Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6945051043

CO-ORDINATED SCIENCES **0654/62**

Paper 6 Alternative to Practical **October/November 2023**

1 hour 30 minutes

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 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

[Turn over

1 A student investigates how small animals respond to the presence of light and water vapour in their surroundings.

The student uses a dish with a lid (choice chamber) as shown in Fig. 1.1.

The choice chamber is divided into four areas. Each area has different conditions:

- black paper provides dark conditions
- damp filter paper provides water vapour.

The animals are free to move between any of the four areas.

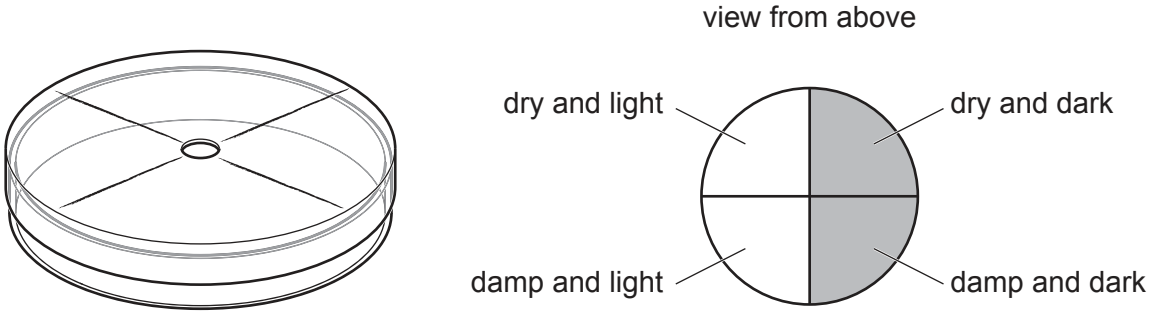


Fig. 1.1

(a) Procedure

The student:

- adds 12 small animals to the centre of the choice chamber
- records the positions of the small animals after 30 minutes
- repeats the procedure.

The results are shown in Fig. 1.2.

