Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

0956006593

CO-ORDINATED SCIENCES **0654/52**

Paper 5 Practical Test **May/June 2024**

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 (DE/CB) 330083/2

1 You are going to investigate the glucose concentration of solution **S**.

You are provided with solution **S** and four different concentrations of glucose solution.

(a) Procedure

step **1** Label five test-tubes **A**, **B**, **C**, **D** and **S**.
step **2** Use a syringe to add $2\,cm^3$ of Benedict's solution to each of the five test-tubes.
step **3** Use clean syringes to prepare the five test-tubes as shown in Table 1.1.

Table 1.1

test-tube	solution added
A	$1\,cm^3$ of 0.0% glucose
B	$1\,cm^3$ of 0.5% glucose
C	$1\,cm^3$ of 1.0% glucose
D	$1\,cm^3$ of 2.0% glucose
S	$1\,cm^3$ of **S**

step **4** Place the test-tubes in a hot water-bath and start the stop-clock.
step **5** Leave the test-tubes in the hot water-bath for 3 minutes.
You may continue with **(b)** and **(c)** while you are waiting.
step **6** After 3 minutes, remove the test-tubes from the water-bath.

(i) Record in Table 1.2 the final colour observed in each test-tube.

Table 1.2

test-tube	percentage glucose concentration of solution	final colour observed
A	0.0	
B	0.5	
C	1.0	
D	2.0	
S	unknown	

[5]

(ii) Suggest the percentage glucose concentration of solution **S**.

Explain your answer.

percentage = ...

explanation ....

....
[1]

(b) **(i)** State **and** explain **one** safety precaution you take while doing this investigation.

precaution ....

explanation ....

.... [1]

(ii) Suggest why a clean syringe is used to add each solution.

.... [1]

(iii) Suggest how you improve this procedure to get a more accurate estimate of the percentage glucose concentration of solution **S**.

....

.... [1]

(c) A student uses a piece of apparatus called a colorimeter to determine the percentage glucose concentration.

The higher the colorimeter reading, the lower the percentage glucose concentration.

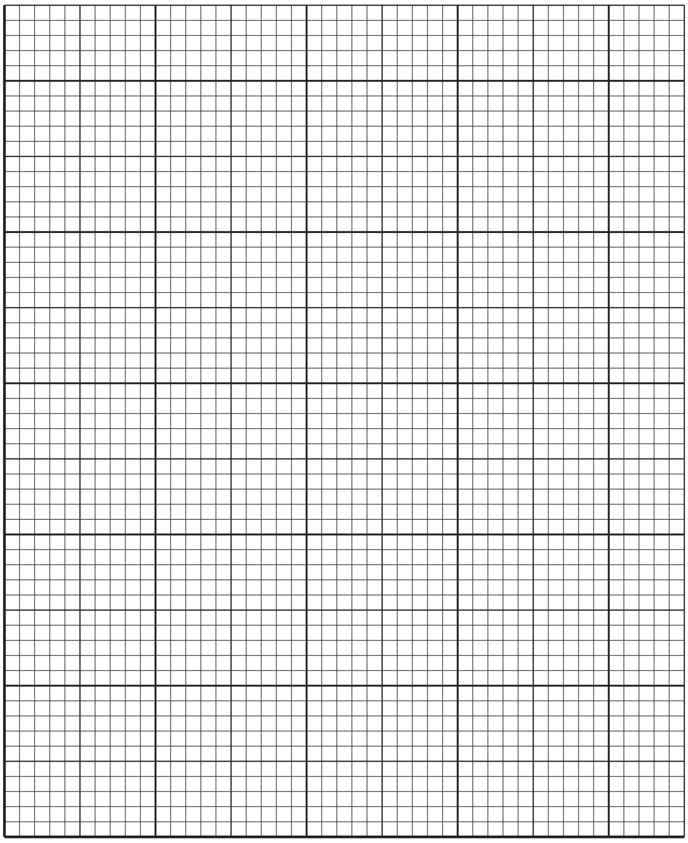
The colorimeter reading has no units.

The student's results are shown in Table 1.3.

Table 1.3

percentage glucose concentration	colorimeter reading
0.0	0.94
0.5	0.67
1.0	0.53
1.5	0.44
2.0	0.38

(i) On the grid, plot a graph of colorimeter reading (vertical axis) against percentage glucose concentration.



[3]

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

(iii) The student tests a sample of solution **S**.

The colorimeter reading is 0.72.

Use your graph to estimate the percentage glucose concentration in solution **S**.

Show your working on the graph.

percentage = ... [2]

(iv) The colorimeter gives a more accurate value than Benedict's solution for the percentage glucose concentration of solution **S**.

Suggest why the value is more accurate.

....

.... [1]

[Total: 16]

Remember to go back and complete 1(a).

2 You are going to test solution **T** for the presence of two different nutrients.

Procedure

step **1** Add approximately 1 cm depth of solution **T** into each of two clean test-tubes.
step **2** Add the same depth of biuret solution to one test-tube containing solution **T**.
step **3** Add a few drops of iodine solution to the other test-tube containing solution **T**.

(a) Record in Table 2.1 the final colours observed in each test-tube.

Table 2.1

testing solution	final colour observed	conclusion
biuret		
iodine		

[2]

(b) Complete Table 2.1 by stating a conclusion for each observation. [2]

[Total: 4]

BLANK PAGE

3 You are going to find the percentage by mass of magnesium in a mixture of magnesium and copper using two different calculations.

When the mixture of magnesium and copper is added to dilute hydrochloric acid, only the magnesium reacts.

Hydrogen gas is made which is collected and measured.

The copper in the mixture does **not** react and is separated from the reaction mixture at the end of the reaction by filtration.

The mass of the copper is measured.

(a) (i) Procedure

- Remove the conical flask from the assembled apparatus.
- Record in Table 3.1 the mass of the empty conical flask.
- Add the mixture of magnesium and copper to the conical flask.
- Record in Table 3.1 the mass of the conical flask with this mixture.

Table 3.1

mass of empty conical flask / g	
mass of conical flask with mixture of magnesium and copper / g	
mass of mixture of magnesium and copper / g	

[2]

(ii)
- Use a measuring cylinder to measure 50 cm^3 of dilute hydrochloric acid.
- Add the dilute hydrochloric acid to the conical flask.
- Quickly replace the flask into the apparatus as shown in Fig. 3.1.

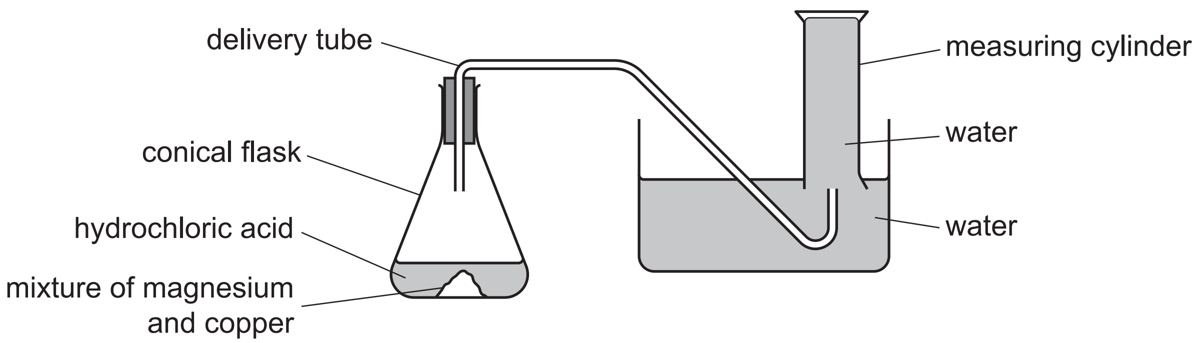


Fig. 3.1

- Wait until the reaction has finished.
- Record in Table 3.2 the volume of hydrogen gas in the upturned measuring cylinder.

Table 3.2

volume of hydrogen gas / cm^3	

[2]

(iii)
- Measure the mass of a filter paper and record it in Table 3.3.
- Filter the contents of the conical flask using this filter paper.
- Rinse the conical flask with water to get as much copper into the filter paper as possible.

Continue with (b) and Q4 while you wait for the filtration to end.

- Remove the filter paper containing the copper.
- Place the filter paper with the copper onto a piece of plastic film.
- Use a balance to find the mass of the filter paper with the copper and plastic film.
- Record this mass in Table 3.3.

