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0653/61

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 **21** printed pages and **3** blank pages.

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1 A student is investigating the relationship between yeast activity and temperature. Active yeast produces a gas which may appear as a foam.

- The student stirs a yeast and sugar suspension and immediately measures out 20 cm^3 into each of two large test-tubes.
- He places one test-tube into beaker **A** containing some water which he maintains at about 20°C .
- He places the other test-tube into beaker **B** containing some water which he maintains at about 40°C .

The apparatus is shown in Fig. 1.1.

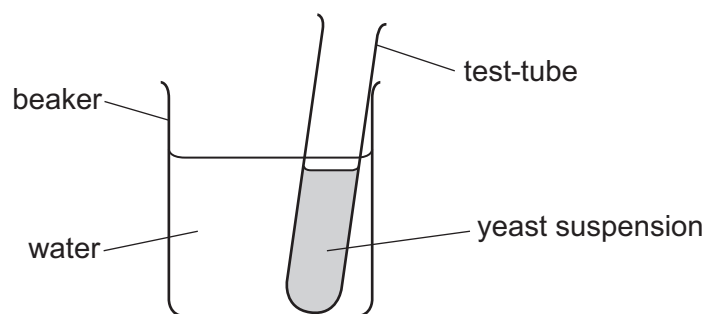


Fig. 1.1

- He measures the temperature of the water in each beaker.
- The temperature of beaker **A** is 19.0°C .

(a) The thermometer in Fig. 1.2 shows the temperature in beaker **B**.

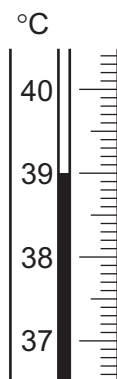


Fig. 1.2

Read and record this temperature.

beaker **B** = ... $^\circ\text{C}$ [1]

- He uses a ruler to measure the height h of the liquid (including any foam) in each test-tube at regular intervals. The arrangement is shown in Fig. 1.3.

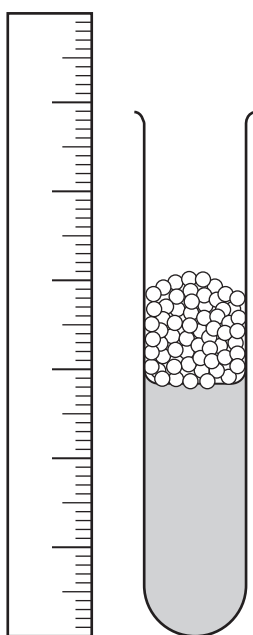


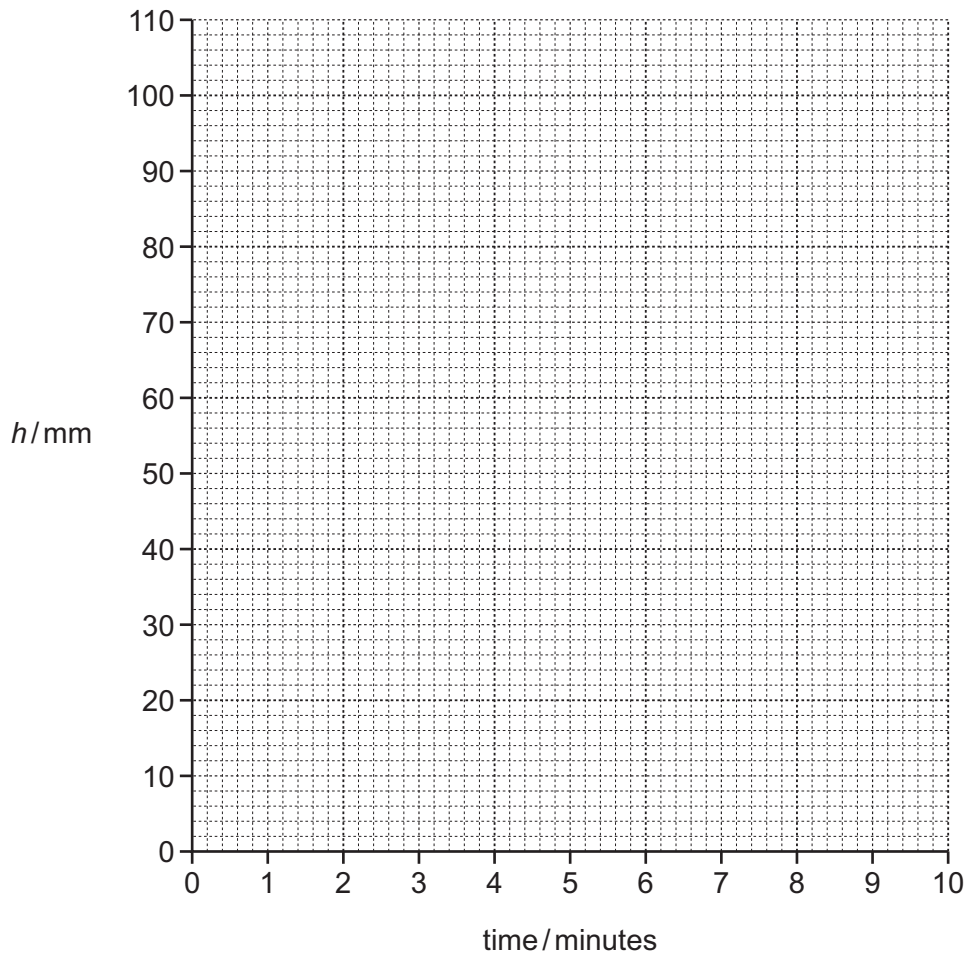
Fig. 1.3

- (b)** On Fig. 1.3, draw a labelled arrow to show the height h . Mark clearly the top and bottom of the measurement. [1]
- The student measures the height h in each test-tube at 2 minute intervals for ten minutes. During this time he maintains the temperatures of the beakers. He records his measurements in Table 1.1.

Table 1.1

time / mins	beaker A height h / mm	beaker B height h / mm
0	40	40
2	40	62
4	40	75
6	41	90
8	42	98
10	44	105

- (c) On the grid provided, plot graphs of height h for each beaker against time. Draw best-fit lines and label them **A** and **B**.



[4]

- (d) A teacher says that yeast activity stops when the temperature of the yeast is too high.

Plan and describe an investigation based on the experiment the student carried out to find out the minimum temperature at which yeast activity stops due to temperature being too high.

.....

.....

.....

.....

.....

.....

[4]

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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 25cm^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.

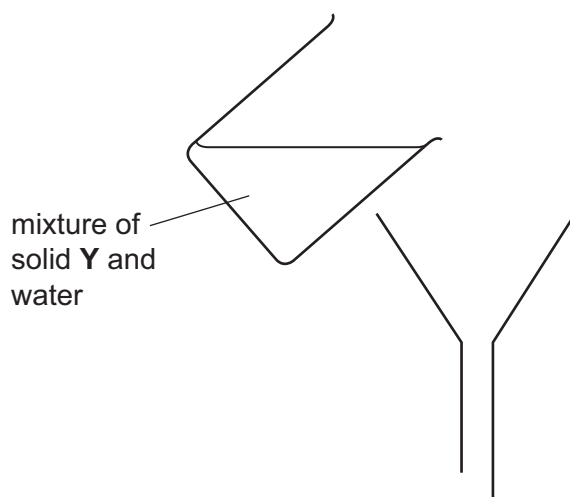


Fig. 2.1

[2]

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

Test 2

To about 2 cm³ of the filtrate from **Test 1** slowly add 20 cm³ 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, Zn²⁺.

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

Suggest what the student observes for **Test 3** if the filtrate does contain Zn²⁺ ions.

Test 3

To about 2 cm³ of the filtrate from **Test 1** slowly add 20 cm³ 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 cm³ 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.

