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CAMBRIDGE International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

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CO-ORDINATED SCIENCES **0654/52**

Paper 5 Practical Test **May/June 2026**

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. Do **not** use correction fluid or tape.
- 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	
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2	
3	
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Total	

This document has **24** pages. Any blank pages are indicated.

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[Turn over

1 You are going to investigate the effect of enzyme volume on an enzyme-controlled reaction.

Plant cells such as celery cells contain the enzyme catalase.

Catalase speeds up the breakdown of aqueous hydrogen peroxide into water and oxygen gas.

The oxygen gas released forms a foam when mixed with detergent.

(a) (i) **Procedure**

- Stir the beaker of celery puree (liquidised celery).
- Use a 10 cm^3 measuring cylinder to put 2 cm^3 of celery puree into a clean boiling tube.
- Add a drop of detergent to this boiling tube.
- Use a syringe to add 2 cm^3 of aqueous hydrogen peroxide to the mixture in the boiling tube.
- Immediately start a stop-watch.
- Measure the total height of the celery puree mixture and any foam at 90 seconds as shown in Figure 1.1.

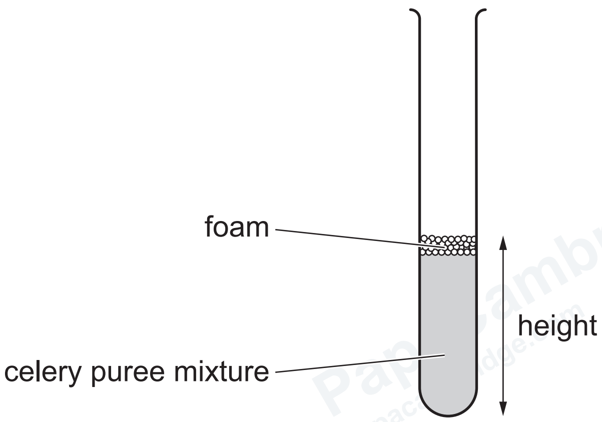

Figure 1.1

Record in Table 1.1 for trial 1 this height in mm.

Table 1.1

volume of celery puree / cm^3	volume of water / cm^3	height / mm		average height / mm
		trial 1	trial 2	
2	0			
1	1			

Repeat the procedure in **1(a)(i)** for a second sample of celery puree.

Record in Table 1.1 for trial 2 this height in mm.

Repeat the procedure in **1(a)(i) two** more times but use 1 cm^3 of celery puree and 1 cm^3 of water instead of the 2 cm^3 of celery puree.

Record the heights in Table 1.1. [5]

(ii) Complete Table 1.1 by calculating the average height for each volume of celery puree. [1]

(iii) Use your results in Table 1.1 to state the relationship between enzyme volume and height.

....

.... [1]

(iv) Use your results in Table 1.1 to state the relationship between enzyme volume and rate of reaction.

....

.... [1]

(v) The rate of reaction decreases when the temperature decreases.

A student repeats the investigation with celery puree and aqueous hydrogen peroxide from a refrigerator at 4 °C.

Suggest how the results are different from those in Table 1.1.

....

.... [1]

(b) **(i)** Suggest why it is important to stir and mix the celery puree in the procedure in **1(a)(i)**.

....

.... [1]

(ii) The celery puree is prepared by mashing and adding water to small pieces of celery stem.

Suggest why it is necessary to liquidise the celery in this way.

....

.... [1]

(iii) Identify **one** source of error when measuring the total height of the mixture and foam in the boiling tube.

Suggest an improvement to overcome this error.

source of error ....

....

improvement ....

....

[2]

[Total: 13]

Turn over

2 When a person exercises, their pulse rate increases from their resting pulse rate.

The time it takes for the pulse rate to return to the resting pulse rate after exercise is called the recovery time.

Plan an investigation to determine the relationship between the height of a person and their recovery time.

You may use any common laboratory apparatus.

You are **not** required to do this investigation.

Include in your plan:

- the apparatus you will need
- a brief description of the method
- what you will measure
- the variables you will control
- how you will process your results to reach a conclusion.

You may include a labelled diagram in your answer.

You may include a results table in your answer. You are **not** required to enter any readings in the table.

[7]

3 You are going to determine the value of **x** in the formula of washing soda, $Na_2CO_3{\bullet}\mathbf{x}H_2O$.

When washing soda crystals are heated, they release water from the crystals.

