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Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0118382178

CO-ORDINATED SCIENCES **0654/63**

Paper 6 Alternative to Practical **October/November 2024**

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.

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1 A student investigates the movement of water into and out of plant cells by osmosis.

The student uses potato tissue and sugar solution.

(a) Procedure

The student:

- prepares five large test-tubes as shown in Table 1.1

Table 1.1

test-tube	volume of sugar solution / cm^3	percentage concentration of sugar solution
A	8	0
B	8	2
C	8	4
D	8	6
E	8	8

- cuts five cylinders of potato tissue each of equal diameter and of mass 40 g
- adds one cylinder of potato tissue to each test-tube as shown in Fig. 1.1

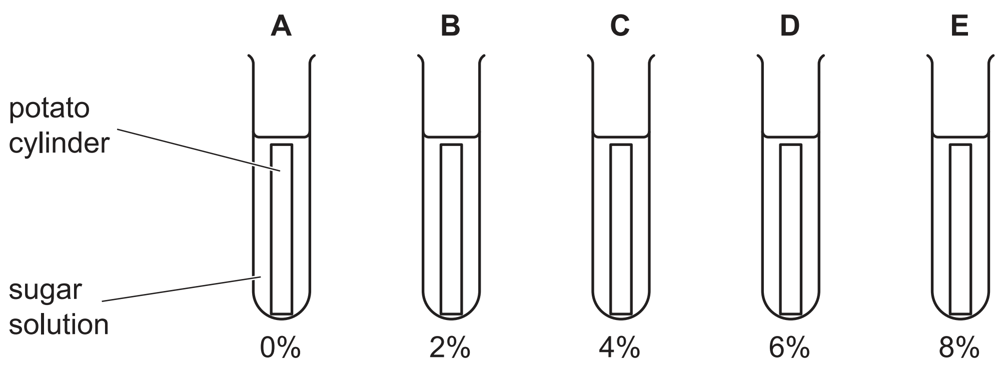


Fig. 1.1

- leaves the potato cylinders in the solutions for 40 minutes
- removes and dries the potato cylinders
- records the mass of each potato cylinder.

(i) Fig. 1.2 shows the balance readings for the cylinders of potato from the 6% and 8% sugar solutions at 40 minutes.

Fig. 1.2

Record in Table 1.2 these masses to the nearest gram.

Table 1.2

test-tube	percentage concentration of sugar solution	initial mass / g	final mass / g	change in mass / g
A	0	40	49	+9
B	2	40	41	+1
C	4	40	39	–1
D	6	40		
E	8	40		

[2]

(ii) Complete Table 1.2 by calculating the change in mass of the potato cylinders for 6% and 8% sugar solutions. [2]

(iii) To make a valid and fair comparison all the potato cylinders have the same mass and diameter at the start.

Explain why it is important to have the same mass and diameter at the start.

....

.... [1]

(iv) Suggest why it is important that the potato cylinders are dried before the final mass is measured.

....

.... [1]

(v) Water molecules can move into and out of potato cells by osmosis.

Sugar molecules cannot move into and out of potato cells.

Use this information to explain the results in the test-tube containing 2% sugar solution.

