Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

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COMBINED SCIENCE **0653/61**

Paper 6 Alternative to Practical **May/June 2025**

1 hour

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 40.
- 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.

This document has **16** pages. Any blank pages are indicated.

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[Turn over

1 A student investigates the nutrient content of three colourless drinks, **A**, **B** and **C**.

Procedure

The student:

step 1 adds 2 cm^3 of drink **A**, drink **B** and drink **C** to separate clean test-tubes

step 2 adds a few drops of iodine solution to each of the test-tubes

step 3 records the results

step 4 repeats **step 1** to **step 3** but adds 1 cm^3 of biuret solution in **step 2** instead of iodine solution.

Fig. 1.1 shows the results the student records.

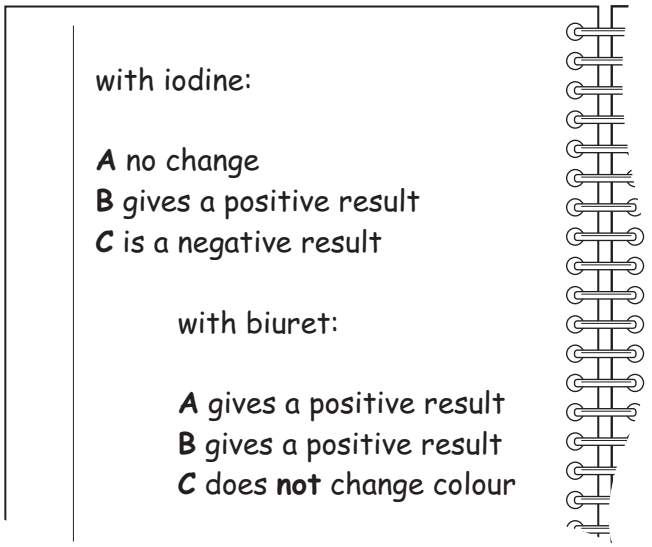

Fig. 1.1

(a) Record in Table 1.1 the colours the student observes in each test-tube.

Table 1.1

drink	colour with iodine solution	colour with biuret solution
A		
B		
C		

[3]

(b) Use Table 1.1 to state conclusions about the nutrient content for each of the drinks.

drink **A** .....

.....

drink **B** .....

.....

drink **C** .....

.....

[3]

(c) State the reagent used to test for fats and oils.

..... [1]

[Total: 7]

2 Invertase is an enzyme.

Invertase breaks down the non-reducing sugar sucrose into reducing sugars.

$$\text{non-reducing sugar sucrose} \xrightarrow{\text{invertase}} \text{reducing sugars}$$

Benedict's solution is used to test for reducing sugars. The activity of invertase can be determined by measuring the time it takes for reducing sugars to form.

Plan an investigation to determine the relationship between the activity of invertase and temperature.

You are provided with:

- a solution of invertase enzyme
- a solution of sucrose
- Benedict's solution.

You may use any common laboratory apparatus.

In your plan, include:

- the apparatus you will need
- a brief description of the method
- what you will measure
- which variables you will keep constant
- how you will process your results to draw a conclusion.

You may include a results table (you are **not** required to enter any readings in the table).

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..... [7]

3 A student investigates aqueous **H**.

(a) Investigating the rate of reaction of aqueous **H** with magnesium.

Procedure

The student:

step 1 pours 25 cm^3 of aqueous **H** into a beaker

step 2 adds a 30 mm length of magnesium ribbon to the aqueous **H**

step 3 immediately starts a stop-watch

step 4 stirs the reaction mixture making sure that the magnesium ribbon is always under the surface of the aqueous **H**

step 5 stops the stop-watch as soon as all of the magnesium ribbon has reacted

step 6 records in Table 3.1 this reaction time

step 7 empties the reaction mixture into a waste container and then rinses the beaker and stirrer with water

step 8 pours 20 cm^3 of aqueous **H** into the beaker

step 9 adds 5 cm^3 of water into the beaker of aqueous **H** and stirs the mixture

step 10 repeats **step 2** to **step 7**

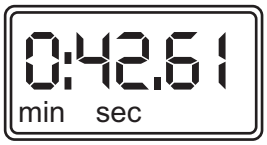
step 11 repeats **step 8** to **step 10** using the volumes of aqueous **H** and water shown in Table 3.1.

Table 3.1

volume of aqueous **H** / cm^3	volume of water / cm^3	reaction time / s	rate of reaction in mm / s
25	0	12	2.5
20	5	18	1.7
15	10		
10	15		
5	20	280	0.11

(i) Fig. 3.1 shows the readings from the stop-watch for 15 cm^3 and 10 cm^3 of aqueous **H**.

15 cm^3 of aqueous **H**



10 cm^3 of aqueous **H**

Fig. 3.1

Record in Table 3.1 these reaction times to the nearest second. [2]

(ii) State the relationship between the volume of aqueous **H** and the reaction time.

Use information from Table 3.1.

.....

..... [1]

(iii) Calculate the rate of reaction for 15 cm^3 and 10 cm^3 of aqueous **H**.

Use the equation shown.

$$\text{rate of reaction} = \frac{30}{\text{reaction time}}$$

Record in Table 3.1 these values to **two** significant figures. [2]

(iv) State the relationship between the volume of aqueous **H** and the rate of reaction.

Use information from Table 3.1.

.....

..... [1]

(v) State the name of a piece of apparatus suitable to measure the volumes of aqueous **H**.

..... [1]

(vi) Explain why in **step 4** it is important that all the magnesium is under the surface of aqueous **H**.

.....

..... [1]

(vii) Explain why in **step 7** it is important the beaker and stirrer are rinsed.

.....

..... [1]

(b) Investigation of some reactions of aqueous **H**.

Procedure

The student:

- pours 2 cm depth of aqueous **H** into each of four test-tubes
- does each of the tests shown in Table 3.2 to a different test-tube of aqueous **H**
- records the observations in Table 3.2.

Table 3.2

test	observation
add 1 cm depth of dilute nitric acid followed by 1 cm depth of aqueous barium nitrate	remains a colourless solution
add 1 cm depth of dilute nitric acid followed by 1 cm depth of aqueous silver nitrate	white precipitate
add 5 drops of universal indicator	red colour
add a small amount of copper(II) carbonate	mixture fizzes and a blue solution forms

(i) Identify the anion (negative ion) shown to be present in aqueous **H**.

..... [1]

(ii) Identify what type of substance is aqueous **H**.

Explain your answer using information from Table 3.2.

type of substance .....

explanation .....

.....

[2]

(iii) State the name of the gas produced in the test with copper(II) carbonate.

..... [1]

[Total: 13]

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4 A student investigates the period T of a pendulum.

(a) Fig. 4.1 shows a bob attached to a string. The string is clamped so that the centre of the bob is a distance x above the bench.

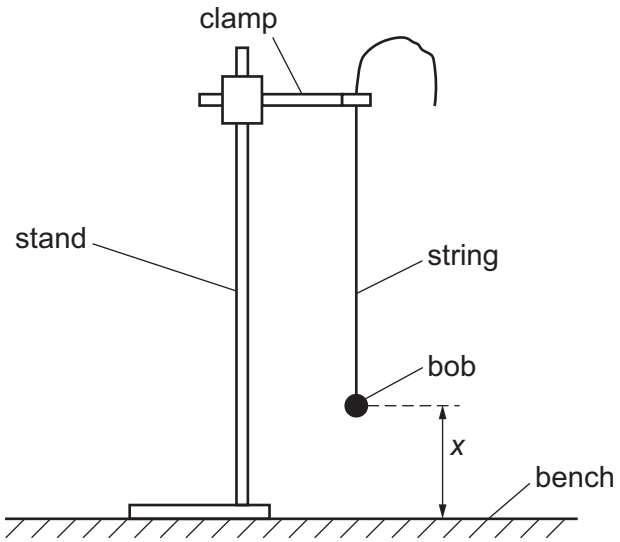


Fig. 4.1

(i) Measure the distance x on Fig. 4.1.

Record your value to the nearest 0.1 cm.

x = ... cm [1]

(ii) Fig. 4.1 is drawn to one-tenth scale.

Calculate the actual distance of the bob above the bench, X.

Record this value of X in Table 4.1.

Table 4.1

distance X / cm	time for 10 oscillations / s		average time for 10 oscillations for trial 1 and trial 2 / s	period T / s	T^2 / s^2
	trial 1	trial 2			
10.0	13.6	13.2	13.4	1.34	1.80
20.0	11.6	12.0	11.8	1.18	1.39
25.0	11.1	10.9	11.0	1.10	1.21
30.0	9.9	10.3	10.1	1.01	1.02

[1]

(b) Procedure

The student:

- measures the time for 10 complete oscillations of the pendulum for each of the values of X shown in Table 4.1
- repeats each measurement.

Fig. 4.2 shows repeated readings on the stop-watch, in seconds, for your value of X in **(a)(ii)**.

reading 1	reading 2	reading 3
12.78	10.08	12.42

Fig. 4.2

(i) Suggest **one** reason why the student needs to take the third reading.

.....

..... [1]

(ii) The student decides to use reading 1 and reading 3.

Record in Table 4.1 these readings to **one** decimal place. [1]

(iii) Calculate the average time for 10 oscillations.

Record this time in Table 4.1. [1]

(iv) Calculate the period T.

Use the equation shown.

$$T = \frac{\text{average time for 10 oscillations}}{10}$$

Record in Table 4.1 this value of T.

Calculate T^2.

Record in Table 4.1 this value of T^2. [1]

(v) For $X = 30.0\,\text{cm}$, the times for the trials are 9.9 s and 10.3 s.

Two values are considered equal within the limits of experimental accuracy if they are within 10% of each other.