The crystals form dry sodium carbonate powder as shown in the equation.

$$\underset{\text{crystals}}{Na_2CO_3{\bullet}\mathbf{x}H_2O} \rightarrow \underset{\text{powder}}{Na_2CO_3} + \mathbf{x}H_2O$$

The crystals lose mass as the water, $\mathbf{x}H_2O$, is given off as steam.

(a) Procedure

- Use a balance to find the mass of an empty evaporating basin.
- Record this mass M_1 in Table 3.1.
- Add 3 spatula loads of washing soda crystals to the evaporating basin.
- Use a balance to find the mass of the evaporating basin and washing soda crystals.
- Record this mass M_2 in Table 3.1.
- Heat the crystals until they form the dry sodium carbonate powder.
- Let the evaporating basin cool.

Continue with Question 4 while you wait for the evaporating basin to cool down.

- Use a balance to find the mass of the cool evaporating basin and dry sodium carbonate powder.
- Record this mass M_3 in Table 3.1.

Table 3.1

mass of empty evaporating basin, M_1 / g	
mass of evaporating basin and washing soda crystals $Na_2CO_3{\bullet}\mathbf{x}H_2O$ before heating, M_2 / g	
mass of evaporating basin and dry sodium carbonate powder Na_2CO_3, M_3 / g	

[4]

(b) (i) Calculate the mass of water lost by the washing soda crystals.

Use the equation shown.

$$\text{mass of water} = M_2 - M_3$$

mass of water = ... g [1]

(ii) Calculate the amount of water in the washing soda crystals.

Use the equation shown.

$$\text{amount of water} = \frac{\text{mass of water}}{18}$$

amount of water = ... mol [1]

(iii) Calculate the mass of dry sodium carbonate powder.

Use the equation shown.

$$\text{mass of dry sodium carbonate powder} = M_3 - M_1$$

mass of dry sodium carbonate powder = ... g [1]

(iv) Calculate the amount of dry sodium carbonate powder.

Use the equation shown.

$$\text{amount of dry sodium carbonate powder} = \frac{\text{mass of dry sodium carbonate powder}}{106}$$

amount of dry sodium carbonate powder = ... mol [1]

(v) Use the answers to **3(b)(ii)** and **3(b)(iv)** to calculate the value of **x** in $Na_2CO_3{\cdot}\mathbf{x}H_2O$.

Use the equation shown.

$$\mathbf{x} = \frac{\text{amount of water}}{\text{amount of dry sodium carbonate powder}}$$

Give your answer to **one** significant figure.

x = ... [2]

(c) Another student repeats the procedure.

They obtain a value for the mass of dry sodium carbonate powder which is larger than expected.

Suggest why the value is larger than expected.

Explain what the student does to reduce this error.

suggestion ....

....

explanation ....

....
[1]

(d) Sodium carbonate powder is dissolved in water to make aqueous sodium carbonate.

Describe how sodium carbonate crystals are made from aqueous sodium carbonate.

....

....

.... [1]

(e) Describe a chemical test for water.

Give the observations for a positive result.

reagent added ....

colour change from .... to ....
[2]

(f) Metal **J** forms a carbonate with the formula $JCO_3•\mathbf{y}H_2O$.

When heated, the carbonate decomposes to give the oxide, steam and carbon dioxide gas.

The equation for this reaction is shown.

$$JCO_3•\mathbf{y}H_2O \rightarrow JO + \mathbf{y}H_2O + CO_2$$

Compare this equation to the equation for heating washing soda crystals.

$$Na_2CO_3•\mathbf{x}H_2O \rightarrow Na_2CO_3 + \mathbf{x}H_2O$$

Explain why the procedure in **3(a)** is **not** used to determine the value of **y** in $JCO_3•\mathbf{y}H_2O$.

....

.... [1]

[Total: 15]

4 You are going to identify the ions present in aqueous **L**.

(a) **Procedure**

- Add approximately 1 cm depth of aqueous **L** into each of three test-tubes.
- Complete the tests described in Table 4.1.
- Record your observations in Table 4.1.

Table 4.1

test number	test	observations
1	add a few drops of aqueous sodium hydroxide add excess aqueous sodium hydroxide	
2	add 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate	
3	add 1 cm depth of dilute nitric acid followed by 1 cm depth of aqueous barium nitrate	

[4]

(b) State the identity of the ions present in aqueous **L**.

.... [1]

[Total: 5]

Go back and complete Question 3.

