Cambridge Assessment International Education

Cambridge O Level

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COMBINED SCIENCE **5129/31**

Paper 3 Experimental Skills and Investigations **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 [ ].

This document has **16** pages.

[Turn over

1 A student investigates the production of peach juice using an enzyme.

Fig. 1.1 shows some peaches.

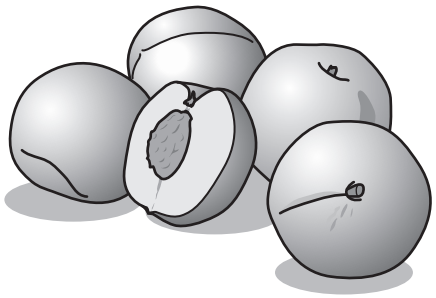

Fig. 1.1

The peaches are crushed, and then mixed with the enzyme which breaks down the cell walls to release the juice.

Procedure

The student:

- mixes 50 g of crushed peach with 2 cm^3 of the enzyme and 2 cm^3 of a buffer solution of pH 7
- places the mixture into a filter funnel lined with filter paper as shown in Fig. 1.2
- measures the time taken for 5 cm^3 of peach juice to be collected
- repeats the investigation using 2 cm^3 of buffer solution of pH 9.

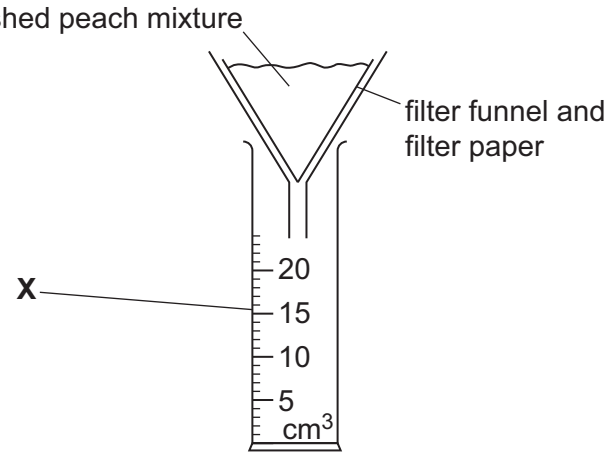

Fig. 1.2

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

..... [1]

(ii) The student's results are shown in Fig. 1.3.

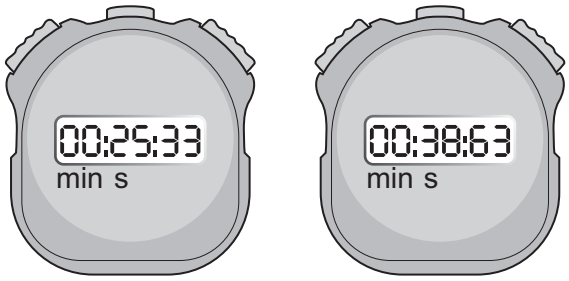

Fig. 1.3

Using the measurements shown in Fig. 1.3, complete Table 1.1.

Record the times to the nearest second.

Table 1.1

pH of crushed peach mixture	time taken to collect 5 cm^3 of peach juice / s
7	.....
9	.....

[1]

(iii) Other students repeat the investigation.

Explain why the results are more accurate if the investigation is repeated.

.....

.....

..... [1]

(b) (i) The student now investigates the effect of changing the temperature of the crushed peach mixture on the volume of peach juice collected in 3 minutes.

The student uses 2 cm^3 of the enzyme and a buffer solution of pH 7. The results are shown in Table 1.2.

Table 1.2

temperature of the crushed peach mixture / °C	volume of peach juice collected in 3 minutes / cm^3
10	3.1
20	4.9
30	8.7
40	6.3
50	2.0

On the grid in Fig. 1.4, plot a graph of volume of peach juice collected in 3 minutes on the *y*-axis against the temperature of the crushed peach mixture on the *x*-axis.

Draw a curved line of best fit.

