Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME										
CENTRE NUMBER						CANDIDATE NUMBER				

0760399811

CO-ORDINATED SCIENCES **0654/61**

Paper 6 Alternative to Practical **October/November 2022**

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.

DC (CE/SW) 301658/3

1 A student investigates the effect of temperature on the release of a red pigment from beetroot cells.

When beetroot with damaged cells is placed in water, the red pigment leaves the beetroot and turns the water red.

(a) Procedure

The student:

step **1** cuts three cylinders of beetroot of the same size

step **2** rinses the beetroot cylinders in water

step **3** half fills three test-tubes with water at room temperature, 40 °C and 60 °C.

step **4** puts one beetroot cylinder into each test-tube

step **5** places the test-tubes in beakers of water to maintain their temperatures at room temp, 40 °C and 60 °C as shown in Fig. 1.1

step **6** leaves the test-tubes for 5 minutes

step **7** removes the cylinders of beetroot from the test-tubes

step **8** observes the water in each test-tube and judges how much colour has transferred from the beetroot into the water.

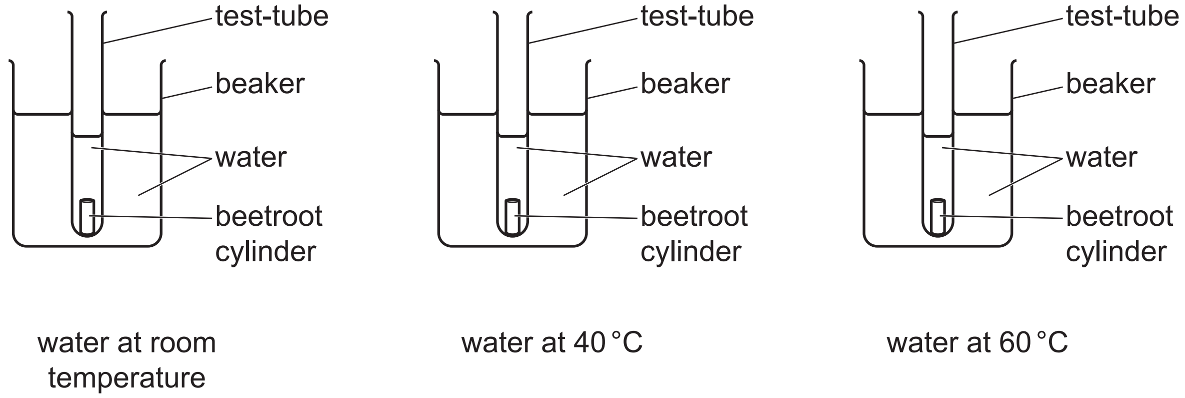

Fig. 1.1

Table 1.1 shows the order in which the student places the test-tubes.

Table 1.1

colour of water	temperature of water in test-tube / °C
lightest red	40.0
↓	room temperature = ...
darkest red	60.0

Fig. 1.2 shows the thermometer reading for the test-tube with water at room temperature.

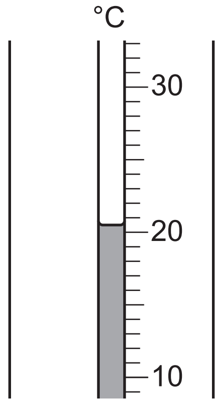

Fig. 1.2

Record in Table 1.1 the temperature of the water to the nearest 0.5 °C. [1]

(b) Fig. 1.3 shows one of the pieces of beetroot, drawn full size.

Fig. 1.3

(i) Record the length of the piece of beetroot in millimetres to the nearest millimetre.

length = ... mm [1]

(ii) In step **1** all of the beetroot cylinders are cut to the same size to make sure the test is fair.

Suggest why it is important that the beetroot cylinders are all cut to the same size.

....

.... [1]

(iii) In step **2** all of the beetroot cylinders are rinsed with water.

Suggest why the beetroot cylinders are rinsed.

....