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5 You are going to find the spring constant, k, of a spring.

(a) The apparatus in Figure 5.1 has been assembled for you.

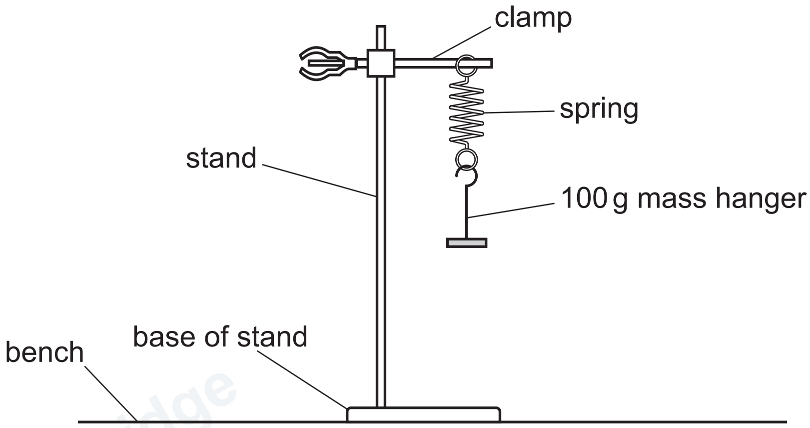


Figure 5.1

When the 100 g mass hanger is pulled down and released, the mass hanger oscillates.

One oscillation is the time taken for the mass hanger to move from **A** to **B** and then back to **A**.

Figure 5.2 shows **one** oscillation.

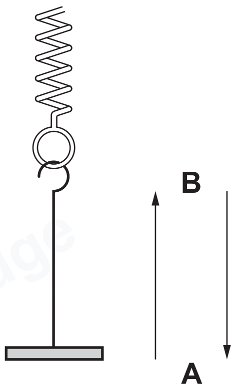


Figure 5.2

(i) **Procedure**

step 1 Gently pull down the mass hanger.

step 2 Measure the time taken, t, for 10 oscillations.

step 3 Record in Table 5.1 this value to the nearest 0.1 second.

step 4 Add a 100 g mass to the 100 g mass hanger; the total mass, m, is now 200 g.

step 5 Repeat step 1 to step 3.

Repeat step 1 to step 3 with total mass, m, of 300 g, 400 g and 500 g.

Table 5.1

m / g	t / s	T / s	T^2 / s^2
100			
200			
300			
400			
500			

[4]

(ii) T is the time taken for one oscillation.

Calculate T for each value of m.

Use the equation shown.