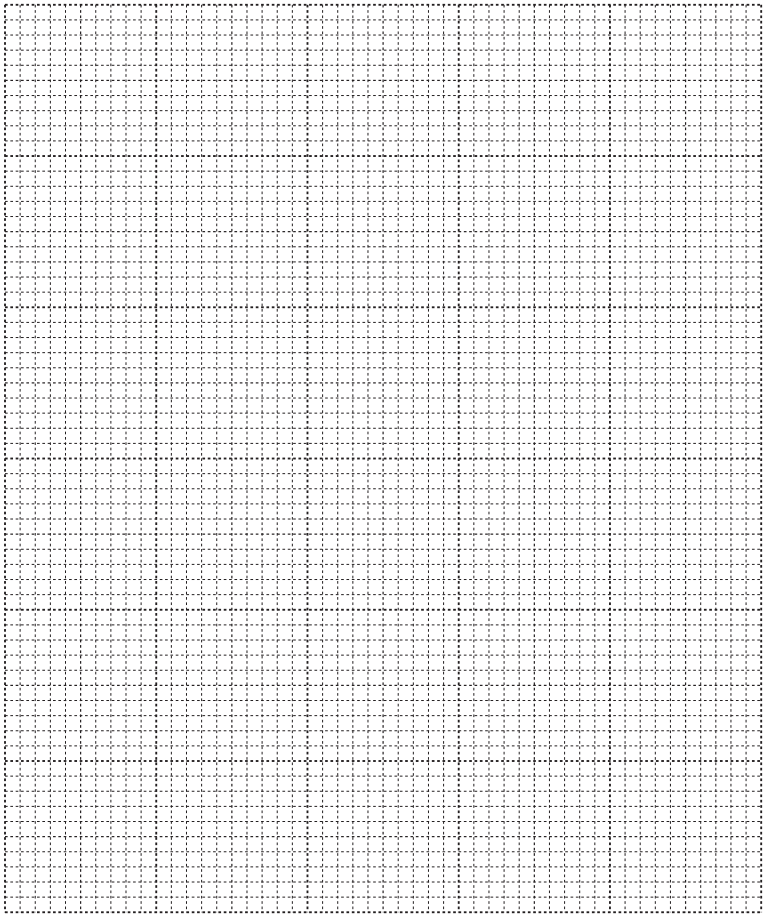

Fig. 1.4

[4]

(ii) Describe the relationship between the temperature of the crushed peach mixture and the volume of peach juice collected in 3 minutes.

.....

.....

.....

.....

..... [2]

(c) The student tests the peach juice for the presence of glucose.

(i) State the name of the test for glucose.

..... [1]

(ii) Complete the sentence.

A positive result for the glucose test is a colour change from

..... to ..... .

[1]

[Total: 11]

2 A student investigates the combustion of a liquid hydrocarbon.

Procedure

The student:

- measures the mass of an empty spirit burner
- places liquid hydrocarbon into the spirit burner
- measures the mass of the spirit burner and liquid hydrocarbon
- lights the spirit burner and lets the hydrocarbon burn for 5 minutes
- extinguishes (puts out) the flame
- measures the final mass of the spirit burner and liquid hydrocarbon.

Fig. 2.1 shows the apparatus the student uses.

The gases given off by the burning hydrocarbon are pulled through the apparatus by a suction pump.

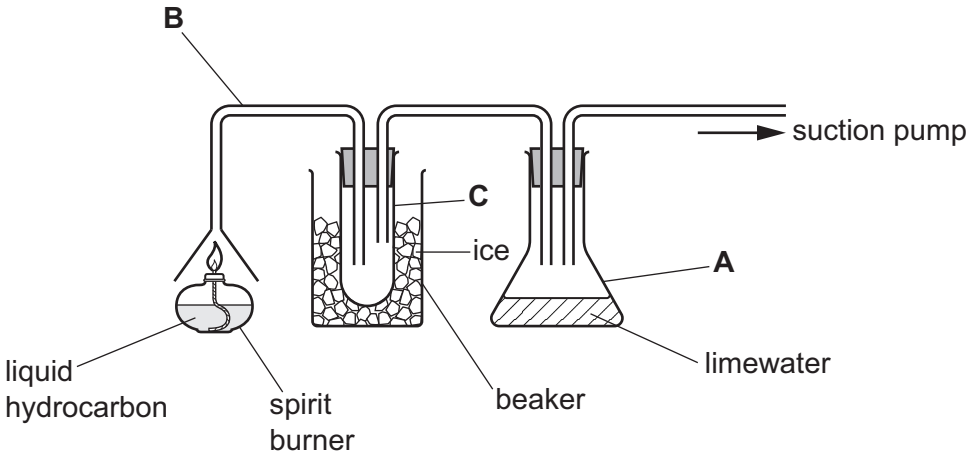

Fig. 2.1

(a) (i) Name the apparatus labelled **A**, **B** and **C**.

A .....

B .....

C .....

[3]

(ii) On Fig. 2.2, draw **one** improvement to the arrangement of the apparatus so that the gases from the burning hydrocarbon pass through the limewater.

