Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

2872917612

PHYSICAL SCIENCE **0652/61**

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 **24** printed pages and **4** blank pages.

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1 A student is trying to find out how much dissolved air is contained in water from a natural source. He collects the water from a mountain stream. He uses the apparatus shown in Fig. 1.1.

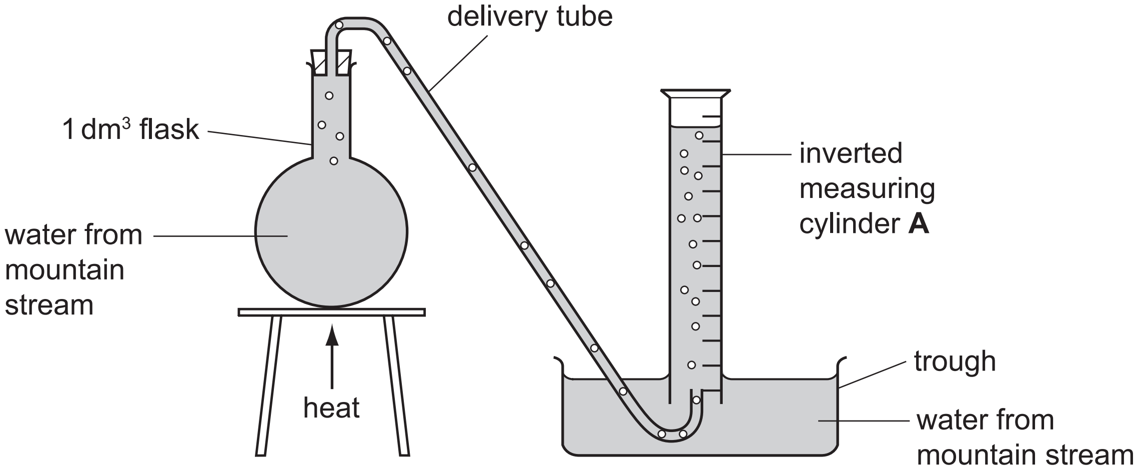

Fig. 1.1

Method

- The student completely fills the flask, the delivery tube and the inverted measuring cylinder with water from a mountain stream.
- He heats the flask so that the water boils.
- Bubbles of air are collected in the measuring cylinder.
- The student stops heating when he sees no more air bubbles.

(a) (i) When the water boils, it changes state from liquid to gas.

Name this change of state.

.... [1]

(ii) The air and the steam pass through the delivery tube, but only the air collects in the measuring cylinder.

Write **one word** to explain what happens to the steam as it passes through the delivery tube.

.... [1]

(b) Fig. 1.2 shows the scale of the measuring cylinder after all the air has been collected.

Read the scale and record the volume of the boiled-out air.

volume of air = ... cm^3 [1]

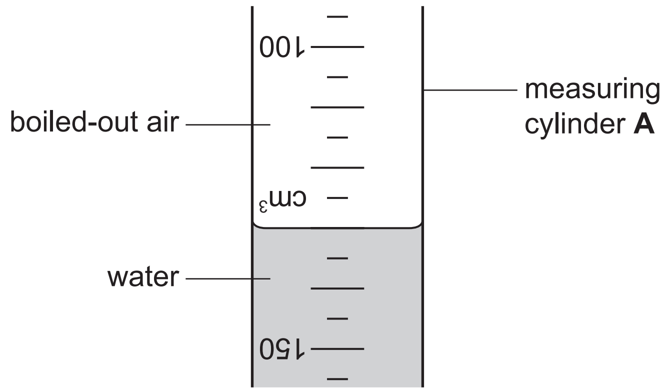

Fig. 1.2

The student wants to know if the boiled-out air has the same composition as normal air.

- Using a syringe, he places the same volume of normal air in measuring cylinder **B**.
- He inserts a cotton bag of iron filings on the end of a piece of stiff wire into each cylinder. The two cylinders, **A** and **B**, are shown in Fig. 1.3.
- He leaves the two measuring cylinders containing the air and iron filings for one week.

