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0653/61

October/November 2015

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 **15** printed pages and **1** blank page.

- 1 A student investigates what happens when food is burned in air.

Part 1

Using forceps, the student places a piece of dry cobalt chloride paper into a large test-tube. Cobalt chloride paper changes colour from blue to pale pink in the presence of water.

- The paper remains blue in colour when placed into the test-tube.
- She then adds 10 cm^3 of limewater to a clean, dry test-tube and shakes it.
- The limewater remains colourless.

Part 2

The student places a piece of food on a mounted needle and ignites it. She collects any gases produced by holding an inverted test-tube about 2 cm above the flame produced as shown in Fig. 1.1.

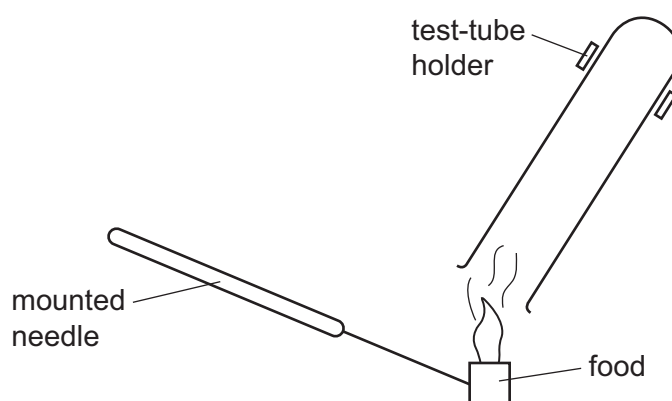


Fig. 1.1

When the sides of the test-tube mist up she places the piece of food into a beaker of water to extinguish the flames and places a stopper on the test-tube.

- (a) Using forceps she places a fresh piece of dry cobalt chloride paper into the test-tube and it turns pale pink.

Explain this observation.

..... [1]

- (b) She adds 10 cm^3 of limewater to the test-tube and shakes it. The limewater turns milky.

Explain this observation.

..... [1]

- (c) Explain the purpose of the experiment in **part 1**.

..... [1]

- (d) In **part 2** the student burns some food in air. Name the process inside living cells that this procedure models.

..... [1]

- (e) State **two** additional observations made by the student in **part 2** that show that energy is released in this experiment.

1

2

[2]

- (f) State **one** necessary precaution if the procedure in **part 2** is to be carried out safely.

..... [1]

- (g) A student carries out a similar procedure to measure the energy content of different foods by measuring the temperature increase of water. The apparatus used is shown in Fig. 1.2.

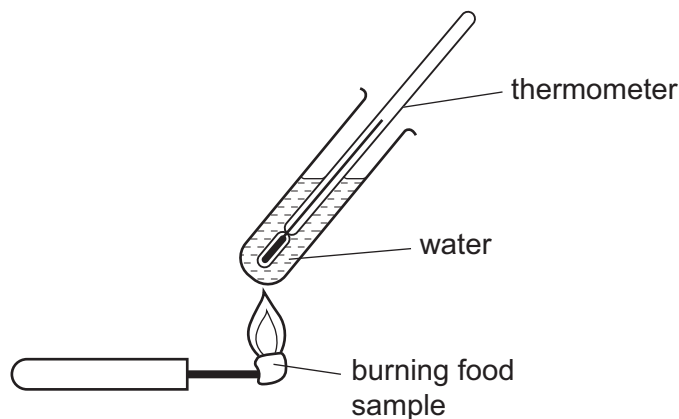


Fig. 1.2

- (i) State **two** ways in which the student could make sure that the procedure shown in Fig. 1.2 is a fair comparison of the energy content of the different foods.

.....

.....

..... [2]

- (ii) State why the procedure shown in Fig. 1.2 is not suitable for accurately measuring the total energy content of food.

.....

..... [1]

- 2 A student investigates how the speed of the reaction between potassium iodide and an oxidising agent is changed by the presence of various catalysts.

When potassium iodide solution reacts with the oxidising agent, iodine is formed. If a particular solution **A** is added, a blue-black colour is seen.

The student first carries out the reaction without a catalyst (experiment **1**) using the procedure below.

He repeats the reaction but adds 1 cm^3 of a solution containing Fe^{3+} ions before adding the oxidising agent (experiment **2**).

He then repeats the reaction twice more, adding Fe^{2+} ions (for experiment **3**) and X^{2+} ions of an unknown metal, **X** (for experiment **4**).

procedure

- Place 10 cm^3 of potassium iodide solution into a conical flask.
- Add 5 drops of the solution **A**.
- Add 1 cm^3 of metal ion solution (experiments **2**, **3** and **4** only).
- Add 10 cm^3 of the oxidising agent solution. Shake well and start the stopclock.
- When the mixture in the flask turns blue-black, stop the stopclock. Record this time in Table 2.1 to the nearest second.

Table 2.1

experiment	metal ion solution added	time taken for blue-black colour / s
1	none added	
2	Fe^{3+}	
3	Fe^{2+}	
4	X^{2+}	1

- (a) Name the solution **A** that produces the blue-black colour when iodine is formed.

..... [1]

- (b) (i) Name a piece of apparatus, other than a measuring cylinder, that can be used to measure accurately 10 cm^3 of potassium iodide solution and transfer it to the flask.

..... [1]

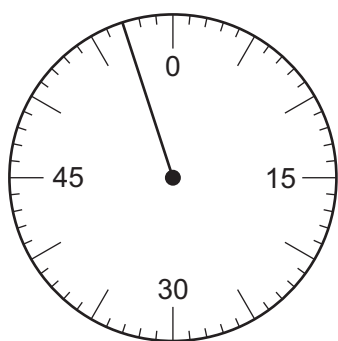
- (ii) Name a piece of apparatus, different to your answer in (b)(i), that can be used to place 5 drops of solution **A** into the flask.

..... [1]

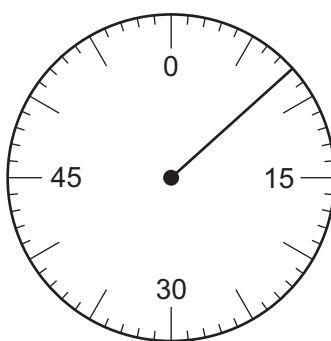
- (c) Fig. 2.1 shows the stopclock dials for the three times missing from the last column of Table 2.1.

Read the dials and record the readings in Table 2.1.

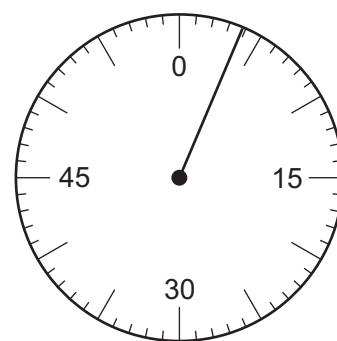
[3]



experiment 1



experiment 2



experiment 3

Fig. 2.1

- (d) Use the results in Table 2.1 to conclude which ion is the better catalyst, Fe^{3+} or Fe^{2+} . Explain your answer.

.....
, [1]

- (e) (i) The student adds ammonia solution to a portion of the solution of X^{2+} ions. He sees a light blue precipitate which dissolves to form a dark blue solution.

Name metal X. [1]

- (ii) Name the light blue precipitate that the student sees when ammonia is added to the solution of X^{2+} ions.

..... [1]

- (f) The teacher says that the experiments are not a fair comparison. Suggest **one** change to experiment 1 which would make the comparison fair.

.....

, [1]

- 3 A student has been given a plastic cup, shown in Fig. 3.1. He finds the volume of the cup in cm^3 using two different methods, **method 1** and **method 2**.

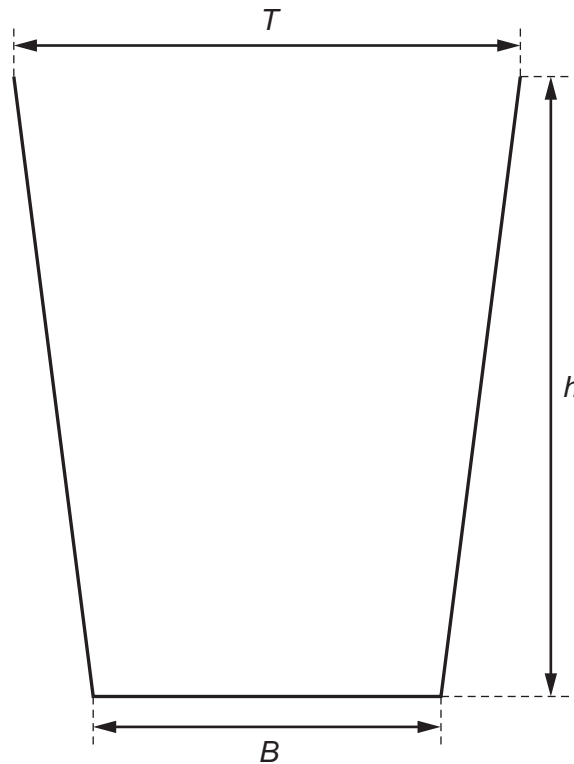


Fig. 3.1

method 1

Fig. 3.1 shows the actual size of the cup. Use a ruler to answer (a)(i), (ii) and (iii).

- (a) (i) Measure h , the vertical height of the cup, to the nearest 0.1 cm.

$h =$ cm [1]

- (ii) Measure B , the diameter of the bottom of the cup, to the nearest 0.1 cm.

$B =$ cm [1]

- (iii) Measure T , the diameter of the top of the cup, to the nearest 0.1 cm.

$T =$ cm [1]

- (iv) Calculate d , the average diameter of the cup, using your answers to (a)(ii) and (iii).