Table 3.3

mass of filter paper / g	
mass of filter paper, copper and plastic film / g	
mass of copper / g	

[2]

(b) (i) Even though you replace the conical flask quickly, some hydrogen gas is still lost to the air and **not** collected.

Suggest how the procedure is changed to give a more accurate value for the volume of hydrogen formed.

Do **not** include repeating the experiment.

....

.... [1]

(ii) Using the values in Table 3.1, calculate the mass of the mixture of magnesium and copper added to the conical flask.

Record your value in Table 3.1. [1]

(iii) Calculate the mass of magnesium in the mixture.

Use the equation shown.

$$\text{mass of magnesium} = \frac{\text{volume of hydrogen gas} \times 24}{24\,000}$$

mass of magnesium = ... g [1]

(iv) Calculate the percentage of magnesium in the mixture of magnesium and copper.

Use the equation shown.

$$\text{percentage of magnesium} = \frac{\text{mass of magnesium from } \textbf{(b)(iii)}}{\text{mass of mixture of magnesium and copper from Table 3.1}} \times 100$$

percentage of magnesium = ... [1]

If the filtering in (a)(iii) is not finished, complete Question 4.

(c) **(i)** Suggest how the procedure is changed to give a more accurate value for the mass of copper on the filter paper.

Do **not** include repeating the experiment or subtracting the mass of the plastic film.

....

.... [1]

(ii) Use the values in Table 3.3 to calculate the mass of copper.

Assume the plastic film has no mass.

Record your value in Table 3.3. [1]

(iii) Calculate the percentage of magnesium in the mixture.

Use the equation shown, Table 3.1 and Table 3.3.

$$\text{percentage of magnesium} = 100 - \boxed{\frac{\text{mass of copper}}{\text{mass of mixture of magnesium and copper}} \times 100}$$

percentage of magnesium = ... [1]

[Total: 13]

BLANK PAGE

4 Pure water boils at a temperature of 100 °C.

When salt is dissolved in the water, the boiling temperature increases.

Plan an experiment to find the relationship between the mass of salt added to water and the increase in boiling temperature.

You are provided with:

- pure water
- salt.

You may use any common laboratory apparatus.

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

Include in your plan:

- the apparatus you will use
- a brief description of the method and explain any safety precautions you will take
- what you will measure and how you will make these as accurate as possible
- which variables you will control
- how you will process your results and use them to draw a conclusion.

You may include a labelled diagram if you wish.

You may also include a table that can be used to record results. You are **not** required to include any results.

[7]

Remember to go back and complete Question 3.

5 You are going to determine the mass of a piece of modelling clay by two different methods.

You are provided with a metre rule, a pivot and a piece of modelling clay.

(a) Procedure

- Mould the piece of modelling clay into the approximate shape of a cube.
- Place the modelling clay on the metre rule so that its centre is at a distance of 10.0 cm from the zero end of the rule.
- Place the rule on the pivot.
- Adjust the position of the pivot so that the rule is as close to balance as possible.

Fig. 5.1 shows the arrangement of the apparatus.

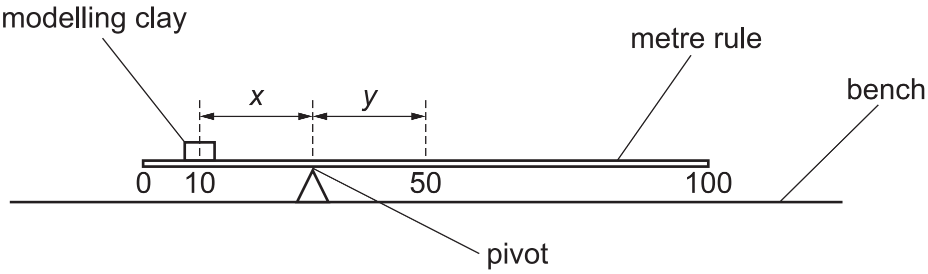


Fig. 5.1

(i) Record to the nearest 0.1 cm the distance x from the centre of the modelling clay to the pivot.

x = ... cm [1]

(ii) Record to the nearest 0.1 cm the distance y from the pivot to the 50.0 cm mark.

y = ... cm [1]

(b) Remove the modelling clay from the metre rule and remove the metre rule from the pivot.

Use the balance provided to measure the mass M of the metre rule.

