Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

2965805136

CO-ORDINATED SCIENCES **0654/51**

Paper 5 Practical Test **October/November 2022**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

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 [ ].
- Notes for use in qualitative analysis are provided in the question paper.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
Total	

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

DC (CE/SW) 301656/2

1 You are going to investigate 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.

You are provided with three cylinders of beetroot.

(a) Procedure

step **1** Label one test-tube **room**, another **40** and another **60**.

step **2** Cut the three cylinders of beetroot so that each cylinder is 30 mm long.

step **3** Rinse the beetroot cylinders in the beaker of rinsing water.

step **4** Place one beetroot cylinder in each test-tube.

step **5** Half-fill a beaker with water at **room** temperature.

step **6** Pour water at **room** temperature into the test-tube labelled **room** until the water is approximately 3 cm higher than the beetroot.

step **7** Place the test-tube labelled **room** into the beaker of water as shown in Fig. 1.1.

step **8** Measure the temperature of the water at room temperature.

(i) Record the temperature to the nearest 0.5 °C.

temperature = ... °C [1]

(ii) Repeat steps **5**, **6** and **7** with water at 40 °C and test-tube **40**.

Repeat steps **5**, **6** and **7** with water at 60 °C and test-tube **60**.

Fig. 1.1 shows the three beakers and their contents.

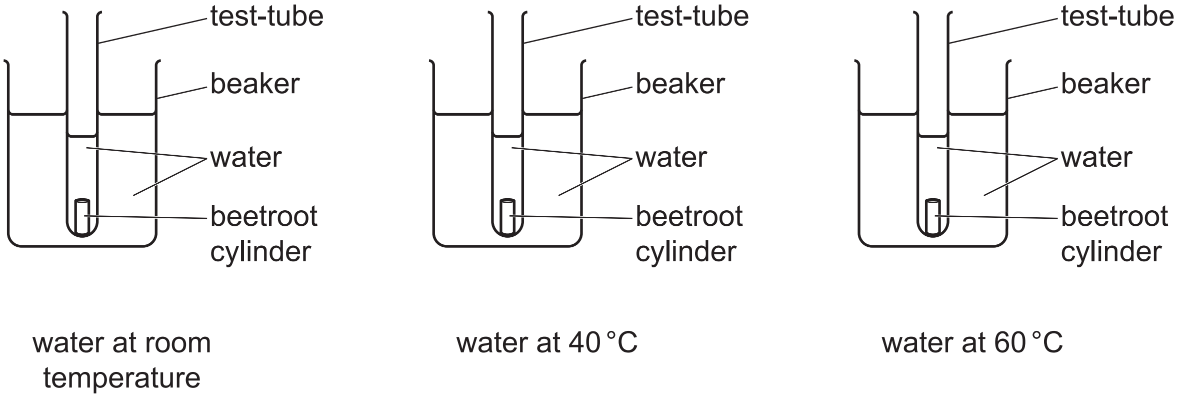


Fig. 1.1

step **9** Leave the beetroot cylinders for at least 5 minutes. You **do not** need to maintain the temperature of the water.

You may continue with parts **(b)** and **(c)** while you are waiting.

step **10** After at least 5 minutes put a stopper in each test-tube and shake the test-tube carefully.

step **11** Place the test-tubes in the test-tube rack in colour order from the lightest red to the darkest red.

Record in Table 1.1 the test-tubes in colour order.

Table 1.1

colour of water	test-tube
lightest red	
↓	
darkest red	

[2]

(b) **(i)** In step **2**, all of the beetroot cylinders are cut to the same length to make sure the test is fair.

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

....

.... [1]

(ii) In step **3**, all of the beetroot cylinders are rinsed with water.

Suggest why the beetroot cylinders are rinsed.

....

.... [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.