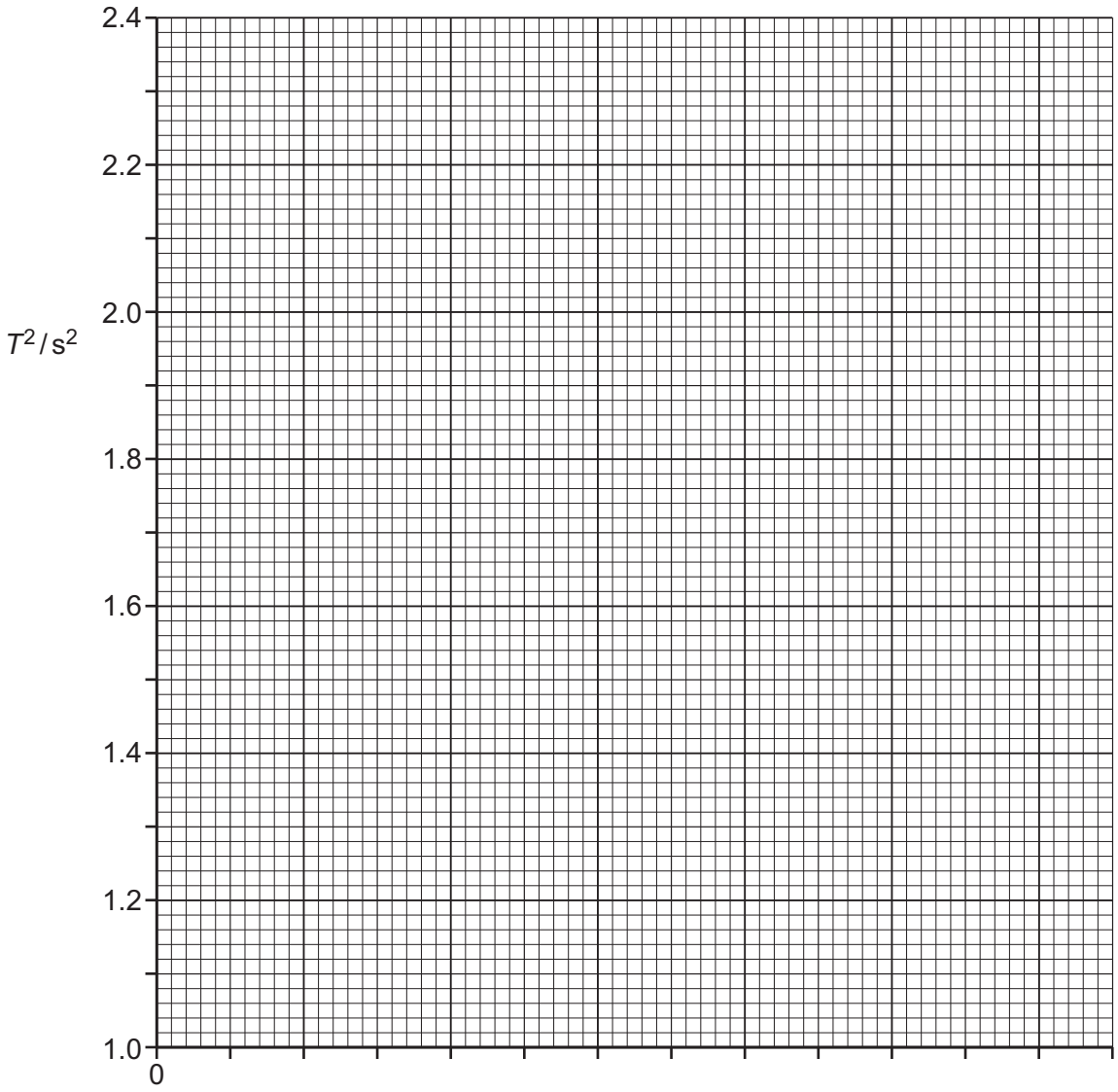
Explain if the two values are equal within the limits of experimental accuracy.

Include a calculation in your answer.

.....

..... [2]

(c) **(i)** On the grid, plot a graph of T^2 (vertical axis) against X.



[2]

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

(iii) Extend your line so that it meets the vertical axis.

Determine the value of T^2 at this point.

T^2 = ...s^2 [1]

(d) Your value in **(c)(iii)** represents the value of T^2 when the distance between the centre of the bob and the top of the bench is zero.

It is possible to take this reading by moving the apparatus to the end of the bench.

Fig. 4.3 shows the bench and some of the string.

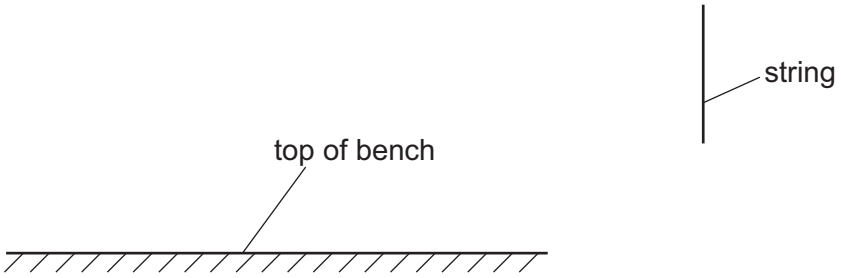


Fig. 4.3

On Fig. 4.3, draw the position of the bob and any extra string. [1]

[Total: 13]

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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.
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