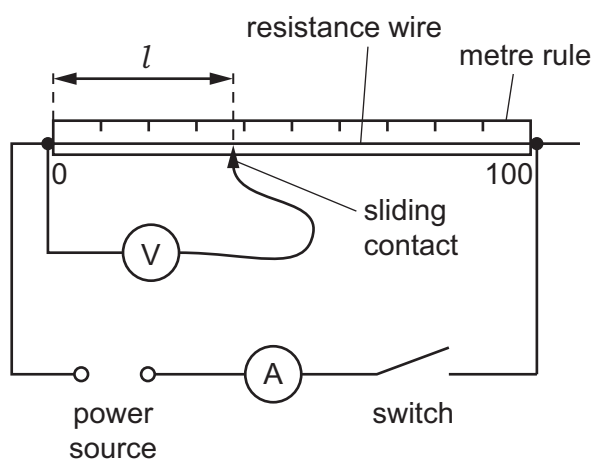


Fig. 3.1

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]

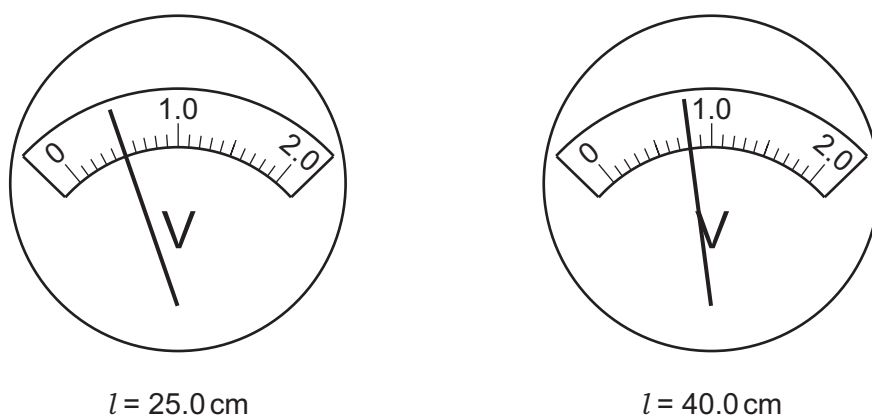


Fig. 3.2

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

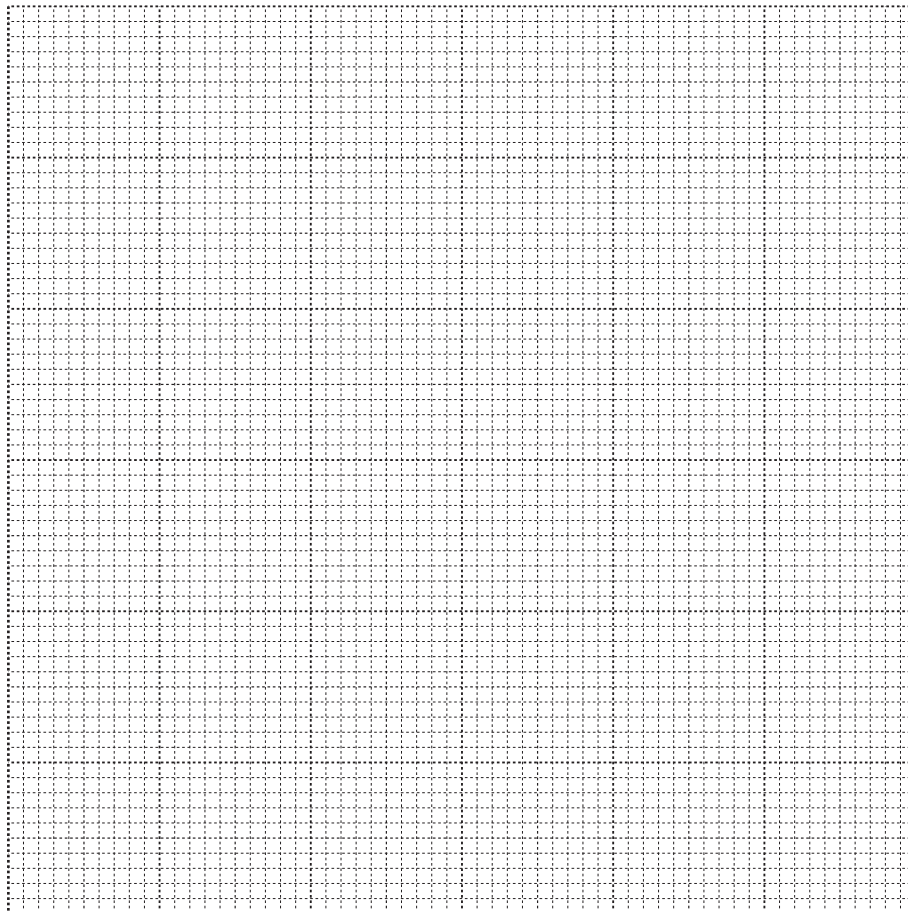
(b) Use the equation

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

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.



- (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 (a) A student wants to find out the largest volume of air that he can breathe out in one breath. This is called the *vital capacity*.

Describe how he could use the apparatus in Fig. 4.1 to do this.

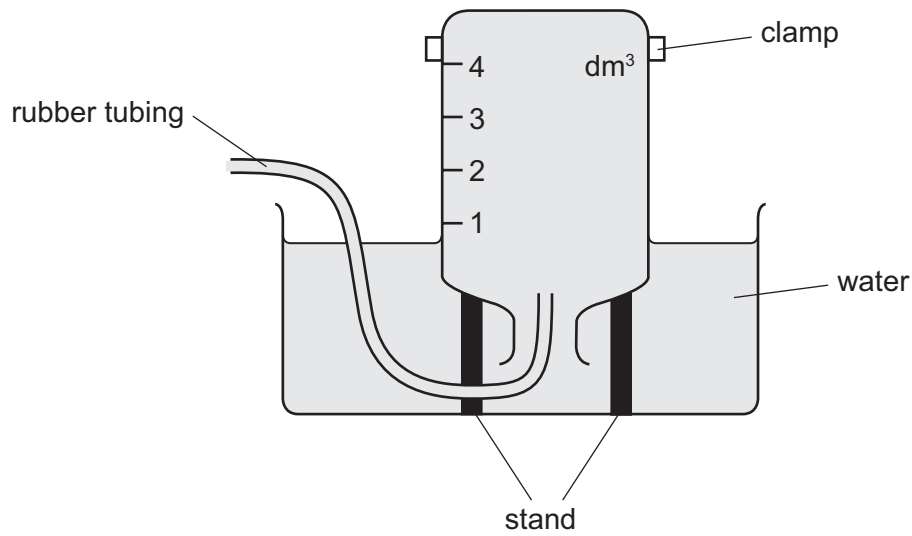


Fig. 4.1

.....

.....

.....

..... [3]

- (b) Suggest how he could check the reliability of his results.

.....

.....

..... [2]

- (c) (i) The teacher suggests that there is a relationship between a person's height and vital capacity. Plan an experiment to test this hypothesis.

.....

.....

.....

.....

.....

..... [2]

- (ii) Describe how you would present your results to show any relationship. You may wish to use this space to draw a suitable table.

.....

..... [1]

- (d) Another student has two gas jars. One jar contains exhaled air and the other jar contains inhaled air. She places a lighted candle inside each jar.

Suggest and explain the difference in results from the two samples of air.

.....

.....

..... [2]

- 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.

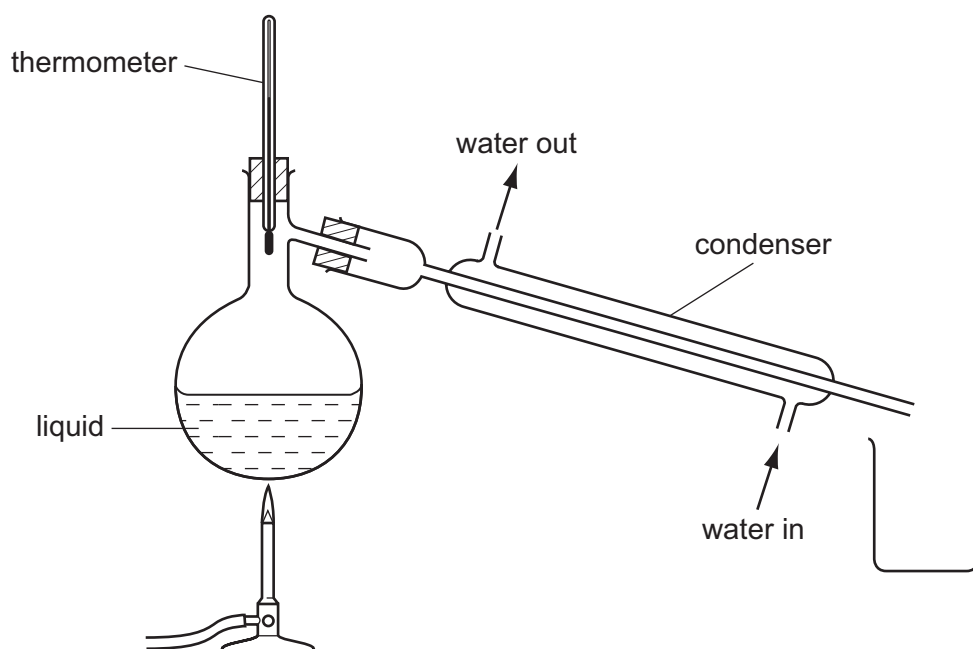


Fig. 5.1

- (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 of the liquid 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.