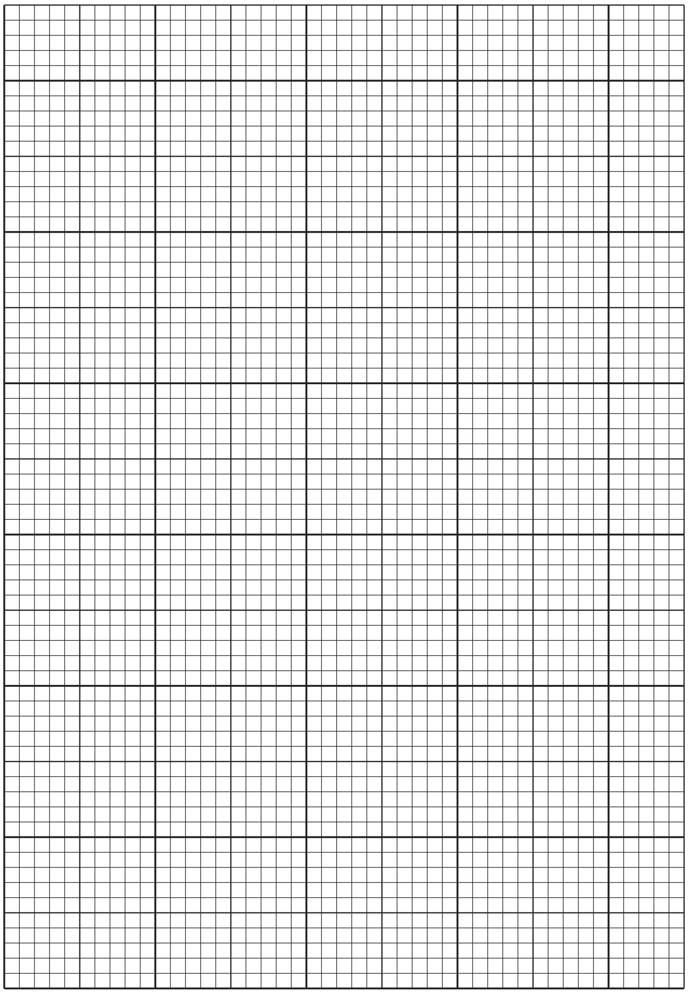
The results are shown in Table 1.2.

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 70 °C.

colour number at 70 °C = ... [1]

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

....

....

[1]

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

....

....

[1]

[Total: 13]

2 You are going to investigate the lungs and breathing.

(a) **(i)** You are provided with two samples, **A** and **B**.

Describe the appearance of the two samples.

sample **A** ....

sample **B** ....
[1]

(ii) Sample **A** is fresh limewater.

Sample **B** is limewater after exhaled air is bubbled through it.

State what sample **B** 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.

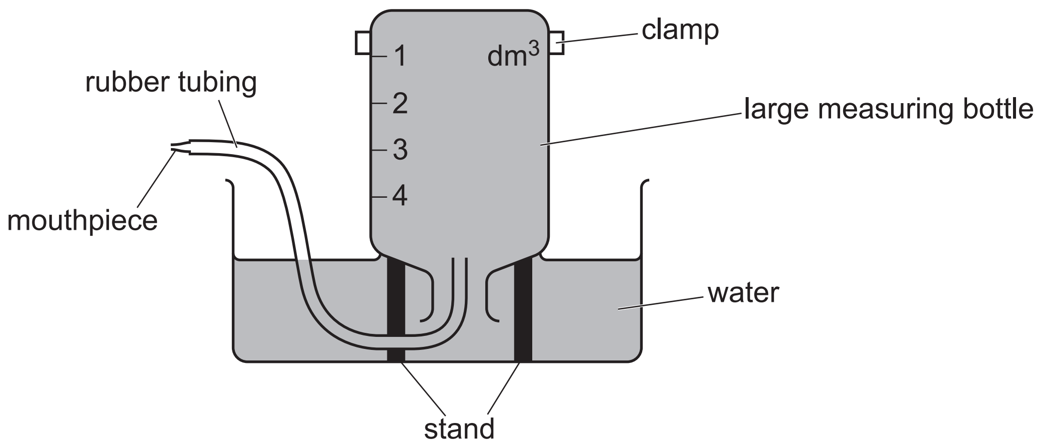


Fig. 2.1

(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: 7]

3 You are going to investigate the pH of milk and vinegar. You will also investigate the mass of solid formed when different volumes of milk react with vinegar.