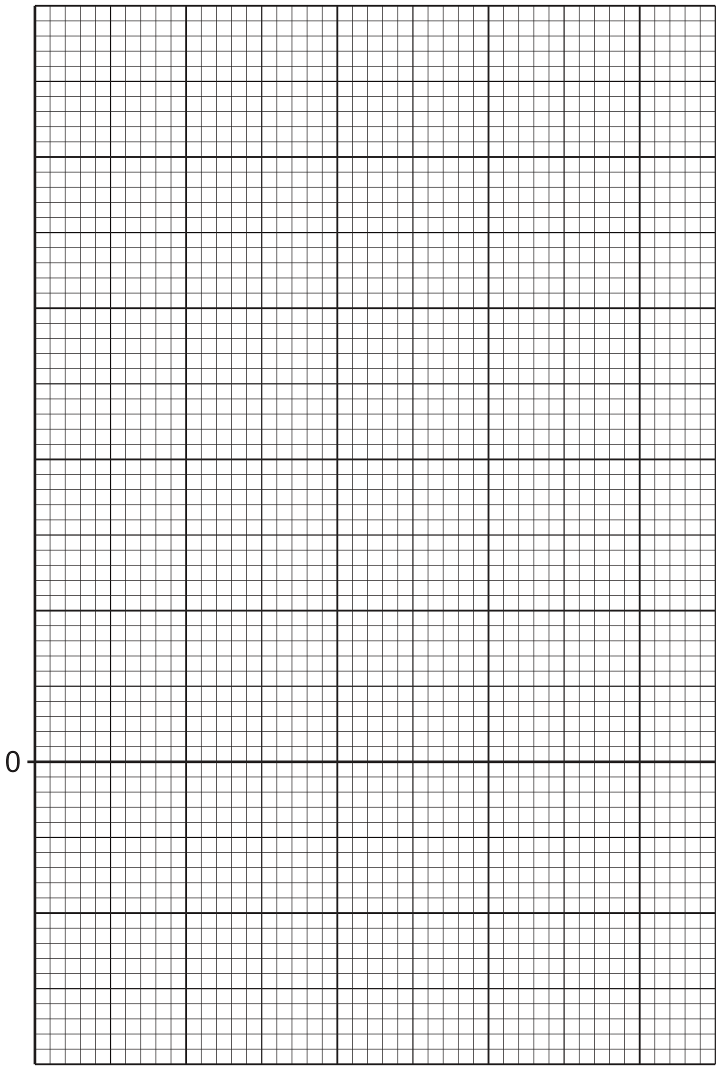
....

....

....

.... [1]

(b) (i) On the grid, plot a graph of change in mass (vertical axis) against percentage concentration of sugar solution.



[3]

(ii) Draw the best-fit curve. [1]

(c) (i) Use your graph to determine the percentage concentration of sugar solution that has no change in mass for the potato cylinder.

Show your working on the graph.

percentage concentration = ... % [2]

(ii) Explain why there is no change in mass of the potato cylinder at the concentration you identified in **(c)(i)**.

....

.... [1]

[Total: 14]

2 A student tests potato and apple for their nutrient content using Benedict's solution, biuret solution and iodine solution.

The potato tests positive with the iodine solution and negative with the Benedict's solution and biuret solution.

The apple tests positive with the Benedict's solution and negative with the biuret solution and iodine solution.

(a) Complete Table 2.1 to show the final colours the student observes.

Table 2.1

	final colour student observes		
type of food	Benedict's solution	biuret solution	iodine solution
potato			
apple			

[3]

(b) Use the student's results to state a conclusion for the nutrient content of each food.

potato ....

....

apple ....

....

[3]

[Total: 6]

3 A student investigates the composition of air.

(a) When iron is heated in air it reacts with oxygen and removes oxygen from the air.

Procedure

The student:

- pulls some air into a syringe
- records in Table 3.1 the initial volume of air in the syringe

Table 3.1

initial volume of air in the syringe / cm^3	
final volume of air without oxygen in the syringe / cm^3	
decrease in volume of air / cm^3	

- empties another syringe
- puts iron powder into a hard-glass tube
- assembles the apparatus shown in Fig. 3.1

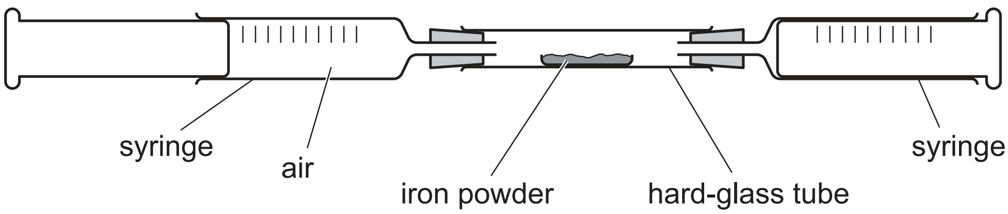


Fig. 3.1

- heats the iron powder strongly with a blue Bunsen burner flame
- slowly pushes the plunger on one side so that air passes over the hot iron powder
- slowly pushes the other plunger so that air passes back over the hot iron powder
- continually passes air over the hot iron powder from one syringe to the other
- after five minutes pushes **all** of the remaining air without oxygen into one syringe
- allows the apparatus to cool down
- records in Table 3.1 the final volume of air without oxygen in the syringe.

(i) Suggest why the student allows the apparatus to cool down before measuring the final volume of air without oxygen.

....

.... [1]

(ii) Fig. 3.2 shows the volumes in the syringe.