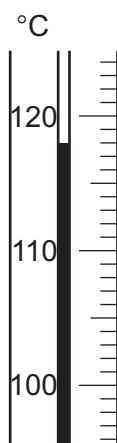


Fig. 5.2

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.

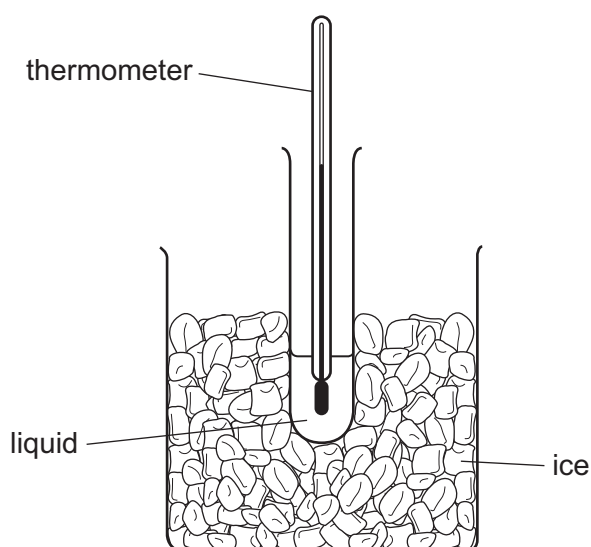


Fig. 5.3

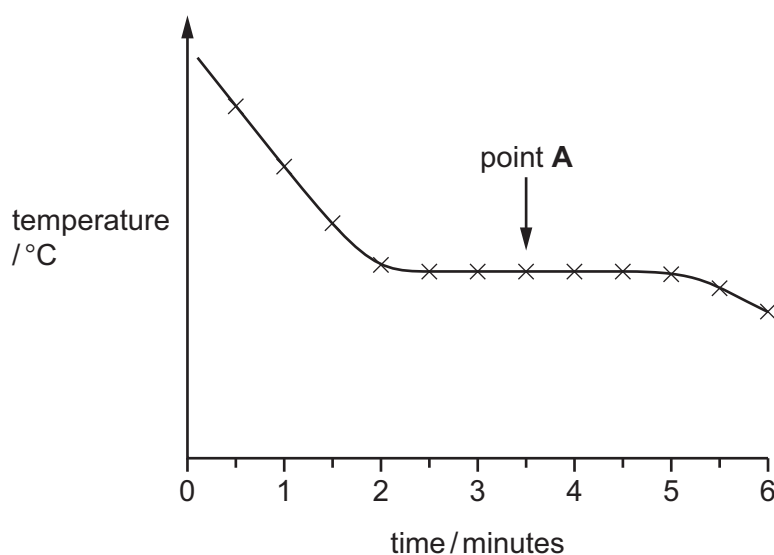


Fig. 5.4

- (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.

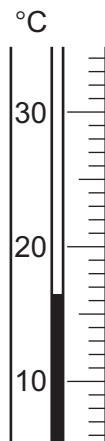


Fig. 5.5

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

freezing point of the liquid = ... $^{\circ}\text{C}$ [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.

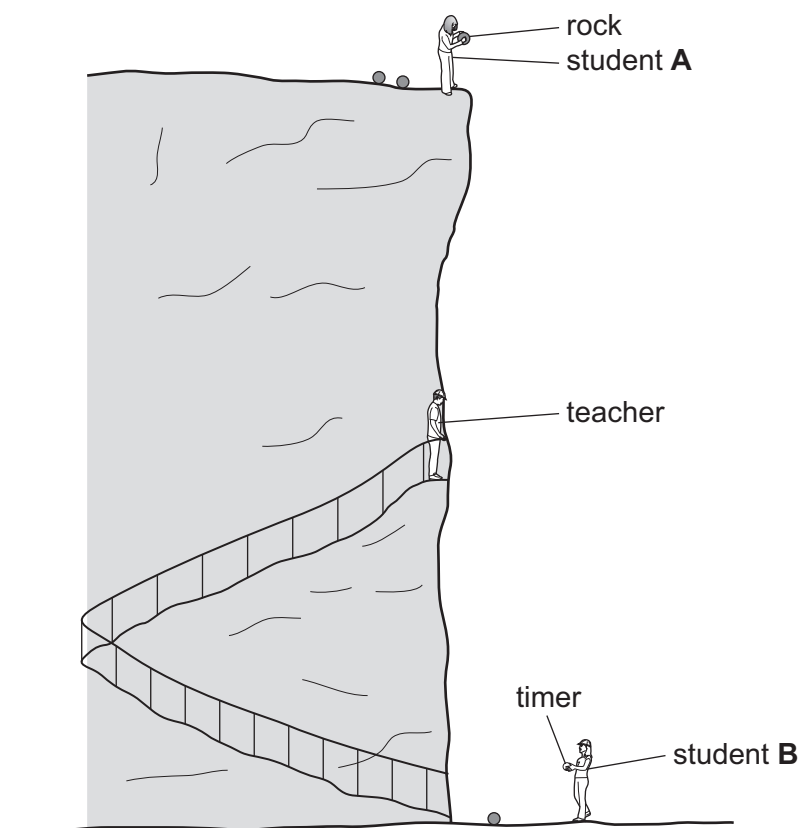


Fig. 6.1

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.

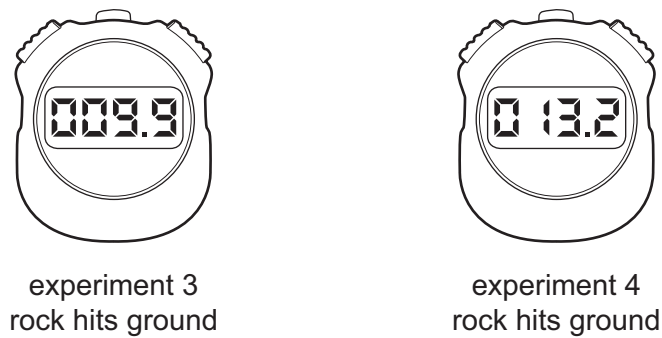


Fig. 6.2

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.

$$h = \frac{1}{2} \times 9.8 \times t^2$$

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.

.....

.....

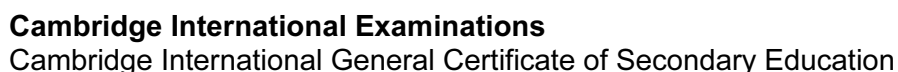
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..... [2]

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0653/62

October/November 2014

1 hour

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This document consists of **16** printed pages.

1 A student is investigating the action of the enzyme amylase on starch.

- He measures 10cm^3 starch suspension into each of tubes **A** and **B** and places them in a water bath at 30°C .
- He places tube **C**, which contains amylase solution, and tube **D**, which contains boiled amylase solution, into the water bath.
- He waits five minutes.
- During this time, he adds two drops of Reagent **X** to each of ten wells in a spotting tile as shown in Fig. 1.1

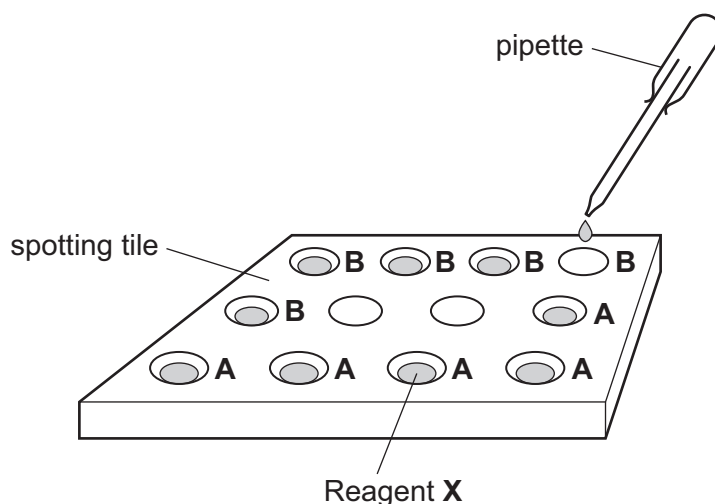


Fig. 1.1

- After 5 minutes he pours the contents of tube **C** into tube **A** and the contents of tube **D** into tube **B**.
- He then starts the stop-clock.
- Immediately, using a dropping pipette, he places 2 drops from tube **A** into one of the wells containing Reagent **X** in the spotting tile. He records in Table 1.1 the colour obtained.
- He repeats this with tube **B** into a different well containing Reagent **X**. He records in Table 1.1 the colour obtained.
- He repeats this procedure for tube **A** and tube **B** at 1 minute intervals for a further 4 minutes.

