Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4265048356

CO-ORDINATED SCIENCES **0654/63**

Paper 6 Alternative to Practical **October/November 2014**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **17** printed pages and **3** blank pages.

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CAMBRIDGE International Examinations

1 A student is provided with three solutions **A**, **B** and **C**. She tests each of the solutions for the presence of nutrients important in the human diet. Each solution contains only one type of nutrient.

Test 1

She puts 5 cm^3 solution **A** into a clean test-tube and adds an equal amount of Benedict's solution. She places the test-tube in a hot water-bath for five minutes. She then repeats this procedure with solutions **B** and **C**.

Test 2

She puts 5 cm^3 solution **A** into a clean test-tube, adds an equal quantity of biuret solution and shakes briefly to mix.

She repeats this with solutions **B** and **C**.

Test 3

She puts 5 cm^3 solution **A** into a clean test-tube and adds a few drops of iodine solution.

She repeats this with solutions **B** and **C**.

The student records the appearance of each solution for each test in Table 1.1.

Table 1.1

solution	**Test 1**	**Test 2**	**Test 3**
A	pale blue		brown
B	pale blue	pale blue	blue-black
C		pale blue	brown

(a) Solution **A** gives a positive result for **Test 2** and solution **C** gives a positive result for **Test 1**. Complete Table 1.1 to show these results. [2]

(b) Use the information in Table 1.1 to name the nutrient in

solution **A** ....

solution **B** ....

solution **C** .... [3]

(c) Another student has two different solutions, **D** and **E** that each test positive with Benedict's solution.

Describe an experiment using Benedict's solution to find out which of **D** or **E** is more concentrated.

....

....

....

....

....

.... [3]

(d) The teacher has another liquid that she thinks contains fat. Describe the test you would use to find out if the teacher is correct and give the positive result.

....

....

.... [2]

2 A student is investigating some properties of solid **A** which is a compound of magnesium.

The teacher has given him two reactions to carry out. The first reaction is shown in Fig. 2.1.

First reaction

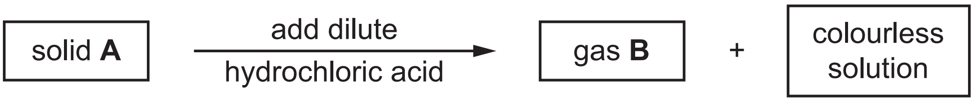

Fig. 2.1

Fig. 2.2 shows a test-tube containing solid **A** and dilute hydrochloric acid. The student uses limewater to test the gas (gas **B**) produced in the first reaction.

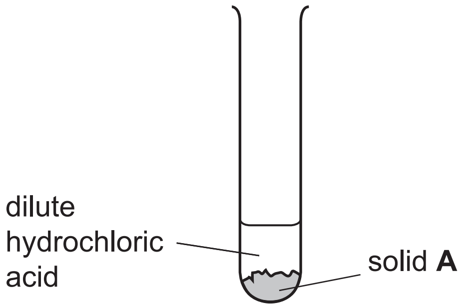

Fig. 2.2

(a) **(i)** Complete Fig. 2.2 to show how the student can use limewater to test gas **B**, the gas produced by the reaction. [2]

(ii) State what the student observes if the test in part **(i)** gives a positive result.

.... [1]

(iii) The limewater test gives a positive result. Name gas **B**.

.... [1]

(iv) Using this result, the student can name the magnesium compound, solid **A**.

Solid **A** is magnesium .... [1]

The second reaction is shown in Fig. 2.3.

Second reaction

Fig. 2.3

- The student heats some solid **A** in a hard glass test-tube for two minutes. There is no change in the appearance of the solid.
- He lets the tube cool down.
- He adds distilled water to the cooled residue and stirs the mixture.
- He filters the mixture and then divides the filtrate, solution **D**, into two portions and carries out two tests.

Tests on solution D

Test 1 He adds red litmus solution to one portion of the filtrate, which turns blue.

Test 2 He adds copper(II) sulfate solution to other portion of the filtrate. There is a light blue precipitate.

(b) **(i)** Explain what **Test 1** tells the student about solution **D**.

.... [1]

(ii) Suggest the name of the light blue precipitate formed when copper(II) sulfate is added to solution **D**.