$d =$ cm [1]

- (v) Calculate V_1 , the volume of the cup, to the nearest cm^3 , using the equation

$$V_1 = \pi d^2 \frac{h}{4}$$

$$V_1 = \dots\dots\dots \text{cm}^3 \quad [1]$$

method 2

The student places 250 cm^3 of water into a measuring cylinder. He fills the plastic cup from the measuring cylinder.

Fig. 3.2 shows the amount of water left in the measuring cylinder.

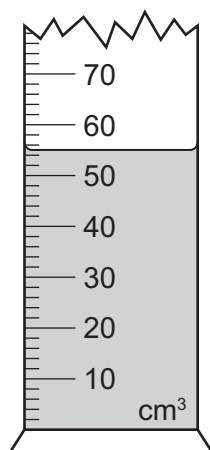


Fig. 3.2

- (b) (i) Read the scale to the nearest 1 cm^3 to find the volume of water left in the measuring cylinder.

$$\text{volume of water} = \dots\dots\dots \text{cm}^3 \quad [1]$$

- (ii) Find V_2 , the volume of water that was placed in the plastic cup.

$$V_2 = \dots\dots\dots \text{cm}^3 \quad [1]$$

- (c) The student thinks that **method 2** is less accurate than **method 1**.

Suggest **two** sources of inaccuracy in **method 2**.

1

.....

2

.....

[2]

- (d) Another student finds the mass in grams of the empty plastic cup. Then he finds its mass when it is full of water.

Explain how he can use these two masses to find the volume of water in the cup.

.....

.....

....., [1]

- 4 A student is given some seeds and asked to investigate the effect of light on the growth of seedlings.

(a) The seeds need to germinate before she can carry out the experiment.

State **two** conditions she needs to provide in order for the seeds to germinate.

- 1
- 2

[2]

She places the seeds in three petri dishes **A**, **B** and **C** and germinates them. After two days, she arranges the dishes as shown in Fig. 4.1.

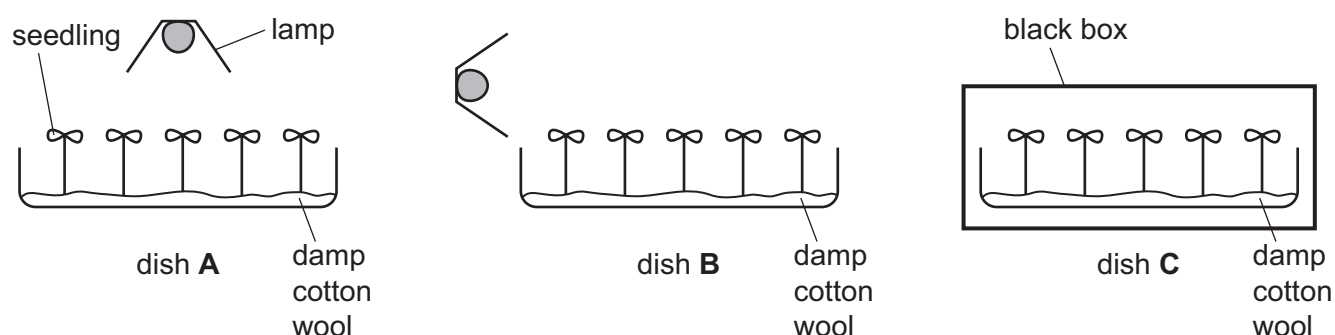


Fig. 4.1

She places dish **A** directly below a lamp, dish **B** to the right of a lamp and dish **C** in the dark.

She leaves the dishes for a further two days and then records the appearance of the seedlings in each dish.

(b) Predict the appearance of the seedlings by completing the diagrams for each dish on Fig. 4.2.

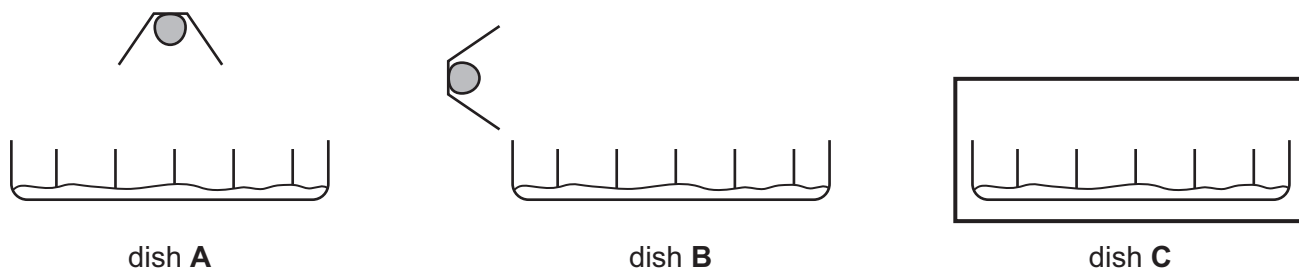


Fig. 4.2

[3]

(c) Name the type of response demonstrated by the seedlings.

..... [1]

(d) Describe how the student could test the seedlings for the presence of reducing sugar. State the observation for a positive result.

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

(e) Suggest **two** reasons why the student used more than one seed in each petri dish.

1
.....
2
....., [2]

- 5 A student carries out an investigation on carbon dioxide.

He dissolves carbon dioxide in water. Then he finds the concentration of the carbon dioxide solution by reacting it with limewater.

Fig. 5.1 shows the apparatus for making the carbon dioxide using marble chips and dilute hydrochloric acid.

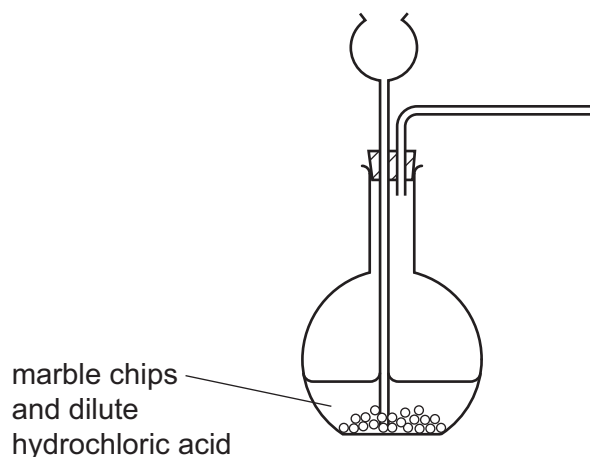


Fig. 5.1

- (a) Complete Fig. 5.1 to show how the carbon dioxide is dissolved in water. [1]

- (b) The student slowly adds limewater to 25 cm^3 of the carbon dioxide solution.

When enough limewater has been added, a precipitate forms in the mixture. He records the volume of limewater used at the point where the precipitate has just formed. He repeats the experiment another two times.

- (i) Suggest the best way for the student to detect the precipitate as soon as it begins to form.

.....
, [1]

- (ii) Fig. 5.2 shows the measuring instruments used to add limewater to the carbon dioxide solution in each of the three experiments. Each instrument is shown after the limewater has been added.

The measuring instruments are filled with limewater to the zero point of the scale and the limewater slowly released from a tap at the bottom of the instrument. The level of limewater in each tube shows how much has been used.

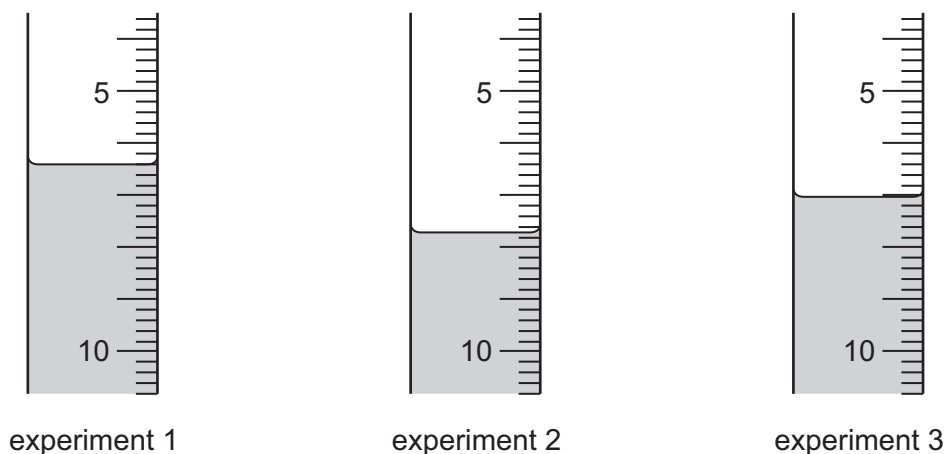


Fig. 5.2

Read the scales and record in Table 5.1 the volume of limewater used to the nearest 0.1 cm^3 .

Table 5.1

experiment	1	2	3
volume of limewater used / cm^3			

[3]

- (iii) Find the average volume of limewater used.

average volume = ... cm^3 [1]

- (c) Calculate the concentration of the carbon dioxide solution. Use the formula shown below.

$$\text{concentration of carbon dioxide solution} = \frac{\text{average volume of limewater} \times 0.015 \text{ mol / dm}^3}{\text{volume of carbon dioxide solution}}$$

concentration of carbon dioxide solution = ... mol / dm³ [2]

- (d) A solution of carbon dioxide in water is slightly acidic.

Limewater is alkaline.

An indicator may be used in this experiment instead of looking for the precipitate.

Suggest a suitable indicator to add to the carbon dioxide solution. State the colour change when enough limewater has been added to react with all of the carbon dioxide solution.

indicator

colour change to [2]

- 6 Two students investigate the speed of a trolley running down a smooth slope. The trolley has a mass of 1 kg. The angle of the smooth slope can be adjusted by raising one end. The arrangement of apparatus is shown in Fig. 6.1.