Table 1.1

time / minutes	colour of solution from tube A when added to Reagent X	colour of solution from tube B when added to Reagent X
0	<i>blue-black</i>	<i>blue-black</i>
1	<i>blue-black</i>	<i>blue-black</i>
2	<i>dark brown</i>	<i>blue-black</i>
3	<i>light brown</i>	<i>blue-black</i>
4	<i>light brown</i>	<i>blue-black</i>

(a) (i) Name Reagent **X**. [1]

(ii) By referring to the colours recorded in Table 1.1, state and explain what happens to the starch in tube **A** during the experiment.

.....

 [3]

(b) (i) Using the results in Table 1.1, state what can be concluded about the presence of starch in tube **B** at the end of the experiment.

..... [1]

(ii) Suggest an explanation for your conclusion in (b)(i).

.....
 [1]

(c) Suggest **one** source of error for this experiment.

.....
 [1]

(d) Suggest how you could change this method to investigate the effect of different temperatures on amylase activity.

.....

 [3]

2 A student is investigating the temperature changes when salts are dissolved in water.

- She measures 25 cm^3 distilled water into a beaker.
- She uses a thermometer to find the temperature of the water, recording it in Table 2.1.
- She adds 2 g powdered sodium chloride to the water and stirs the mixture.
- She finds the temperature after 30 s and records it in Table 2.1.
- She washes out the beaker.
- She repeats the experiment using powdered anhydrous copper(II) sulfate.
- She repeats the experiment using powdered ammonium chloride.

Table 2.1

name of salt used	sodium chloride	copper(II) sulfate	ammonium chloride
initial temperature / °C	21.9	22.0	21.7
temperature / °C after 30 s	20.8		
change in temperature / °C			

(a) Suggest a reason why the samples of the salts used in the experiment are powdered before being added to the water.

.....
 [1]

(b) (i) Fig. 2.1 shows the thermometer scales for the temperatures after 30 s for copper(II) sulfate and ammonium chloride.

Read the temperatures and record them in Table 2.1.

[2]

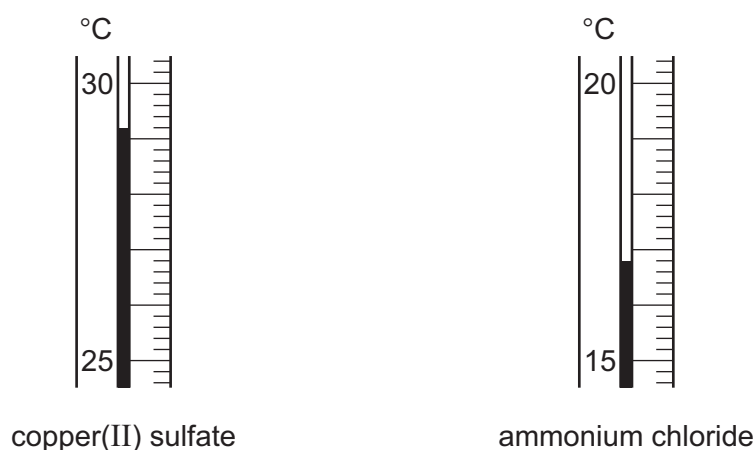


Fig. 2.1

- (ii) Calculate the change in temperature for each of the salts.

Record the changes in Table 2.1.

Place a + sign in front of a temperature rise and a – sign in front of a temperature fall. [2]

- (c) State the type of energy change observed for the dissolving of

copper(II) sulfate in water, ...

ammonium chloride in water. [2]

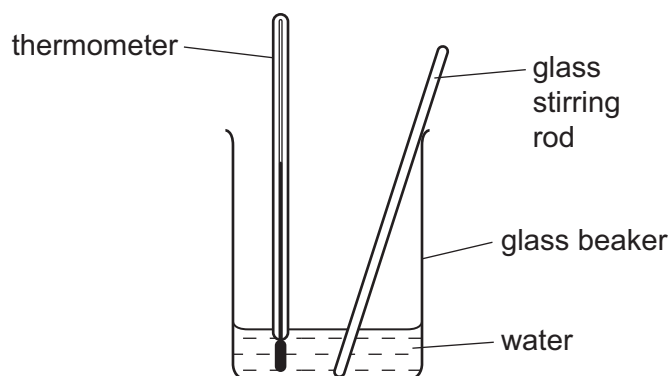


Fig. 2.2

- (d) The student uses a glass beaker and a glass stirring rod, shown in Fig. 2.2, when dissolving the salts. She thinks that the results of the experiment can be made more accurate by modifying the apparatus.

Suggest **one** way that she can get a more accurate result for the temperature changes during the experiment.

.....
 [1]

- (e) The teacher says that when a solid salt is dissolved in water, energy is required to pull the ions of the solid away from each other. When new bonds are formed between the ions and the water molecules to make a solution, energy is given out.

Use this information to suggest an explanation for the temperature change that took place when copper(II) sulfate was dissolved in water, according to your answer in part (c).

.....

 [2]

- 3 A student is carrying out an experiment to determine the density of a stone.

In **Part 1** of the experiment he finds out how the extension of a spring varies with the load.

In **Part 2** he finds the extension produced when the stone is hung on the spring in air and in water.

Part 1

- The student sets up the apparatus shown in Fig. 3.1 so that the pointer reads 0.0 cm when there is no mass attached to the spring.
- He hangs a 250 g mass on the spring and records the pointer reading.
- He replaces the 250 g mass by a 500 g mass and records the pointer reading.

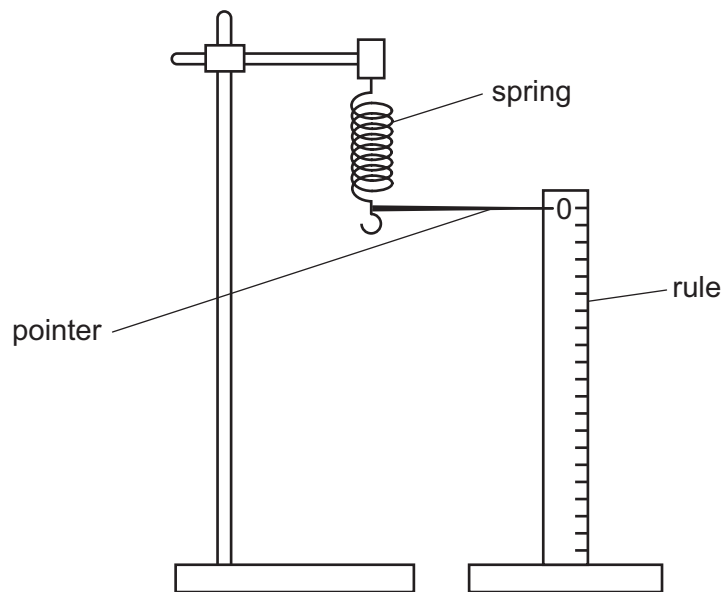


Fig. 3.1

Fig. 3.2 shows the pointer readings for the 250 g and 500 g masses.