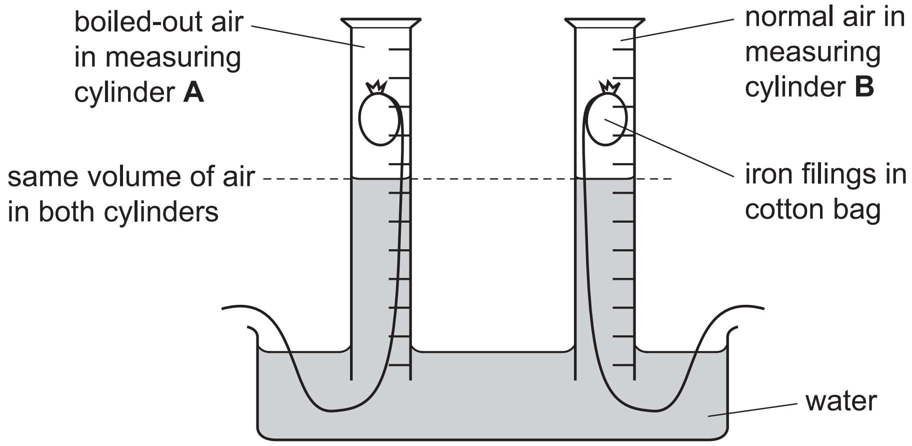

Fig. 1.3

After one week, the student removes the bags of iron filings from the measuring cylinders. Fig. 1.4 shows the scales of cylinders **A** and **B** containing the air left over.

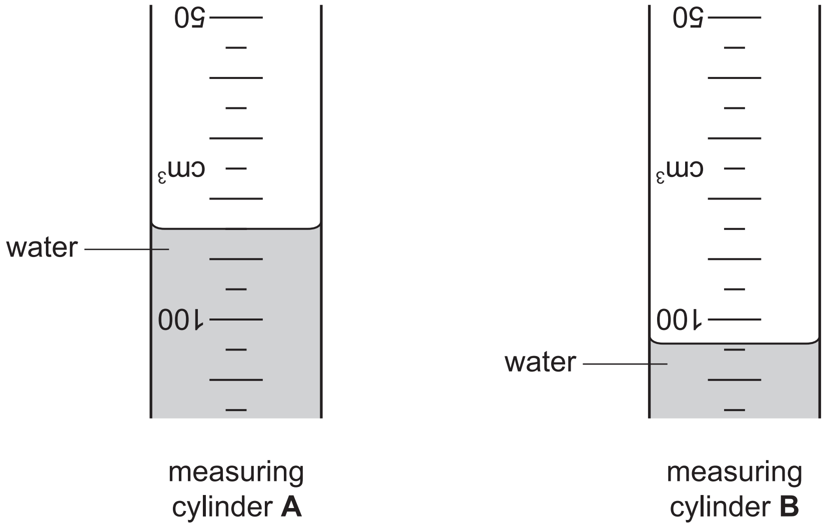

Fig. 1.4

(c) (i) The student says that the oxygen has been removed from the air by a chemical reaction with the iron filings.

State the common name of the iron oxide that has been formed by this reaction.

.... [1]

(ii) Use the results from Figs. 1.2 and 1.4 to complete Table 1.1.

Table 1.1

measuring cylinder	**A**	**B**
type of air	boiled-out air	normal air
total volume of air at first / cm^3		
volume of gas left over after iron filings have reacted / cm^3		
volume of oxygen used up / cm^3		

[4]

(d) (i) Using Table 1.1, state the difference between the amounts of oxygen in boiled-out air and normal air.

....

.... [1]

(ii) Calculate the approximate percentage of oxygen by volume in the boiled-out air.

approximate percentage = ... % [1]

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2 A student has been given a sample of solid **Y** which is a mixture of three compounds each containing a different metal.

He has been told to carry out six tests to identify the compounds contained in solid **Y**.

> **Test 1**
>
> Place the sample of solid **Y** in a beaker and add about 25 cm^3 distilled water.
> Stir the mixture and then filter it.
> Keep the filtrate and residue for **Tests 2**, **3** and **4**.
>
> Record your observations.

The student has recorded his observations for **Test 1**.

The filtrate is colourless, the residue is brown-black. ....

(a) Complete Fig. 2.1 to show how, in **Test 1**, the mixture is separated into filtrate and residue. Label your diagram.

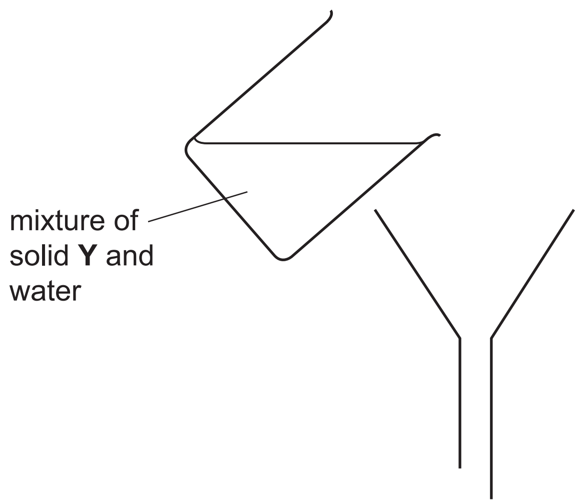


Fig. 2.1

[2]

The student carries out **Test 2** and writes his observations.