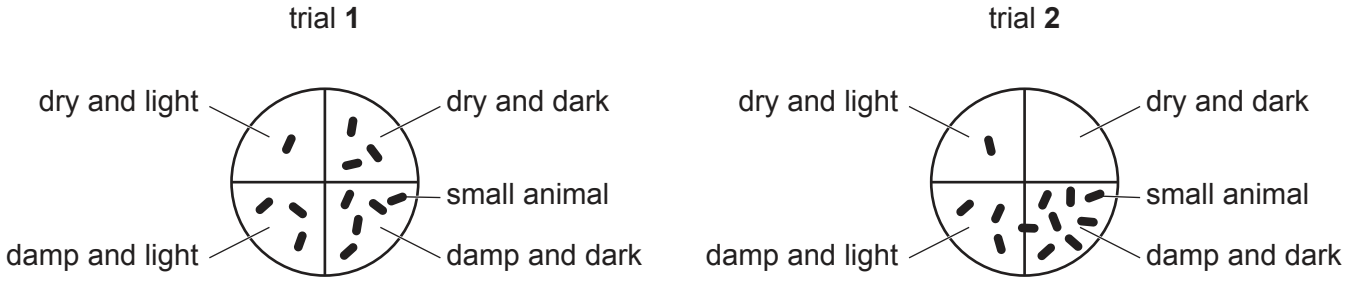


Fig. 1.2

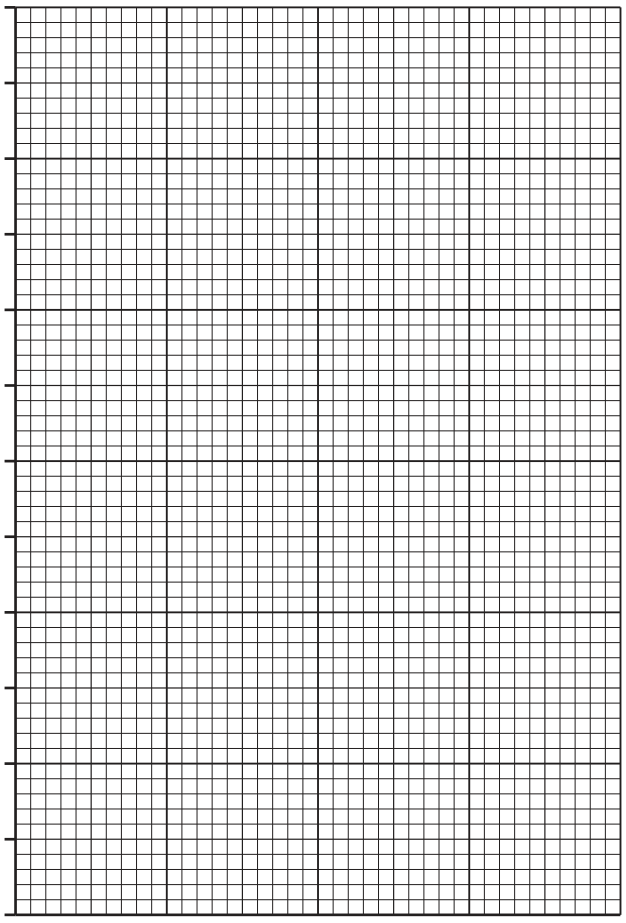
(i) Count the number of small animals in the damp and dark area of the choice chamber in both trials. Record these numbers in Table 1.1. [1]

Table 1.1

conditions in each area	number of small animals counted		average number of small animals
	trial **1**	trial **2**	
dry and dark	3	0	
damp and dark			
damp and light	3	3	3
dry and light	1	1	1

(ii) Complete Table 1.1 by calculating the average number of small animals. [1]

(b) Draw a bar chart of the average number of small animals found in each area.



[3]

(c) (i) State which area of the choice chamber the small animals prefer.

.....

..... [1]

(ii) The choice chamber has a small hole in the centre of the lid to allow the small animals to be added. Suggest why it is important that the small animals are added to the **centre** of the choice chamber.

.....

..... [1]

(iii) Use these results to explain why another trial is needed to allow the student to identify anomalies.

.....

..... [1]

[Total: 8]

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2 A student investigates the movement of molecules through a partially permeable membrane.

The partially permeable membrane allows small molecules such as water to pass through it.

It does not allow large molecules such as sugar to pass through.

The student sets up the apparatus shown in Fig. 2.1.

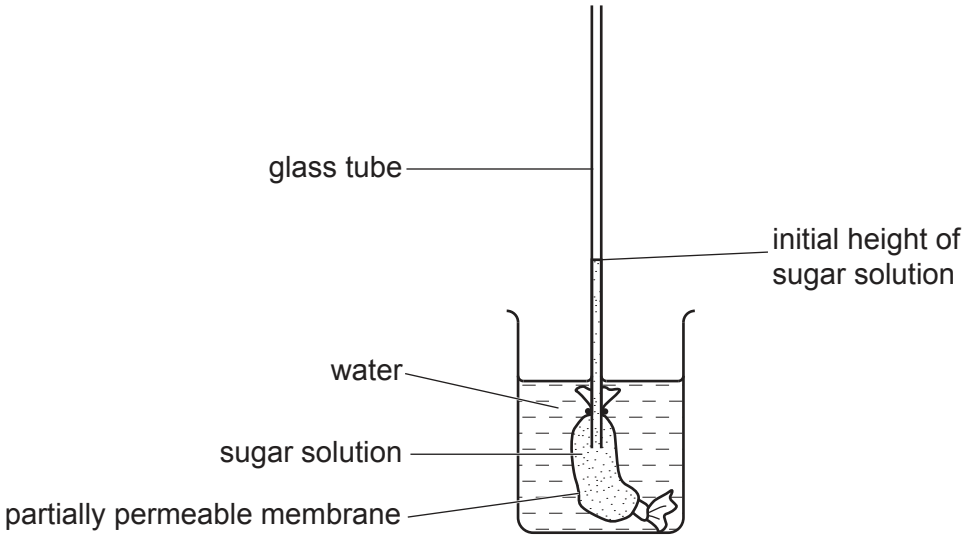


Fig. 2.1

(a) The student measures the initial height of the sugar solution in the glass tube and leaves the apparatus for 20 minutes.

