Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

8334175815

CO-ORDINATED SCIENCES **0654/53**

Paper 5 Practical Test **May/June 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.

1 Catalase is an enzyme found in living cells such as celery cells.

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

The catalase is not used up in the reaction.

You are going to investigate the volume of oxygen gas made using celery puree and hydrogen peroxide solution.

(a) The apparatus shown in Fig. 1.1 has been set up for you.

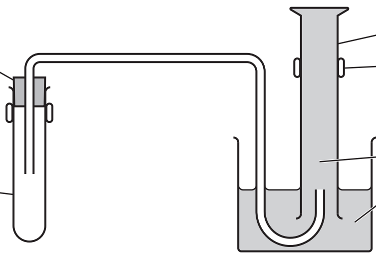


Fig. 1.1

Procedure

- Use the stirring rod to mix the celery puree.
- Remove the stopper from the boiling tube (large test-tube) and pour in about 2 cm depth of celery puree.
- Use the syringe to add 2 cm^3 of hydrogen peroxide solution to the boiling tube and quickly replace the stopper.
- Immediately start the stop-watch.
- Read the volume of gas in the measuring cylinder and record this value in Table 1.1 at time = 0 minutes. If the volume is below the start of the scale, then record this value as 0.
- Record in Table 1.1 the volume of gas in the measuring cylinder to the nearest 0.5 cm^3 every 2 minutes for 8 minutes.

Table 1.1

time / minutes	volume of gas collected / cm^3
0	
2	
4	
6	
8	

[3]

(b) Suggest **one** source of error in the procedure and state how you can overcome this.

source of error ....

improvement ....

....
[2]

(c) A student repeats the procedure in **(a)** using larger amounts of celery puree and hydrogen peroxide.

The results are shown in Table 1.2.

Table 1.2

time / minutes	volume of gas collected / cm^3
0	0
5	52
10	87
15	109
20	120
25	120

(i) On the grid, plot a graph of volume of gas collected (vertical axis) against time using the data from **Table 1.2**.

[3]

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

(iii) Describe the relationship between the volume of gas collected and time.

....

....

.... [2]

(iv) Explain the results in Table 1.2 between 20 and 25 minutes.

....

.... [1]

[Total: 12]

2 You are going to investigate the nutrient content of celery and potato.

You are provided with two samples of celery puree and two samples of potato puree.

(a) Procedure

- Add about 1 cm depth of biuret solution to a sample of celery puree.
- Add about 1 cm depth of biuret solution to a sample of potato puree.
- Add a few drops of iodine solution to the other sample of celery puree.
- Add a few drops of iodine solution to the other sample of potato puree.

(i) Complete Table 2.1 by recording the **final colours** observed in each sample.

Table 2.1

food sample	final colour observed with biuret solution	final colour observed with iodine solution
celery puree		
potato puree		

[4]

(ii) State the nutrients present **and** the nutrients absent in each food sample.

celery:
nutrients present ....

nutrients absent ....

potato:
nutrients present ....

nutrients absent ....
[2]

(b) A student tests the celery for the presence of fats.

(i) State the two reagents the student needs to add to the celery puree.

.... and .... [1]

(ii) State the observation for a positive result.

.... [1]

[Total: 8]

3 You are going to investigate the pH of several solutions and their reactivity with sodium carbonate.

The pH scale is shown in Fig. 3.1.

pH	1		7		14
description	strongly acidic	weakly acidic	neutral	weakly alkaline	strongly alkaline

Fig. 3.1

(a) (i) Procedure

- Place about 1 cm depth of dilute hydrochloric acid, orange juice, salt solution, soap solution, vinegar and limewater into separate test-tubes.
- To each solution, add 4 drops of universal indicator solution.
- Record in Table 3.1 the colours obtained.

Table 3.1

solution	colour in universal indicator	pH	description
dilute hydrochloric acid			
orange juice			
salt solution			
soap solution			
vinegar			
limewater			

[2]

(ii) Record in Table 3.1 the pH of each solution. Use the pH colour chart. [2]

(iii) Record in Table 3.1 a description of each solution. Use information from Fig. 3.1. [2]

(b) (i) Procedure

Step **1** Place about 3 cm depth of dilute hydrochloric acid into a clean boiling tube (large test-tube).
Step **2** Add 2 spatula loads of sodium carbonate to the dilute hydrochloric acid, quickly start a stop-watch and time how long it takes for the fizzing to stop.
Step **3** Record in Table 3.2 this time to the nearest second.

Repeat the procedure in **(b)(i)** using orange juice, salt solution, soap solution, vinegar and limewater instead of dilute hydrochloric acid.

If the mixture fizzes but takes longer than 3 minutes to stop, then record the time as >180 seconds.

If the mixture does **not** fizz, then record ‘no reaction’ in Table 3.2.

Table 3.2

solution	time for fizzing to stop / s
dilute hydrochloric acid	
orange juice	
salt solution	
soap solution	
vinegar	
limewater	

[3]

(ii) The reaction which took the least time to finish fizzing is the fastest.