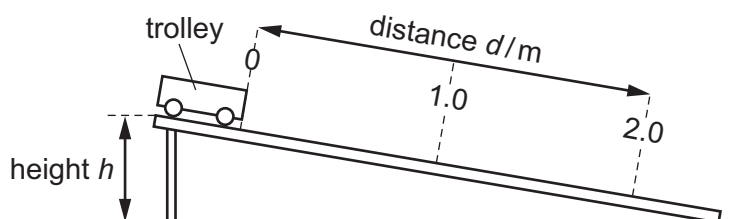


Fig. 6.1

method

- the height h is initially set at 2 cm.
 - The trolley is placed at the top end of the slope as shown in Fig. 6.1.
 - The trolley is released and a timer is started.
 - When the trolley passes the 1 m mark, the time t_1 is noted and recorded in Table 6.1.
 - When the trolley reaches the 2 m mark, the time t_2 is noted and recorded in Table 6.1.
 - The experiment is repeated using different heights of 4 cm and 5 cm.
- (a) Explain the best way for the students to work together to obtain the data recorded in Table 6.1 for each experiment.

.....
, [1]

- (b) The timer displays for the missing values of t_1 and t_2 are shown in Fig. 6.2. Read the displays and record the times in the correct places in Table 6.1.

You will have to decide which reading goes in which column. [1]



Fig. 6.2

Table 6.1

height h / cm	time t_1 / s for 1 m	time t_2 / s for 2 m
2	3.5	4.9
4		
5	2.0	3.1

- (c) (i) Use data for $h = 2$ cm from Table 6.1, to show that the trolley accelerates as it runs down the slope. Show your working.

[2]

- (ii) Use data from Table 6.1 to show that the trolley reaches a greater speed over 2 m when the height of the slope is greater. Show your working.

[2]

- (d) The students repeat the experiments using a trolley of mass 2 kg. Predict how the results of this set of experiments will compare with the results in Table 6.1. Justify your answer.

.....

, [2]

- (e) One of the students suggests that the height h is increased to 30 cm. Suggest why the results may be inaccurate for this experiment.

.....
, [1]

- (f) State the energy transformation that occurs as the trolley runs down the slope.

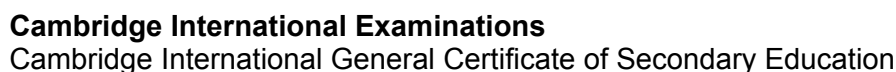
.....
, [1]

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COMBINED SCIENCE

0653/62

Paper 6 Alternative to Practical

October/November 2015

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 **19** printed pages and **1** blank page.

1 A student carries out some tests to determine the food groups present in rice and milk.

(a) (i) Complete the second row of Table 1.1 to show which food group each test is able to identify. [3]

(b) Milk gives a positive result with Benedict's reagent and biuret reagent.

Rice gives a positive result with biuret reagent and iodine solution.

Complete Table 1.1 to show the colours observed for these positive results. [3]

Table 1.1

reagent	Benedict's	biuret	iodine
food group identified			
colour with milk at end of test			orange
colour with rice at end of test	blue		

(c) (i) Describe how you could carry out the test for the presence of fats in a food.

.....

, [2]

(ii) State what is observed if the result of the test in (c)(i) is positive.

..... [1]

(iii) Suggest why the test you have described in (c)(i) may be difficult to carry out on the milk.

....., [1]

2 The teacher gives a student samples of a calcium salt. The student will carry out four experiments.

(a) Fig. 2.1 shows the apparatus for **experiment 1**. Read the instructions for the experiment which are shown below the diagram.

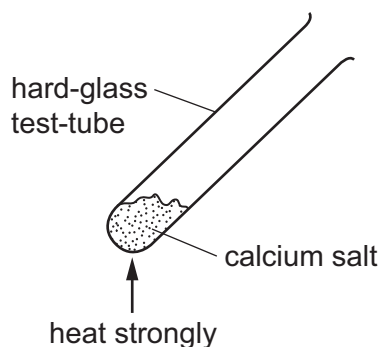
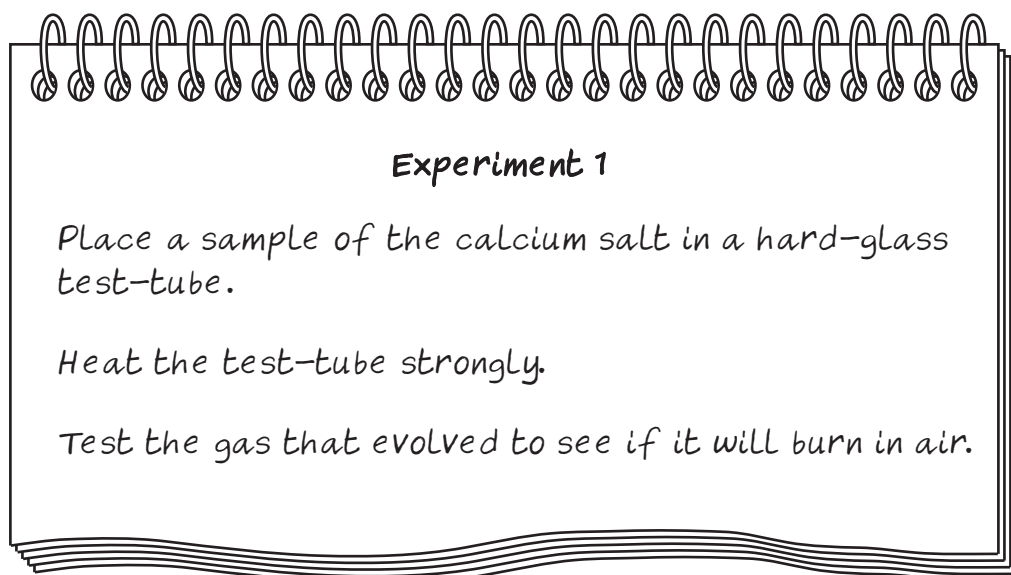


Fig. 2.1



Describe how the student can find out if the gas will burn in air.

test

result [1]

- (b) Fig. 2.2 shows the apparatus for **experiment 2**. Read the instructions for the experiment which are shown below in the diagram.

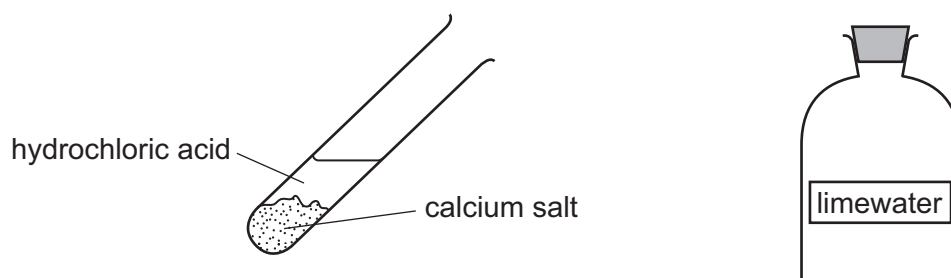
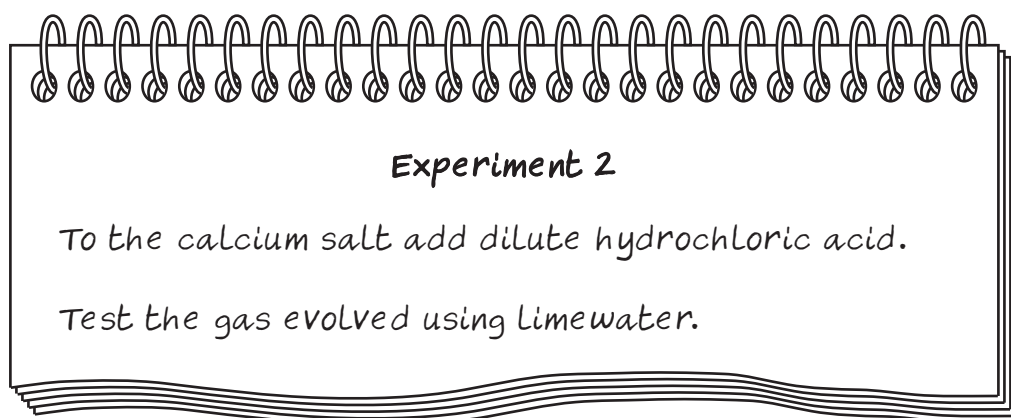


Fig. 2.2



- (i) Draw a diagram to show how the student can test the gas coming out of the test-tube using limewater. State the positive result for this test.

result [2]

- (ii) Name the gas that gives the positive result in (b)(i).

..... [1]

- (c) **Experiment 2** gives a positive result with limewater.

Name this calcium salt.

..... [1]

- (d) Fig. 2.3 shows the apparatus for **experiment 3**. Read the instructions for the experiment which are shown below the diagram.

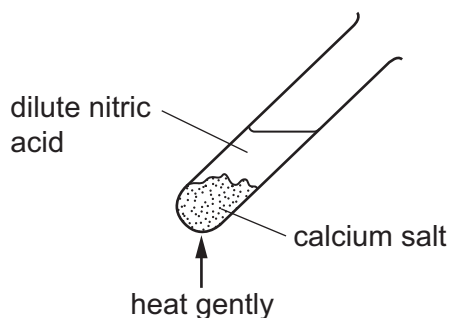


Fig. 2.3

Experiment 3

Add dilute nitric acid to a fresh sample of the calcium salt.

Warm the test-tube gently.

Test the gas that evolves to see if it is acidic.

- (i) Describe how the student can test if the gas is acidic.

test

result [2]

- (ii) Explain why the test-tube must be warmed gently rather than heated strongly.

..... [1]

- (e) The teacher gives the student two acids of the same concentration, acid **Y** and acid **Z**.

Fig. 2.4 shows the apparatus for **experiment 4**. Read the instructions for the experiment which are shown below the diagram.