Fig. 2.2 shows the initial height and height after 20 minutes of the sugar solution.

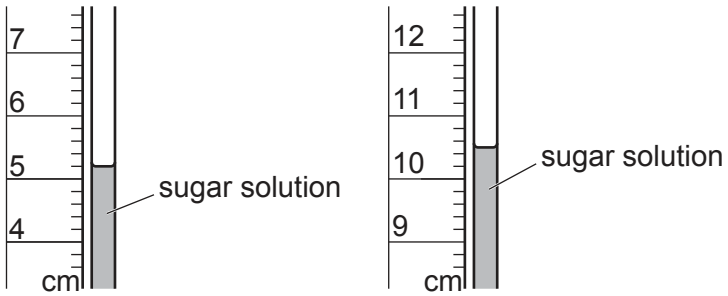


Fig. 2.2

(i) Record these heights to the nearest millimetre.

initial height = ... cm

height after 20 minutes = ... cm
[2]

(ii) Use your values in **(a)(i)** to calculate the change in height of the sugar solution in the glass tube over the 20 minutes.

change in height = ... cm [1]

(iii) Calculate the rate of movement of the sugar solution.

Use the equation shown.

$$\text{rate of movement} = \frac{\text{change in height}}{\text{time}}$$

Include the unit in your answer.

rate = ... unit ..... [2]

(b) Explain why the sugar solution moves up in the glass tube. Refer to molecules in your answer.

.....

.....

.....

..... [3]

(c) The student repeats the investigation but with water inside the partially permeable membrane, instead of the sugar solution.

Predict what the student observes in the glass tube after 20 minutes. Explain your answer.

prediction .....

explanation .....

.....
[1]

(d) The student tests for the presence of reducing sugar.

(i) State the name of the testing solution used.

..... [1]

(ii) State the colour observed when:

reducing sugar is present

.....

reducing sugar is **not** present.

.....
[2]

[Total: 12]

3 A student investigates the thermal (heat) energy released when alcohols burn.

Methanol, ethanol, propanol, butanol, pentanol and hexanol are alcohols.

Procedure

The student:

- measures 100 cm^3 of water into a beaker
- measures the initial temperature of the water
- puts methanol into a spirit burner
- measures the initial mass of the spirit burner and methanol
- assembles the apparatus shown in Fig. 3.1

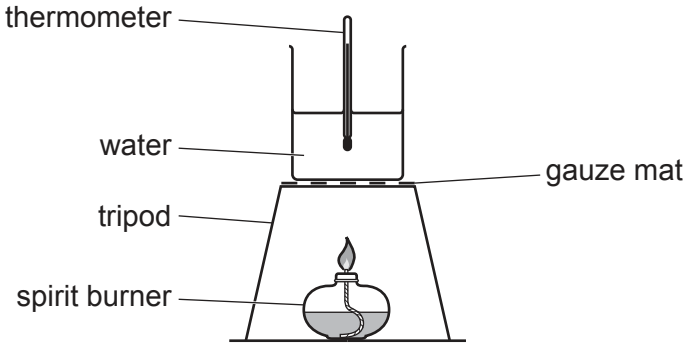


Fig. 3.1

- lights the spirit burner and heats the water for 5 minutes
- extinguishes the flame on the spirit burner
- stirs the heated water and then measures the final temperature of the water
- measures the final mass of the spirit burner and methanol.

The student repeats the procedure with ethanol, propanol, butanol, pentanol and hexanol.

The student uses their results to calculate the thermal energy released by each alcohol.

The values are recorded in Table 3.1.

Table 3.1

alcohol	number of carbon atoms in alcohol molecule	amount of thermal energy released E / kJ
methanol	1	700
ethanol	2	1300
propanol	3	
butanol	4	2600
pentanol	5	2150
hexanol	6	3990

(a) (i) Suggest why the student stirs the heated water before measuring the temperature.

.....