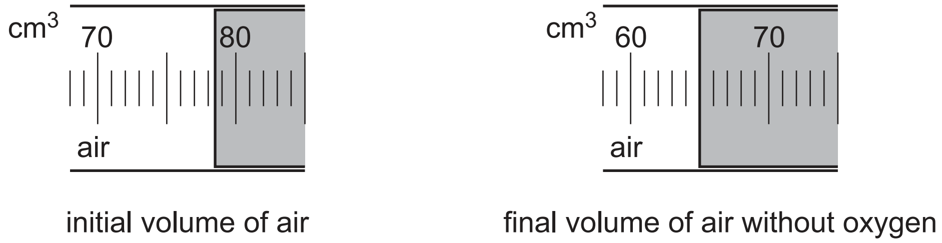


Fig. 3.2

Record in Table 3.1 these volumes to the nearest 0.5 cm^3. [2]

(iii) Calculate the decrease in volume of air.

Record this value in Table 3.1. [1]

(iv) Calculate the percentage of oxygen in the air.

Use the equation shown.

$$\text{percentage of oxygen} = \frac{\text{decrease in volume of air}}{\text{initial volume of air}} \times 100$$

percentage of oxygen = ... % [1]

(b) The actual percentage of oxygen in the air is 21%.

Suggest **one** improvement to the procedure to increase the percentage determined by the student in **(a)(iv)**.

....

....

.... [1]

(c) The student tests the gas that remains in the syringe with a lighted splint.

Suggest what happens to the lighted splint.

Explain your answer.

....

....

.... [1]

(d) The student puts the mixture from the hard-glass tube into a test-tube.

The student adds dilute nitric acid to the mixture.

The solution formed contains aqueous iron(III) ions.

State a test for aqueous iron(III) ions. Give the observation for a positive result.

test ....

observation ....

.... [1]

(e) **Procedure**

The student:

- puts 50.0 cm^3 of air into a syringe and adds some limewater
- shakes the syringe
- records the final volume of air in the syringe as 50.0 cm^3.

The student observes that the limewater goes milky (contains a white precipitate) because of the carbon dioxide present in the air.

The carbon dioxide is removed from the air when it reacts with the limewater.

Suggest why the measurement of the volume of air in the syringe initially and after adding the limewater is the same.

....

.... [1]

(f) **Procedure**

The student:

- assembles the apparatus shown in Fig. 3.3

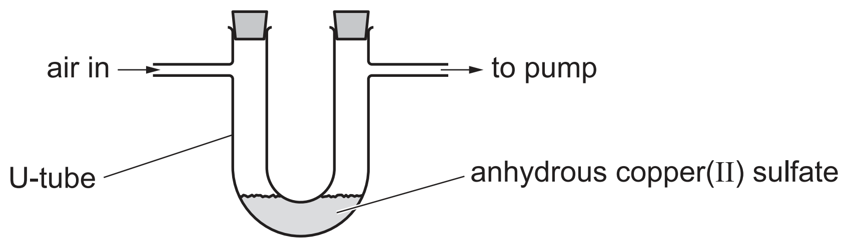


Fig. 3.3

- switches on the pump and pulls air through the tube for fifteen minutes.

The anhydrous copper(II) sulfate shows that water vapour is present in the air.

State the colour change the student observes.

colour changes from .... to .... [1]

(g) Iron rusts in the presence of air and water.

Boiling water removes the air dissolved in the water.

Calcium chloride removes water vapour from air.

A student investigates the rusting of iron nails.

Fig. 3.4 shows the four experiments the student does.

