Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

CO-ORDINATED SCIENCES **0654/51**

Paper 5 Practical Test **May/June 2023**

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 **16** pages. Any blank pages are indicated.

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1 You are going to investigate the use of an enzyme for the extraction of juice from apples.

You are provided with two beakers of apple puree, a solution of an enzyme and some warm water, that have all been kept at 40 °C.

Procedure

- Add the enzyme solution to beaker **A**.
- Add the warm water to beaker **B**.
- Use a glass rod to stir the contents of beaker **A**.
- Clean the glass rod with a paper towel.
- Use the clean glass rod to stir the contents of beaker **B**.
- Start the stop-watch and leave the beakers for at least 5 minutes at room temperature.
- Label one of the measuring cylinders **A** and the other one **B**.
- Place a filter funnel in the top of each measuring cylinder.
- Place a folded piece of filter paper in each funnel.

Continue with part (b) while you are waiting.

- Almost fill the filter paper in measuring cylinder **A** with apple puree from beaker **A**.
- Almost fill the filter paper in measuring cylinder **B** with apple puree from beaker **B**.
- Zero and re-start the stop-watch.

(a) **(i)** Measure and record in Table 1.1 the total volume of juice collected in each measuring cylinder after 2 minutes.

Table 1.1

time / minutes	total volume of juice collected / cm^3	
	measuring cylinder **A**	measuring cylinder **B**
0	0	0
2		
4		
6		
8		

[1]

(ii) Measure and record in Table 1.1 the total volume of juice collected in each measuring cylinder after 4, 6 and 8 minutes. [3]

Keep the juice collected for Question 2.

(b) **(i)** Suggest why it is important to clean the glass rod before using it for beaker **B**.

....

.... [1]

(ii) Explain why it is important to stir and mix the contents of the two beakers.

....

.... [1]

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(iii) Beaker **B** is set up as a control.

Explain why a control is used in this investigation.

....

.... [1]

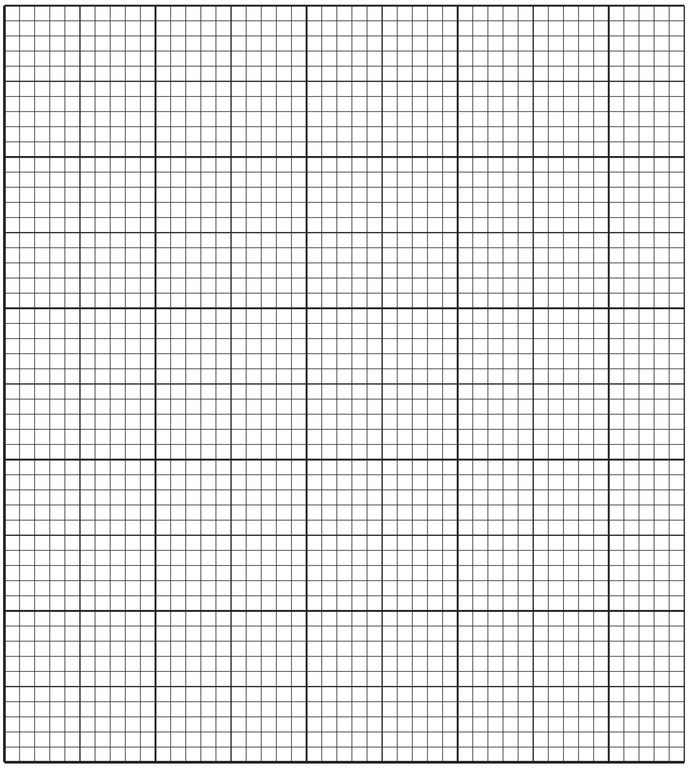
Remember to go back and complete the procedure and part (a).

(c) Use your results to suggest why an enzyme is used in the large-scale production of fruit juice.

....

.... [1]

(d) **(i)** On the grid, plot a graph of total volume of juice collected (vertical axis) against time for **only** measuring cylinder **A**.



[3]

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

(iii) Use your graph to estimate the volume of juice produced at 5 minutes.

Show your working on your graph.

volume of juice produced at 5 minutes = ... cm^3 [2]

[Total: 14]

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2 You are going to test some of the apple juice, made in Question 1, for its nutrient content.

(a) Procedure

- Pour about 1 cm depth of apple juice from measuring cylinder **A** into a test-tube.
- Add the same depth of Benedict's solution to this test-tube.
- Place this test-tube in a hot water-bath for at least 3 minutes.
- Pour about 1 cm depth of apple juice from measuring cylinder **A** into a clean test-tube.
- Add the same depth of biuret solution to this test-tube.

(i) Record in Table 2.1 the final colour observed in each test-tube.

Table 2.1

testing solution	final colour observed	conclusion
Benedict's		
biuret		

[2]

(ii) Complete Table 2.1 by stating a conclusion for the result obtained with each testing solution. [2]

(b) Name the reagents used to test for the presence of fat.

State the observation for a positive result.

reagents .... and ....

observation ....
[2]

[Total: 6]

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3 You are going to investigate the rate of the reaction between solutions **K** and **H**.

When solutions of **K**, **H** and starch are mixed together, a blue-black colour is observed after a period of time.

(a) (i) Procedure

Experiment **1**

Step 1 Using the syringe labelled **K**, add 10 cm^3 of solution **K** into a conical flask.

Step 2 Add 5 drops of starch solution into the conical flask.

Step 3 Using a clean 2 cm^3 syringe, add 2 cm^3 of distilled water into the conical flask.

Step 4 Using the syringe labelled **H**, add 10 cm^3 of solution **H** into the conical flask, swirl the flask and immediately start the stop-watch.

Step 5 Stop the stop-watch when the solution turns blue-black.

Record in Table 3.1 the time taken in seconds to the nearest second for the mixture to turn blue-black.

Table 3.1

experiment number	volume of solution **K** / cm^3	drops of starch solution	extra solution added	volume of solution **H** / cm^3	time taken / s
1	10	5	2 cm^3 distilled water	10	
2	10	5	2 cm^3 distilled water	10	
3	10	5	2 cm^3 aqueous iron(II) chloride	10	
4	10	5	2 cm^3 aqueous sodium chloride	10	
5	10	5	2 cm^3 aqueous iron(III) chloride	10	
6	10	5	2 cm^3 aqueous copper chloride	10	

[1]

(ii) Repeat the procedure in **(a)(i)** using a clean conical flask.

Record in Table 3.1 the time taken in seconds to the nearest second for experiment **2**. [1]

(iii) Experiment **2** is a repeat of experiment **1**.

This is done to check the reliability of the experiment.

Two results are considered to be equal, within the limits of experimental error, if they are within 10% of each other.

Suggest if experiments **1** and **2** give reliable results.

Include data and a calculation in your answer.

....

.... [2]

(iv) Explain why a different syringe is used to measure solution **K**, solution **H** and distilled water.

....

.... [1]

(v) The substance made when solutions **K** and **H** react together turns the starch solution blue-black.

Identify the substance made in the reaction.

.... [1]

(b) Repeat the procedure in **(a)(i)** for experiments **3**, **4**, **5** and **6**, using the solutions in Table 3.1.

Record in Table 3.1 the times taken for experiments **3**, **4**, **5** and **6**. [4]

(c) **(i)** A catalyst is a substance that increases the rate of a chemical reaction.

State which extra solutions added are catalysts for the reaction between solutions **K** and **H**.

Explain your answer with reference to data in Table 3.1.

solutions ....

explanation ....

....
[2]

(ii) A student suggests that another experiment is needed.

"Each of the four additional solutions, aqueous iron(II) chloride, aqueous sodium chloride, aqueous iron(III) chloride and aqueous copper chloride, need to be tested with starch alone."

Suggest why this improves the investigation with solutions **K** and **H**.

....

.... [1]

[Total: 13]

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4 Aqueous hydrogen peroxide is a solution that breaks down slowly into water and oxygen gas.

hydrogen peroxide → water + oxygen

A catalyst is a substance that increases the rate of a chemical reaction.

Manganese(IV) oxide is a catalyst for this reaction.

The reaction is too fast to count the bubbles of gas formed.

Plan an investigation to find the relationship between the mass of manganese(IV) oxide added and the rate of this reaction.

You are provided with:

- aqueous hydrogen peroxide
- manganese(IV) oxide solid.

You may use any common laboratory apparatus.

You will not be doing this experiment.

Include in your plan:

- the apparatus needed
- a brief description of the method, with an explanation of 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 use your results to draw a conclusion.

You may include a diagram if it helps to explain your plan.

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

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.... [7]

5 You are going to investigate the stretching of a spring.

The spring and the metre rule have been set up for you as shown in Fig. 5.1.

Do **not** remove the spring from the clamp or adjust the height of the clamp.

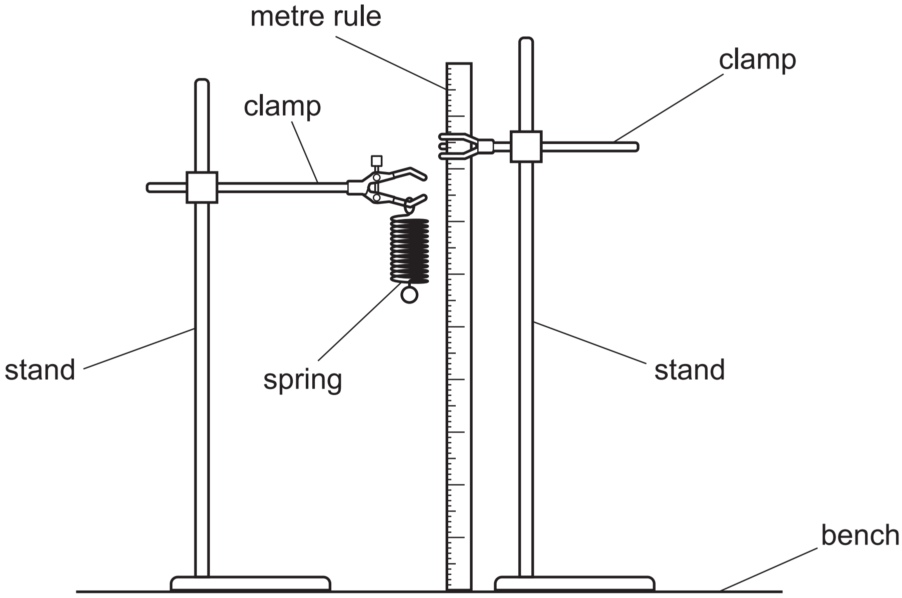

Fig. 5.1 (not to scale)

(a) (i) Take readings from the metre rule of the top and the bottom of the coiled part of the spring. Do **not** include the loops at the ends of the spring.

Record your readings to the nearest 0.1 cm.

reading of top of spring = ... cm

reading of bottom of spring = ... cm
[2]

(ii) Calculate the length l_0 of the coiled part of the spring.

Show your working.

Record in Table 5.1 this value of l_0 for load L = 0.0 N.

Table 5.1

load L / N	0.0	1.0	2.0	3.0	4.0	5.0
length l / cm						

[1]

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(iii) Use a double-headed arrow (⟷) on Fig. 5.1 to show clearly the length l_0. [1]

(b) **Procedure**

- Place a load L = 1.0 N on the spring.
- Record in Table 5.1 the length l of the coiled part of the spring.
- Repeat this procedure for load L = 2.0 N, 3.0 N, 4.0 N and 5.0 N.

[2]

(c) Line of sight (parallax) errors can occur when readings are taken from the metre rule.

State two practical precautions that you take to ensure that accurate readings are taken from the metre rule.

precaution 1 ....

....

precaution 2 ....

....
[2]

(d) A student suggests that the stretched length l of the spring is proportional to load L.

State if your readings support this suggestion.

Use values from Table 5.1 to justify your answer.

statement ....

justification ....

....
[1]

(e) A student wants to stretch the spring to three times the length l_0 of the unstretched spring.

Use your results in Table 5.1 to predict the load L the student needs to add to the spring.

predicted load L = ... N [1]

[Total: 10]

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6 You are going to investigate the cooling of hot water in a beaker.

You are provided with a beaker, a supply of hot water and a thermometer.

(a) Procedure

- Pour 200 cm^3 of hot water into the beaker.
- Place the thermometer into the hot water.
- Wait for 30 seconds.
- Measure the initial temperature *T* of the hot water.

(i) Record this value of *T* to the nearest 0.5 °C in Table 6.1 at time *t* = 0 and start the stop-watch.

Table 6.1

time *t* / s	temperature *T* / °C
0	
60	
120	
180	
240	
300	
360	

[1]

(ii) Record in Table 6.1 the temperature of the water every 60 seconds until you have a total of seven values, up to a time of 360 seconds. [3]

(b) State why it is good experimental technique to wait for 30 seconds before measuring the initial temperature of the hot water.

....

.... [1]

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(c) **(i)** Use your temperature values in Table 6.1 to calculate the average rate of cooling of the water during the first 180 seconds of cooling.

Use the equation shown.

$$\text{average rate of cooling} = \frac{\text{temperature decrease during the first 180 seconds}}{180}$$

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

average rate of cooling during the first 180 seconds = ... °C / s [2]

(ii) Use your temperature values in Table 6.1 to calculate the average rate of cooling of the water during the last 180 seconds of cooling.

average rate of cooling during the last 180 seconds = ... °C / s [1]

(d) Write a conclusion about the rate at which hot water cools in a beaker.

....

.... [1]

(e) The experiment is repeated by another student.

Suggest **one** change that **reduces** the rate of cooling of the water during the experiment.

.... [1]

[Total: 10]

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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

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