..... [1]

(ii) Thermal energy is lost by the water as it is being heated.

Some of the heat from the flame does **not** heat the water.

Suggest what the student can do to reduce the amount of heat loss from:

- the water as it is being heated in the experiment
- the flame as it heats the water.

Give a different suggestion for each heat loss.

the water as it is being heated in the experiment .....

.....

.....

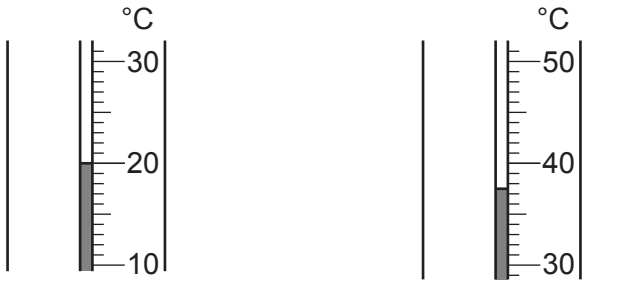
the flame as it heats the water .....

.....

.....

[2]

(b) (i) The readings on the thermometer for propanol are shown in Fig. 3.2.



initial temperature of water for propanol

final temperature of water for propanol

Fig. 3.2

Record these temperatures to the nearest 0.5 °C.

initial temperature = ... °C

final temperature = ... °C
[2]

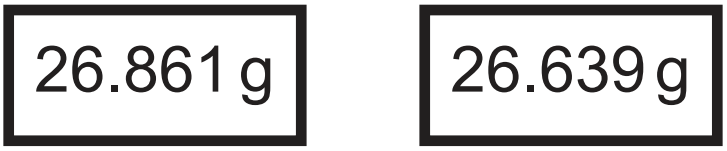
(ii) Calculate the increase in temperature of water for propanol.

Use the equation shown.

temperature increase ΔT = final temperature – initial temperature

ΔT = ... °C [1]

(c) (i) The readings on the balance for propanol are shown in Fig. 3.3.



initial mass of propanol and spirit burner

final mass of propanol and spirit burner

Fig. 3.3

Record these masses to **2** decimal places.

initial mass = ... g

final mass = ... g
[2]

(ii) Calculate the mass of propanol burned.

Use the equation shown.

mass of propanol burned Δm = final mass of propanol – initial mass of propanol

Δm = ... g

Calculate the amount of propanol burned Δn.

Use the equation shown.

$$\Delta n = \frac{\Delta m}{60}$$

Δn = ...
[2]

(d) Calculate the energy released E by propanol.

Use the equation shown.

$$E = \frac{0.42 \times \Delta T}{\Delta n}$$

Record this value in Table 3.1. [1]

(e) **(i)** **One** of the values of energy released E in Table 3.1 is anomalous.

Suggest which value is anomalous. (Do **not** include the value you have calculated for propanol.)

Suggest what might have caused this result to be anomalous.

anomalous result .....

reason .....

.....
[1]

(ii) State the relationship between the number of carbon atoms in the alcohol molecule and the amount of thermal energy released when the alcohol burns.

.....

..... [1]

[Total: 13]

4 When sodium carbonate solid reacts with dilute hydrochloric acid it makes carbon dioxide gas.

When the carbon dioxide gas made is bubbled into a detergent the bubbles make a foam.

The more carbon dioxide that is bubbled into the detergent the more foam is made.

You are provided with:

- detergent (washing up liquid)
- sodium carbonate
- dilute hydrochloric acid
- any common laboratory apparatus.

Plan an investigation to find the relationship between the mass of sodium carbonate added to dilute hydrochloric acid and the height of foam made.

Include in your plan:

- the apparatus needed, including a labelled diagram if you wish
- a brief description of the method, including any safety precautions
- the measurements you will make, including how to make them as accurate as possible
- the variables you will control
- how you will process your results to draw a conclusion.

Include a results table if you wish. You are **not** required to add any results into the table.

[7]

5 A student investigates the image formed by a converging lens.

(a) Procedure

The student:

- places a screen at a distance d = 80.0 cm from an illuminated object
- switches on a lamp and places a converging lens close to the illuminated object
- adjusts the position of the lens by moving it slowly away from the object along the bench until a sharp image of the illuminated object is formed on the screen.