(a) (i) Procedure

step **1** Add about 1 cm depth of vinegar into a clean test-tube.

step **2** Add three drops of universal indicator into the vinegar in the test-tube.

step **3** Record in Table 3.1 the colour in the test-tube.

step **4** Record in Table 3.1 the pH of the vinegar. Use the pH colour chart to help.

step **5** Repeat steps **1**, **2**, **3** and **4** with milk instead of vinegar.

Table 3.1

substance	colour with universal indicator	pH
vinegar		
milk		

[3]

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

....

.... [1]

(b) Procedure

step **1** Add about 2 cm depth of vinegar into a clean test-tube.

step **2** Add one spatula load of sodium carbonate to the vinegar in the test-tube.

step **3** Record in Table 3.2 your observations.

Repeat steps **1**, **2** and **3** with milk instead of vinegar.

Table 3.2

substance	observation when sodium carbonate is added
vinegar	
milk	

[1]

(c) Use the results from Tables 3.1 and 3.2, to complete Table 3.3.

Table 3.3

substance	type of substance (acid, neutral or alkali)
vinegar	
milk	

[1]

(d) (i) Procedure

step **1** Label three small beakers **20**, **40** and **60**.

step **2** Label three paper towels **20**, **40**, and **60**.

step **3** Place 20 cm^3 of hot milk into the small beaker labelled **20**.

step **4** Place 40 cm^3 of hot milk into the small beaker labelled **40**.

step **5** Place 60 cm^3 of hot milk into the small beaker labelled **60**.

step **6** Use a syringe to add 2 cm^3 of vinegar to each beaker of milk.

step **7** Stir the beaker labelled **20** with a spatula, and make the solid formed into one lump.

step **8** Take out the lump and place it on the paper towel labelled **20**.

step **9** Repeat steps **7** and **8** for the other two beakers of milk, placing each lump of solid on the correctly labelled paper towel.

step **10** Pat the solid on paper towel **20** removing as much liquid as possible. Use extra paper towels if needed.

step **11** Cut a small piece of cling film and put the solid on it.

step **12** Use a balance to find the mass of the solid. Record the mass in Table 3.4.

step **13** Repeat steps **10**, **11** and **12** for each lump of solid.

Table 3.4

volume of milk / cm^3	mass of solid / g
20	
40	
60	

[4]

(ii) A student says that the mass of solid is directly proportional to the volume of milk used.

State if your results agree with the student.

Explain your answer using the results in Table 3.4.

....

....

.... [1]

(iii) The mass of solid recorded by the student is a little more than expected.

The cling film does **not** cause this difference.

Suggest a reason why the mass recorded is more than expected.

....

.... [1]

(iv) Suggest what you can do to have more confidence in the mass of solid formed.

Do **not** repeat your answer to **(d)(iii)**.

....

.... [1]

[Total: 13]

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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.

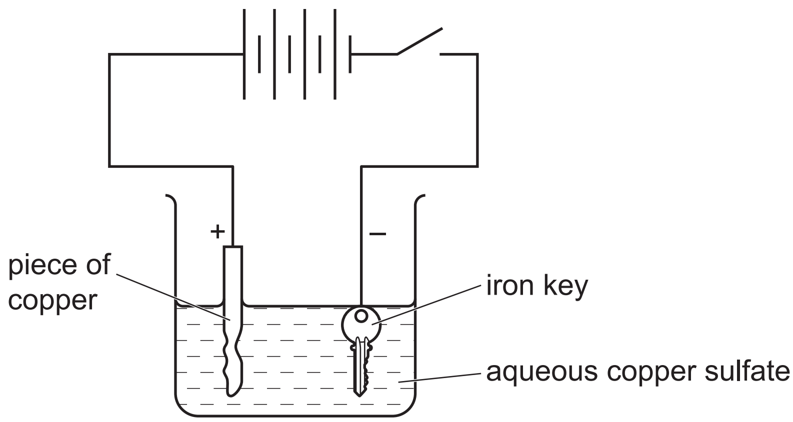

Fig. 4.1

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 mass 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 reach 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 You are going to investigate 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.