List the solutions in order of rate of reaction starting with the most reactive.

If the solutions do **not** react, place them together at the bottom of the list.

most reactive

↓

least reactive

[1]

(c) Look at the pH column in Table 3.1 and the rate of reaction in **(b)(ii)**.

Describe the relationship between pH and rate of reaction with sodium carbonate.

....

....

....

.... [2]

(d) When sodium carbonate is added to dilute hydrochloric acid, carbon dioxide gas is given off.

State the test for carbon dioxide gas. Include the observation for a positive result.

test ....

observation ....

[1]

[Total: 13]

4 Solid sodium carbonate does not decompose when it is heated.

Sodium carbonate solid dissolves in water to form sodium carbonate solution.

Sodium carbonate **solution** does not decompose when it is heated.

Sodium carbonate solution reacts with acid to give carbon dioxide gas.

You are going to plan an experiment to find out which sodium carbonate solution, **A**, **B** or **C**, contains the most dissolved solid sodium carbonate.

You are provided with three different sodium carbonate solutions, **A**, **B** and **C**.

You may use any common laboratory apparatus.

You are not required to do this experiment.

Include in your plan:

- the apparatus needed
- 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 labelled diagram if you wish.

You may include a results table if you wish. You are **not** required to include any results.

[7]

5 You are going to investigate the oscillations of a pendulum.

A pendulum has been set up in a clamp for you as shown in Fig. 5.1.

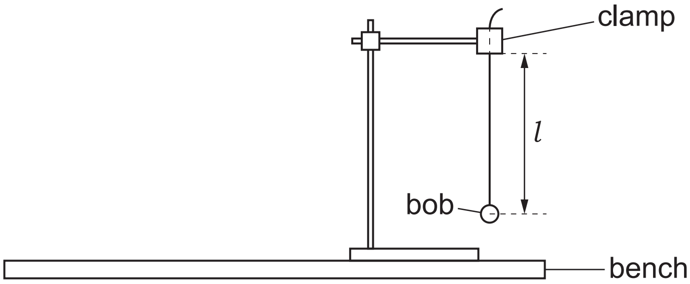


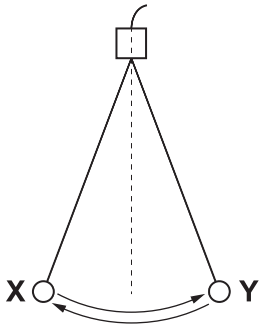
Fig. 5.1

The length l of the pendulum is the distance from the bottom of the clamp to the centre of the pendulum bob.

(a) Measure the length l of the pendulum in centimetres to the nearest 0.1 centimetre.

l = ... cm [1]

(b) One complete oscillation of the pendulum is shown in Fig. 5.2.



one complete oscillation takes place when the bob swings from **X** to **Y** and then back to **X**

Fig. 5.2

(i) Procedure

- Give the bob a small sideways displacement.
- Release it so that it swings to and fro.
- Measure the time t for 20 complete oscillations.

t = ... s [1]

(ii) Calculate the time T for **one** complete oscillation of the pendulum.

Use the equation shown.

$$T = \frac{t}{20}$$

T = ... s [1]

(iii) Calculate T^2.

T^2 = ……..………………….. s^2 [1]

(c) **(i)** The length l in centimetres of a pendulum which has a time T for one oscillation is calculated using the equation shown.

$$l = 25.0\,T^2$$

Use this equation and your value of T^2 from **(b)(iii)** to calculate a value for l.

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

l = …………………………… cm [2]

(ii) Two values are considered to be equal within the limits of experimental error if they are within 10% of each other.

Compare your measured value of l from **(a)** with the calculated value of l from **(c)(i)**.

State if your values agree within the limits of experimental error.

Justify your answer with reference to your values.

....

.... [1]

(d) Adjust the string until the length l of the pendulum is double the length you measured in **(a)**.

Repeat the procedure in **(b)(i)** and the calculation in **(b)(ii)** for the new pendulum length.

t = ………………………………. s

T = ……………………………….s
[1]

(e) A student states that the time T for one oscillation of a pendulum is proportional to the length l of the pendulum.

Compare your answers in **(b)(ii)** and **(d)** to state if you agree with the student.

Give a reason for your answer.

statement ....

reason ....

....
[1]

(f) **(i)** State **one** precaution you take while doing your experiment to get accurate readings.

....

.... [1]

(ii) Human reaction timing errors occur when a stop-watch is used.

Suggest why the time t recorded for 20 oscillations of the pendulum in **(d)** is more accurate than the time t for 20 oscillations of the pendulum in **(b)(i)**.

....

.... [1]

[Total: 11]

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6 You are going to investigate the temperature of the air at different distances from a lamp.

The apparatus shown in Fig. 6.1 has been set up for you.

Do **not** move the lamp or the rule.