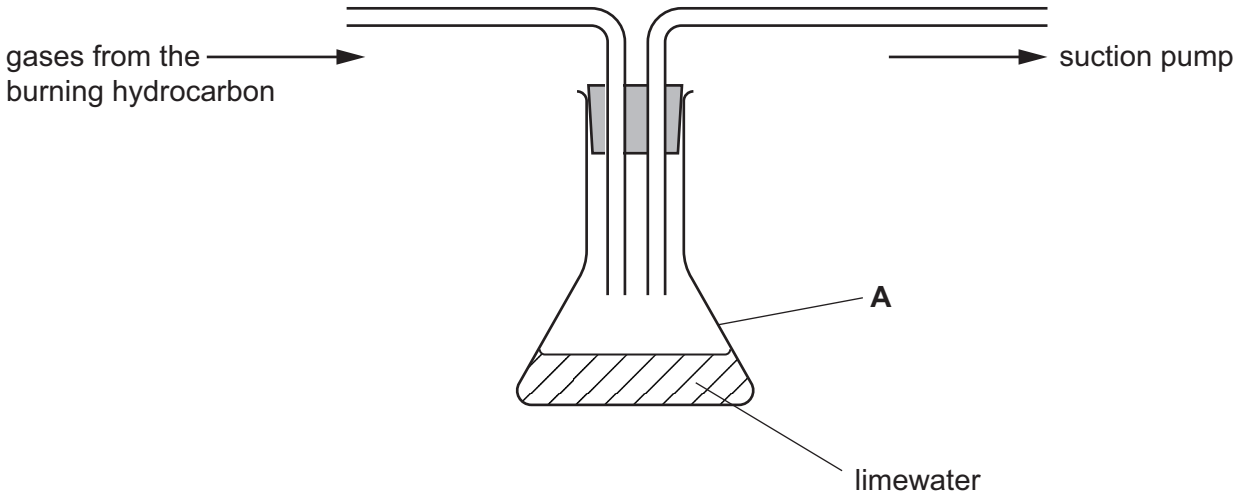

Fig. 2.2

[1]

(iii) The student improves the apparatus so that the limewater turns milky when the gases from the burning hydrocarbon pass through it.

State what causes the limewater to turn milky.

..... [1]

(b) (i) Steam is produced when a hydrocarbon burns.

Name the liquid seen in apparatus **C** in Fig. 2.1 **and** describe its appearance.

name .....

appearance .....

[1]

(ii) Explain why ice is needed in the beaker in Fig. 2.1.

.....

.....

..... [1]

(c) (i) Some of the results are shown in Table 2.1.

Table 2.1

mass of empty spirit burner / g	85
mass of the spirit burner and liquid hydrocarbon / g	110
mass of the spirit burner and liquid hydrocarbon after burning for 5 minutes / g	93

Table 2.2

initial mass of hydrocarbon in the spirit burner / g	.....
final mass of hydrocarbon in the spirit burner / g	.....
change in the mass of hydrocarbon in the spirit burner / g	.....

Use the results in Table 2.1 to complete Table 2.2 by calculating:

- the initial mass of hydrocarbon in the spirit burner
- the final mass of hydrocarbon in the spirit burner
- the change in the mass of hydrocarbon in the spirit burner.

[2]

(ii) Explain why the mass of the hydrocarbon in the spirit burner decreases rather than increases.

.....

.....

..... [2]

[Total: 11]

3 A student makes a paper cylinder and investigates how it is deformed by a load.

(a) Fig. 3.1 shows the end view of the paper cylinder.

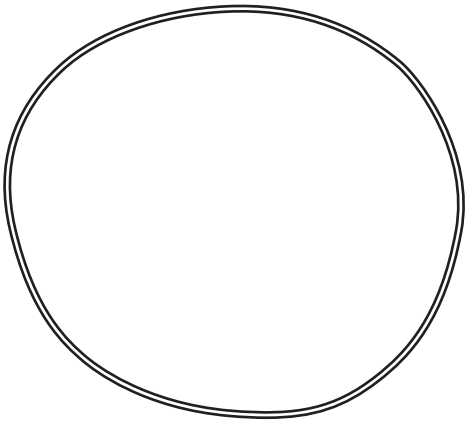

Fig. 3.1

(i) On Fig. 3.1, draw three different diameters. [2]

(ii) Calculate the average diameter length.

Show your working and give the unit.

average diameter = ... unit ..... [3]

(b) The student assembles the apparatus shown in Fig. 3.2.