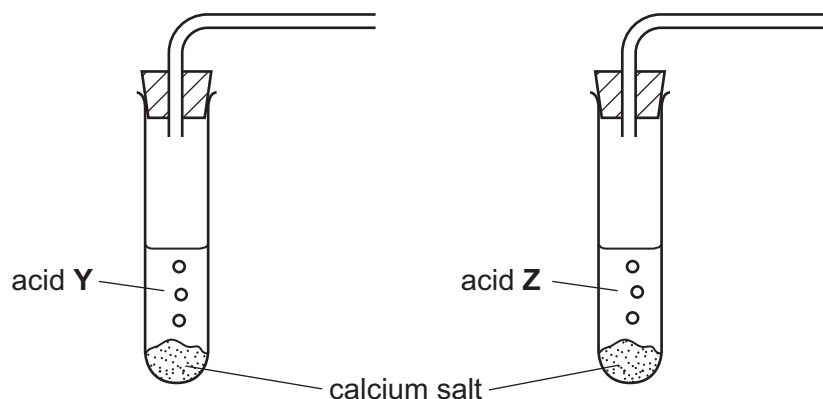
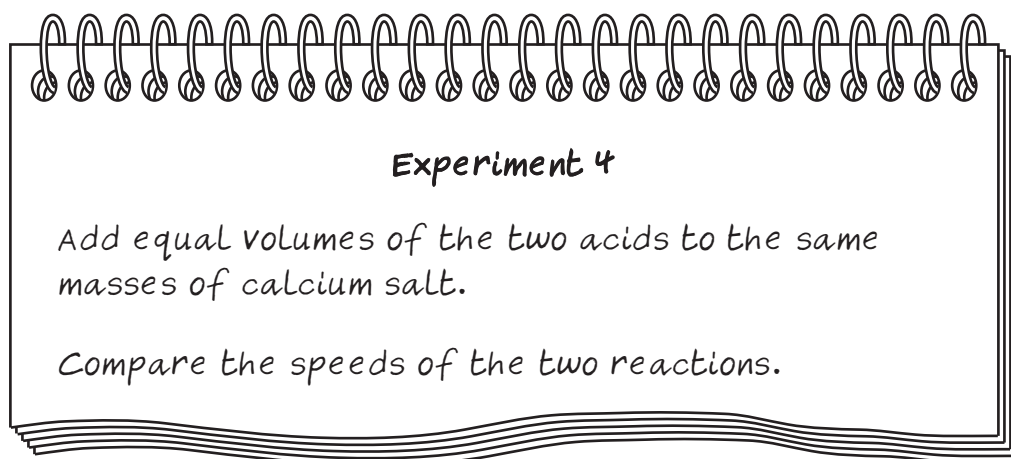


Fig. 2.4



Suggest how the student can use the gas produced by each reaction to compare the speeds of the reactions. You may draw a diagram to illustrate your answer.

.....

.....

....., [2]

- 3 A student is investigating different components in a circuit.

He sets up the apparatus shown in Fig. 3.1. He then carries out an experiment to measure the resistance of the power supply.

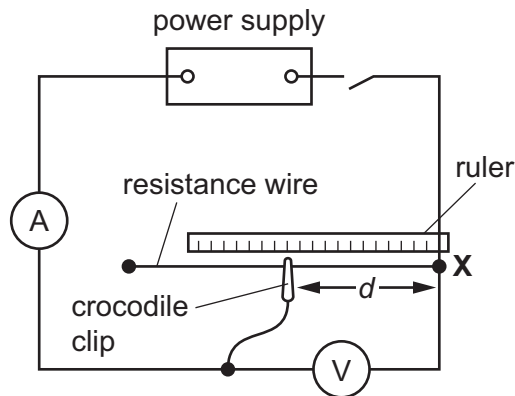


Fig. 3.1

Procedure

- Connect the crocodile clip to the resistance wire at a distance $d = 15$ cm from point **X**.
- Close the switch.
- Read the ammeter and voltmeter and then immediately open the switch.
- Record the readings in Table 3.1.
- Repeat this procedure for the other distances from point **X** shown in Table 3.1.

- (a) Fig. 3.2 shows the ammeter and voltmeter readings for the distances $d = 25$ and $d = 40$ cm. Read the meters to a suitable number of decimal places and record the readings in Table 3.1.

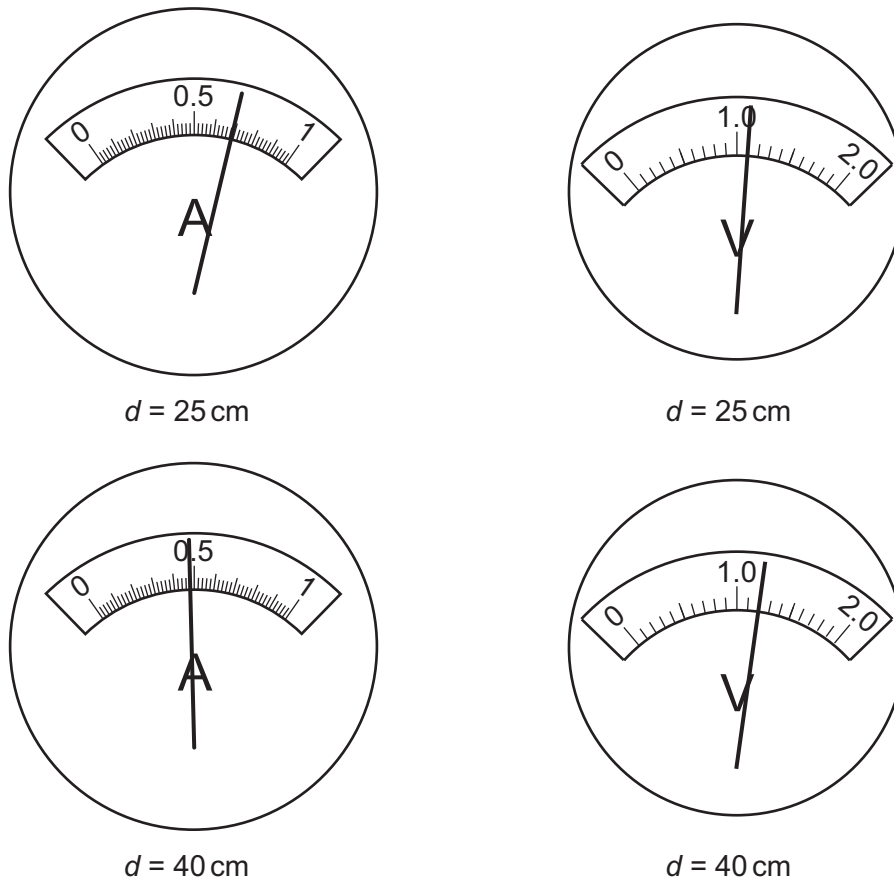


Fig. 3.2

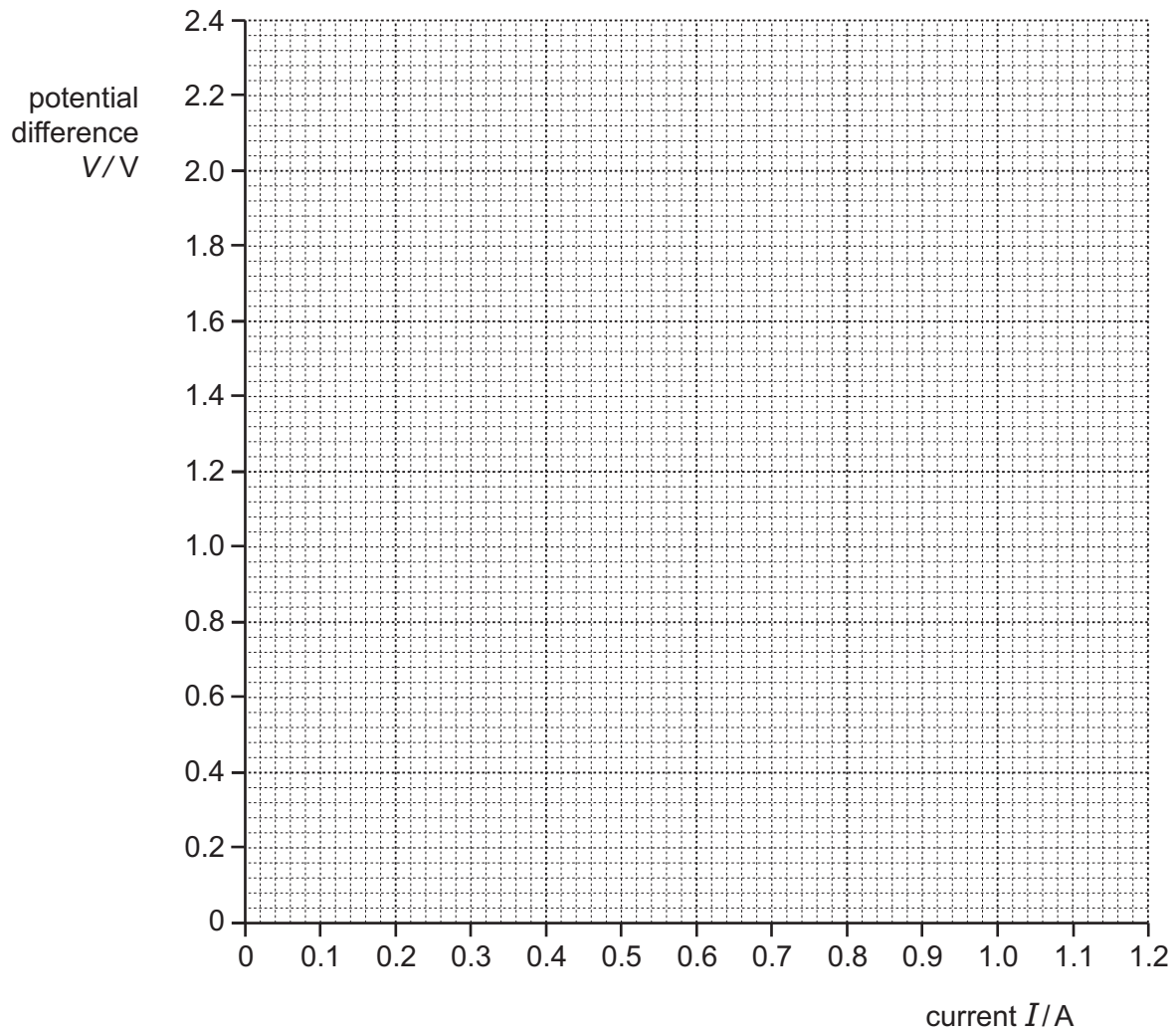
[3]

Table 3.1

distance d /cm	current I /amps	potential difference V /volts
15	0.97	0.9
20	0.81	1.0
25		
40		
60	0.34	1.3
100	0.22	1.4

(b) (i) On the grid provided, plot a graph of V against I . Draw the best-fit straight line.