.... [1]

(iv) The teacher says that the water at room temperature should be the lightest red.

Suggest what may have caused the student to obtain a different result.

....

.... [1]

(c) Another student repeats the investigation using six different temperatures.

The student compares the colours of the solutions to a colour chart.

The colour chart gives each shade of colour a number.

The results are shown in Table 1.2.

Table 1.2

temperature of water / °C	colour number		
	trial 1	trial 2	average
10	1.2	1.4	1.3
20	1.4	1.6	1.5
30	1.5	1.7	
50	3.0	2.6	2.8
60	4.8	4.4	4.6
80	11.5	11.9	11.7

Complete Table 1.2 by calculating the average colour number for 30 °C. [1]

(d) **(i)** On the grid plot a graph of **average** colour number (vertical axis) against temperature of water.

[3]

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

(iii) Use your graph to estimate the colour number for a temperature of water of 70 °C.

Show on your graph how you arrived at your answer.

colour number at 70 °C = ... [2]

(e) **(i)** Describe the relationship between temperature and the colour number of the solution.

....

.... [1]

(ii) Suggest the relationship between temperature and the number of beetroot cells damaged.

....

.... [1]

[Total: 14]

2 A student investigates the lungs and breathing.

(a) The student uses a straw to blow exhaled air into a sample of limewater.
The limewater turns milky.

State what this shows about the content of exhaled air.

....

.... [1]

(b) The apparatus in Fig. 2.1 is used to measure the maximum volume of air exhaled (breathed out) in one breath.

The student puts the mouthpiece into their mouth and breathes out through the tube. Exhaled air enters the large measuring bottle.

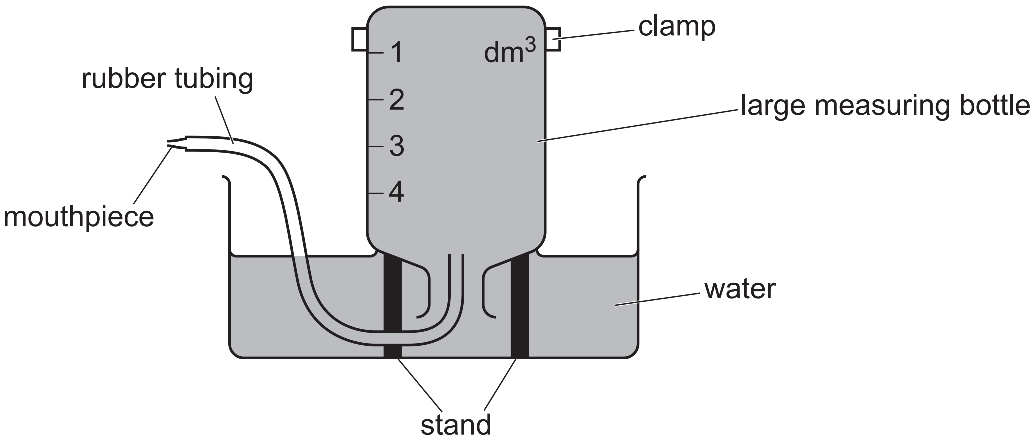

Fig. 2.1

(i) Suggest what the student does to make sure they measure the **maximum** volume of air in their lungs.

....

.... [1]

(ii) The student does the experiment four times.

The results are shown in Table 2.1.

Table 2.1

	trial 1	trial 2	trial 3	trial 4	average
volume of air breathed out / dm^3	3.8	2.2	4.2	4.3	4.1

Suggest why trial 2 is **not** used to calculate the average.

....

.... [1]

(iii) State the maximum volume of air exhaled (breathed out) by the student.

volume = ... dm^3 [1]

(c) Suggest a safety precaution that must be taken to allow several students to use the same apparatus.

Explain your answer.

suggestion ....

....

explanation ....

....
[2]

[Total: 6]

3 A student investigates the pH of milk and vinegar. The student also investigates the mass of solid formed when different volumes of milk react with vinegar.