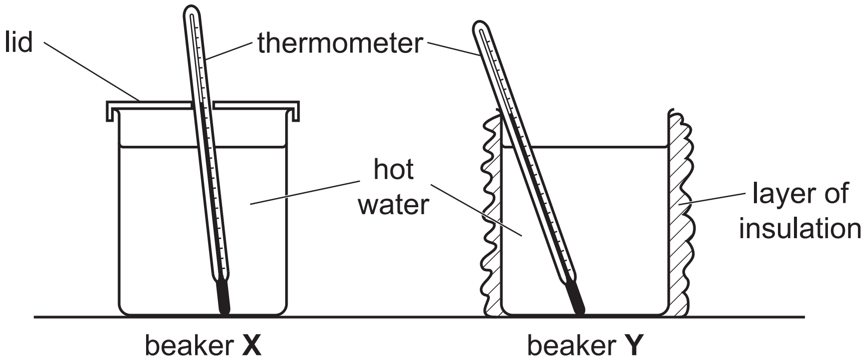

Fig. 5.1

Procedure

- Pour 150 cm^3 of hot water into beaker **X** and replace the lid.
- Place the thermometer into the water and when the reading stops rising, measure the temperature θ of the hot water and start the stop-watch.

(a) **(i)** Record, in Table 5.1, this temperature at time t = 0.

Table 5.1

beaker X

time t / s	temperature θ / °C
0	
30	
60	
90	
120	
150	
180	

[1]

(ii) Measure the temperature of the hot water every 30 s for 180 s. Stir the water gently before reading the temperature.

Record your results in Table 5.1. [2]

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

....

.... [1]

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

Use the equation shown.

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

θ_X = ... °C [1]

(ii) 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]

(c) Repeat the procedure in **(a)** using beaker **Y** instead of beaker **X**.

Record your results in Table 5.2.

Table 5.2

beaker Y

time t/s	temperature θ/°C
0	
30	
60	
90	
120	
150	
180	

[1]

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

θ_Y = ... °C [1]

(ii) 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]

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

Use your results from **(b)(ii)** and **(d)(ii)** and explain how you reach this conclusion.

more effective method ....

explanation ....

.... [1]

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

.... [1]

[Total: 12]

6 You are going to measure the density of the material from which a metre rule is made.

Procedure

- Place the load **M** on the metre rule and adjust its position carefully until the centre of load **M** is directly above the 15.0 cm mark on the rule.
- Place the pivot under the rule and adjust the position of the pivot carefully until the rule is as close to balance as possible.
- Check that the centre of load **M** remains above the 15.0 cm mark.

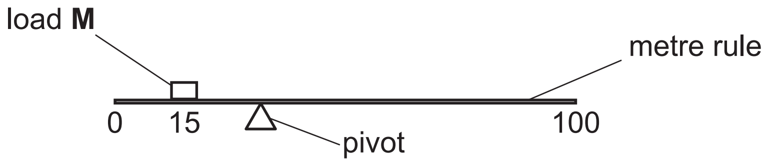

Fig. 6.1

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

r = ... cm [1]

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

d = ... cm [1]

(b) Describe how you make sure that the centre of load **M** is exactly above the 15.0 cm mark. You may draw a diagram if you wish.

....

.... [1]

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

Use the equation shown.

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

m = ... g [1]

(d) Fig. 6.2 is a diagram of a metre rule.

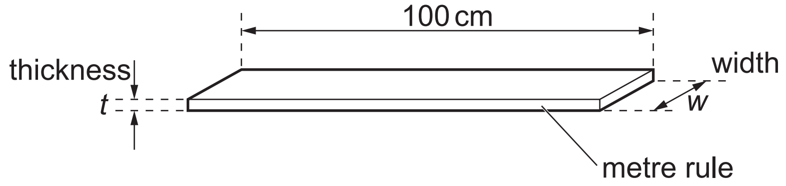

Fig. 6.2

(i) Measure the thickness t and the width w of **your** metre rule in centimetres to the nearest 0.1 cm.

t = ... cm

w = ... cm
[1]

(ii) 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)** and **(d)(ii)** to calculate the density ρ of the material from which the metre rule is made.

Use the equation shown. State the units.

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

ρ = ... unit = ... [2]

[Total: 8]

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NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	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.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt., or very slight white ppt.
copper (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	green ppt., insoluble in excess
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
copper(II) (Cu^{2+})	blue-green