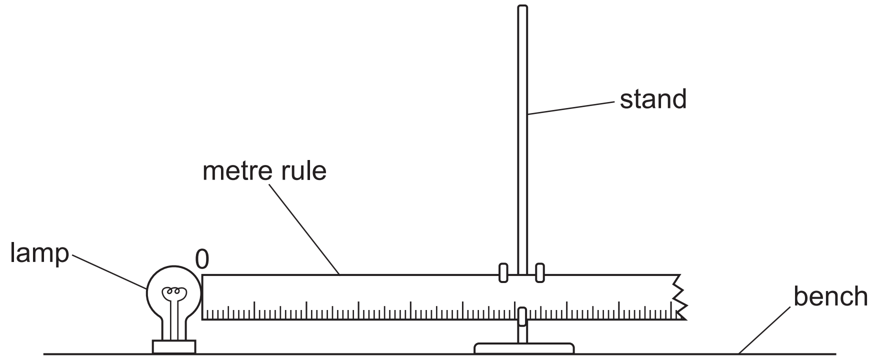

Fig. 6.1

(a) Use the thermometer to measure room temperature θ_R to the nearest 0.5 °C.

θ_R = ... °C [1]

(b) Procedure

- Switch on the lamp.
- Place the thermometer bulb a horizontal distance d_H = 10 mm from the lamp as shown in Fig. 6.2.
- Wait for approximately 20 seconds.

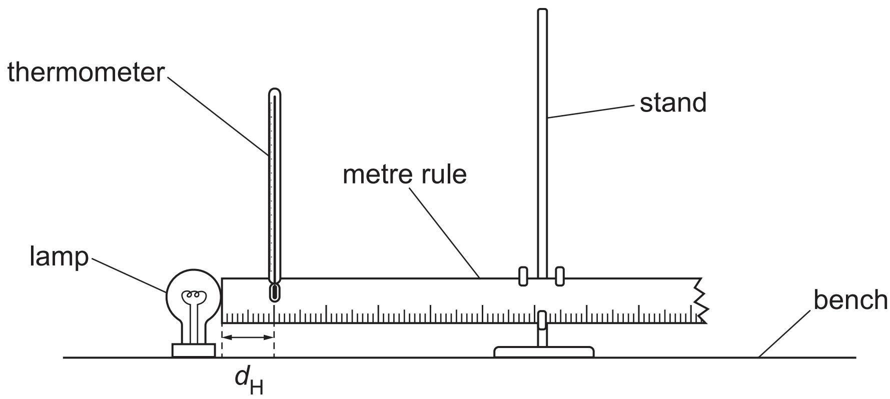

Fig. 6.2

(i) Record in Table 6.1 the temperature θ_H shown by the thermometer.

Table 6.1

d_H / mm	θ_H / °C
10	
20	
40	
60	
80	
100	

[1]

(ii) Move the thermometer until its bulb is a horizontal distance of d_H = 20 mm from the lamp.

Record in Table 6.1 the temperature θ_H shown by the thermometer. [1]

(iii) Repeat **(b)(ii)** for values of d_H = 40 mm, 60 mm, 80 mm and 100 mm from the lamp.

Switch off the lamp. [1]

(c) State the relationship between the air temperature θ_H and the horizontal distance d_H of the thermometer bulb away from the lamp.

....

.... [1]

(d) Predict the temperature reading θ when the thermometer is at a horizontal distance of 2000 mm from the lamp.

θ = ... °C [1]

(e) **(i)** Adjust the position of the thermometer in the clamp until its bulb is a vertical distance d_V = 100 mm above the lamp, as shown in Fig. 6.3.

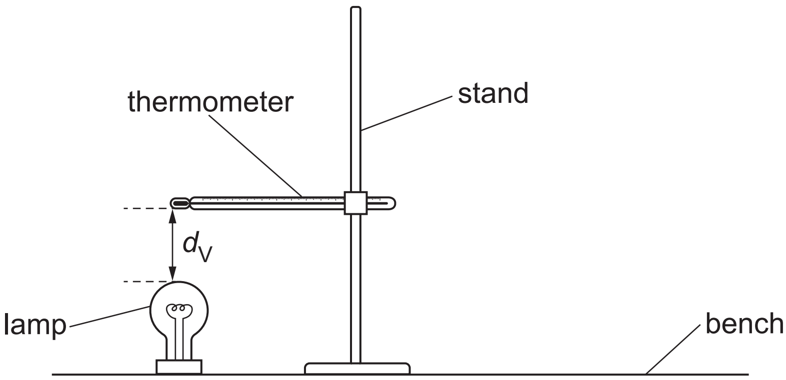

Fig. 6.3

Record the temperature θ_V shown by the thermometer.

θ_V = ... °C [1]

(ii) Calculate the difference in temperature between θ_V and the thermometer reading θ_H at a horizontal distance of 100 mm from the lamp.

difference in temperature = ... °C [1]

(f) Explain why it is important to wait for 20 seconds before reading the thermometer in **(b)**.

....

.... [1]

[Total: 9]

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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(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	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