Test 2

To about 2 cm^3 of the filtrate from **Test 1** slowly add 20 cm^3 sodium hydroxide solution. Stir the mixture.

Record your observations.

observations

White precipitate at first which dissolves to form a colourless solution.

(b) The student thinks that the filtrate contains zinc ions, Zn^{2+}.

He carries out **Test 3**. He has not written his observations.

Suggest what the student observes for **Test 3** if the filtrate does contain Zn^{2+} ions.

Test 3

To about 2 cm^3 of the filtrate from **Test 1** slowly add 20 cm^3 ammonia solution. Stir the mixture.

Record your observations.

observations

....

.... [2]

(c) The student carries out **Test 4** and **Test 5** and records his observations.

Test 4

Place some of the residue from **Test 1** into a beaker and add dilute hydrochloric acid. When the reaction has finished, filter the mixture.

Record your observations.

observations

The mixture bubbled and a gas is given off. The filtrate is blue and the residue is black.

Test 5

To 2 cm^3 of the filtrate from **Test 4**, add excess dilute sodium hydroxide. Stir the mixture.

Record your observations.

observations

A light blue precipitate is formed.

The student thinks that solid **Y** contains copper(II) carbonate. In **Test 4**, this compound reacts with the hydrochloric acid.

(i) Suggest a test on the gas that was given off in **Test 4** that will confirm that solid **Y** contains a carbonate.

....

.... [2]

(ii) To confirm that the filtrate from **Test 4** contains copper(II) ions, the student slowly adds excess ammonia solution.

State **two** observations he makes to confirm that copper(II) ions are present.

1 ....

....

2 ....

.... [2]

(d) The student has found out that solid **Y** contains zinc ions and copper(II) ions. He carries out **Test 6**.

He thinks that the third compound present in solid **Y** contains iron.

Test 6
Dissolve the residue from **Test 4** in nitric acid. Slowly add ammonia solution until it is in excess. Record your observations.

Describe his observations for **Test 6** that suggest that iron(III) ions are present in the solution of the residue from **Test 4.**

....

.... [2]

Please turn over for Question 3.

3 A student is investigating the relationship between the length of a piece of wire and its electrical resistance. She sets up the circuit shown in Fig. 3.1.

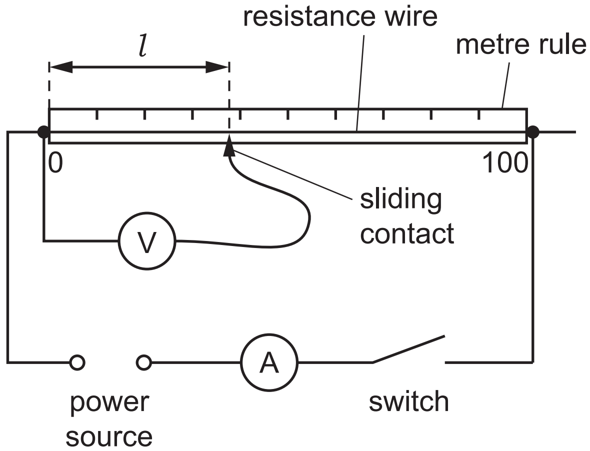


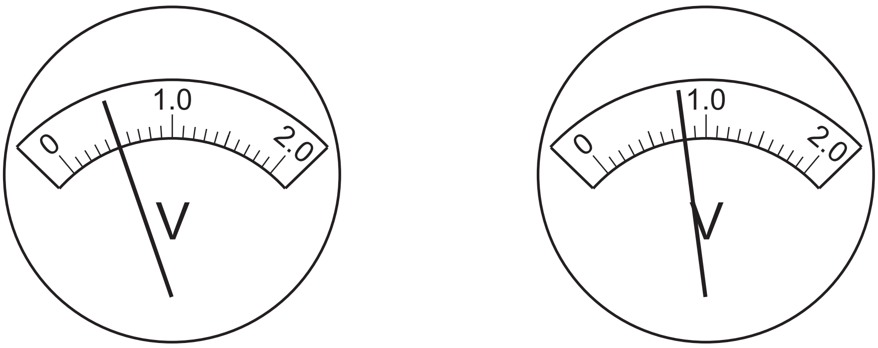
Fig. 3.1

Method

- She closes the switch.
- She places the sliding contact on the wire so that l = 10.0 cm.
- She reads the ammeter and voltmeter and records the values of current and voltage in Table 3.1.
- She opens the switch.
- She repeats the procedure for l = 25.0, 40.0, 70.0 and 85.0 cm of wire.

(a) Fig. 3.2 shows the dials of the voltmeter for the voltage across 25.0 cm and 40.0 cm of wire.

