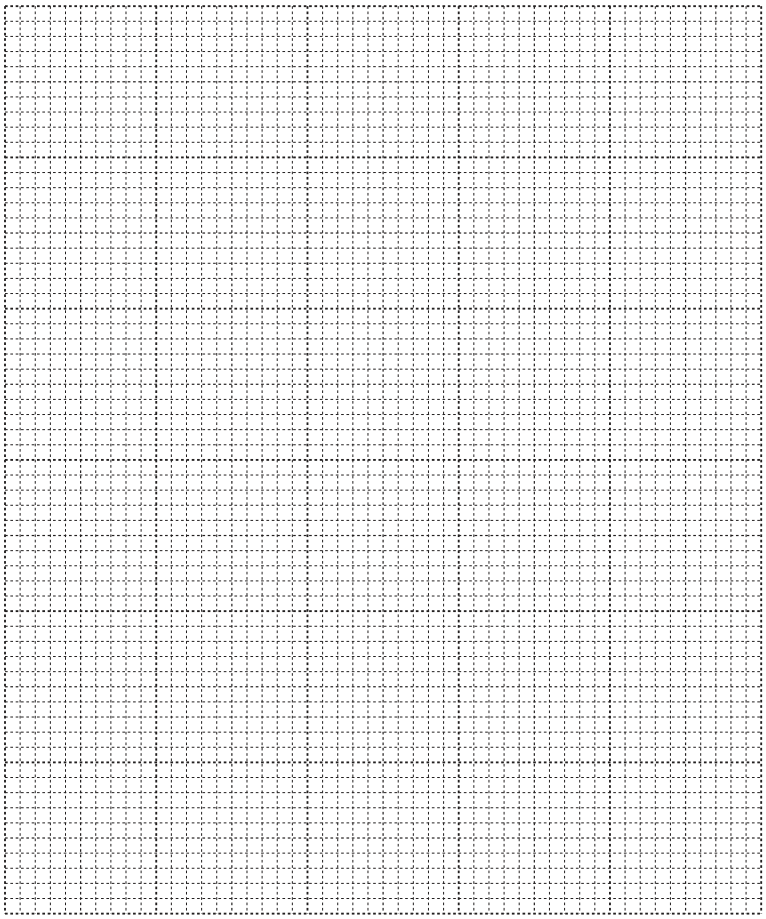
Table 3.1 shows the results of this experiment.

Table 3.1

swept area *A* /× 10^3 mm^2	**maximum power *P* /× 10^{-3} W**
2	11
4	24
6	33
8	47
9	56
10	60

On the grid provided, plot a graph of *P* on the *y*-axis against *A* on the *x*-axis. Start your graph at (0, 0).

Draw the straight line of best fit through your points.



[4]

(e) In the procedure given in **3(c)**, the student blows on the turbine and observes the reading on the ammeter to find the maximum current.

The student then blows on the turbine and observes the reading on the voltmeter to find the maximum voltage.

Identify **one** source of error in this procedure.

Suggest **one** improvement that reduces this error.

source of error .....

.....

improvement .....

.....

[2]

[Total: 11]

4 Photosynthesis produces oxygen.

When a light source is placed near an aquatic plant in water, bubbles of oxygen are given off by the plant.

A student states that the closer the light source is to the aquatic plant, the greater the number of bubbles of oxygen produced per minute.

You are provided with a boiling tube containing an aquatic plant in water as shown in Figure 4.1.

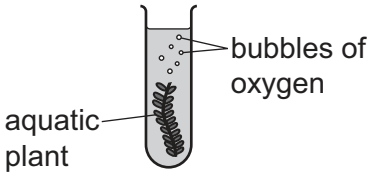


Figure 4.1

Plan an investigation to find out if the student's statement is correct.

You may use any other apparatus usually found in a school laboratory.

Include in your answer:

- the additional apparatus you use
- a brief description of your method, including the measurements you make
- the variables you keep constant
- a table with column headings in which to record your measurements
- how you use your results to show if the student is correct.

You do **not** have to include any results in your table.

.....

.....

.....

[7]

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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
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

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

