Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/62**

Paper 6 Alternative to Practical **October/November 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.

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1 A student uses the apparatus shown in Fig. 1.1 to compare the energy content of two different types of food, **A** and **B**.

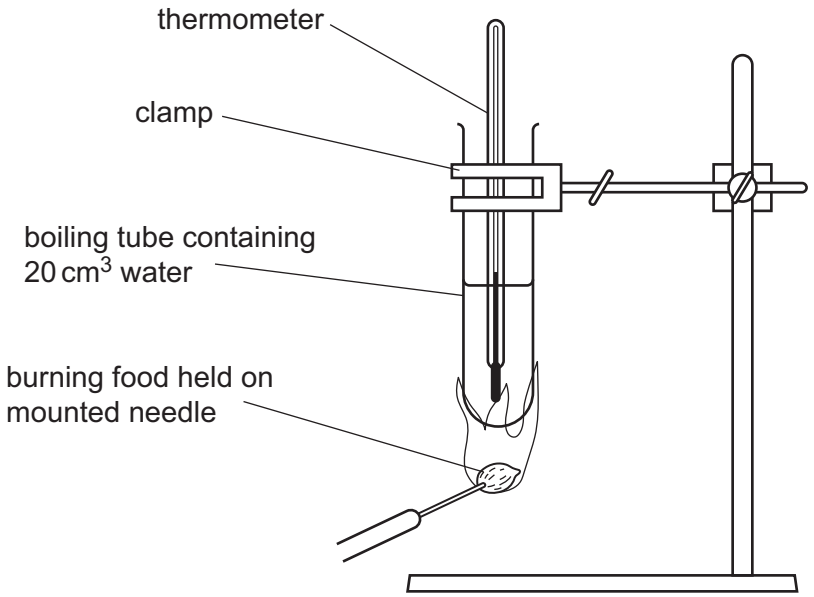

Fig. 1.1

The thermal energy released by the burning food heats the water in the boiling tube. The more energy the food contains, the greater the increase in temperature of the water.

Procedure

The student:

step 1 records in Table 1.1 the initial temperature of the water in the boiling tube

step 2 records in Table 1.1 the mass of a small piece of food **A**

step 3 ignites the food and holds it under the boiling tube as shown in Fig. 1.1 until the food stops burning

step 4 records in Table 1.1 the final temperature of the water in the boiling tube.

The student allows the apparatus to cool and then repeats the procedure for food **B**.

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(a) (i) Fig. 1.2 shows the balance readings for the mass of food **A** and the mass of food **B**.

food **A** food **B**

Fig. 1.2

Record in Table 1.1 these values to **one** decimal place.

Table 1.1

food	mass of food /g	initial temperature of water /°C	final temperature of water /°C	change in temperature of water /°C
A		20.0	56.0	36.0
B		19.0	37.0	18.0

[2]

(ii) The energy contained in 1.0 g of food is calculated using the equation shown.

$$\text{energy per gram of food} = \frac{20 \times \text{change in temperature of water} \times 4.2}{\text{mass of food}}$$

Use the equation to calculate the amount of energy in:

- 1.0 g of food **A**
- 1.0 g of food **B**.

energy per gram in food **A** = ... J/g

energy per gram in food **B** = ... J/g
[2]

(iii) Food **A** is high in fat and food **B** is high in protein.

State what can be concluded about the amount of energy in fat compared to the amount of energy in protein.

.....

..... [1]

(iv) Explain why the amount of energy is calculated per gram of food.

.....

..... [1]

(b) (i) The student states that the procedure gives an inaccurate estimate of the energy of the food samples.

Identify **two** sources of error in the procedure.

1 .....

2 .....
[2]

(ii) Consider **one** source of error identified in **(b)(i)**.

Describe **one** improvement in the procedure to minimise this error.

.....

.....

..... [1]

(c) Describe the tests that confirm the presence of fat and the presence of protein in food. Include the observation for a positive result for each test.

test for fat .....

.....

observation for a positive result .....

test for protein .....