.... [1]

(c) Use your answers to parts **(a)** and **(b)** to explain the chemical reactions that take place when

(i) solid **A** is heated,

....

.... [2]

(ii) solid **C** reacts with water.

....

.... [1]

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3 The science teacher tells some students that a fixed amount of thermal energy is absorbed by 1 g of a substance to raise its temperature by 1 °C. This amount of energy, measured in joules, is known as the *specific heat capacity*.

The specific heat capacities of glass and of water have different values.

A student carries out an experiment to determine the specific heat capacity of glass.

Method

- The student measures out 100 cm^3 of water and pours it into a glass beaker.
- He draws a line to represent the 100 cm^3 mark on the glass using a permanent marker.
- He adds another 100 cm^3 of water and draws another line to represent the 200 cm^3 mark.

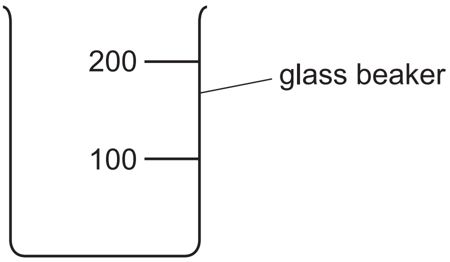


Fig. 3.1

(a) Name the piece of apparatus the student needs to use to make sure that the 100 cm^3 and 200 cm^3 marks on the beaker are drawn accurately, other than the marker pen.

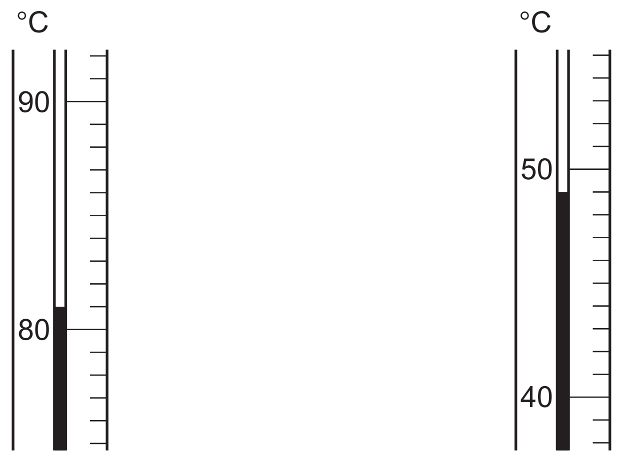
.... [1]

Experimental procedure

- He weighs the empty beaker and records its mass in Table 3.1 on page 8.
- He places 100 cm^3 of water in the beaker and finds T_1, the temperature of the water. He records the temperature in Table 3.1.
- He heats the water for a short time and then finds the temperature, T_2. He records this temperature in Table 3.1.
- He adds another 100 cm^3 of the cold water at temperature T_1 to the hot water in the beaker. He thoroughly mixes the water and finds the new temperature, T_3. He records this temperature in Table 3.1.

(b) Fig. 3.2 shows the thermometer scales for temperatures T_2 and T_3.

Read the temperatures and record them in Table 3.1. [2]



temperature T_2 temperature T_3

Fig. 3.2

Table 3.1

mass of beaker / g	temperature T_1 / °C	temperature T_2 / °C	temperature T_3 / °C
85	22		

(c) The student has written the sentences below to describe the changes of thermal energy when the hot water and the cold water are mixed.

Fill in the blank spaces using the words from the list.

fall **gain** **lose** **rise**

Each word may be used once, more than once or not at all.

The temperature of the hot water and the beaker will ....

The temperature of the cold water will ....

This is because the hot water and the beaker will .... thermal energy.

The cold water will .... thermal energy. [1]

(d) **(i)** Calculate T_C, the change in temperature of the cold water on mixing.

T_C = ... °C [1]

(ii) Calculate T_H, the change in temperature of the hot water and the beaker on mixing.

T_H = ... °C [1]

(e) The teacher has given the student four equations.

Use the data from Table 3.1 and part **(d)** and the equation to carry out each of the following calculations.