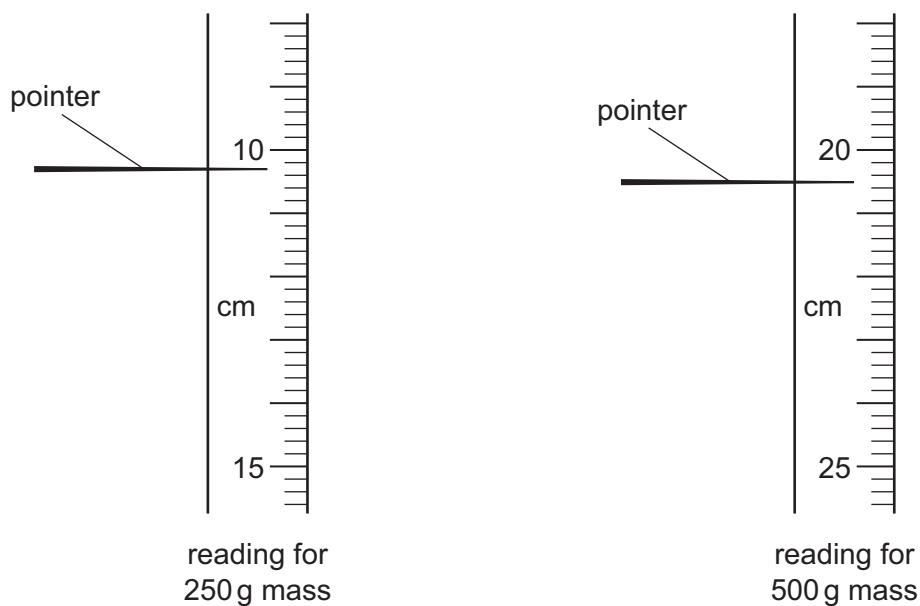


Fig. 3.2

Table 3.1

mass attached	position of pointer / cm
0	0.0
250 g	
500 g	

- (a) (i) Read to the nearest 0.1 cm the positions of the pointer in Fig. 3.2 for the 250 g and 500 g masses.

Record the readings in Table 3.1. [2]

- (ii) Use the results in Table 3.1 to state how the extension of the spring varies with the load.

..... [1]

Part 2

- The student attaches a piece of wire to the stone and hangs it on the spring.
- He reads E_A the position of the pointer and records it in Table 3.2.
- He immerses the stone in a beaker of water as in Fig. 3.3.
- He reads E_w the new position of the pointer and records it in Table 3.2.

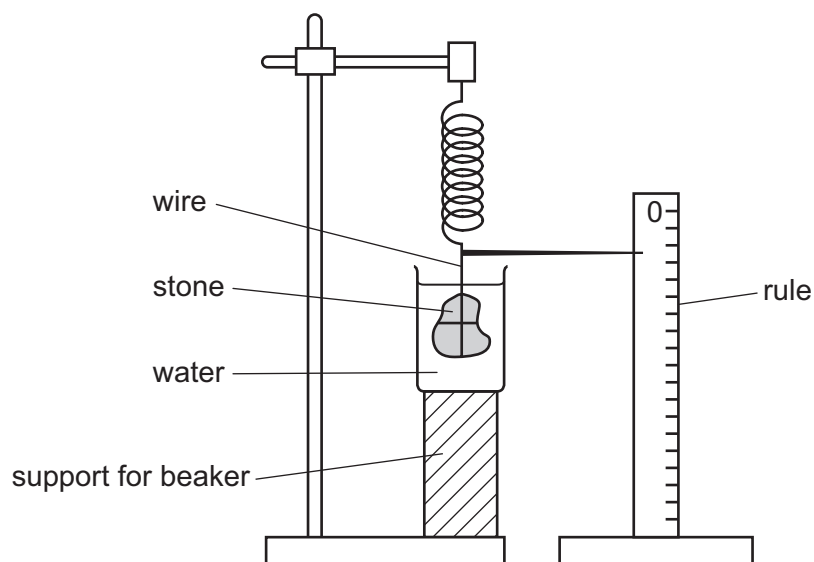


Fig. 3.3

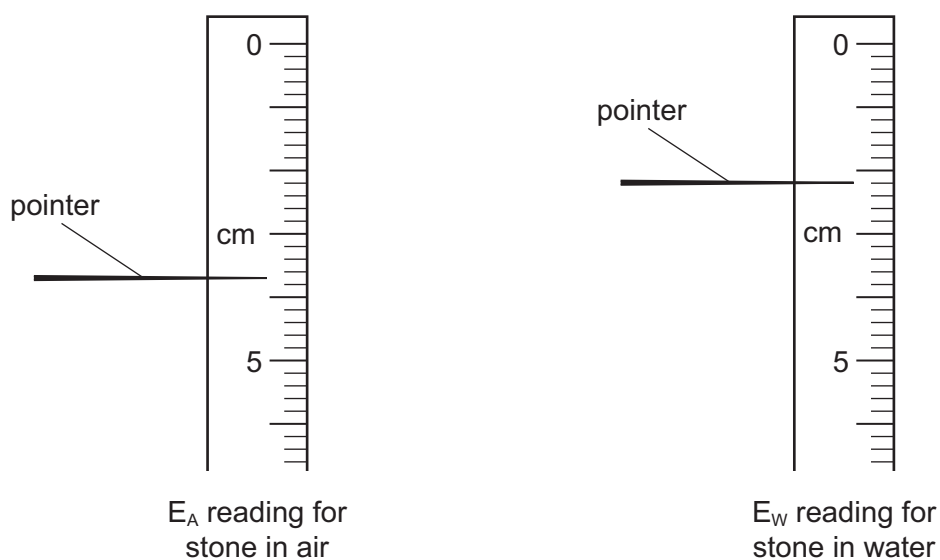


Fig. 3.4

Table 3.2

mass attached	position of pointer/cm
stone hanging in air	$E_A = \dots\dots\dots$
stone immersed in water	$E_W = \dots\dots\dots$

(b) Read to the nearest 0.1 cm the positions of the pointer in Fig. 3.4. Record the readings in Table 3.2. [2]

(c) (i) The teacher has given the student an equation for calculating the density of the stone.

Use the equation and data from Table 3.2, to calculate the density of the stone.

$$\text{density of the stone} = \frac{E_A}{(E_A - E_W)}$$

density of the stone = ... g/cm³ [1]

(ii) Compare the equation that you have used to calculate the density of the stone with the density equation $d = m/v$ to help you to complete this statement.

E_A is proportional to the of the stone. [1]

- (iii) Compare the equation that you have used to calculate the density of the stone with the density equation $d = m/v$ to help you to complete this statement.

$(E_A - E_W)$ is proportional to the of the stone. [1]

- (d) Suggest **two** reasons why the result may be slightly inaccurate when this method is used to find the density of the stone. Fig. 3.3 may help you.

.....
..... [2]

- 4 A student is investigating one of the characteristics of living things using insects.

She sets up the apparatus as shown in Fig. 4.1.

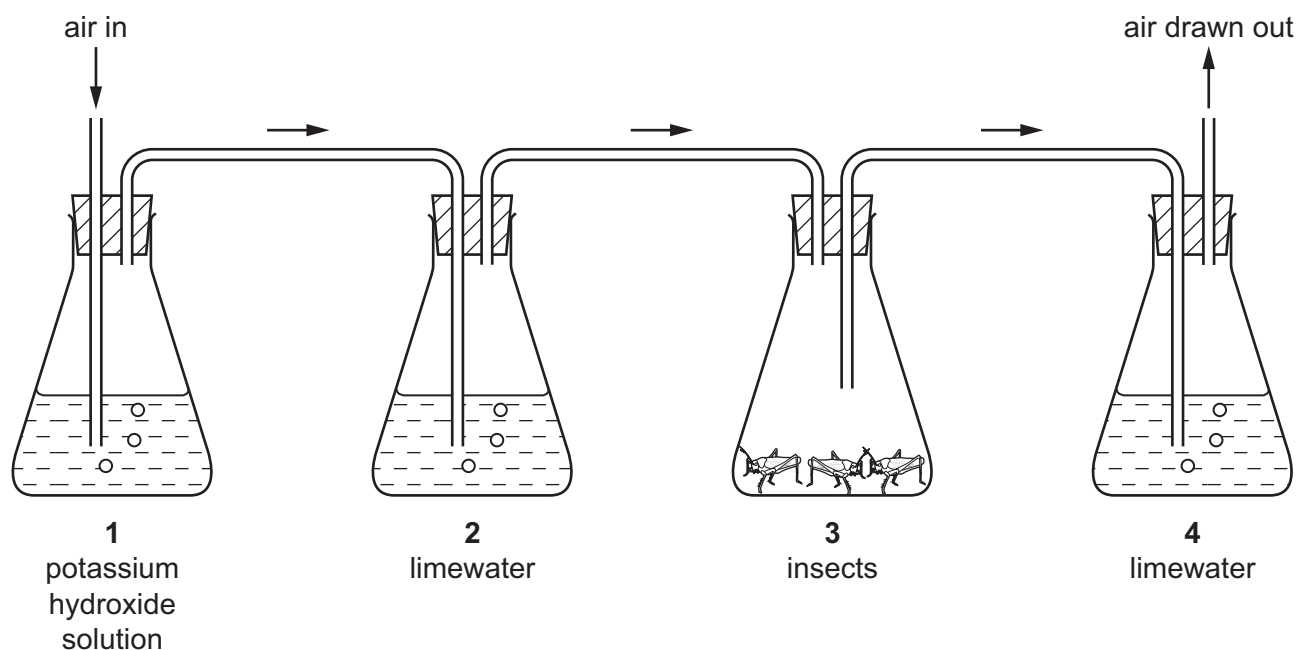


Fig. 4.1

Air is drawn through the apparatus from left to right as shown. The potassium hydroxide in flask 1 removes any carbon dioxide from the air.

- (i) State the purpose of the limewater in flask 2.

..... [1]

- (ii) Predict the appearance of the limewater in flask 2 after 10 minutes.

..... [1]

- (b) (i) State the purpose of the limewater in flask 4.

..... [1]

- (ii) Predict the appearance of the limewater in jar 4 after 10 minutes.

..... [1]

- (c) Suggest a control for this experiment.

..... [1]

- (d) (i)** State the appearance of the liquid in flask 4 at the end of the experiment if it had contained water and Universal (full range) Indicator rather than the limewater.

.....
..... [1]

- (ii)** Explain your answer to **(d)(i)**.

.....
.....
..... [3]

- (e)** Name the process inside living cells that is responsible for the changes that are observed in this experiment.

..... [1]

- 5** A science student has been given a Test Plan to identify five metals. The Test Plan is shown on page 13.

The metals are calcium, iron, silver, zinc and magnesium. The small pieces of the metals are all grey or silver colour. The metals are labelled **A**, **B**, **C**, **D** and **E**.

The student has written some of his observations and conclusions.

Study the Test Plan and answer the questions below. **Do not write anything on the Test Plan.**

- (a) (i)** Name the gas given off in Test **1**.

..... [1]

- (ii)** Explain how the student can test for the presence of this gas as it escapes from the test-tube and describe the positive result of this test.

.....
 [2]

- (b) (i)** Name the white precipitate seen in observation **2b**.

..... [1]

- (ii)** Suggest the name of the solution formed when metal **B** reacts with cold water.

..... [1]

- (c)** Name metal **A**. Use the observation in Test **3** to help you.

..... [1]

- (d) (i)** Observation **5a** tells the student that metal **C** is zinc.

Explain what he sees.

.....

 [2]

- (ii)** Write the formula of the green precipitate that is seen in observation **5b**.

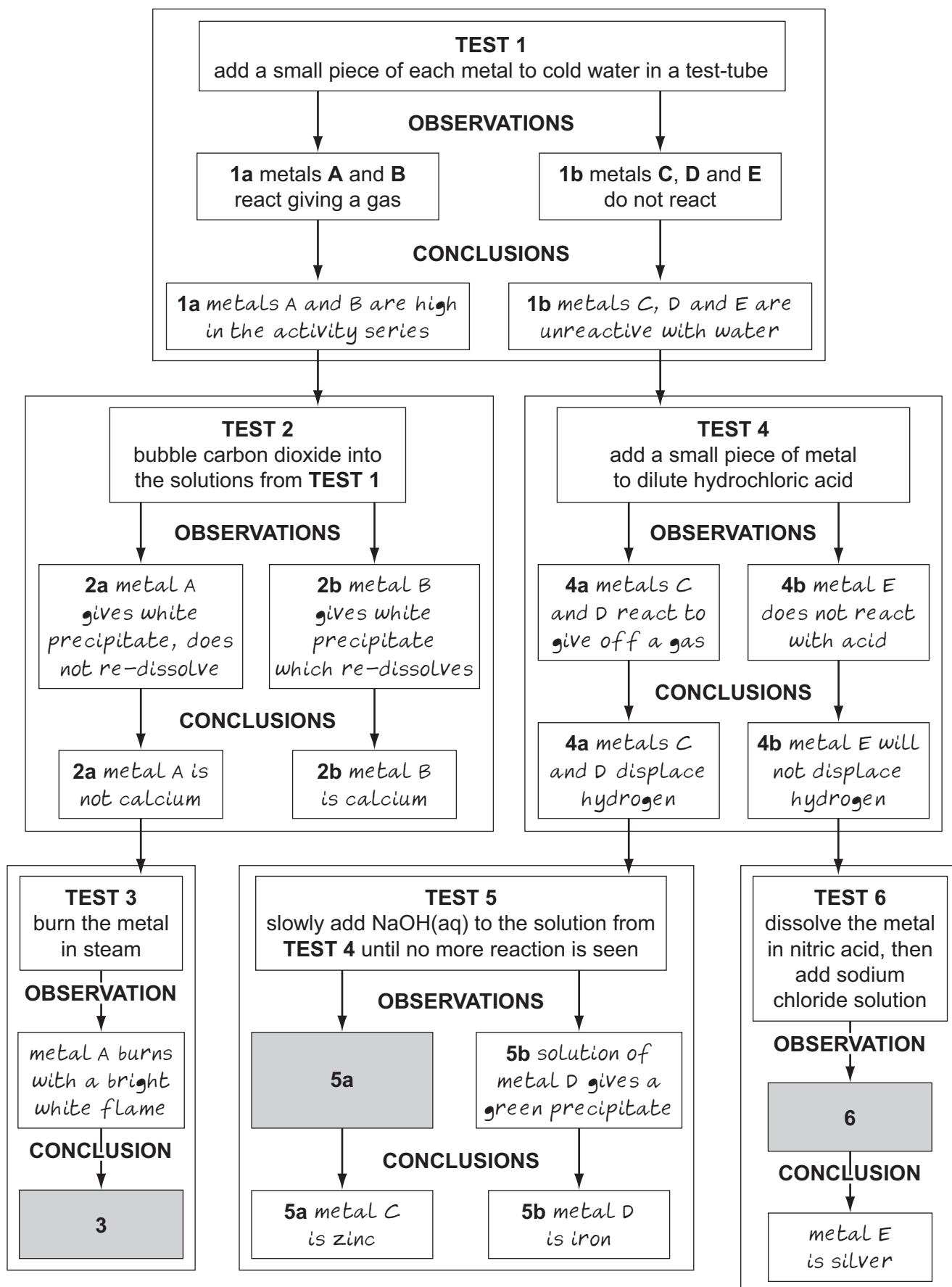
..... [1]

- (e)** Suggest what the student sees in Test **6** to tell him that metal **E** is silver.

..... [1]

TEST PLAN TO IDENTIFY FIVE METALS

Do not write anything on this page.



- 6 A student is testing the Law of Reflection which says that the angle of reflection is equal to the angle of incidence.

He is using a mirror made of polished stainless steel and a light source that creates a narrow beam. This is shown in Fig. 6.1.

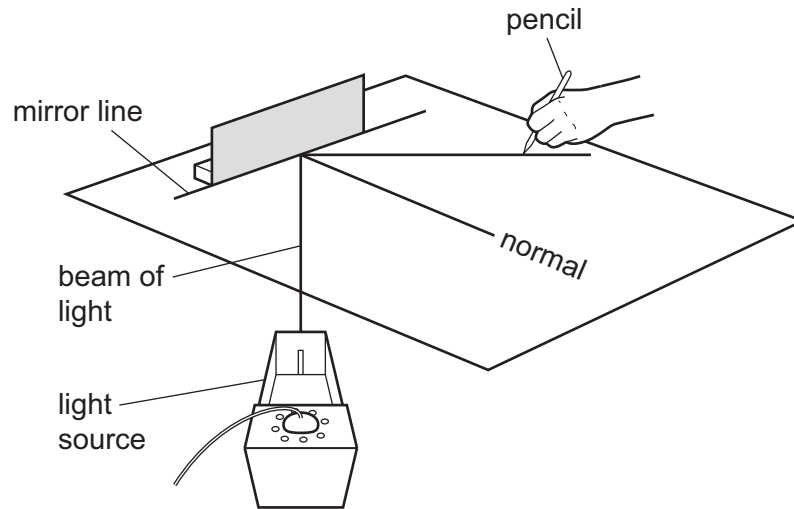


Fig. 6.1

Procedure

- The student draws a straight line on a piece of paper and labels it *mirror line*.
- He draws another line and labels it *normal*.
- He places the stainless steel mirror on the mirror line.
- He switches on the light source and arranges it so that its beam hits the mirror at the point where the normal meets the mirror line.
- Using a pencil, the student marks the incident and reflected beams of light.
- He removes the mirror and light source and then draws the incident and reflected rays. See Fig. 6.2.
- He measures two angles on the diagram.