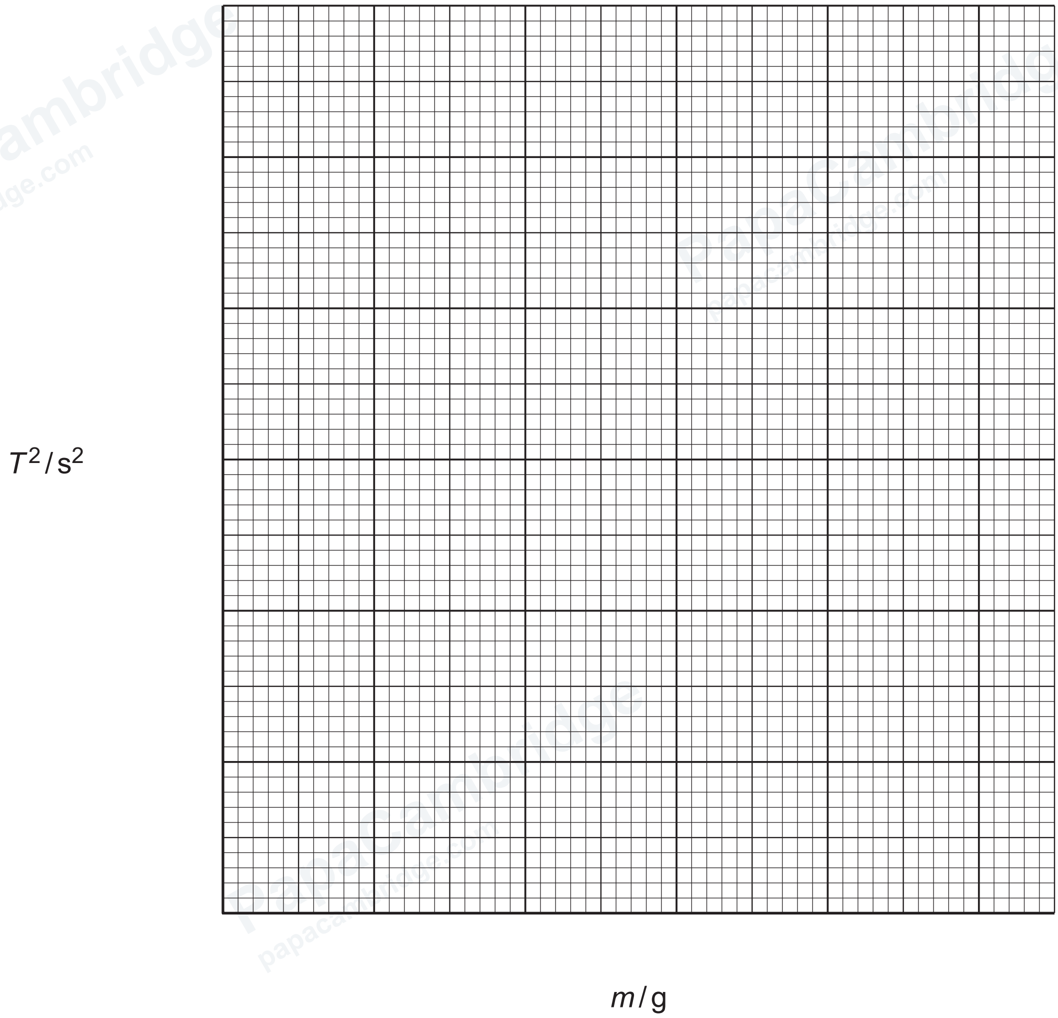
$$T = \frac{t}{10}$$

Record your values in Table 5.1. [1]

(iii) Calculate T^2 for each value of m.

Record in Table 5.1 your values to **two** decimal places. [1]

(b) **(i)** On the grid, plot T^2 (vertical axis) against m.



[2]

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

(iii) Calculate the gradient of the line of best fit.

Show your working on the graph.

gradient = ... [2]

(iv) Calculate the spring constant, k.

Use the equation shown.

$$k = \frac{0.039}{\text{gradient}}$$

k = ... N / m [1]

(c) Explain why measuring the time taken for 20 oscillations is more accurate than measuring the time for 10 oscillations.

....

.... [1]

[Total: 13]

6 You are going to investigate the temperature changes when hot and cold water are mixed.

(a) Procedure

- Use a measuring cylinder to pour 100 cm^3 of cold water into a 250 cm^3 beaker.
- Record in Table 6.1 the temperature of this water to the nearest 0.5 °C.
- Use a measuring cylinder to pour 50 cm^3 of hot water into a 100 cm^3 beaker.
- Record in Table 6.1 the temperature of this water to the nearest 0.5 °C.
- Immediately pour the hot water into the 250 cm^3 beaker of cold water.
- Stir the mixture.
- Record in Table 6.1 the temperature of this water to the nearest 0.5 °C.

Table 6.1

	temperature / °C
cold water	
hot water	
mixture of hot and cold water	

[3]

(b) Calculate the change in temperature of the cold water.

Use the equation shown.

change in temperature = temperature of mixture – temperature of cold water

change in temperature = ... °C

Calculate the change in temperature of the hot water.

Use the equation shown.

change in temperature = temperature of hot water – temperature of mixture

change in temperature = ... °C
[1]

(c) A student suggests the change in temperature of the hot water is double the change in temperature of the cold water.

State if your results support the student's suggestion.

Explain your answer.

....

.... [1]

(d) Figure 6.1 shows a thermometer being used by a student to measure the temperature of water.

Suggest **two** mistakes this student is making.

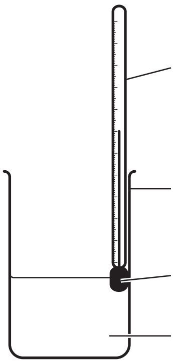


Figure 6.1

1 ....

....

2 ....

....
[1]

(e) Another student takes cold water with a temperature of 4 °C directly from a refrigerator.

The student records the temperature immediately after placing the thermometer in the cold water.

Suggest a value for the reading on the thermometer.

Explain your answer.

reading on the thermometer .... °C

explanation ....

....

[1]

[Total: 7]

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NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	test	test result
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	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.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, 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(II), 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, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
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

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