[2]



(ii) Calculate the gradient of your line. Show all working and indicate on your graph the values you chose to enable the gradient to be calculated.

gradient = ... [2]

(iii) The positive value of the gradient of the graph is equal to the resistance of the power supply. Write the positive value of the gradient to an appropriate number of significant figures.

resistance of power supply = ... Ω [1]

- (c) (i) Suggest a reason why distance d must not be less than 15 cm.

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

- (ii) Suggest a reason why the student must open the switch immediately after taking each reading.

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

- 4 In a flower, ripe stigmas produce a fluid containing sugar. The sugar stimulates pollen grains that land on a stigma to grow *pollen tubes*. These pollen tubes allow the nucleus from the pollen to travel to the egg (ovum) in the ovary so that fertilisation can take place.

Pollen tubes can be observed using a light microscope. Fig. 4.1 shows a photograph of some of these pollen tubes.

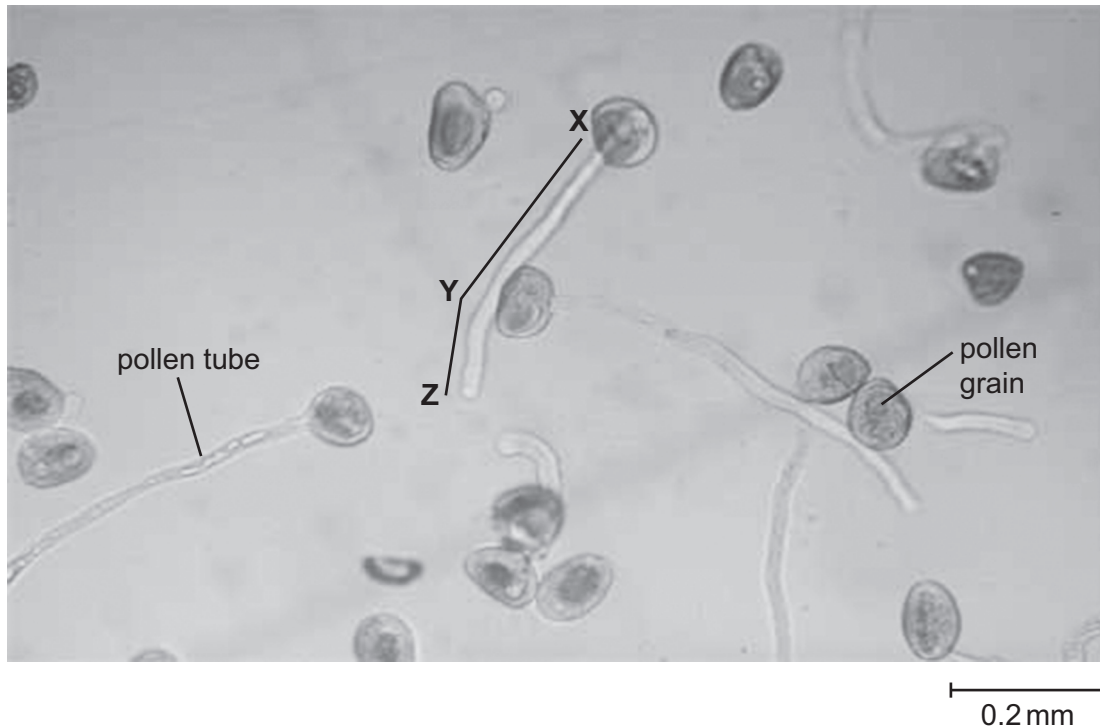


Fig. 4.1

- (a) Measure and record the total length of the pollen tube as indicated by the line **X-Y-Z** on Fig. 4.1. With the help of the scale bar on the side of Fig. 4.1, calculate the actual length of the pollen tube.

Show your working.

Total length of pollen tube on image (**X-Y-Z**) = ... mm [2]

Actual length of **X-Y-Z** = ... mm [2]

(b) A student investigates the effect of different strength sugar solutions on the growth of pollen tubes.

- He places a drop of sugar solution on a microscope slide and adds pollen grains to it.
- He leaves the slide in a warm place for an hour and then looks at the slide using the microscope.
- He counts the number of pollen grains that he can see and then calculates the percentage that have pollen tubes.

His results are shown in Table 4.1.

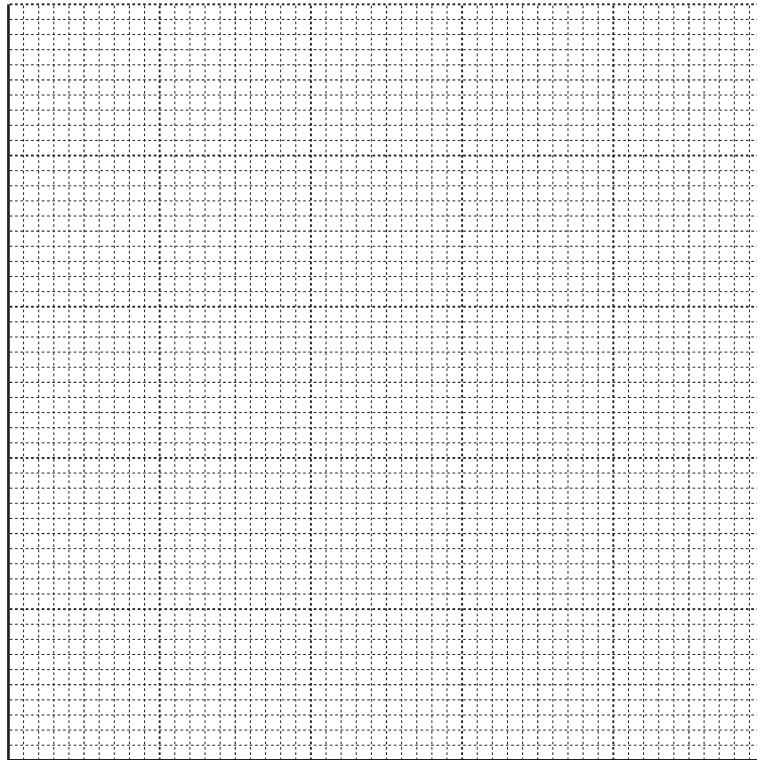
Table 4.1

concentration of sugar solution (mol/dm^3)	% of pollen grains with pollen tubes			
	experiment 1	experiment 2	experiment 3	average
0	0	0	0	0
0.25	36	28	32	
0.50	72	68	76	
0.75	49	41	45	
1	10	7	13	

Complete the last column of Table 4.1.

[1]

- (c) (i) Use Table 4.1 to plot on the grid below a graph of average percentage of pollen grains with tubes (vertical axis) against sugar concentration. Draw a best-fit curve.



[4]

- (ii) Use your graph to suggest the best concentration of sugar for pollen tube growth.

..... [1]

- 5 A group of students investigate some of the chemical and physical properties of iron, Fe.

Chemical properties

One student places iron nails into test-tubes, as shown in Fig. 5.1, and leaves them for one week.

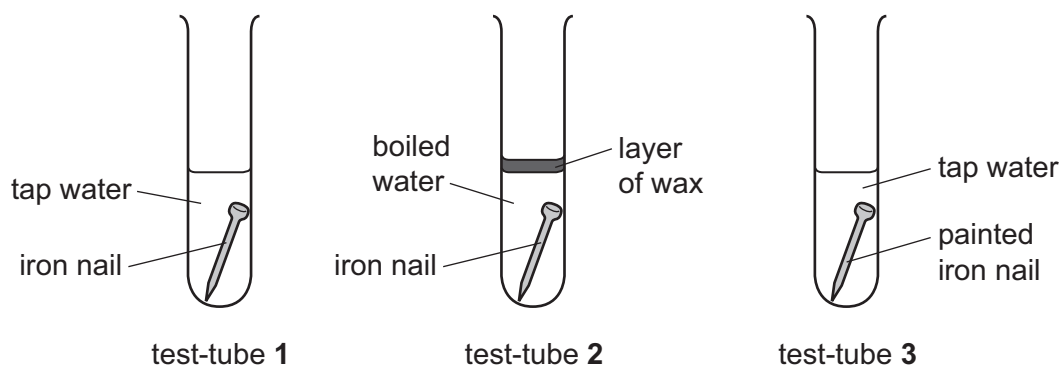


Fig. 5.1

- (a) (i) State how the appearance of the nail in test-tube 1 changes after one week.

.....
, [1]

- (ii) Describe the appearance of the nail in test-tube 2 after one week.

.....
, [1]

- (iii) Explain why there is no change to the nail in test-tube 3 after one week.

.....
, [1]

- (b) Another student adds hydrochloric acid to iron filings. He notices that bubbles of gas are formed.

- (i) He carries out a test that confirms the gas is hydrogen.