Record your reading to the nearest gram.

M = ... g [1]

(c) Calculate the mass m_1 of the piece of modelling clay.

Use your answers to **(a)(i)**, **(a)(ii)** and **(b)** and the equation shown.

$$m_1 = \frac{M \times y}{x}$$

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

m_1 = ... g [2]

(d) **(i)** **Procedure**

- Pour approximately 50 cm^3 of water into the measuring cylinder.
- Record the volume V_1 of water in the measuring cylinder.

V_1 = ... cm^3

- Use the thread to lower the modelling clay into the measuring cylinder until it is completely immersed. You will need to re-mould your modelling clay into any shape that fits into the measuring cylinder.
- Record the new volume V_2.

V_2 = ... cm^3
[1]

(ii) Calculate the volume V of the piece of modelling clay.

Use the equation shown.

$$V = V_2 - V_1$$

V = ... cm^3 [1]

(iii) Describe how you avoid a line-of-sight (parallax) error when reading the scale of the measuring cylinder.

....

.... [1]

(e) The density ρ of the modelling clay is 1.9 g / cm^3.

Calculate the mass m_2 of the modelling clay.

Use your answer from **(d)(ii)** and the equation shown.

$$m_2 = V \times \rho$$

m_2 = ... g [1]

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

Compare your value m_1 from **(c)** with your value m_2 from **(e)**.

State if your values for the mass of the modelling clay are equal, within the limits of experimental accuracy.

Justify your statement with a calculation.

statement ....

justification ....

....

.... [2]

[Total: 11]

BLANK PAGE

6 You are going to investigate the rate of cooling of hot water.

The apparatus is assembled as shown in Fig. 6.1.

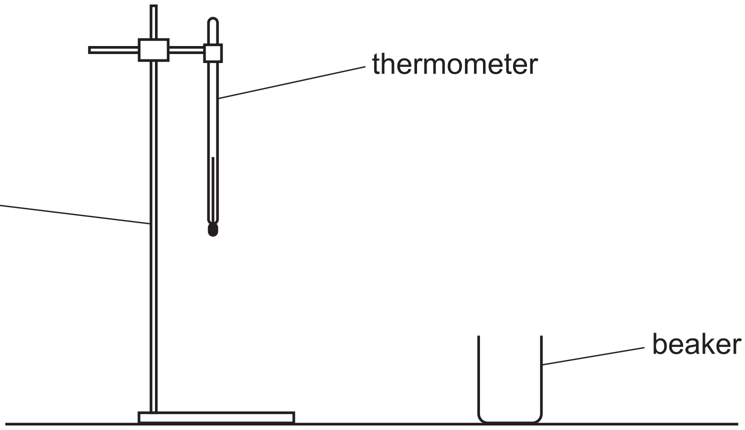


Fig. 6.1

(a) Record the room temperature θ_R to the nearest 0.5 °C.

θ_R = ... °C [1]

(b) Procedure

- Place the beaker on the stand under the thermometer.
- Pour hot water into the beaker up to the 200 cm^3 mark.
- Lower the thermometer into the hot water.
- Wait for 30 s.
- Measure the temperature θ of the hot water.

(i) Record, in Table 6.1, θ to the nearest 0.5 °C at time t = 0 and start the stop-clock.

Table 6.1

time t / minutes	temperature θ / °C
0	
1	
2	
3	
4	
5	
6	

[1]

(ii) Record, in Table 6.1, the temperature of the water every minute for 6 minutes. [2]

(c) Explain why you wait for 30 s before measuring the initial temperature of the hot water.

....

.... [1]

(d) **(i)** Calculate the temperature decrease $\Delta\theta_F$ of the water during the **first 3** minutes of cooling.

Use your readings in Table 6.1.

$\Delta\theta_F$ = ... °C [1]

(ii) Calculate the temperature decrease $\Delta\theta_L$ of the water during the **last 3** minutes of cooling.

Use your readings in Table 6.1.

$\Delta\theta_L$ = ... °C [1]

(e) Use your results to write a conclusion about the rate at which hot water in a beaker cools.

....

.... [1]

(f) Use your answers to **(d)** to estimate the temperature of the water after it cools for **9** minutes.

You are **not** required to make this measurement.

temperature = ... °C [1]

[Total: 9]

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