(i) thermal energy change for the hot water and the beaker

$$E_H = 420 \times T_H$$

E_H = ... J [1]

(ii) thermal energy change for the cold water

$$E_C = 420 \times T_C$$

E_C = ... J [1]

(iii) thermal energy change for the beaker

$$E_B = E_H - E_C$$

E_B = ... J [1]

(iv) specific heat capacity of glass, s.h.c.

$$\text{s.h.c.} = \frac{E_B}{\text{mass of beaker x } T_C}$$

s.h.c. = ... J/g/°C [1]

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4 A student investigates an aquatic plant using the apparatus shown in Fig. 4.1. He places the bench lamp at a distance *d* of 50 cm from the centre of the glass beaker. He counts the number of bubbles of gas rising from the funnel over 5 minutes.

He then moves the bench lamp to a distance of 40 cm and repeats the experiment.

He carries out this procedure for different values of distance *d*.

He records his results as a chart. This is shown in Fig. 4.2 on page 12.

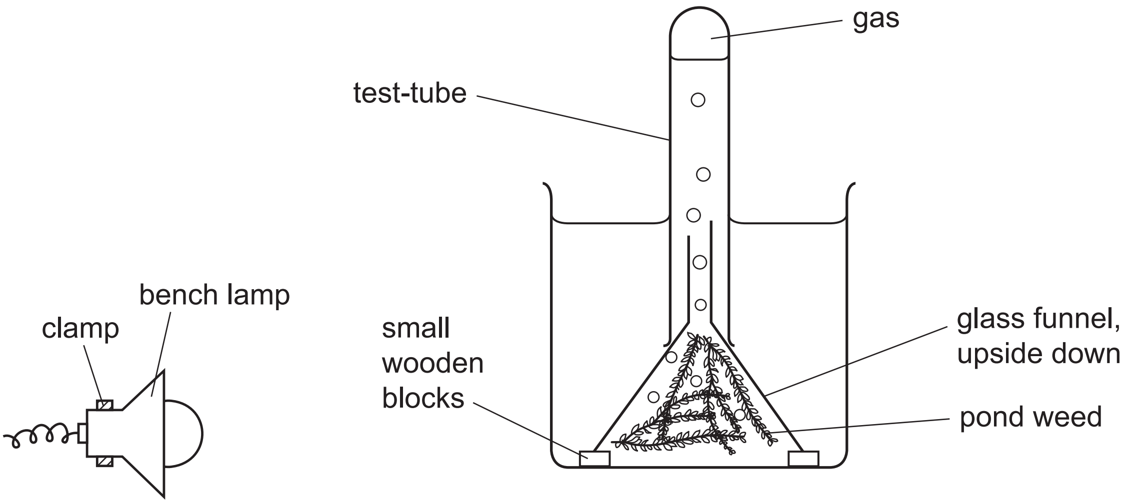


Fig. 4.1

(a) On Fig. 4.1, draw an arrow to show the distance *d*. Mark clearly the beginning and end of your arrow. [1]

(b) The student records his results in the chart shown in Fig. 4.2. Each line represents one bubble.

Use Fig. 4.2 to complete Table 4.1 for the distances given. [2]

distance *d* / cm	number of bubbles produced in 1 minute
70	𝍸 𝍸 𝍸 II
50	𝍸 𝍸 𝍸 𝍸 𝍸 III
40	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 III
30	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸
20	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 IIII