The pH scale for universal indicator is a continuous colour spectrum as partly shown in Fig. 3.1.

pH	1			7			14
colour	red	orange	yellow	pale green	dark green	blue	purple
description	strongly acidic		weakly acidic	neutral	weakly alkaline		strongly alkaline

Fig. 3.1

(a) Procedure

The student:

step **1** adds about 1 cm^3 of vinegar to a test-tube

step **2** adds 3 drops of universal indicator to the vinegar in the test-tube

step **3** records in Table 3.1 the pH of the vinegar

step **4** repeats steps **1** to **3** using milk instead of vinegar.

Table 3.1

substance	colour with universal indicator	pH	description
vinegar		4	
milk		7	

(i) Record in Table 3.1 the colour of each solution with the universal indicator.

Use the pH scale in Fig. 3.1. [2]

(ii) Explain why it is difficult for the student to be sure of the pH of milk.

....

.... [1]

(iii) Complete Table 3.1 using information from Fig. 3.1. [1]

(b) Sodium carbonate gives off carbon dioxide gas when it reacts with acids.

The student adds some sodium carbonate powder to separate test-tubes of vinegar and milk.

Complete Table 3.2 with the observations the student sees in each test-tube. Use information from Table 3.1.

Table 3.2

substance	observation when sodium carbonate is added
vinegar	
milk	

[1]

(c) The student reacts hot milk with vinegar to make a white solid.

Procedure

The student:

step **1** places 30 cm^3 of hot milk into a small beaker

step **2** adds 1 cm^3 of vinegar to the beaker

step **3** stirs the mixture and filters off the white solid formed

step **4** scrapes the white solid onto a paper towel and squeezes out as much liquid from the solid as possible

step **5** uses a balance to find the mass of the white solid and records its mass in Table 3.3

step **6** repeats steps **1** to **5** using 2, 3, 4 and 5 cm^3 of vinegar instead of 1 cm^3.

Table 3.3

volume of vinegar / cm^3	mass of white solid / g
1	1.6
2	
3	5.0
4	
5	6.6

(i) Fig. 3.2 shows the readings on the balance for 2 and 4 cm^3 of vinegar added.

3.32 g	6.58 g
2 cm^3 of vinegar	4 cm^3 of vinegar

Fig. 3.2

Record these masses to **two** significant figures in Table 3.3. [2]

(ii) Look at steps **4** and **5**.

The mass of each solid is a little more than expected.

Suggest a reason why the mass of each solid is more than expected.

....

.... [1]

(iii) Suggest what the student can do to have more confidence in the mass of each solid formed.

Do **not** repeat your answer to **(c)(ii)**.

....

.... [1]

(iv) A student adds 10 cm^3 of vinegar to the milk and finds the mass of the white solid is the same as that for 5 cm^3 of vinegar.

Suggest why the masses are the same.

....

.... [1]

(v) State the relationship between the volume of vinegar added and the mass of white solid made.

....

....

.... [2]

[Total: 12]

4 Copper is an unreactive metal. It is a pink-orange colour.

In an experiment a grey coloured iron key is attached to the negative terminal of a power supply. A piece of copper is attached to the positive terminal of the power supply.

The iron key and the piece of copper are both dipped in aqueous copper sulfate.

A diagram of the apparatus is shown in Fig. 4.1.

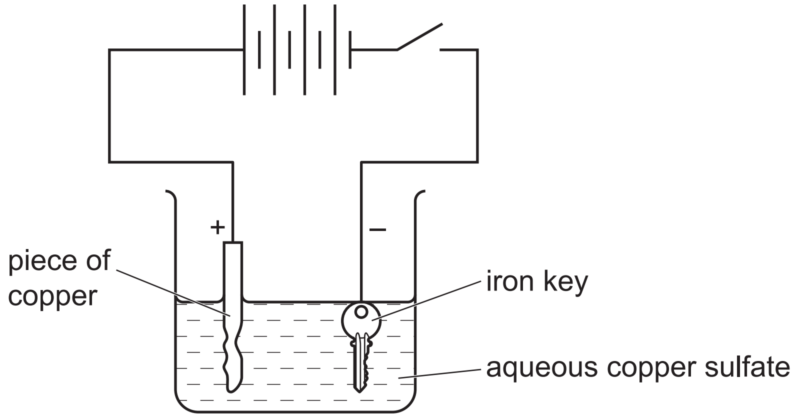

Fig. 4.1

The power supply is turned on. The voltage on the power supply must not be higher than 20 V for safety reasons.