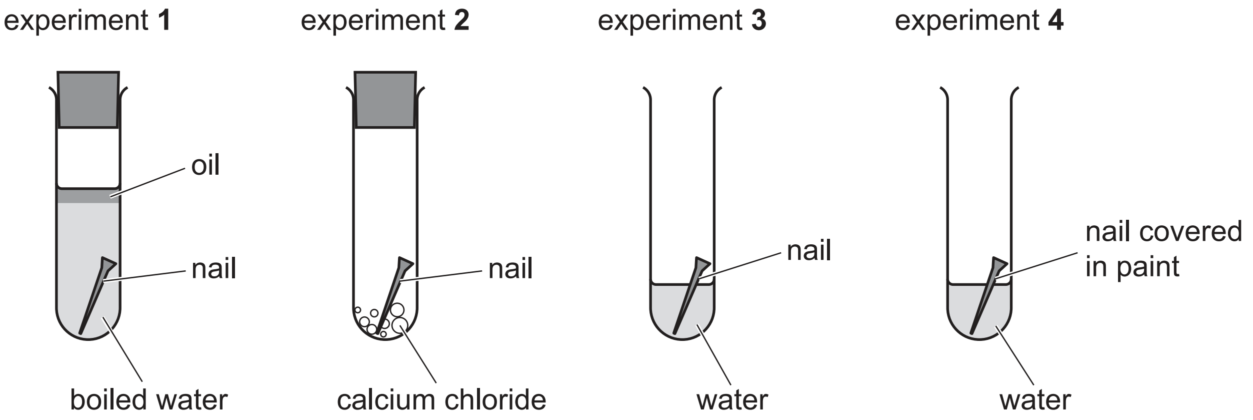


Fig. 3.4

The iron nails are left for 10 days.

State the experiments in which the iron nails do **not** rust.

Explain your answer for each experiment where the iron nail does **not** rust.

experiment numbers ....

explanation for each nail that does **not** rust

....

....

....

....
[3]

[Total: 13]

4 Rust is a brown solid that forms on the surface of iron.

At first, the brown solid cannot be seen with the eye.

The rusting of iron in salt water is detected using indicator **X**.

Indicator **X**:

- dissolves in water
- turns blue as soon as iron starts to rust in water
- is poisonous.

Plan an investigation to find the relationship between the mass of salt added to water and the time it takes for rust to start forming.

You are given:

- water
- salt
- iron pieces
- indicator **X**.

You may use any common laboratory apparatus.

Include in your plan:

- the apparatus you will use
- a brief description of the method explaining any safety precautions you will take
- what you will measure and how you will make these measurements as accurate as possible
- which variables you will control
- how you will process your results and use them to draw a conclusion.

You may include a labelled diagram if you wish.

You may also include a table that can be used to record results. You are **not** required to include any results.

[7]

5 A student measures the focal length of a converging lens.

The student assembles the apparatus as shown in Fig. 5.1.

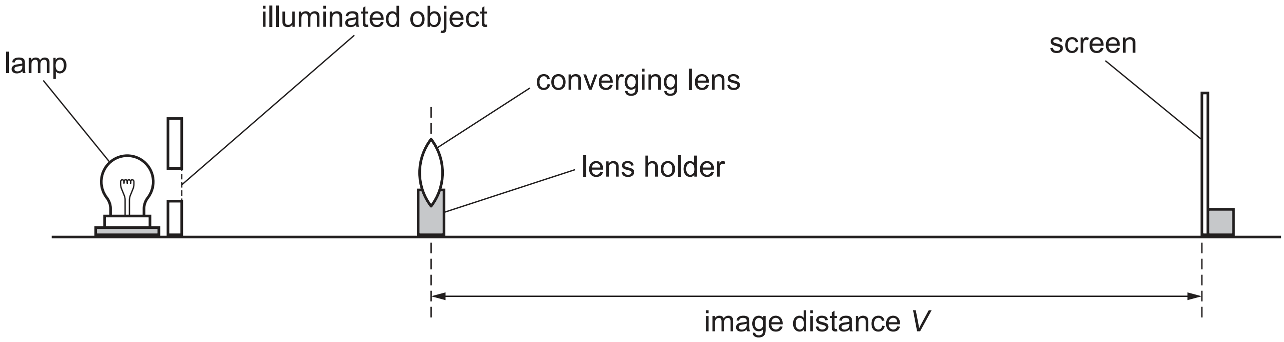


Fig. 5.1

(a) Procedure

The student:

- switches on the lamp and places the lens 20.0 cm from the illuminated object
- adjusts the position of the screen until the image of the illuminated object is in focus on the screen.

(i) On Fig. 5.1, measure the image distance *V* from the lens to the screen.

Record *V* to the nearest 0.1 cm.

V = ... cm [1]

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

Calculate the actual image distance *v* from the lens to the screen.

v = ... cm [1]

(iii) Describe the technique used to obtain a sharp image of the illuminated object on the screen.

....

.... [1]

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

Use the equation shown.

$$f_1 = \frac{20v}{(20 + v)}$$

f_1 = ... cm [1]

(c) The student repeats the procedure in **(a)** but places the lens a distance of 50.0 cm from the illuminated object.

The student measures the image distance v from the lens to the screen.

$$v = 21.5\,\text{cm}$$

Calculate the focal length f_2 of the lens.