Describe the test he uses and the observation.

test

observation

....., [1]

- (ii) The iron dissolves, making a light green solution. The student thinks that the green solution contains iron(II) ions.

Explain how he proves the presence of iron(II) ions in the green solution.

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

- (iii) The student takes some of the green solution and adds a colourless oxidising agent. The mixture changes colour.

The teacher says that the iron(II) ions have been changed to iron(III) ions.

State the colour of the mixture containing iron(III) ions.

..... [1]

- (iv) Explain how the student proves the presence of iron(III) ions in this mixture.

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

(c) Physical properties

A student uses the apparatus in Fig. 5.2 to investigate how a thick metal wire changes shape when a force is applied to it.

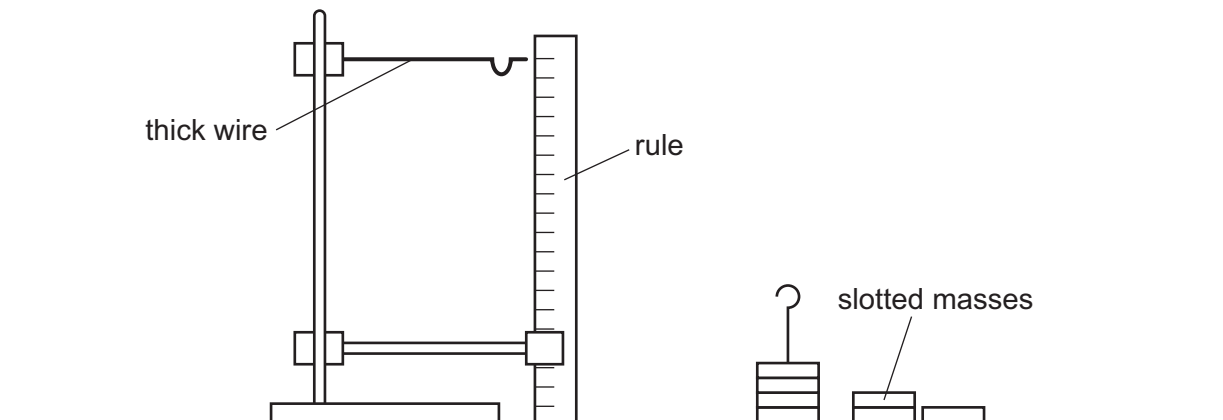


Fig. 5.2

Describe a procedure, using this apparatus, that the student can carry out to compare a wire made of iron with a wire made of steel (an alloy of iron). Explain how you can ensure that this is a fair comparison.

.....

.....

.....

.....

.....

....., [3]

- 6 A student has samples of three different liquids, **A**, **B** and **C**.

He carries out an experiment to compare the densities of these liquids. The apparatus he uses is shown in Fig. 6.1.

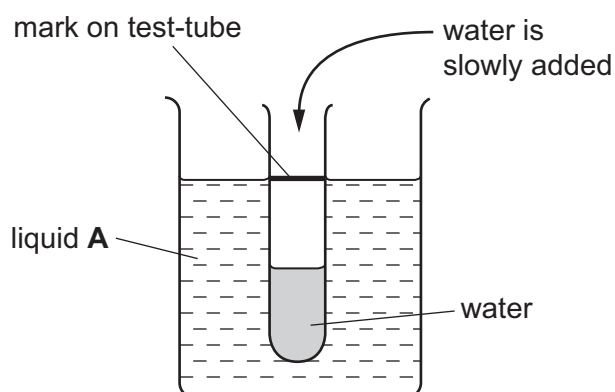


Fig. 6.1

Method

- He makes a mark on a test-tube.
- He holds the test-tube upright in the beaker and slowly adds water to it, drop by drop, until it floats in the beaker of liquid **A** and the mark on the test-tube is level with the surface of liquid **A**.
- He pours the water from the test-tube into a measuring cylinder and records the volume in Table 6.1.
- He repeats the experiment using liquids **B** and **C**.

- (a) Name the piece of apparatus that the student could use to add water, drop by drop, to the test-tube in Fig. 6.1.

..... [1]

- (b) The liquid which requires the greatest volume of water in the test-tube is the most dense. Fig. 6.2 shows the volume of water contained in each test-tube when it floats in liquids **A**, **B** and **C**.

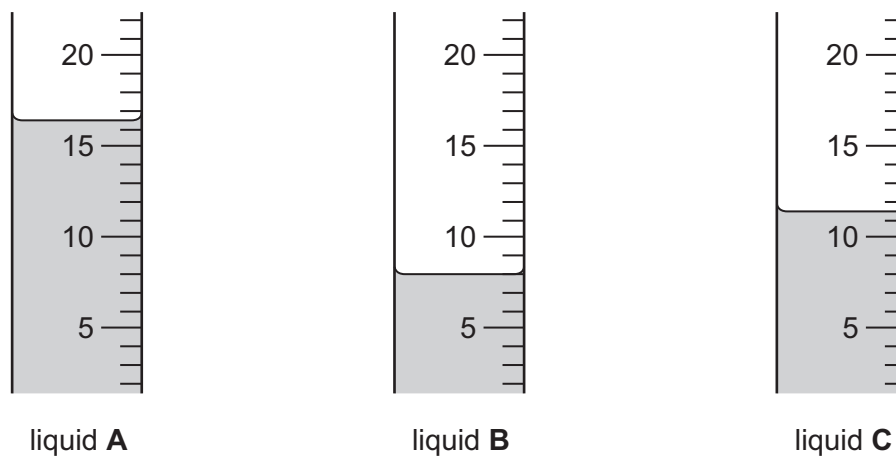


Fig. 6.2

- (i) Record, in Table 6.1, each volume of water to the nearest 0.5 cm^3 .

Table 6.1

	liquid A	liquid B	liquid C
volume of water / cm^3			

[3]

- (ii) Use the results from Table 6.1 to place the liquids **A**, **B**, and **C** in order of density.

most dense

.....

least dense

[1]

- (c) The teacher tells the student that one of the three liquids is water.

Suggest **one** chemical test and **one** physical test that the student can use to identify the water.

chemical test

.....

physical test

.....

[2]

- (d) Another student uses two pieces of apparatus to measure two properties of the sample of liquid **A** which he can use to calculate the density of liquid **A**.

- (i) Suggest the names of two pieces of apparatus that he uses and the property measured by each by completing the sentences.

The student uses a to measure the
of the sample of liquid **A**.

The student uses a to measure the
of the sample of liquid **A**. [2]

- (ii) State how the student uses the two measurements to calculate the density of liquid **A**.

.....

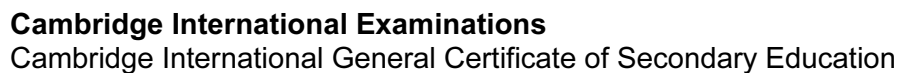
....., [1]

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* 9 5 4 8 0 4 3 9 2 2 *

0653/63

October/November 2015

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 **19** printed pages and **1** blank page.

- 1 Emperor penguins live and breed in the Antarctic. Their average body temperature needs to be maintained at 39°C but air temperature can fall as low as -40°C .

Penguins often huddle together. A student investigates how this behaviour may be beneficial to the penguins by using test-tubes to represent them.

- The student places a set of three large test-tubes that are held together with a rubber band into a large beaker labelled **A**. He then places an individual large test-tube into a second beaker labelled **B**.
- He takes the temperature of a beaker of hot water. He records this in Table 1.1 as the temperature at time zero.
- He immediately pours equal amounts of the hot water into each of the four test-tubes as shown in Fig. 1.1.

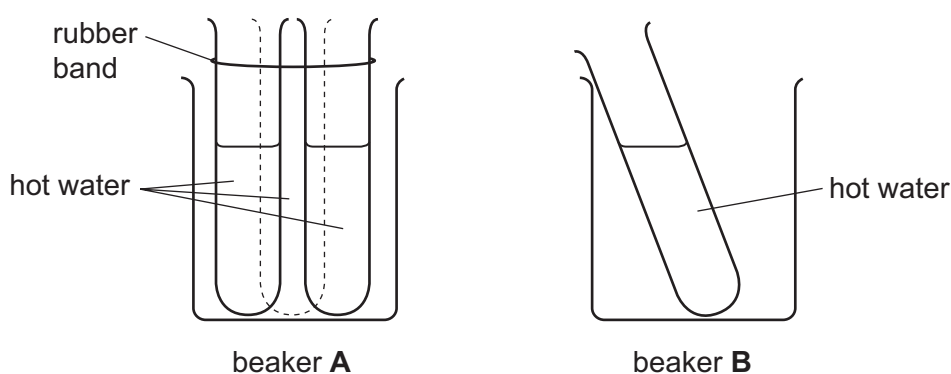


Fig. 1.1

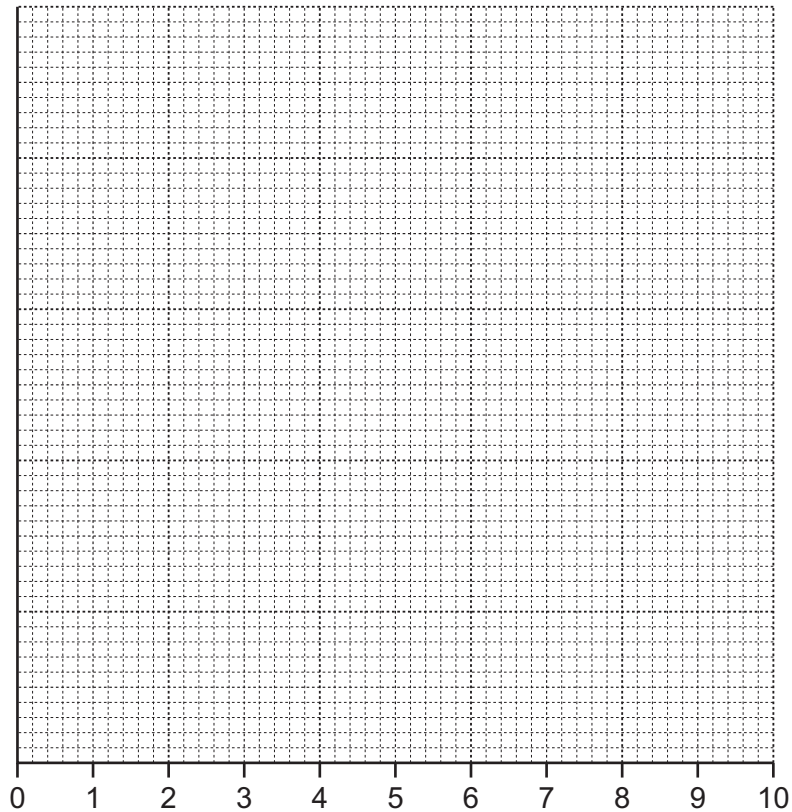
- He starts a stopclock and immediately places a thermometer into the test-tube in beaker **B** and a second thermometer into **one** of the test-tubes in beaker **A**.
- After two minutes he records the temperature of the water in both test-tubes. He repeats this at two minute intervals for 10 minutes.
- His results table is shown in Table 1.1.