Fig. 5.1 shows the position of the lens when the image is sharp.

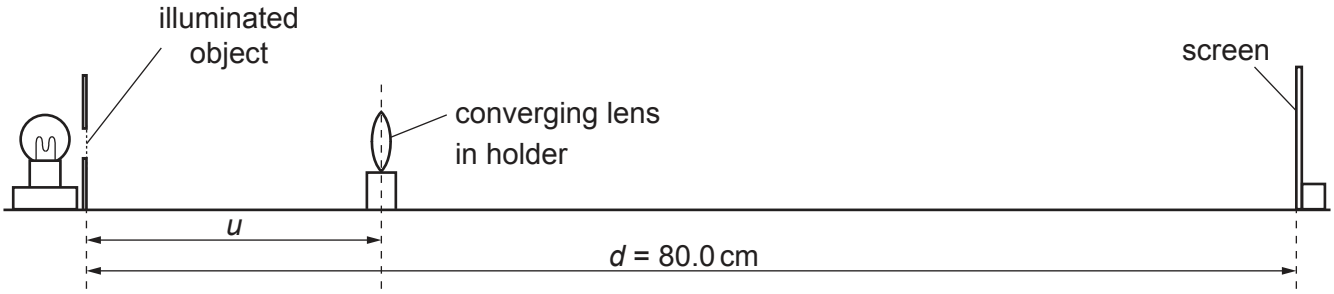


Fig. 5.1

(i) Measure, on Fig. 5.1, the object distance u from the illuminated object to the lens.

Record u to the nearest 0.1 cm.

u = ... cm [1]

(ii) Fig. 5.1 is drawn to a scale of **one-fifth** full size.

Calculate the actual object distance U from the illuminated object to the lens.

U = ... cm [1]

(iii) Calculate the actual image distance V from the lens to the screen.

Use the equation shown.

$$V = 80.0 - U$$

V = ... cm [1]

(iv) Calculate the focal length f_1 of the lens.

Use the equation shown.

$$f_1 = \frac{U \times V}{80}$$

Give your answer to **3** significant figures.

f_1 = ... cm [2]

(b) The student continues to move the lens away from the illuminated object until a second sharp image of the illuminated object is formed on the screen.

Fig. 5.2 shows the position of the lens when the image is sharp.

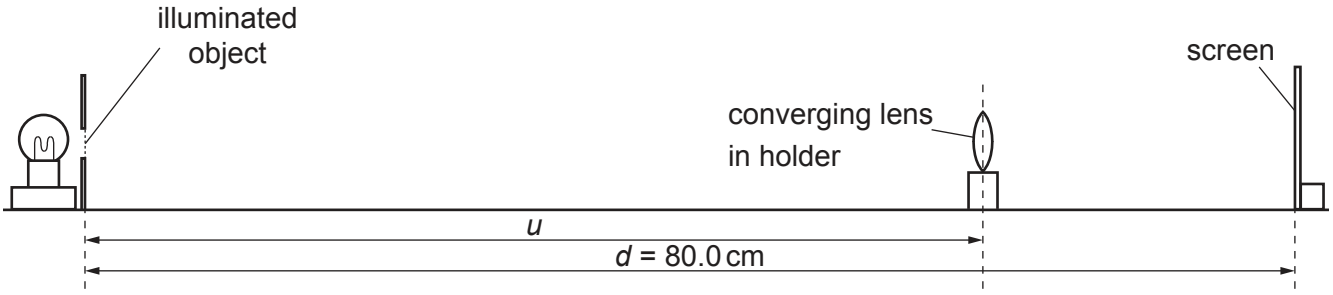


Fig. 5.2

The new actual object distance U_1 from the lens = 59.8 cm.

(i) Calculate the new image distance V_1.

V_1 = ... cm [1]

(ii) Calculate a second value f_2 for the focal length of the lens.

Use the equation shown.

$$f_2 = \frac{U_1 \times V_1}{80}$$

f_2 = ... cm [1]

(c) Use your results from **(a)(iv)** and **(b)(ii)** to calculate an average value for the focal length f of the lens.

f = ... cm [1]

(d) Describe **one** practical technique used to obtain accurate results in this experiment.

.....

..... [1]

(e) The illuminated object is a triangle, which has been drawn to actual size in Fig. 5.3.

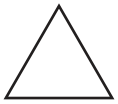


Fig. 5.3

The image produced on the screen by the lens in part **(a)** is inverted and enlarged.

The image in part **(b)** is inverted and diminished.

In the space below draw both images.

image in part (a) **image in part (b)**

[2]

[Total: 11]

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6 A student investigates whether two resistance wires **X** and **Y** are made from the same metal.

X and **Y** have the same thickness but have different lengths.

(a) Procedure

The student:

- sets up the circuit shown in Fig. 6.1
- measures the length l of each resistance wire between the crocodile clips and records the values in Table 6.1

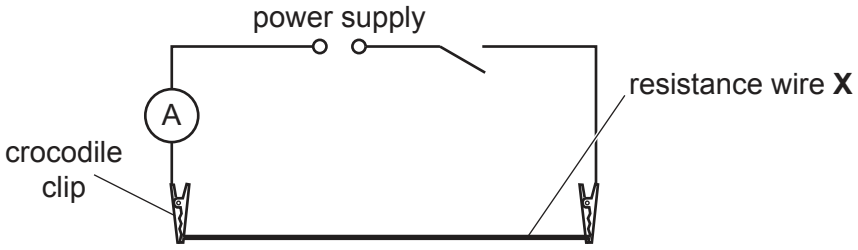

Fig. 6.1

- connects a voltmeter into the circuit to measure the potential difference across resistance wire **X**
- closes the switch
- measures the potential difference V and the current I and records the values in Table 6.1
- opens the switch.

On Fig. 6.1, draw a voltmeter connected to measure the potential difference across resistance wire **X**. [2]

(b) The readings on the voltmeter and the ammeter for resistance wire **X** are shown in Fig. 6.2.

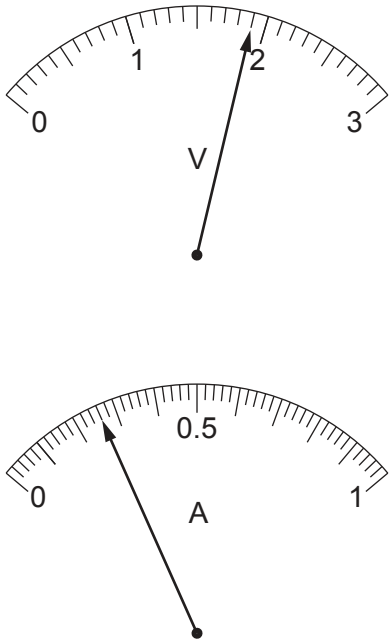

Fig. 6.2

Read both of the meters and record the values of potential difference V and current I in Table 6.1.
[2]

Table 6.1

resistance wire	l/m	V/V	I/A	R/Ω
X	0.850			
Y	0.650	2.0	0.37	5.4

(c) The student replaces resistance wire **X** with resistance wire **Y** and repeats the measurements of potential difference V and current I.

The values are recorded in Table 6.1.

Calculate, and record in Table 6.1, the resistance R of resistance wire **X**.

Use the equation shown.

$$R = \frac{V}{I}$$

[1]

(d) Calculate the resistance per metre r of each resistance wire.

Use the equation shown.

$$r = \frac{R}{l}$$

r for wire **X** = ... Ω / m

r for wire **Y** = ... Ω / m
[1]

(e) Two quantities can be considered to be the same, within the limits of experimental accuracy, if their values are within 10% of each other.

Use your values from **(d)** to suggest if the resistance wires are made from the same metal.

Support your answer with a calculation.

.....

.....

.....

..... [2]

(f) In this experiment the resistance wires heat up.

Suggest **one** method of reducing the heating effect in the wires.

.....

..... [1]

[Total: 9]