The iron key becomes covered in copper metal. The piece of copper becomes smaller.

Plan an experiment to find out the relationship between the voltage of the power supply and the amount of copper plated onto the iron key.

You will **not** be doing this experiment.

Include in your plan:

- the apparatus needed, you do **not** need to include what is shown in Fig. 4.1
- a brief description of the method, explaining 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.

You may include a table that can be used to record results if you wish. You are not required to include any results.

[7]

5 A student investigates different methods of thermally insulating two beakers, **X** and **Y**.

Beaker **X** has a lid, but no insulation.

Beaker **Y** has a layer of insulation wrapped around it but has no lid.

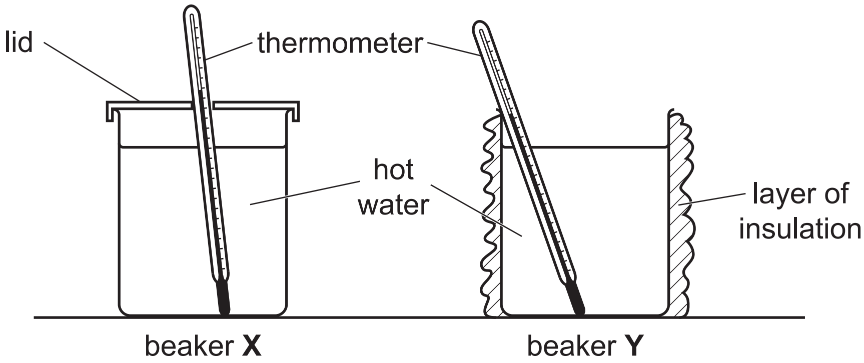

Fig. 5.1

(a) Procedure

The student:

- pours 150 cm^3 of hot water into beaker **X** and replaces the lid
- places a thermometer into the water
- measures the temperature of the hot water when the reading stops rising
- immediately starts a stop-watch.

Fig. 5.2 shows the maximum temperature of the hot water.

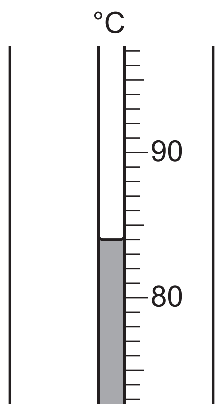

Fig. 5.2

(i) Record the temperature to the nearest 0.5 °C in Table 5.1. This is the temperature at time $t = 0$.

Table 5.1

time t / s	temperature of beaker **X** / °C	temperature of beaker **Y** / °C
0		85.0
30	81.0	79.0
60	78.5	75.0
90	76.0	71.0
120	74.0	67.5
150	72.5	64.0
180	71.0	61.0

[1]

(ii) The student measures the temperature of the hot water every 30 s for 180 s, stirring the water before reading each temperature.

The student's results are shown in Table 5.1.

State why it is important to stir the water before reading its temperature.

.... [1]

(iii) Describe **two** safety precautions that must be observed when working with hot water.

Explain how each precaution reduces the risk.

1 ....

....

2 ....

....

[2]

(iv) Calculate the decrease in temperature θ_X of the hot water in beaker **X** during the 180 s.

Use the equation shown.

$$\theta_X = \text{temperature at } 0\,\text{s} - \text{temperature at } 180\,\text{s}$$

θ_X = ... °C [1]

(v) Calculate the average rate of temperature decrease R_X of the hot water in beaker **X** during the 180 s.