Read the dials and record the values, to the nearest 0.1 V, in Table 3.1. [2]



l = 25.0 cm l = 40.0 cm

Fig. 3.2

Table 3.1

length, l / cm	current / A	voltage / V	resistance / ohms
10.0	0.32	0.2	0.6
25.0	0.32		
40.0	0.32		
70.0	0.32	1.4	4.4
85.0	0.32	1.7	5.3

(b) Use the equation

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

to calculate, to the nearest 0.1 ohm, the resistances of 25.0 cm and 40.0 cm of wire. Record them in Table 3.1.

[2]

(c) **(i)** On the grid provided, plot a graph of resistance / ohms (vertical axis) against length / cm. Include the point (0,0) in your graph. Draw the best- fit straight line.

[3]

(ii) Use your graph to state the relationship between the length of wire and the resistance.

....

.... [1]

(d) The teacher tells the student that the values of resistance may not be reliable unless the current is switched off between readings.

Suggest a reason for this.

....

....

.... [1]

(e) The student wants to try the same experiment using a wire made of the same alloy but thicker.

Suggest how the results of this new experiment will differ from those in Table 3.1.

....

....

.... [1]

4 Some science students are designing and making three different Chinese lanterns, **A**, **B** and **C**. A Chinese lantern is shown in Fig. 4.1.

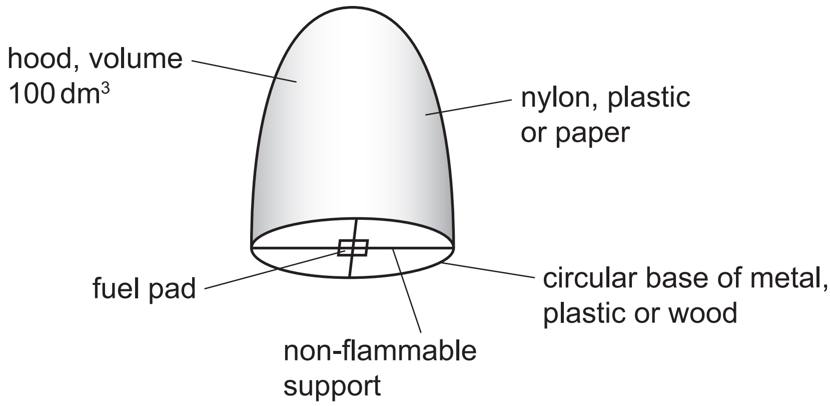


Fig. 4.1

Before the lanterns are made into the shape shown in Fig. 4.1, the materials are folded up and weighed on a balance.

The balance windows showing the masses of lanterns **B** and **C** are shown in Fig. 4.2.

total mass of materials for lantern **B**

total mass of materials for lantern **C**

Fig. 4.2

(a) Read the scales and record the masses of the materials for lanterns **B** and **C** in Table 4.1. [2]

Table 4.1

lantern	**A**	**B**	**C**
approximate volume / dm^3	100	100	100
materials	nylon hood, metal support, hydrocarbon fuel	plastic hood, plastic support hydrocarbon fuel	paper hood, wood support, hydrocarbon fuel
mass of materials / g	18.5		
time taken to begin to rise / s	46		

The lanterns are ready to launch. Student **X** holds the lantern in a vertical position. Student **Y** uses a flame to ignite the fuel. This is shown in Fig. 4.3.

After some time, the lantern begins to float and student **X** releases it.

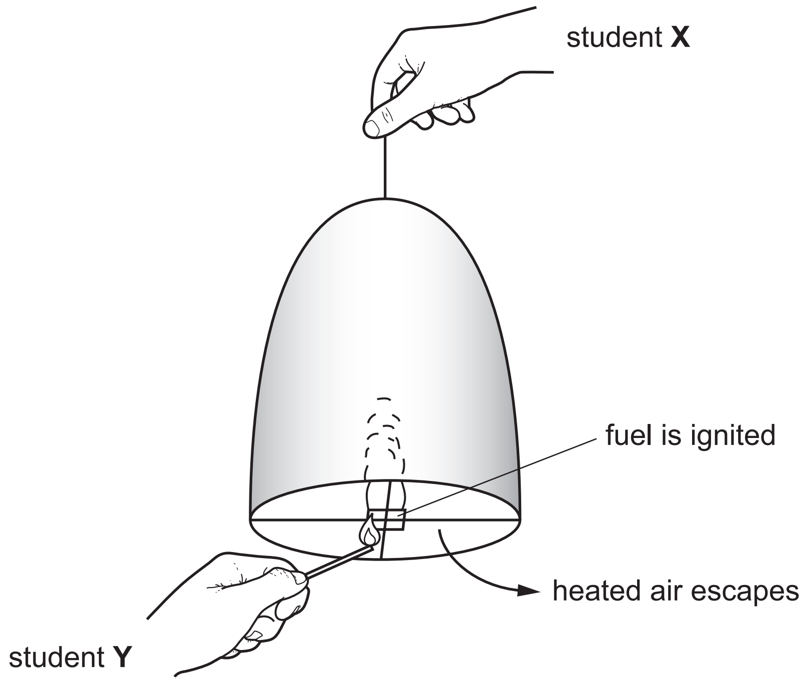


Fig. 4.3

When the fuel ignites, a timer is started. The timer is stopped when the lantern begins to rise into the air.