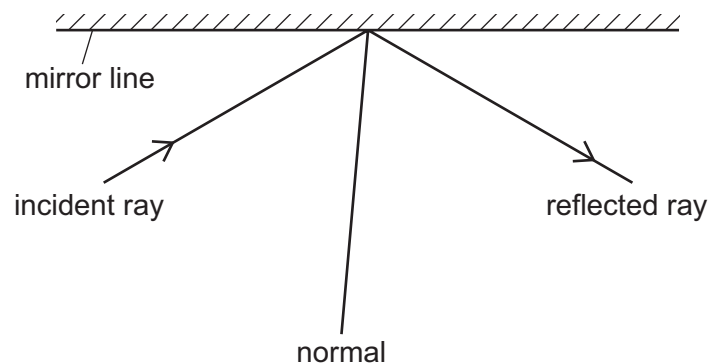


Fig. 6.2

(a) The student has measured two angles. He has written the following two statements.

A *"The angle between the incident ray and the mirror line is equal to the angle between the reflected ray and the mirror line."*

B *"This proves that the Law of Reflection is obeyed."*

(i) Use a protractor to measure the angle of incidence and the angle of reflection.

angle of incidence = ... degrees

angle of reflection = ... degrees [2]

(ii) Describe the student's mistake in drawing the diagram.

.....
 [1]

(iii) State and explain whether or not your measurements prove that the Law of reflection is obeyed.

.....
 [1]

(b) The student decides to test the same Law of Reflection using a mirror made from polished aluminium. He uses the same procedure as before, but he draws the normal line correctly.

Fig. 6.3 shows the result of this experiment. The student has used a pencil to mark the incident and reflected beams.

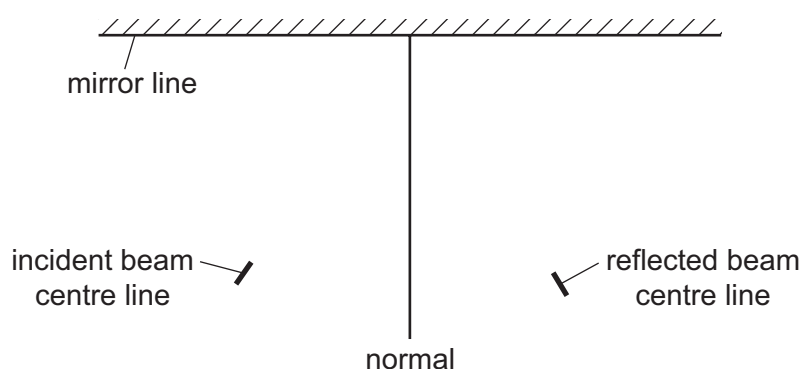


Fig. 6.3

(i) Complete Fig. 6.3 to show an incident ray and a reflected ray. [1]

(ii) Use a protractor to measure the angle of incidence and the angle of reflection.

angle of incidence = ... degrees

angle of reflection = ... degrees [2]

- (iii) The teacher tells the student that he has made mistakes in this experiment. As a result, the two angles are not equal.

Suggest a mistake that the student may have made when he

placed the mirror on the paper, ...

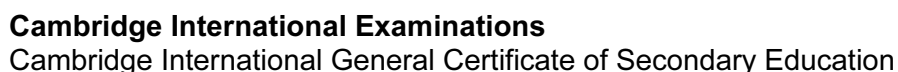
.....

drew the incident beam and reflected beam lines on the paper.

..... [2]

- (c) The experiments use a solid metal and a solid metal alloy as reflective surfaces. The student states that solid metals reflect light because of the free movement of particles within them.

Suggest the name of these particles. [1]



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* 5 9 1 7 1 2 7 1 3 0 *

0653/63

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.

- 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 cm³ 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 cm³ 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 cm³ 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

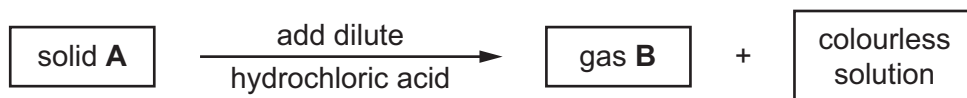


Fig. 2.1

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.

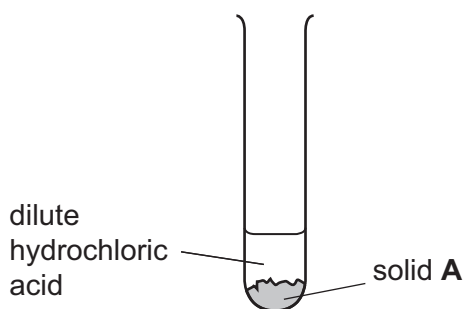


Fig. 2.2

- (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.

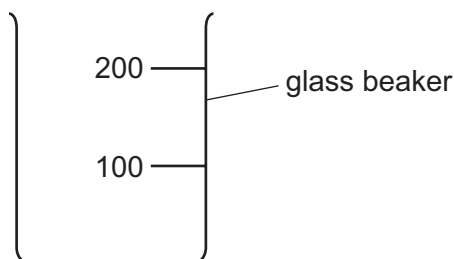


Fig. 3.1

- (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]

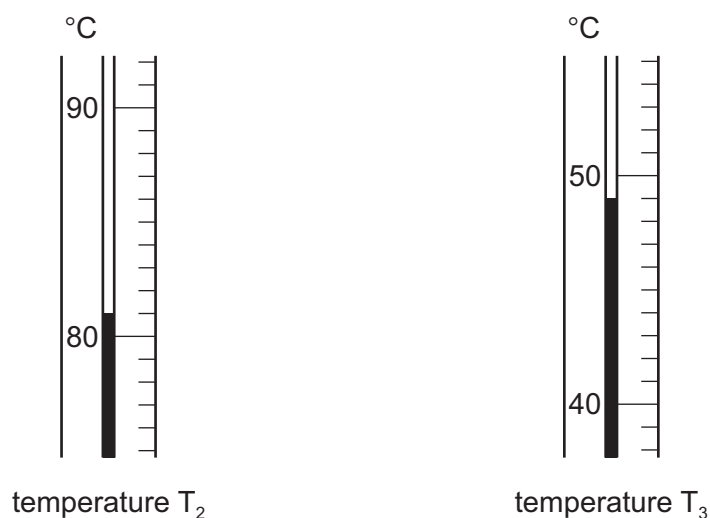


Fig. 3.2

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.

$$T_C = \dots\dots\dots^\circ\text{C} \quad [1]$$

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

$$T_H = \dots\dots\dots^\circ\text{C} \quad [1]$$

- (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

$$E_H = 420 \times T_H$$

$$E_H = \dots\dots\dots \text{ J} \quad [1]$$

- (ii) thermal energy change for the cold water

$$E_C = 420 \times T_C$$

$$E_C = \dots\dots\dots \text{ J} \quad [1]$$

- (iii) thermal energy change for the beaker

$$E_B = E_H - E_C$$

$$E_B = \dots\dots\dots \text{ J} \quad [1]$$

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

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

$$\text{s.h.c.} = \dots\dots\dots \text{ J/g/}^\circ\text{C} \quad [1]$$

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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.

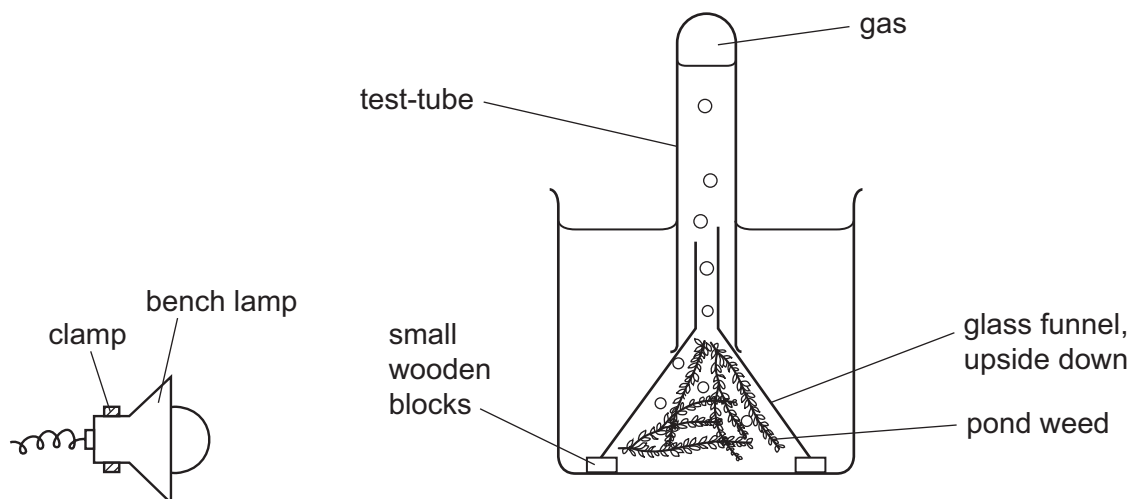


Fig. 4.1

- (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	
50	
40	
30	
20	

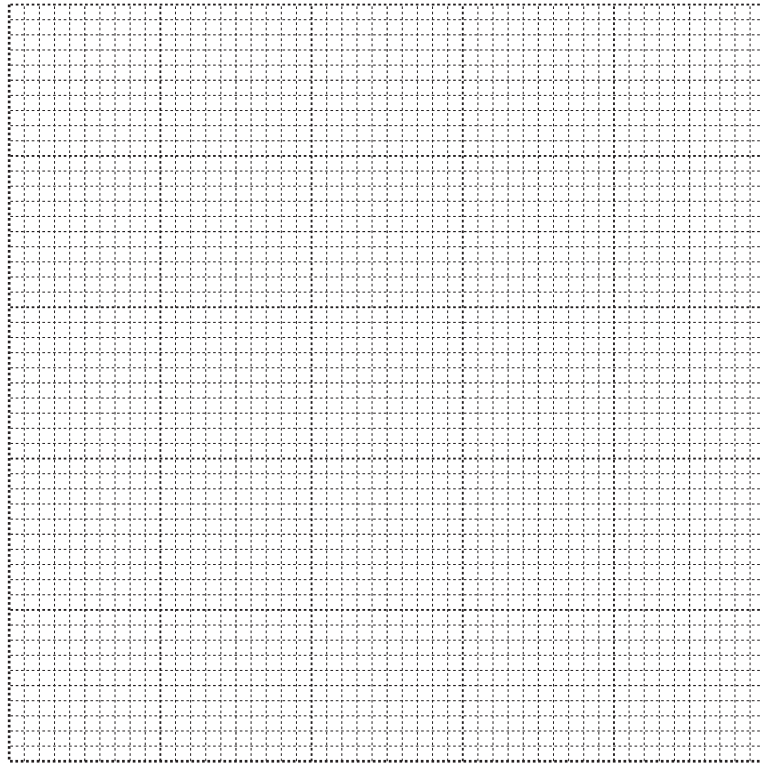
Fig. 4.2

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 $d = 60\text{ cm}$.

Show how you did this on your graph.

number of bubbles when $d = 60\text{ cm}$ [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]

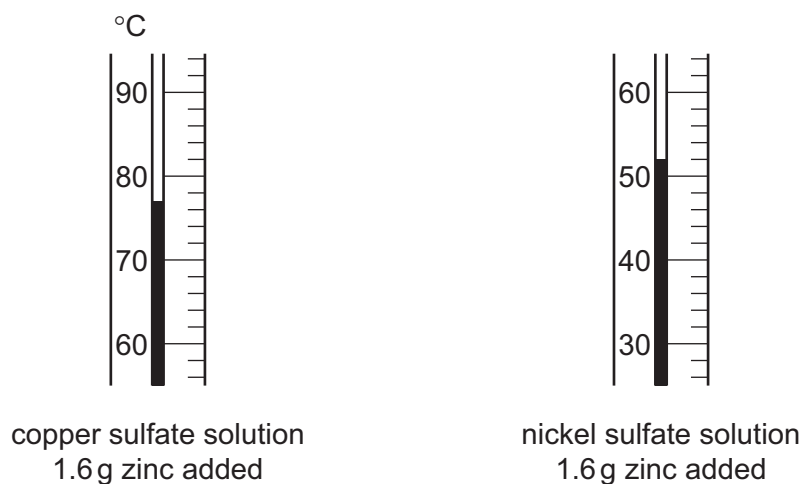
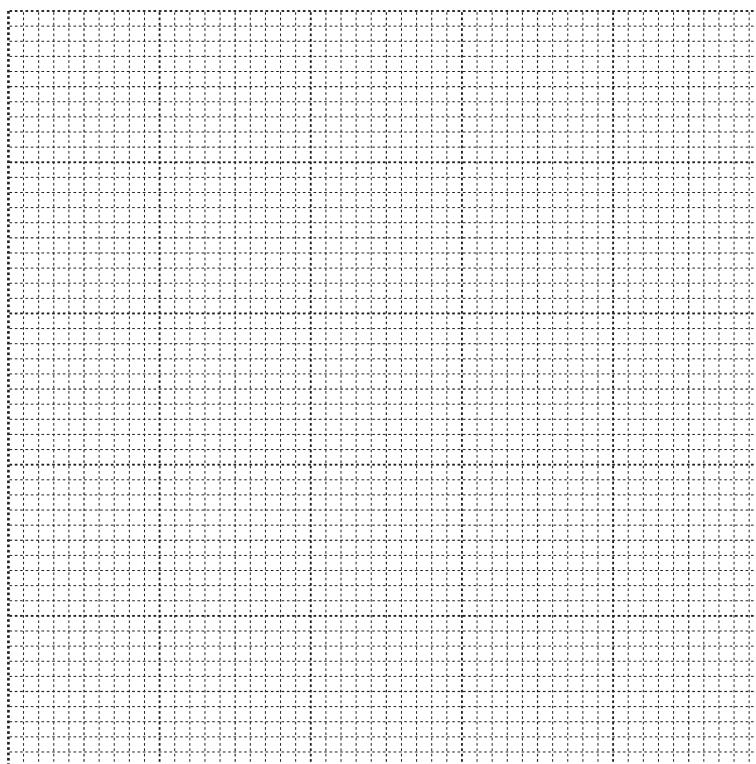


Fig. 5.1

- (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.

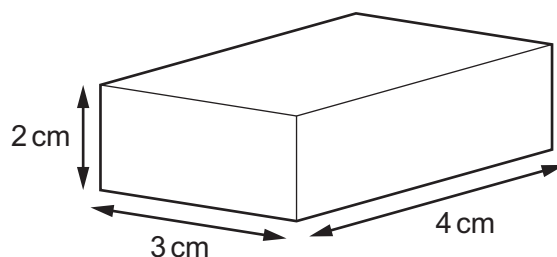


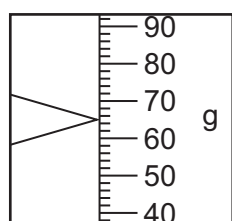
Fig. 6.1

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

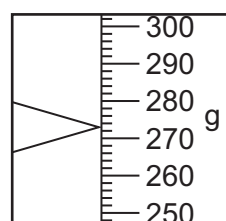
volume = ... cm³ [1]

- (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/cm³

density of lead = ... g/cm³ [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.

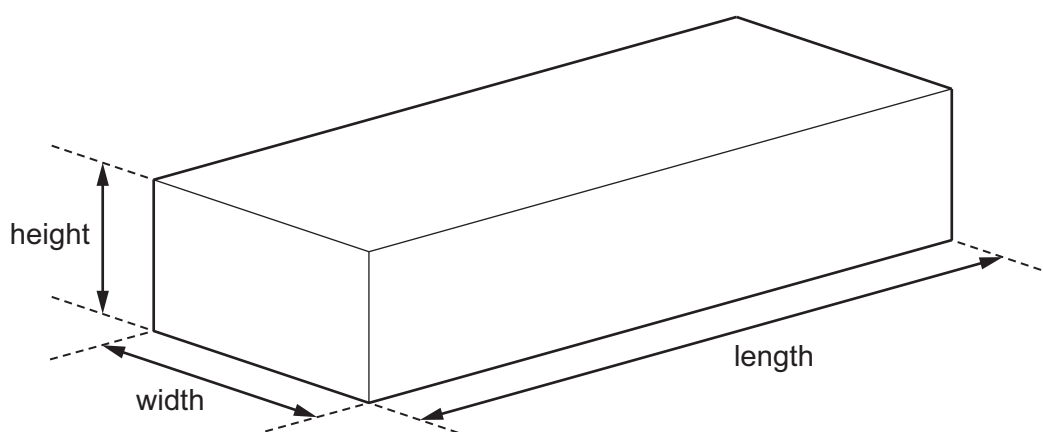


Fig. 6.3

- (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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