.....

observation for a positive result .....
[4]

[Total: 13]

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

(a) The student investigates the relationship between the mass of **H** added to water and the temperature increase it produces.

Procedure

The student:

step 1 pours 20.0 cm^3 of distilled water into a beaker
step 2 records in Table 2.1 the temperature of the distilled water
step 3 adds 0.5 g of **H** to the distilled water
step 4 stirs the mixture of **H** and distilled water
step 5 records in Table 2.1 the highest temperature reached.

The student repeats **step 1** to **step 5** using the different masses of **H** shown in Table 2.1.

(i) Explain why it is important to stir the mixture of **H** and distilled water in **step 4**.

.....

..... [1]

(ii) Fig. 2.1 shows the reading on the thermometer for the highest temperature reached for 1.0 g and for 2.5 g of **H**.

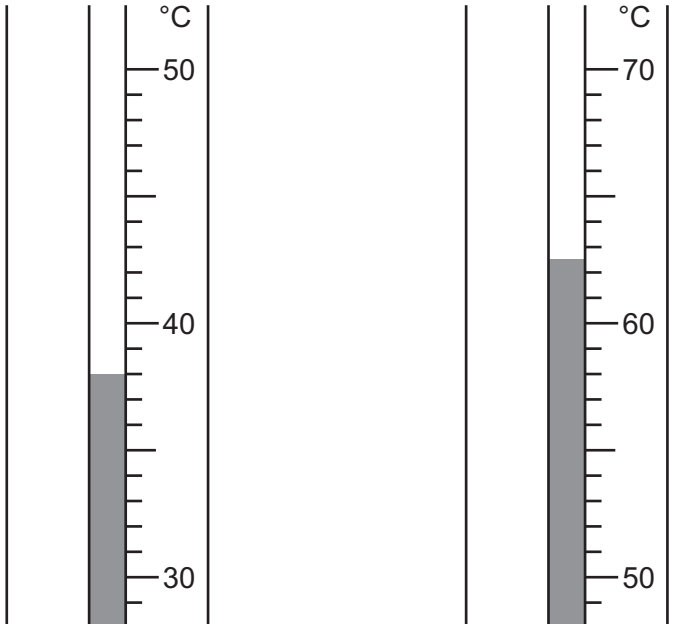


Fig. 2.1

Record in Table 2.1 these temperatures to the nearest 0.5 °C.

Table 2.1

mass of **H** / g	temperature of distilled water / °C	highest temperature reached / °C	temperature increase / °C
0.5	21.0	29.5	8.5
1.0	21.0		
1.5	21.0	46.0	25.0
2.0	21.0	48.0	27.0
2.5	21.0		
3.0	21.0	70.0	49.0

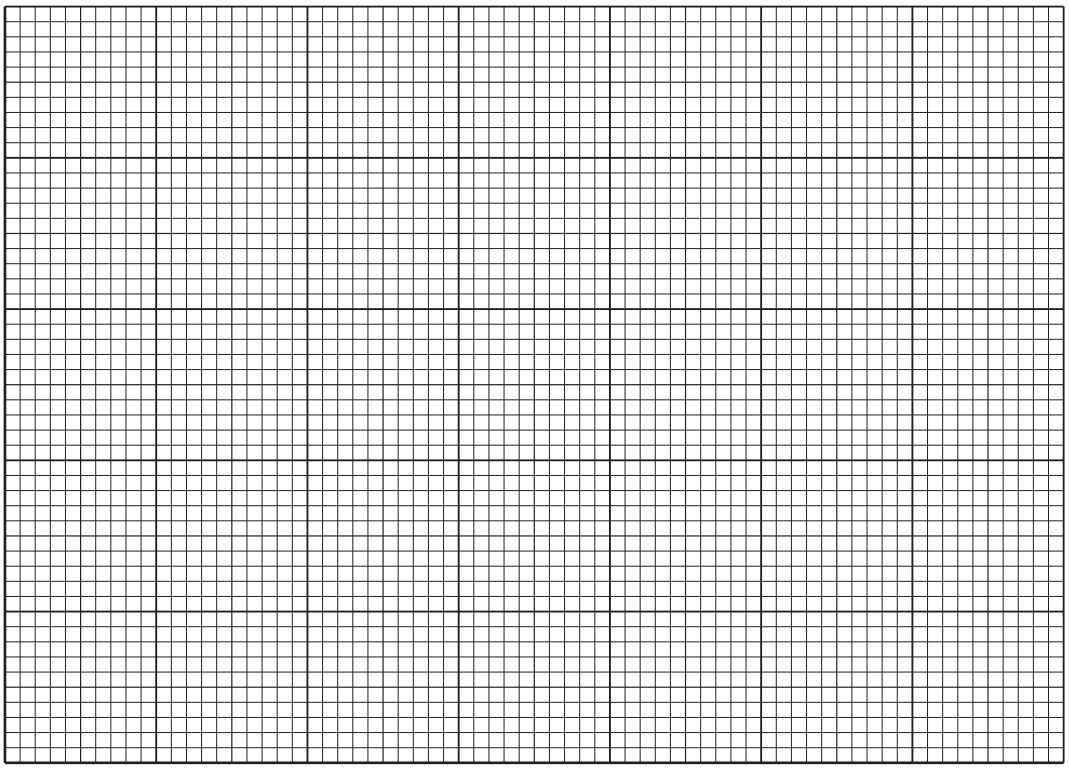
[2]

(iii) Calculate the temperature increase for 1.0 g and for 2.5 g of **H**.

Record your answers in Table 2.1. [1]

(iv) On the grid, plot a graph of temperature increase (vertical axis) against mass of **H**.

Start the axes at the origin (0, 0).



[3]

(v) One of the values for the temperature increase is anomalous.

Circle on the grid the anomalous value. [1]

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

(vii) Describe the relationship between the mass of **H** and the temperature increase.

.....

..... [1]

(b) During the procedure in **(a)**, the white solid **H** dissolves to form a blue solution.

The student tests the blue solution to identify **H**.

The tests and observations are shown in Table 2.2.

Table 2.2

test	observation
add dilute nitric acid followed by aqueous barium nitrate	white precipitate
flame test	green-blue flame

Identify **H** by placing a tick (✓) in the correct box.

copper(II) chloride	☐	copper(II) sulfate	☐
potassium chloride	☐	potassium sulfate	☐
sodium chloride	☐	sodium sulfate	☐

Explain your answer using information from the tests in Table 2.2 and the information about **H**.

.....

.....

.....

.....

[3]

[Total: 13]

3 A student investigates the refraction of light through a semi-circular glass block.

Procedure

The student:

- draws a straight line **AB** down the centre of a sheet of white paper
- draws a straight line **PQ** across the sheet of paper that intersects line **AB** at right angles at point **O**
- uses a protractor to draw a straight line from point **O** at an angle of 10° to line **AB**
- places the semi-circular glass block onto the paper with the straight face along line **PQ** and the middle of the straight face at point **O**
- uses a ray box to shine an incident ray of light towards point **O** at an angle of incidence i = 10°, as shown in Fig. 3.1

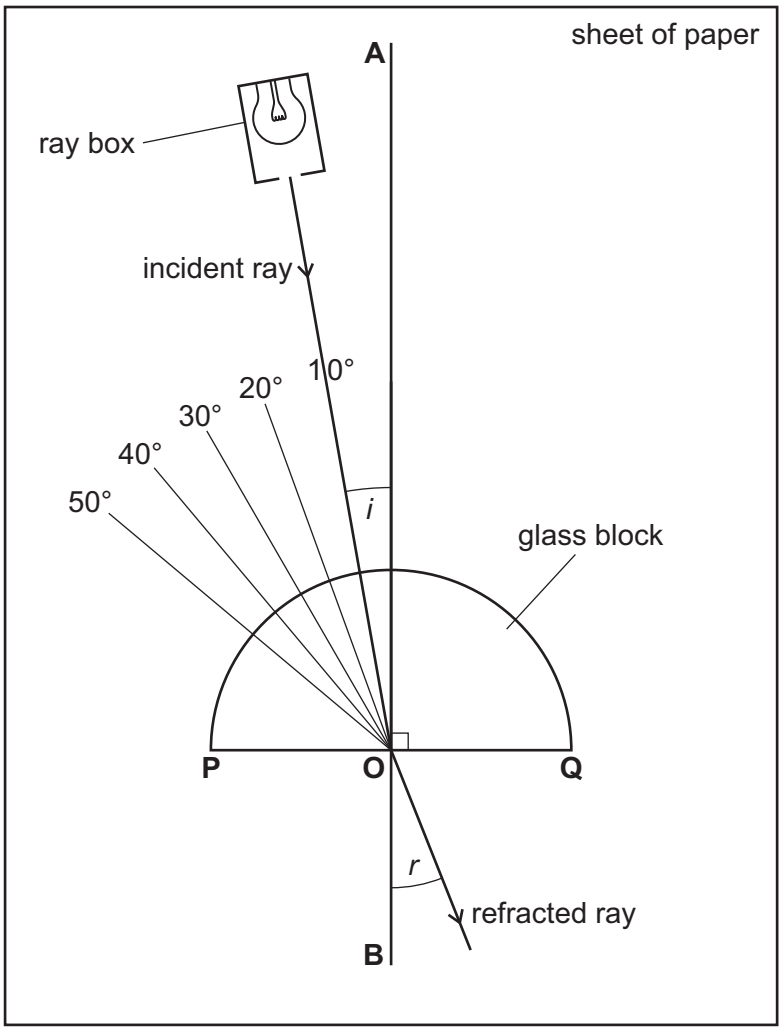


Fig. 3.1 (not to scale)

- uses a protractor to measure the angle of refraction r of the refracted ray
- records angles i and r in Table 3.1.

The student repeats the procedure for i = 20°, 30°, 40° and 50°.

(a) Suggest why the student does this investigation in a dark room.

.....

..... [1]

(b) The ray box in Fig. 3.1 is connected to a power supply.

The student uses a voltmeter to measure the electromotive force (e.m.f.) of the power supply.

Fig. 3.2 shows the reading on the voltmeter.

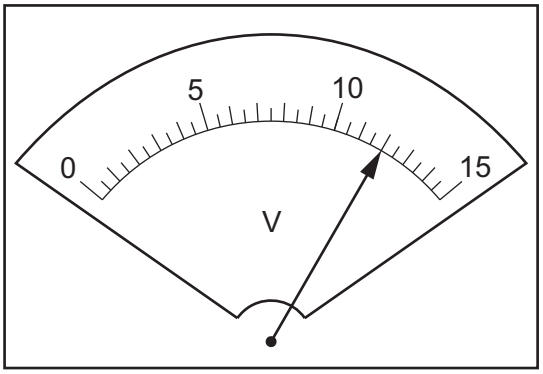


Fig. 3.2

Record the e.m.f. of the power supply.

e.m.f. = ... V [1]

(c) Fig. 3.3 is drawn to scale and shows the refracted ray for the incident ray at angle of incidence $i = 20°$.