(b) Fig. 4.4 shows the timer dial when lanterns **B** and **C** begin to rise into the air.

Read the dials and record, in Table 4.1, the times taken by lanterns **B** and **C**. The dials measure in seconds. [2]

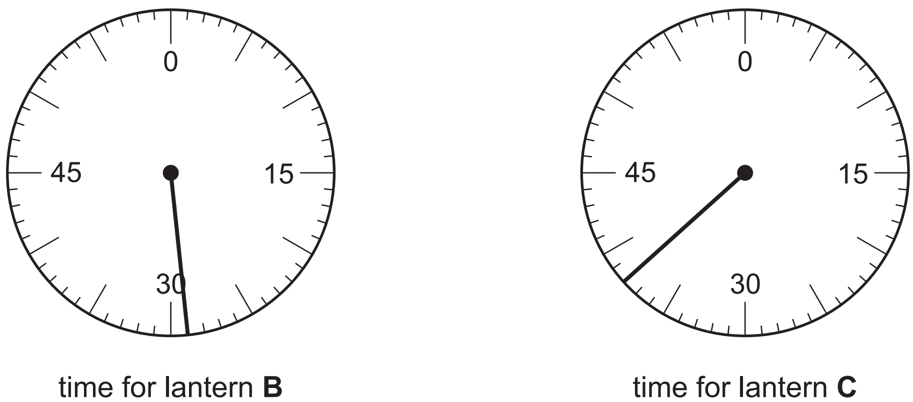


Fig. 4.4

When the air inside the lantern is heated by the burning fuel, it expands. Some of the air escapes so the mass of the air inside the lantern decreases.

When the decrease in the mass of air is equal to or greater than the mass of the materials of which the lantern is made, the lantern floats and begins to rise into the air.

When the students light the lanterns, the air temperature is 10 °C.

The teacher has drawn a graph, Fig. 4.5, to show how the mass of air in the lantern decreases as the temperature inside the lantern rises.

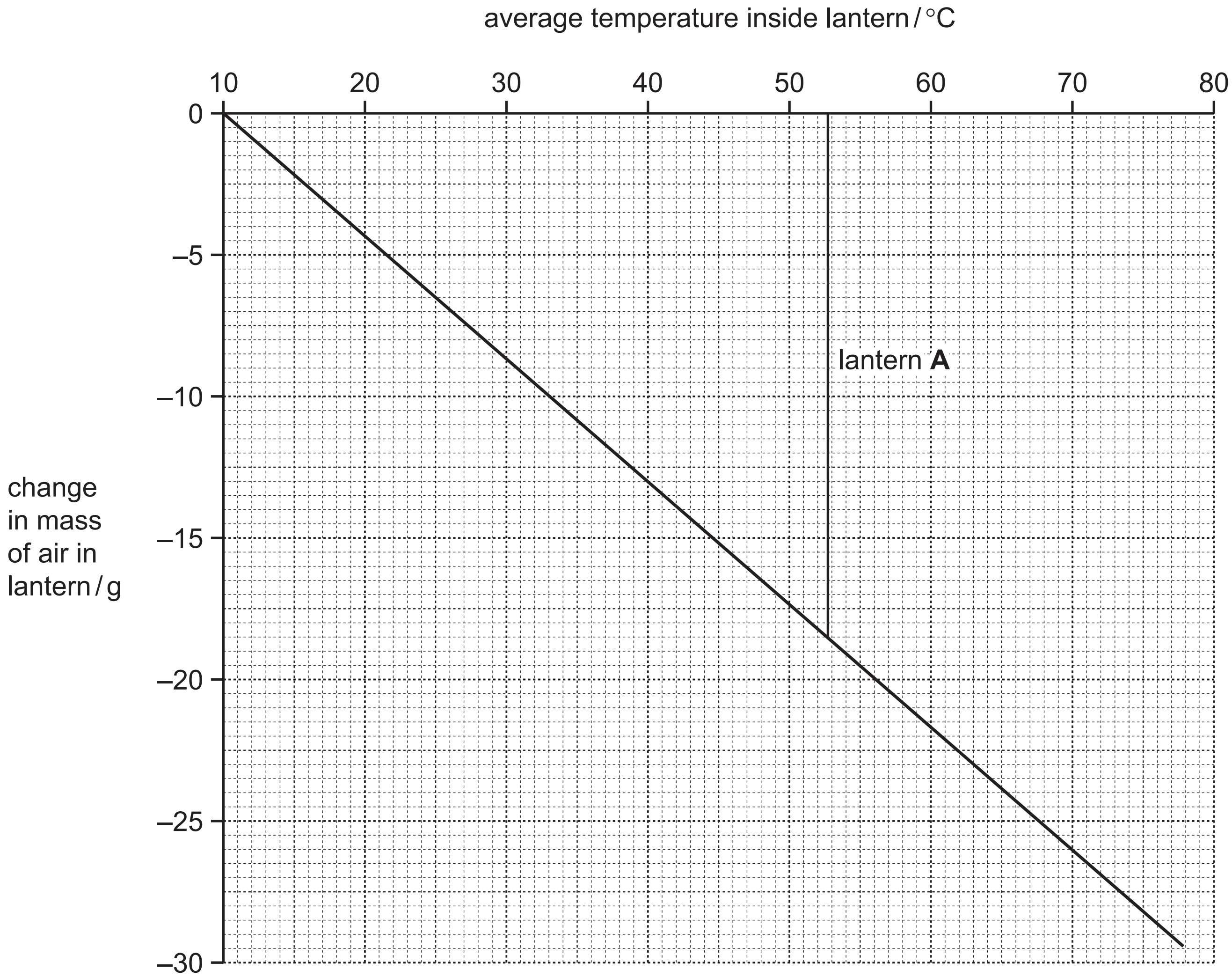


Fig. 4.5

(c) (i) Use the graph, and data from Table 4.1, to find the average temperatures inside lanterns **B** and **C** when they begin to float. Draw lines on the graph to show how you do this.

Record the temperatures in Table 4.2. The temperature for lantern **A** has already been done for you.

Table 4.2

lantern	**A**	**B**	**C**
temperature inside the lantern when it begins to rise / °C	52.5		

[2]

(ii) Suggest **one** other reason why the mass of the lantern decreases after the fuel has been ignited.

....

.... [1]

(d) The teacher asks the students to explain why the air inside the lantern expands when it is heated.

Use your knowledge of the kinetic theory to explain why the air expands. In your answer, refer to the way in which the molecules behave when they are heated.

....

....

.... [2]

(e) The teacher says that the design of one of the lanterns is more environmentally friendly than the others.

Using the information in Table 4.1, on page 15, suggest which design, **A**, **B** or **C**, is more suitable for releasing into the environment than the others. Give a reason for your answer.

....

.... [1]

5 A student is investigating the boiling and freezing points of a liquid.

Fig. 5.1 shows the apparatus he uses to find the boiling point.

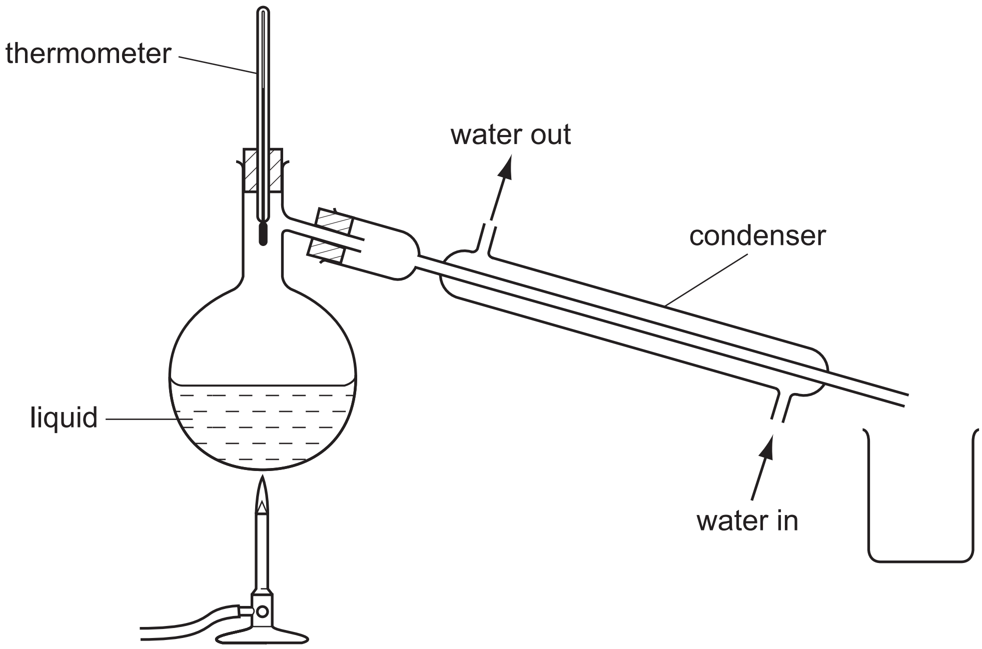


Fig. 5.1

(a) (i) He observes the liquid in the apparatus while he gently heats the flask with a Bunsen burner flame. The liquid and its vapour are colourless and transparent.

Suggest **one** observation that will tell the student when the reading on the thermometer shows the boiling point of the liquid.

....

.... [1]

(ii) Explain why the temperature does not rise above its boiling point even though the flask is still being heated. Use the words *thermal energy* in your answer.

....

....

.... [2]

(iii) Fig. 5.2 shows the thermometer scale at the point when the liquid boils.

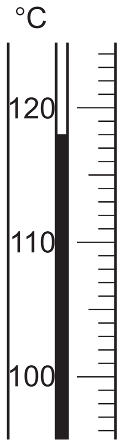


Fig. 5.2

Complete the sentence.

The boiling point of the liquid is .... °C [1]

(iv) Explain what happens to the molecules of vapour when they enter the condenser. Use the word *energy* in your answer.

....

.... [2]

Fig. 5.3 shows the apparatus the student uses to find the freezing point of the liquid.

He places some of the liquid in a large test-tube surrounded by ice. He measures the temperature of the liquid every 30 seconds and plots the graph shown in Fig. 5.4.

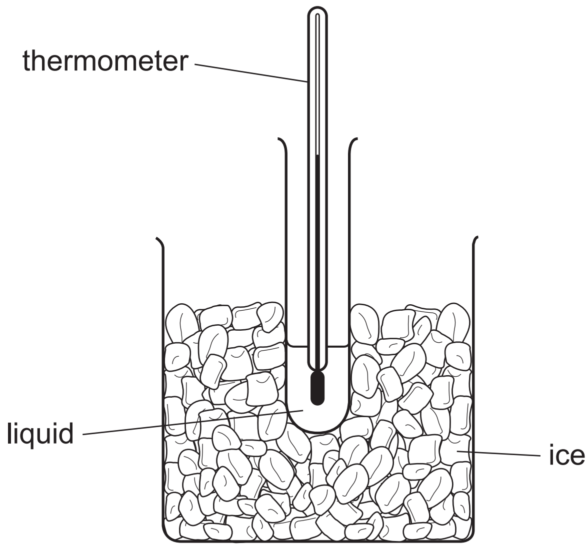


Fig. 5.3

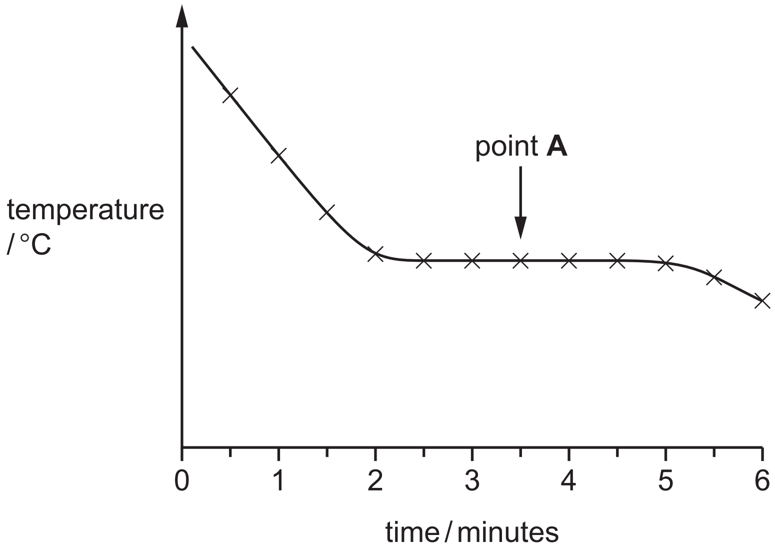


Fig. 5.4

(b) **(i)** The student also watches the liquid in the tube while it cools.

State what he observes in the test-tube when the liquid reaches the freezing point.

.... [1]

(ii) Fig. 5.5 shows the thermometer corresponding to point **A** on the graph. This is the temperature at which the liquid freezes.

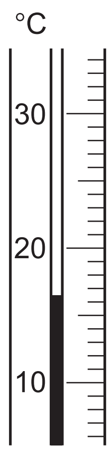


Fig. 5.5

Read the scale and record the temperature of point **A** to the nearest 0.5 °C.

freezing point of the liquid = ... °C [1]

(iii) Explain why the temperature stays constant at the temperature of point **A** on the graph for several minutes even though the contents of the test-tube have not yet cooled to 0 °C, the temperature of the ice.