Use the equation shown.

$$f_2 = \frac{50v}{(50 + v)}$$

f_2 = ... cm [1]

(d) Use your answers from **(b)** and **(c)** to calculate an average value for the focal length f of the lens.

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

f = ... cm [2]

(e) The illuminated object is a triangular hole cut in a piece of card.

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

Fig. 5.2 shows the illuminated object.

On Fig. 5.2 draw the image next to the illuminated object.

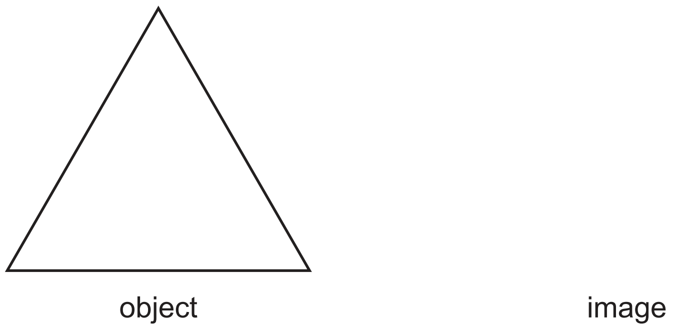


Fig. 5.2

[2]

(f) The student does this experiment in a darkened room.

Explain how this makes it easier to decide when the image is in focus.

....

.... [1]

[Total: 10]

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6 A student investigates the rate of cooling of water.

The student assembles the apparatus shown in Fig. 6.1.

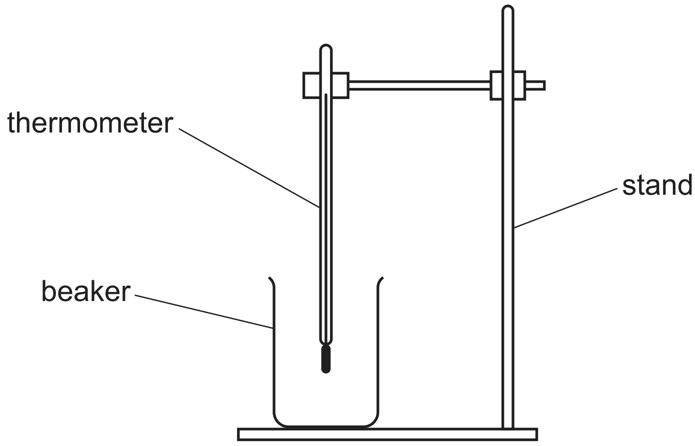

Fig. 6.1

(a) Procedure

The student:

- pours 250 cm^3 of hot water into the beaker
- waits for 30 s
- measures and records the initial temperature θ of the water
- measures the temperature of the water at one-minute intervals for 5 minutes
- records in Table 6.1 the temperatures to the nearest 0.5 °C.

The thermometer reading for time t = 1 minute is shown in Fig. 6.2.

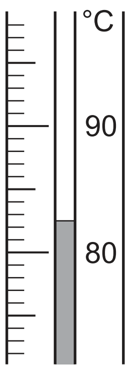

Fig. 6.2

(i) Record in Table 6.1 the temperature at time t = 1 minute.

Table 6.1

time t / min	temperature θ / °C
0	87.5
1	
2	77.0
3	72.0
4	67.5
5	63.5

[1]

(ii) Suggest why it is important for the student to wait for 30 s before measuring the initial temperature of the hot water.

....

.... [1]

(iii) State how the student ensures that the temperature readings are as accurate as possible.

....

.... [1]

(b) (i) Calculate the decrease in temperature $\Delta\theta$ of the hot water during the first two minutes of cooling.

$\Delta\theta$ = ... °C [1]

(ii) Calculate the average rate of cooling R_1 of the hot water during the first two minutes of cooling.

Use the equation shown.

$$R_1 = \frac{\text{decrease in temperature}}{\text{time}}$$

R_1 = ... °C / min [1]

(c) Calculate the average rate of cooling R_2 of the hot water during the final two minutes of cooling.

R_2 = ... °C/min [2]

(d) Use your results to write a conclusion about the way in which hot water in a beaker cools.

....

.... [1]

(e) **(i)** Calculate the total decrease in the temperature of the water $\Delta\theta$ over the five-minute cooling period.

$\Delta\theta$ = ... [1]

(ii) Estimate the temperature of the water θ after a further five minutes of cooling.

θ = ... °C [1]

[Total: 10]