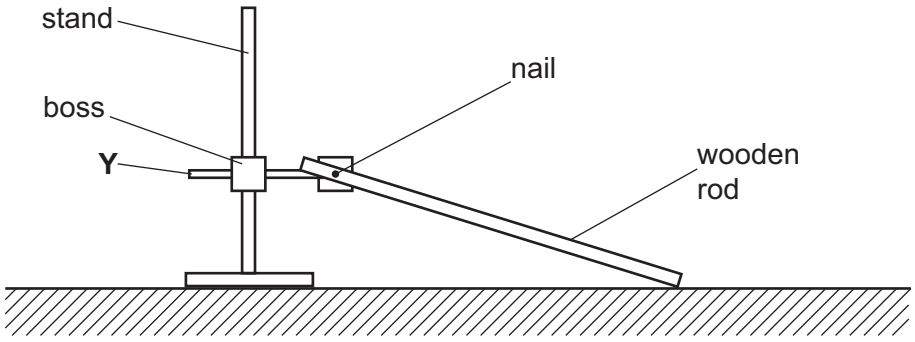

Fig. 3.2

The wooden rod is attached to a nail so that it can pivot freely.

State the name of apparatus **Y** used to attach the nail and rod to the stand.

..... [1]

(c) Procedure

The student:

- places the paper cylinder under the wooden rod as shown in Fig. 3.3, and measures h_1

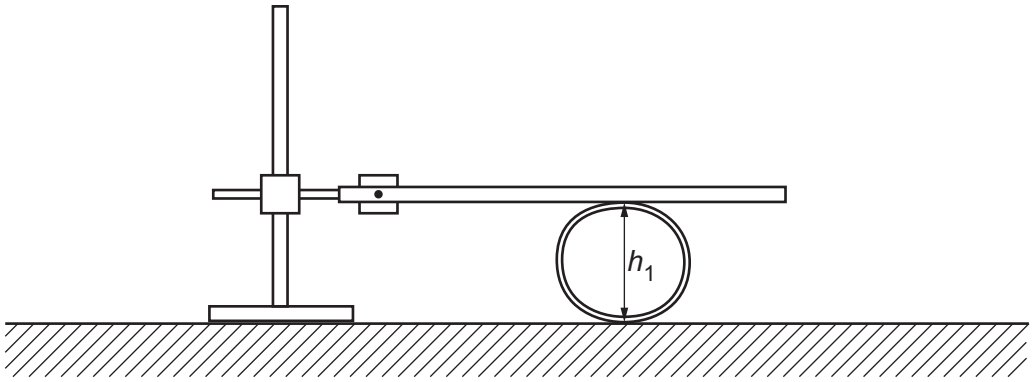

Fig. 3.3

- places a load at the end of the wooden rod as shown in Fig. 3.4, and measures h_2.

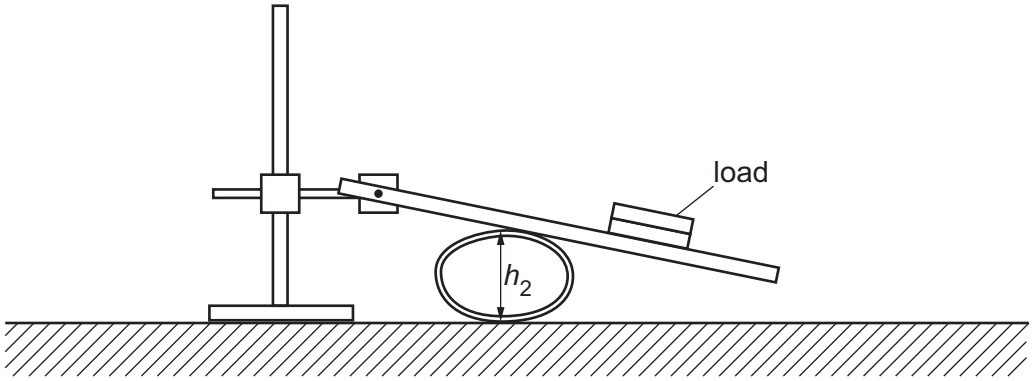

Fig. 3.4

(i) Measure and record h_1 and h_2.

h_1 = ... mm

h_2 = ... mm
[1]

(ii) Calculate the percentage difference, H in your values of h_1 and h_2.

Use the equation:

$$H = \frac{h_1 - h_2}{h_1} \times 100$$

H = ... % [1]

(iii) The arrangement of the apparatus in Fig. 3.4 has an error that means that h_2 is not a valid measurement of the deformation of the paper cylinder produced by the load.