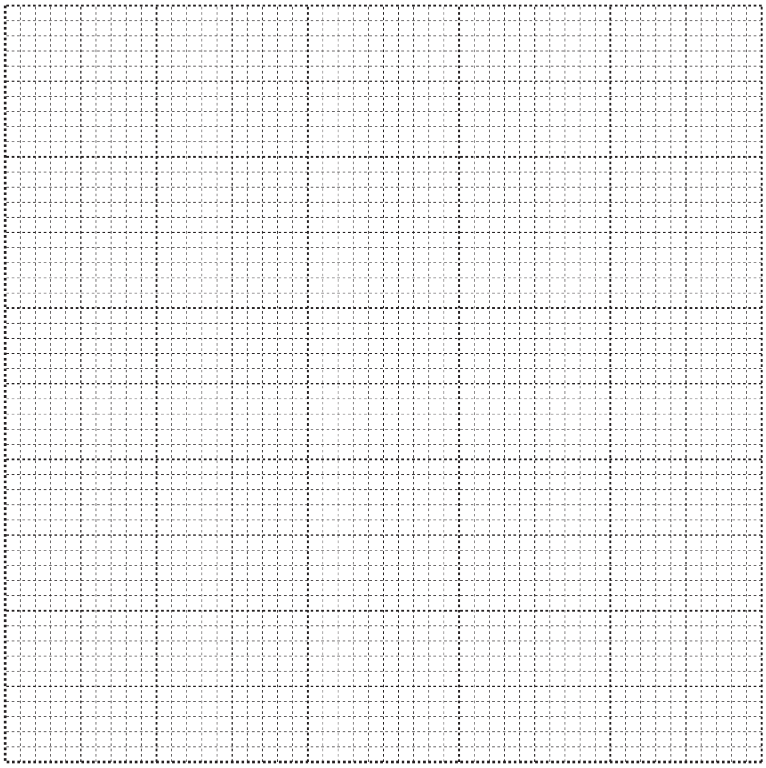
Fig. 4.2

Table 4.1

distance *d* / cm	number of bubbles produced in 1 minute
70	
50	
40	
30	
20	

(c) Plot a graph of the student's results and draw a smooth curve of best fit using the grid below.

number of bubbles given off in five minutes



distance d / cm

[3]

(d) Use your graph to estimate the number of bubbles produced when d = 60 cm.

Show how you did this on your graph.

number of bubbles when d = 60 cm .... [2]

(e) **(i)** Name the process in the aquatic plant that causes bubbles to be produced.

.... [1]

(ii) State what this experiment shows about the effect of light intensity on the rate of this process.

....

.... [1]

5 A student carries out experiments using powdered zinc.

He reacts zinc powder with solutions of copper and nickel sulfates.

Procedure

- He adds 6 g copper sulfate to 20 g water and stirs to dissolve the crystals.
- He places the solution in a polystyrene container and records the temperature in Table 5.1.
- He adds 0.4 g of zinc powder and stirs the mixture, then records the new temperature.
- He adds more 0.4 g portions of zinc powder, stirring the mixture and finding the new temperature each time.
- He repeats the procedure using 6 g nickel sulfate in place of the copper sulfate.

Table 5.1

	mass of zinc powder added / g				
	0	0.4	0.8	1.2	1.6
temperature of copper sulfate solution / °C	21	36	50	64	
temperature of nickel sulfate solution / °C	20	29	37	45	

(a) The thermometers in Fig. 5.1 show the missing temperatures. Read the thermometers and record the temperatures in Table 5.1. [2]

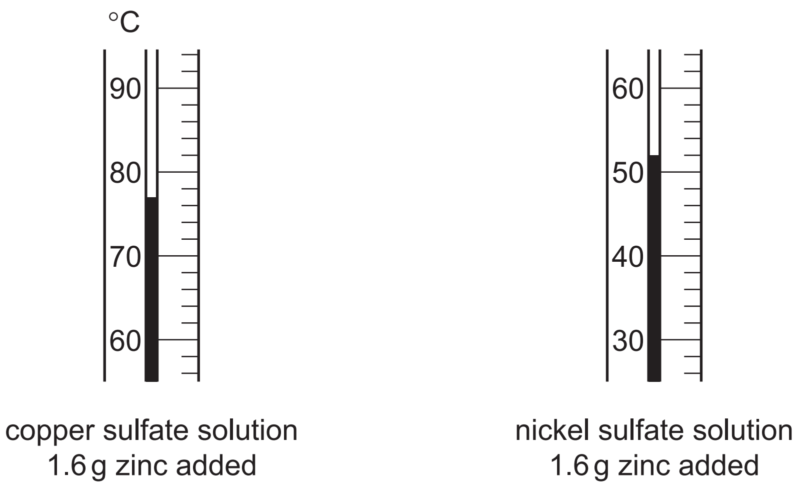


Fig. 5.1

(b) On the graph grid provided, plot graphs of the recorded temperatures (vertical axis) against the mass of zinc added for the two reactions.

Draw **two** smooth curves. Label the curves **copper sulfate** and **nickel sulfate**.

[4]

(c) **(i)** State which solution reacts more strongly with zinc powder.

Explain your answer.

[1]

(ii) Suggest how the results of this experiment will differ if powdered magnesium, instead of powdered zinc, is added to copper sulfate solution.

Explain your answer.

[1]

(d) After 1.6 g of zinc powder had been added to the copper sulfate solution, the student records, in Table 5.2, the appearance of the solution and the solid left in the polystyrene beaker.