Table 1.1

time /	temperature recorded in beaker A / $^{\circ}\text{C}$	temperature recorded in beaker B / $^{\circ}\text{C}$
0	81.0	81.0
2	68.0	67.6
4	64.2	61.8
6	61.0	57.0
8	58.2	53.0
10	56.0	49.6

(a) Complete the heading for the first column in Table 1.1. [1]

(b) On the grid provided, plot a graph of temperature (vertical axis) against time for both beakers. Draw a smooth best-fit curve for each set of readings.



[4]

(c) Refer to the results to suggest why forming a huddle may be beneficial to Emperor Penguins.

.....

 [2]

(d) (i) Suggest **one** source of inaccuracy in this experiment.

..... [1]

(ii) Suggest how this experiment could be changed to reduce this source of inaccuracy.

.....
 [1]

(e) Describe how the results from this experiment could be made more reliable.

.....

..... [1]

- 2 A student investigates the effect of solution **X** on the exothermic reaction between zinc and copper sulfate solution.

He uses three procedures. He is given copper sulfate solution, a beaker containing unknown solution **X** and three 0.5 g samples of zinc powder.

Procedure 1

- Place 10 cm^3 of the copper sulfate solution into a plastic cup. Add 10 cm^3 of water and stir well.
- Measure the temperature T_1 of the solution and record it in Table 2.1.
- Add 0.5 g of zinc powder and stir well.
- Find the highest temperature T_2 of the mixture and record it in Table 2.1.

Procedure 2

- Place 10 cm^3 of the copper sulfate solution into a beaker. Add 5 cm^3 of solution **X** plus 5 cm^3 of water and stir well.
- Filter the mixture to remove the light blue precipitate.
- Measure 10 cm^3 of the filtrate and follow the method for **Procedure 1** using this filtrate instead of copper sulfate solution.

Procedure 3

- Place 10 cm^3 of the copper sulfate solution into a beaker. Add 10 cm^3 of solution **X** and stir well.
- Filter the mixture to remove the light blue precipitate.
- Measure 10 cm^3 of the filtrate and follow the method for **Procedure 1** using this filtrate instead of copper sulfate solution.

Table 2.1

procedure	volume of solution X used / cm^3	temperature / $^{\circ}\text{C}$		temperature / $^{\circ}\text{C}$
		T_1	T_2	$T_2 - T_1$
1	0	20.0		
2	5	20.0		
3	10	21.5		

- (a) (i) Fig. 2.1 shows the thermometer scales for the highest temperature T_2 reached in each of the three procedures. Read the temperatures to the nearest 0.5°C and record them in Table 2.1. [3]

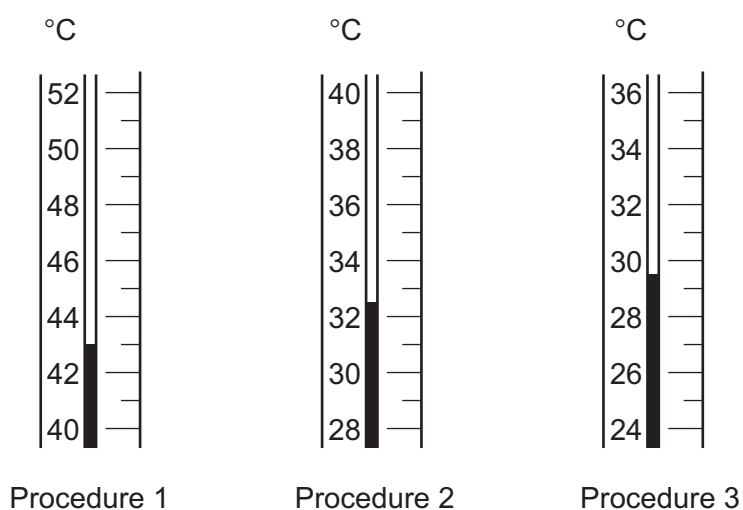


Fig. 2.1

- (ii) Calculate the temperature changes and complete the last column of Table 2.1.

[1]

- (b) (i) State the trend in temperature changes as the volume of solution **X** used changes.

.....
 [1]

- (ii) Suggest an explanation for the trend you have stated in part (i).

.....

 [2]

- (c) Suggest a chemical name for the solution **X** that produces the light blue precipitate.

..... [1]

- (d) Suggest a reason why the student uses a plastic cup rather than a glass beaker for the exothermic reaction.

.....
 [1]

- (e) Suggest a reason why only 10 cm^3 of the filtrate, instead of all of it, is added to the zinc in **Procedure 2** and **Procedure 3**.

.....
 [1]

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- 3 A science student investigates how the size of a shadow cast by an object varies with the distance of the object from the lamp.

The apparatus he uses is shown in Fig. 3.1. The diagram is not to scale.

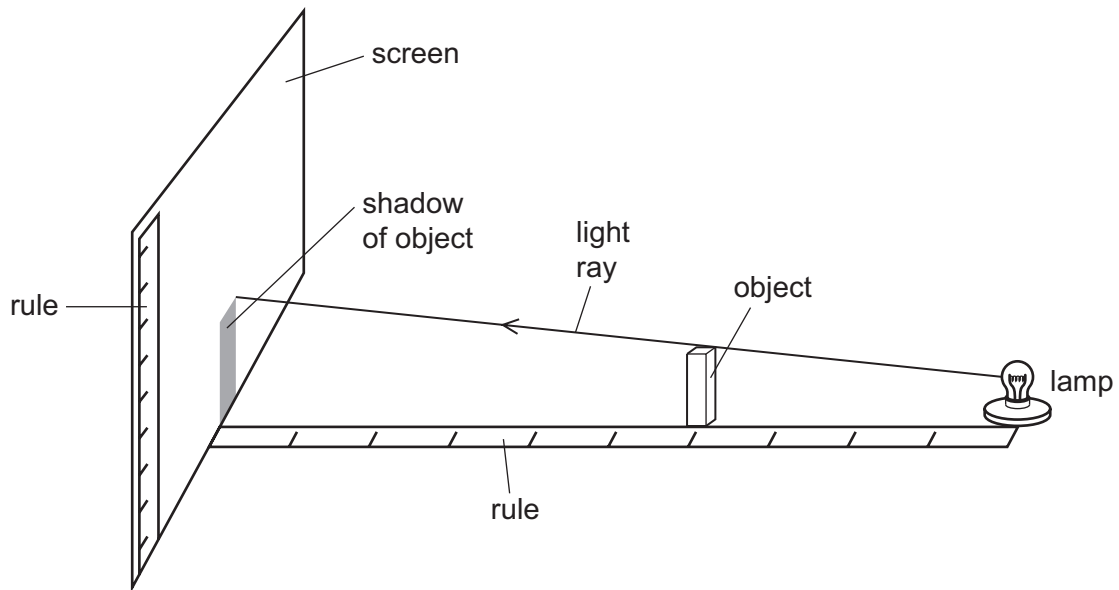


Fig. 3.1

- (a) (i) Fig. 3.2 shows the actual size of the object. Use a ruler to measure H , the height of the object to the nearest 0.1 cm.

H , height of the object = ... cm [1]

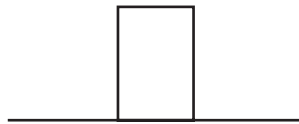


Fig. 3.2

- (ii) Use Fig. 3.1 to help you suggest why a shadow is formed.

.....
 [1]

The student measures the height h of the shadow formed when the object is placed at distances $d = 55$ cm, $d = 45$ cm, and $d = 35$ cm from the lamp. He records his measurements in Table 3.1.

Table 3.1

d/cm	15	25	35	45	55
h/cm			2.6	2.0	1.6

(b) Fig. 3.3 shows the shadows produced when the object is placed at 15 cm and 25 cm from the lamp.

Use a ruler to measure the missing values of h to the nearest 0.1 cm.

Record these values in Table 3.1.