Identify the error by comparing Fig. 3.3 with Fig 3.4 and describe the improvement you would make to produce a valid measurement of h_2.

error .....

.....

improvement .....

.....

[2]

(iv) The student corrects the error and calculates a new value of H.

The student also calculates **another** value of H that is suggested by theory.

The student compares the two values of H.

State how the two values of H are used to evaluate whether they are the same within the limits of experimental accuracy.

.....

.....

..... [1]

[Total: 11]

4 A children's toy contains a ball and a spring inside a metal tube as shown in Fig. 4.1.

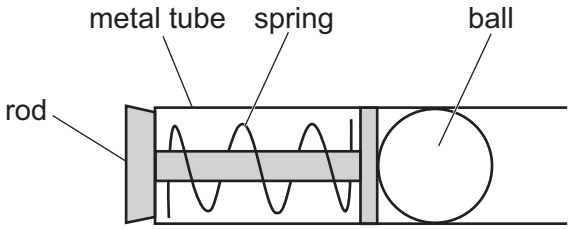

Fig. 4.1

The rod is pulled back a distance *R* and then released.

This pushes the ball out of the tube as shown in Fig. 4.2.

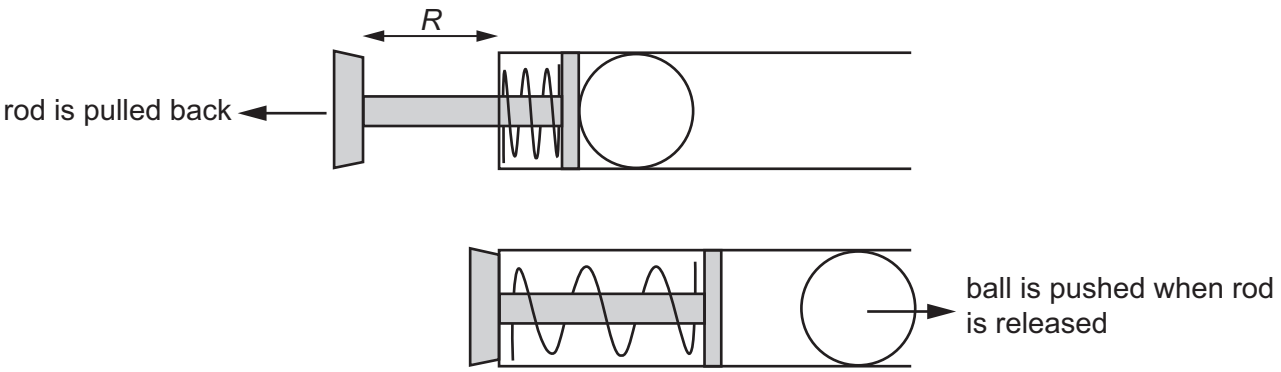

Fig. 4.2

The released ball moves a distance *d* up a ramp as shown in Fig. 4.3.

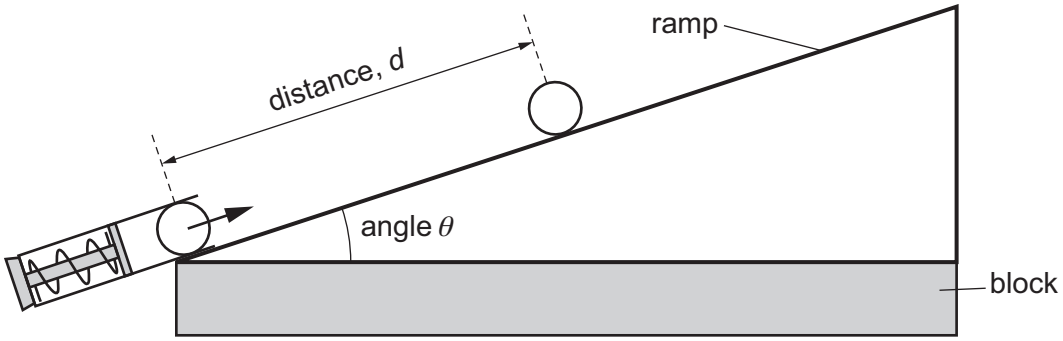

Fig. 4.3

A student states that the greater the distance *R* that the rod is pulled back, the greater the distance *d* moved by the ball up the ramp.

Plan an investigation to test whether this statement is true.

Include in your answer:

- any additional apparatus you will use
- a brief description of the method and the measurements you will make
- what you will keep constant and what you will change
- how you will use your results to draw a conclusion.

[7]

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