Table 5.2

appearance of solid residue	appearance of solution
red-brown	colourless

Use the information in Table 5.2 to suggest the name of the

solid, ...

solution. .... [2]

6 A science class is investigating the density of solids. One student has pieces of aluminium and lead of the same size and shape. One of the pieces is shown in Fig. 6.1.

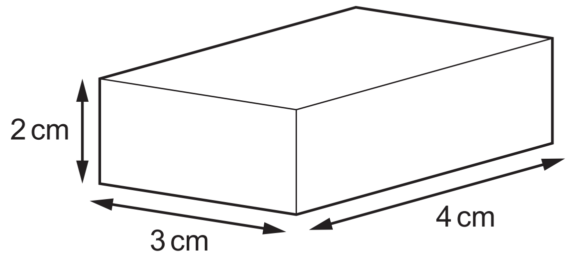


Fig. 6.1

(a) (i) Calculate the volume of this piece of metal.

volume = ... cm^3 [1]

(ii) The student weighs the pieces of metal. Fig. 6.2 shows the balance windows.

Read the scales to the nearest 1 g and record the masses below.

mass of aluminium

mass of lead

Fig. 6.2

mass of aluminium = ... g

mass of lead = ... g [2]

(iii) Find the density of each metal. Use the formula given.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

density of aluminium = ... g/cm^3

density of lead = ... g/cm^3 [2]

(iv) Table 6.1 shows some data about aluminium and lead. The two metals have the same crystal structure.

Table 6.1

metal	atomic size / nm	relative atomic mass
aluminium	0.29	27
lead	0.35	207

Use the data in Table 6.1 to suggest why lead is much denser than aluminium.

....

.... [1]

(b) The student has cut pieces of two types of wood; balsa and pine. The pieces are the same size and shape as shown in Fig. 6.3.

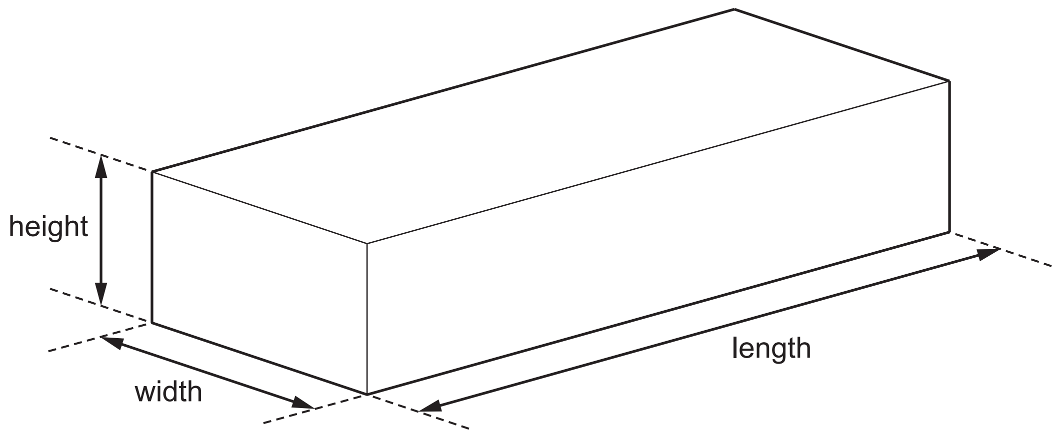


Fig. 6.3

(i) Use a ruler to measure, to the nearest 1 mm, the length, width and height of this piece of wood.

length .... cm

width .... cm

height .... cm [1]

(ii) Table 6.2 shows data collected by the student about the pine wood and balsa wood.

Use your answer to part **(i)** to calculate the volume of the pieces of wood. Record them in Table 6.2.

[1}

Table 6.2

wood	balsa	pine
volume / cm^3		
mass / g	0.77	40.8
density g / cm^3	0.16	0.85

(c) **(i)** The student immerses the pieces of aluminium, lead, balsa wood and pine wood in water and leaves them there for one week.

After one week, he weighs them again.

Both pieces of wood have gained mass. Both metals have the same mass as before.

Suggest a reason for the gain in mass of the pieces of wood.

....

.... [1]

(ii) Wood consists of carbohydrates.

Suggest **one** reason why the density of balsa wood is much less than the density of pine wood.

....

.... [1]

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