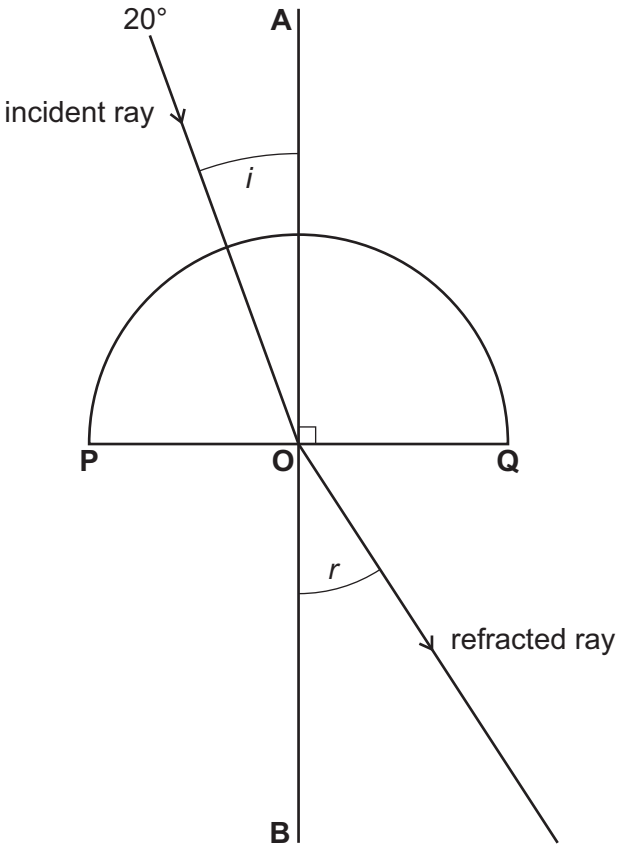


Fig. 3.3 (drawn to scale)

Measure angle *r* in Fig. 3.3.

Record in Table 3.1 angle *r* to the nearest degree.

Table 3.1

angle of incidence *i* / °	angle of refraction *r* / °
10	15
20	
30	49
40	75
50	total internal reflection observed

[1]

(d) For the incident ray at angle of incidence $i = 50°$, the student observes an effect called total internal reflection. The incident ray is not refracted at **O** but instead is reflected, as shown in Fig. 3.4.

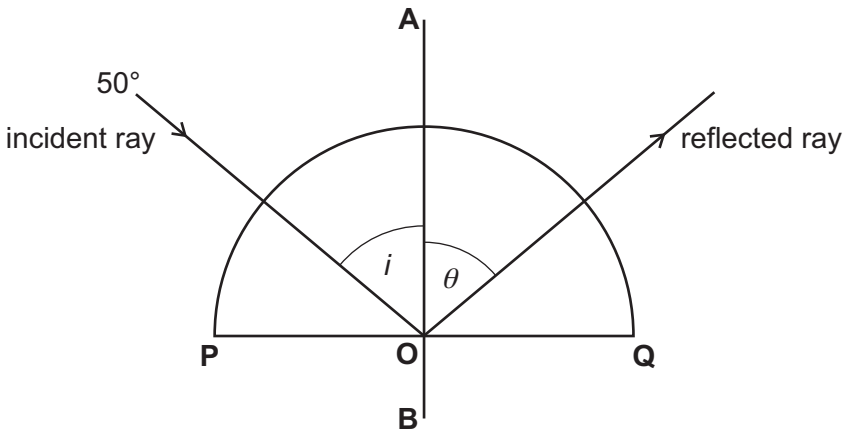


Fig. 3.4 (not to scale)

The student tries to measure the angle of reflection θ of the reflected ray, but the position of the semi-circular block makes it difficult to use the protractor.

Describe a method for marking the path of the reflected ray that overcomes this difficulty.

.....

.....

.....

..... [2]

(e) The effect of total internal reflection only occurs when the angle of incidence i is greater than a critical angle, i_c.

(i) Use the results in Table 3.1 to estimate a value for i_c.

i_c = ... ° [1]

(ii) Suggest what the student can do to obtain a more accurate estimate of i_c.

.....

..... [1]

[Total: 7]

4 Fig. 4.1 shows a spring of diameter *D* made using a coil of metal wire.

Fig. 4.1

The spring stretches with an extension *x* when a load *F* is applied to the spring.

The spring constant *k* is a measure of the elastic stiffness of the spring. The spring constant *k* is calculated using the equation shown.

$$k = \frac{F}{x}$$

Plan an investigation to determine the relationship between the diameter *D* of the spring and the spring constant *k*.

You are provided with:

- springs of different diameter.

You may use any common laboratory apparatus in your plan.

In your plan, include:

- any apparatus needed
- a brief description of the method, including what you will measure and any safety precautions you will take
- the variables you will keep constant
- a results table to record your measurements (you do not need to enter any readings in the table)
- how you will process your results to draw a conclusion.

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..... [7]