[2]

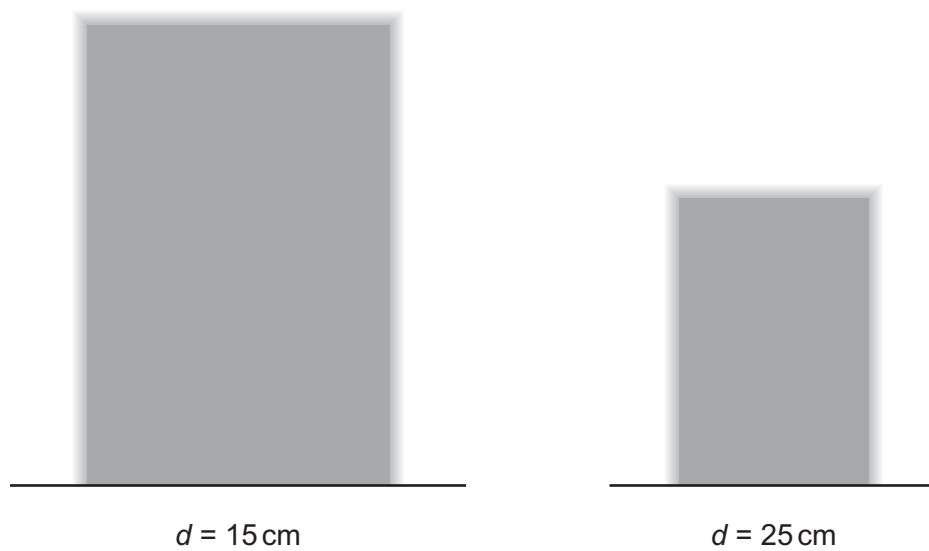
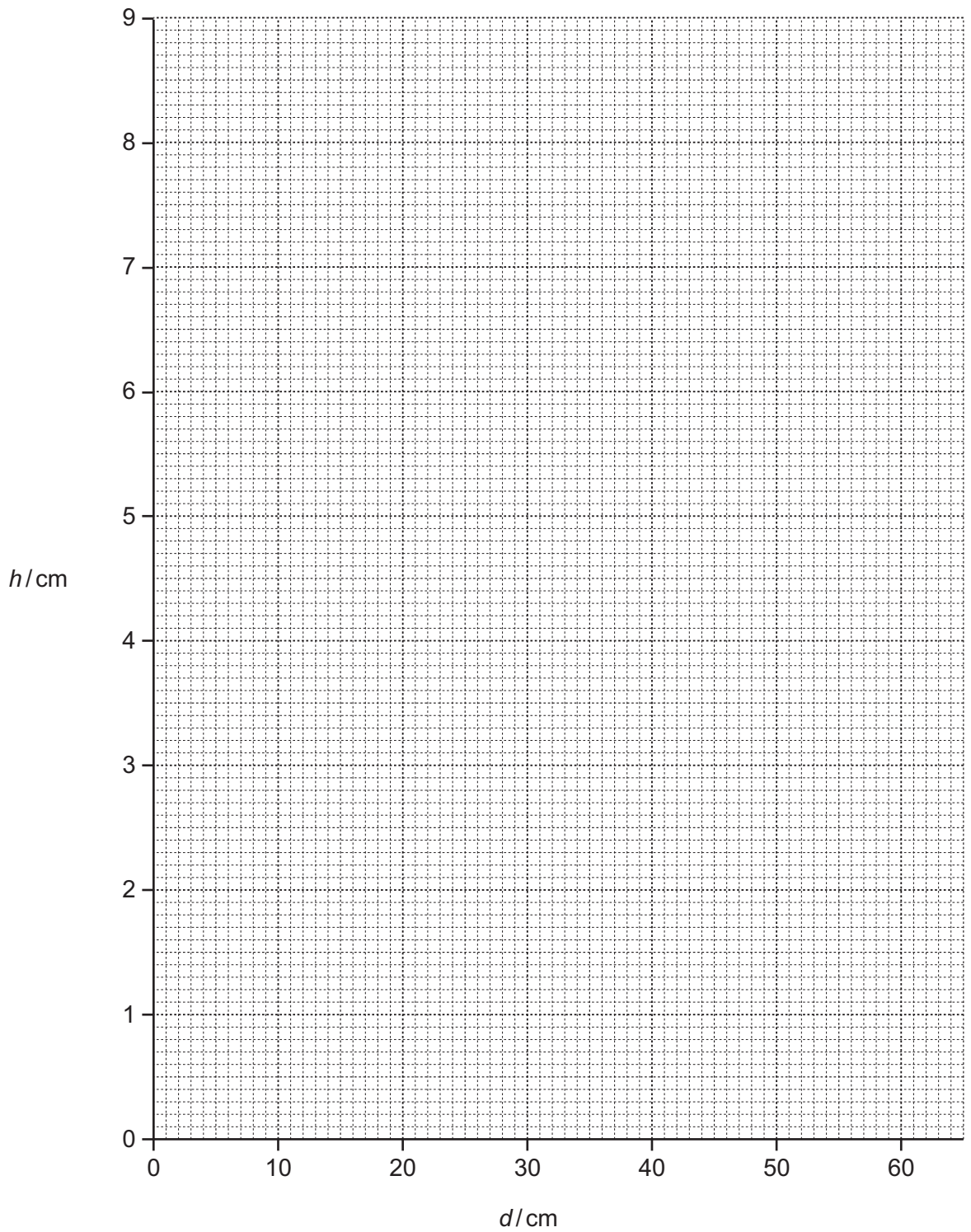


Fig. 3.3

(c) (i) On the grid provided, plot a graph of h against d . Draw the best-fit curve.



[2]

- (ii) The student suggests that the height of the shadow for $d = 30$ cm, h_{30} , is equal to twice the actual height of the object. He has written an equation:

$$h_{30} = 2H$$

Use your graph to show if he is correct. Show your working on the graph and then write your conclusion.

conclusion:
 [2]

- (d) (i) Extend your curve to predict the height of the shadow when $d = 10$ cm.

height = ... cm [1]

- (ii) State **one** problem that the student might find if d is reduced to 5 cm.

..... [1]

Please turn over for Question 4.

4 A student investigates respiration in woodlice.

She sets up the airtight apparatus shown in Fig. 4.1. The soda lime absorbs carbon dioxide.

Every minute for 4 minutes she records the position of the oil drop in the capillary tube and records her results in Table 4.1.

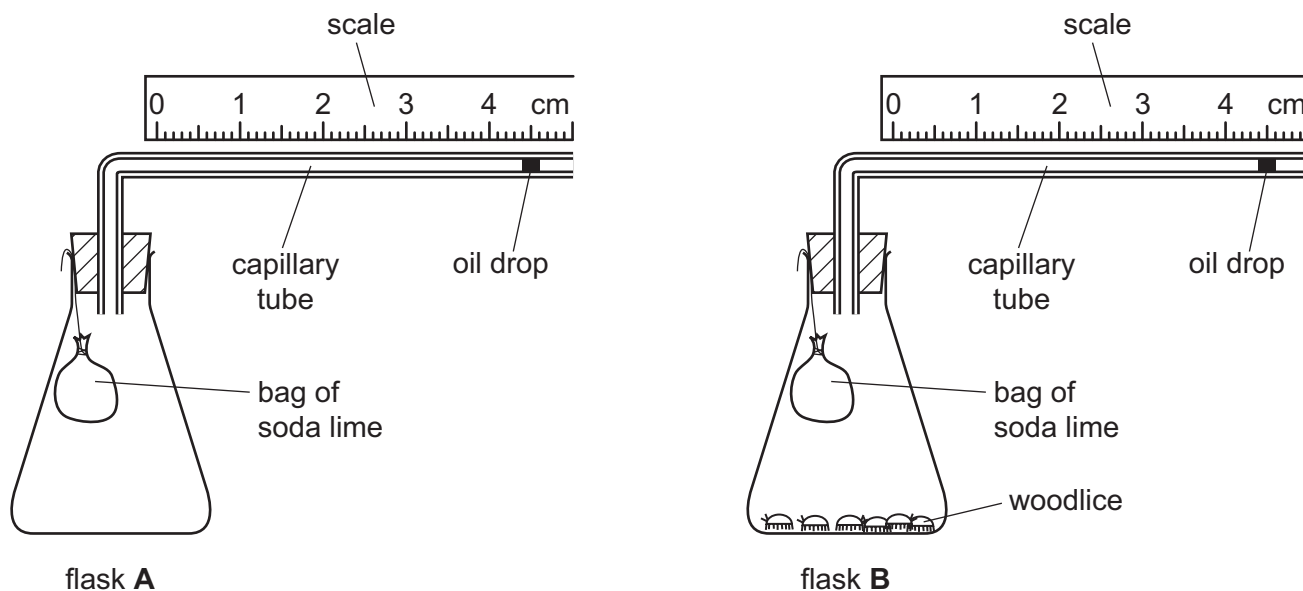


Fig. 4.1

(a) Explain why flask **A** is used in this experiment.

.....
 [1]

(b) (i) Use the diagrams in Fig. 4.2 to complete the results in Table 4.1 for time = 2 minutes. The student uses the left edge of the oil drop to record her initial readings.

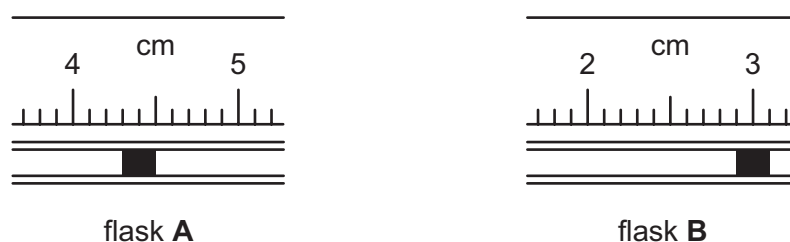


Fig. 4.2

- (ii) Complete Table 4.1 to show the total distance moved by the oil drop for each flask. [2]

Table 4.1

time / minutes	position of oil drop / cm	
	beaker A	beaker B
0	4.4	4.4
1	4.4	3.6
2		
3	4.3	2.1
4	4.3	1.3
total distance moved by oil drop / cm		

[1]

- (c) (i) The oil drop for flask **A** moves slightly during the experiment. Suggest why it moves.

.....
 [1]

- (ii) