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Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

1702824118

CO-ORDINATED SCIENCES **0654/62**

Paper 6 Alternative to Practical **February/March 2025**

1 hour 30 minutes

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 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.

This document has **20** pages. Any blank pages are indicated.

DC (DE/JG) 343251/4

1 A student investigates the loss of thermal energy from a large animal and from a small animal using a boiling tube and a test-tube to represent the animals. The boiling tube is larger than the test-tube.

(a) Procedure

The student:

- almost fills the boiling tube with hot water
- places a thermometer in the hot water
- waits 30 seconds and then records in Table 1.1 the temperature of the water for time = 0
- records in Table 1.1, the temperature of the water every minute for 5 minutes.

Repeats the procedure using the test-tube instead of the boiling tube.

Fig. 1.1 shows the thermometer readings for each tube at time = 4 minutes.

Record in Table 1.1 these values to the nearest 0.5 °C.

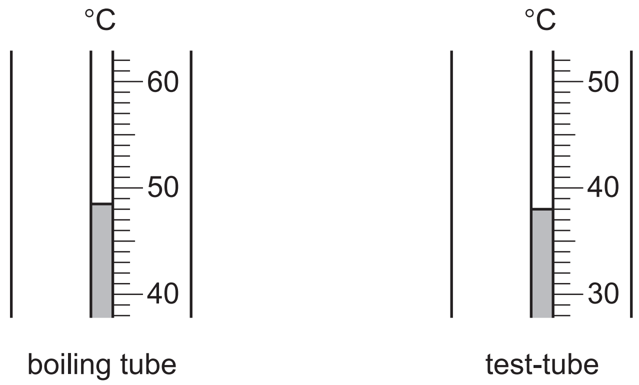

Fig. 1.1

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Table 1.1

time / minutes	temperature of water in boiling tube / °C	temperature of water in test-tube / °C
0	80.0	77.5
1	66.0	54.0
2	57.5	46.5
3	52.0	42.0
4		
5	46.0	36.5

[2]

(b) (i) You are going to plot both sets of data in Table 1.1 on the same grid.

On the grid:

- plot temperature of water in the boiling tube (vertical axis) against time
- draw the curve of best fit and label this curve L
- plot temperature of water (vertical axis) against time for the test-tube
- draw the curve of best fit and label this curve S.

[5]

(ii) Use your graph to estimate the temperature of the water in the boiling tube at 1.5 minutes.
Show your working on the graph.

temperature = ... °C [2]

(c) (i) Calculate the decrease in temperature for the water in each tube between the start and at 5 minutes.

boiling tube .... °C

test-tube .... °C
[1]

(ii) Use your results to suggest how the rate of loss of thermal energy from a large animal compares to the rate of loss of thermal energy from a small animal.

....

.... [1]

(d) (i) Explain why repeating the procedure increases confidence in the results.

....

.... [1]

(ii) Suggest why it is important to wait 30 seconds before taking the first thermometer reading.

....

.... [1]

(iii) Suggest why it is important to stir the water before taking each temperature reading.

....

.... [1]

[Total: 14]

2 (a) A student has two leaves **A** and **B**, on a white tile.
The leaves are from the same species of plant.

The green chlorophyll is removed from each leaf.

(i) The student puts a few drops of iodine solution to cover the upper surface of each leaf.

- The iodine solution on leaf **A** changes colour.
- The iodine solution on leaf **B** does not change colour.

State the colours the student observes.

leaf **A** ....

leaf **B** ....

[2]

(ii) State a conclusion for the observations in **(a)(i)**.

leaf **A** ....

leaf **B** ....

[1]

(iii) Leaf **A** is from a plant grown in the light for 2 days.
Leaf **B** is from a plant grown in the dark for 2 days.

Explain your conclusion in **(a)(ii)**.

....

....

....

.... [1]

(b) (i) Suggest why chlorophyll is removed from each leaf.

....

.... [1]

(ii) Describe how chlorophyll is removed from a leaf.

....

.... [1]

[Total: 6]

3 A student identifies solid **J** and some of the ions present in solid **K** and in aqueous **L** and aqueous **M**.

Solid **K** and aqueous **L** contain the same cation.

(a) **J** is a shiny grey solid.

J is kept in a sealed container because it reacts with water vapour in the air and gives off a gas.

The student adds **J** to water.

The student observes:

- **J** moving up and down in the water
- bubbling
- **J** getting smaller
- a colourless solution forming
- a gas forming which pops with a lighted splint.

(i) Identify the gas formed.

.... [1]

(ii) **J** is an element.

State the type of element.

.... [1]

The solution formed in **3(a)** is also used in **3(b)(i)**, **3(c)**, and **3(d)**.

(b) **(i)** **Procedure**

The student:

- pours some of the solution formed in **(a)** into a boiling tube of carbon dioxide gas
- puts a stopper in the boiling tube and shakes the tube.

The student sees a white precipitate form in the solution.

Identify the solution.

.... [1]

(ii) The student separates the solid precipitate from the solution.

Draw a labelled diagram of the assembled apparatus the student uses.

Label the precipitate and the solution.

[2]

(c) Procedure

The student:

- pours some aqueous **L** and some of the solution formed in **(a)** into separate test-tubes
- adds aqueous sodium hydroxide dropwise to each test-tube until it is in excess.

In both solutions the student observes a white precipitate that does not dissolve in excess aqueous sodium hydroxide.

Identify the cation present in aqueous **L** and identify solid **J**.

cation in aqueous **L** ....

solid **J** ....
[1]

(d) Procedure

The student:

- puts solid **K** into a boiling tube and connects a delivery tube to the boiling tube
- heats **K** and bubbles the gas formed into some of the solution formed in **(a)**.

The student sees a white precipitate form in the solution.

(i) Identify the anion present in solid **K**.

.... [1]

(ii) Draw a labelled diagram of the assembled apparatus the student uses.

[2]

(e) Flame tests are often used to identify metal ions.

State **two** reasons why a flame test is done using a blue Bunsen burner flame rather than a yellow one.

reason 1 ....

....

reason 2 ....

....
[2]

(f) The student tests aqueous **M** for the presence of chloride ions.

They add dilute hydrochloric acid, $HCl(aq)$, and aqueous silver nitrate to aqueous **M**.

The student observes a white precipitate.

A teacher tells the student that the test they have used does **not** confirm the identity of the chloride ion.

Explain why the test the student uses does **not** prove that chloride ions are present in aqueous **M**.

State an improvement to the test to confirm the presence of chloride ions.

explanation ....

....

improvement ....

....
[2]

[Total: 13]

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4 When ammonium sulfate is heated with sodium hydroxide, it reacts to form ammonia gas.

Ammonia gas is **not** collected over water because it is soluble in water.

Plan an investigation to find the relationship between the mass of ammonium sulfate used and the volume of ammonia gas made.

You are provided with:

- aqueous sodium hydroxide
- ammonium sulfate powder.

You may use any common laboratory apparatus.

Include in your plan:

- the apparatus you will need and an explanation of any safety precautions
- a brief description of the method
- the measurements you will make and how you make them as valid 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 enter any readings in the table.

[7]

5 A student investigates how the stability of a plastic bottle depends on the height of the water in the bottle.

Fig. 5.1 shows the apparatus the student uses and where the student pushes the bottle.

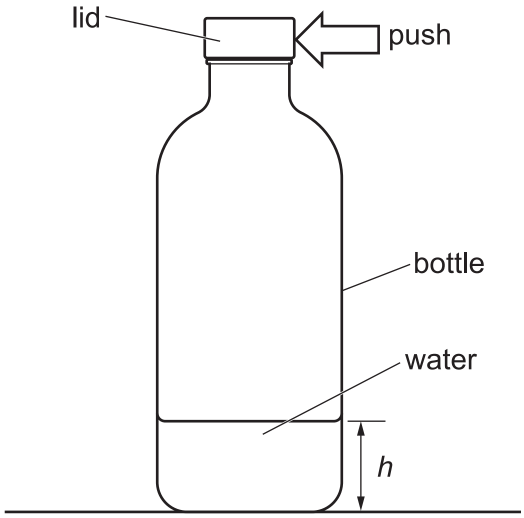

Fig. 5.1

(a) **(i)** Fig. 5.1 shows the height h of the water in the bottle.

Record h in cm to the nearest 0.1 cm.

h = ... cm

Fig. 5.1 is drawn to a scale of one-fifth full size.

Calculate the actual height H of the water in the bottle.

Record this value of H in Table 5.1.

Table 5.1

height of water in the bottle H / cm	angle θ / °
10	61
15	66
20	70
25	72

[2]

(ii) **Procedure**

The student:

- gently pushes sideways at the top of the bottle until they find the point where it **just** starts to fall over without pushing any more
- measures the angle θ. The angle θ is the angle between the bottle and the table.

The student repeats the procedure for another 4 values of *H*.

Table 5.1 shows the results the student obtains.

Fig. 5.2 shows the bottle as it just starts to fall over.

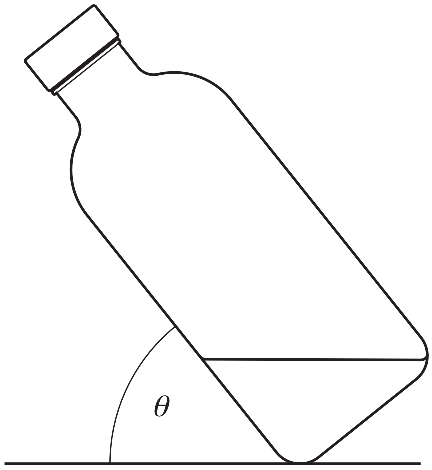

Fig. 5.2

Measure the angle θ in Fig. 5.2.

Record this value in Table 5.1. [1]

(b) Describe in detail, the relationship between the height *H* of water in the bottle and angle θ.

....

....

....

.... [2]

(c) It is difficult to hold the bottle in the exact position when it starts to fall over and measure the angle θ at the same time.

Suggest how to overcome this difficulty.

Do **not** include using another person in your answer.

....

.... [1]

(d) Another student repeats the procedure using the same apparatus.
The bottle falls over at an angle θ of 64°.

Estimate the height H of water in the bottle.
Use the results in Table 5.1.

height .... cm [1]

[Total: 7]

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6 A student determines the density of modelling clay using two different methods.

The student is provided with a cuboid made of modelling clay.

(a) Method 1

(i) The modelling clay is shown in Fig. 6.1.

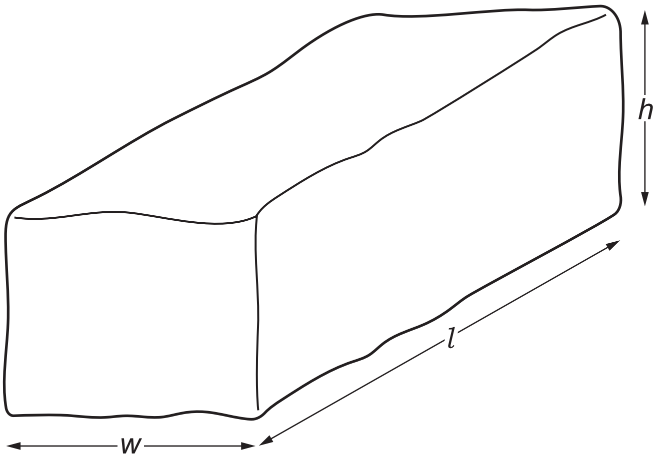

Fig. 6.1

Record the dimensions l, w and h of the cuboid in cm to the nearest 0.1 cm.

l = ... cm

w = ... cm

h = ... cm
[2]

(ii) Calculate the volume V_1 of the modelling clay.

Use the equation shown.

$$V_1 = l \times w \times h$$

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

V_1 = ... cm^3 [2]

(iii) The student measures the mass of the modelling clay.
The reading on the balance is shown in Fig. 6.2.

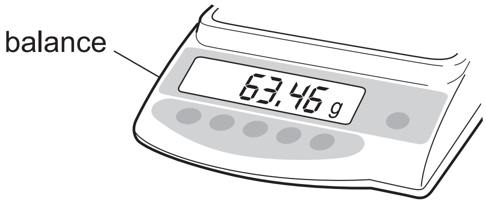

Fig. 6.2

Record the mass m of the modelling clay to the nearest 0.1 g.

m = ... g [1]

(iv) Calculate the density ρ_1 of the modelling clay.

Use the equation shown.

$$\rho_1 = \frac{m}{V_1}$$

ρ_1 = ... g/cm^3 [1]

(b) Describe **one** reason why your measurements of the dimensions in **(a)(i)** are **not** accurate.

....

.... [1]

(c) Method 2

(i) Another student finds the volume of the same piece of modelling clay by displacing water in a measuring cylinder.

The student shapes the modelling clay so that it fits into the measuring cylinder.

The student puts the modelling clay into the water so that it is completely below the surface of the water.

Fig. 6.3 shows the readings on the measuring cylinder.

volume of water V_2 volume of water and modelling clay V_3

Fig. 6.3

Record V_2 and V_3 to the nearest cm^3.

V_2 = ... cm^3

V_3 = ... cm^3 [1]

(ii) Calculate the volume V_c of the modelling clay.

Use the equation shown.

$$V_c = V_3 - V_2$$

V_c = ... cm^3 [1]

(iii) Calculate the density ρ_2 of the modelling clay.

Use the value of *m* from **(a)(iii)**.

ρ_2 = ... g/cm^3 [1]

(d) (i) It is more accurate for the student to do **method 1** before **method 2** to determine the density of the modelling clay.

Explain why it is more accurate.

....

.... [1]

(ii) Two values are considered to be equal within the limits of experimental error if the difference between them is less than 10%.

Explain if your values of ρ_1 and ρ_2 are considered equal within the limits of experimental error.

Justify your answer with a calculation.

....

.... [1]

(iii) Another student repeats the procedure in **method 2**.

The student spills some of the water from the measuring cylinder when they put the modelling clay into the water.

Suggest what effect this has on the calculated value of density.

Explain your answer.

suggestion ....

explanation ....

....
[1]

[Total: 13]

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