Your answer must include a reference to the thermal energy of the molecules of the liquid.

....

....

.... [2]

6 The science teacher asks his students to find the height of the steep cliff shown in Fig. 6.1.

The students must find *t*, the time taken for a rock to fall from the top of the cliff to the bottom. They can use this value of *t* to calculate the height of the cliff.

Student **A** holds the rock, ready to drop it over the edge of the cliff. Student **B** has a timer which can measure to the nearest 0.1 s.

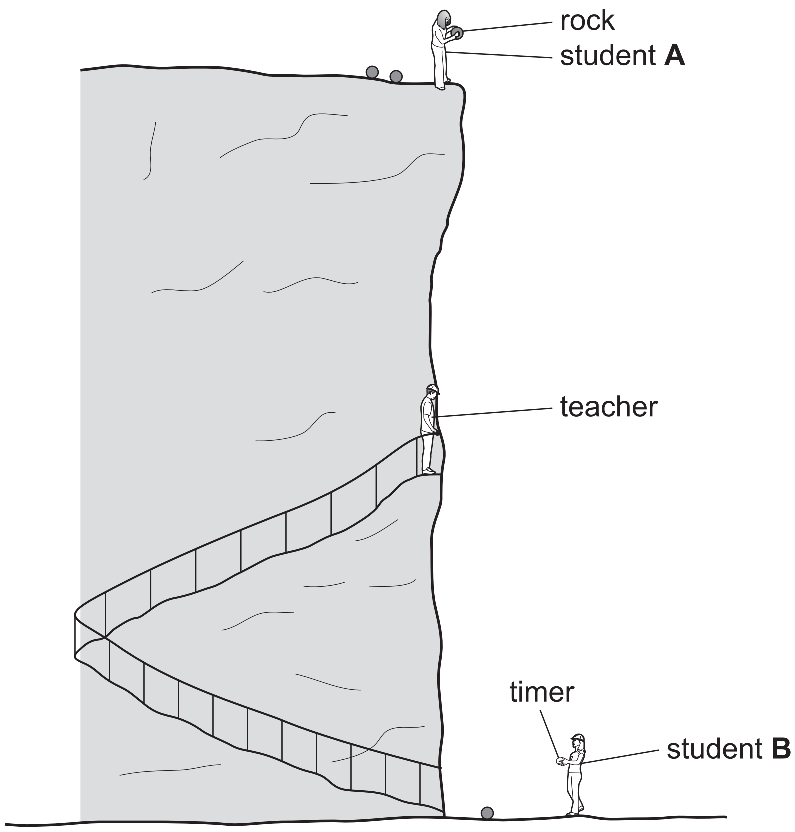


Fig. 6.1

Method

- Student **A** shouts to student **B**, calling "3, 2, 1, 0".
- When student **A** calls "0" he releases the rock.
- When student **B** hears the count of "0" he starts the timer.
- When the rock hits the ground student **B** stops the timer and records the timer reading in Table 6.1.
- They repeat the experiment three more times. Student **B** does not reset the timer to zero between repeats.

(a) Fig. 6.2 shows the readings on the timer when the rock hits the ground for experiments 3 and 4. Remember that student **B** does not reset the timer to zero between the experiments.

Fig. 6.2

Table 6.1

experiment number	1	2	3	4
timer reading when rock hits ground / s	3.2	6.5		
timer reading when rock is released / s	0	3.2		
t, time taken for the rock to fall / s	3.2	3.3		

(i) Use the timer readings shown in Fig. 6.2 to complete the first row of Table 6.1. [1]

(ii) Complete the second row of Table 6.1. [1]

(iii) Calculate the times taken for the rock to fall in experiments 3 and 4 and complete the third row of Table 6.1.

[2]

(b) **(i)** The students calculate the height of the cliff using *g*, the acceleration due to gravity, equal to 9.8 m/s^2 and the time *t* taken for the rock to fall.

Calculate *h*, the height of the cliff, using the value of *t* obtained in experiment 2.

Use the formula shown below.

$$h = ½ \times 9.8 \times t^2$$

h, the height of the cliff = ... m [2]

(ii) Explain why it might be better, when calculating *h*, to use an average of the four values of *t* instead of one of the values.

....

....

.... [2]

(c) The method used by the students gives a value of *h* that is less than the actual height of the cliff. The teacher tells them to do the experiment again, using a different method.

This time, the teacher shouts to the students from a ledge at equal distances from both students (See Fig. 6.1). The teacher counts down to zero, calling "3, 2, 1, 0."

Student **A** releases the rock and student **B** starts the timer when they hear the teacher call "0".

Student **B** stops the timer when the rock hits the ground, as before.

Explain why this method will give a more accurate value for *t*, the time for the rock to fall.

....

....

....

.... [2]

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