Use the equation shown.

$$R_X = \frac{\theta_X}{180}$$

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

R_X = ... °C / s [2]

(b) Procedure

The student:

- pours 150 cm^3 of hot water into beaker **Y**.
- places a thermometer into the water
- measures the temperature of the hot water when the reading stops rising
- immediately starts a stop-watch.

The student's results are shown in Table 5.1.

(i) The temperature of the water in both beakers decreases as the time increases.

State one **other** similarity in the way the water temperature decreases in beaker **X** and beaker **Y**.

....

.... [1]

(ii) Calculate the decrease in temperature θ_Y of the hot water in beaker **Y** during the 180 s.

θ_Y = ... °C [1]

(iii) Calculate the average rate of temperature decrease R_Y of the hot water in beaker **Y** during the 180 s.

Use the equation shown.

$$R_Y = \frac{\theta_Y}{180}$$

R_Y = ... °C / s [1]

(c) State which is the more effective method of insulating a beaker to prevent thermal energy loss from hot water.

Use your results from **(a)(v)** and **(b)(iii)** and explain how you reach this conclusion.

more effective method ....

explanation ....

....
[1]

(d) State **one** factor which is controlled to ensure that the comparison between beaker **X** and beaker **Y** is fair.

.... [1]

(e) Suggest **one** way, apart from adding a lid, that the rate of cooling of the water in beaker **Y** can be further reduced.

.... [1]

[Total: 13]

6 A student measures the density of the material from which a metre rule is made.

(a) Procedure

The student:

- places a load **M** on a metre rule and adjusts its position carefully until the centre of the load is directly above the 15.0 cm mark on the metre rule
- places a pivot under the rule and adjusts the position of the pivot carefully until the rule is as close to balance as possible.

Fig. 6.1 shows the metre rule at balance viewed from the side.

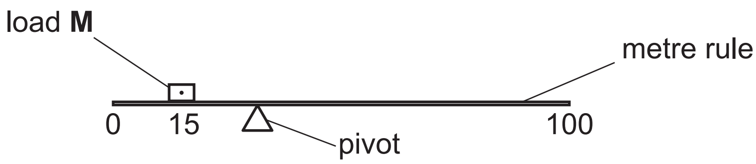

Fig. 6.1

Fig. 6.2 shows the position of the pivot at balance viewed from above.

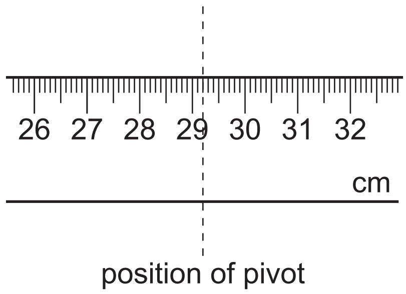

Fig. 6.2

(i) Record the position *r* of the pivot in centimetres to the nearest 0.1 cm.

r = ... cm [1]

(ii) Calculate the distance *d* from the centre of load **M** to the pivot.

d = ... cm [1]

(b) Describe how the student makes sure that the centre of load **M** is directly above the 15.0 cm mark on the metre rule. You may draw a diagram if you wish.

....

.... [1]

(c) **(i)** Calculate the mass m of the metre rule.

Use the equation shown.

$$m = \frac{150 \times d}{(35 - d)}$$

m = ... g [1]

(ii) State the name of a piece of apparatus that the student uses to check the result in **(c)(i)**.

.... [1]

(d) The student measures the thickness t and the width w of the metre rule. The student's results are shown.

$t = 0.5\,\text{cm}$

$w = 2.5\,\text{cm}$

Calculate the volume V of the metre rule.

Use the equation shown.

$$V = 100 \times t \times w$$

V = ... cm^3 [1]

(e) Use your answers to **(c)(i)** and **(d)** to calculate the density ρ of the material from which the metre rule is made.

Use the equation shown.

$$\rho = \frac{m}{V}$$

ρ = ... unit = ... [2]

[Total: 8]

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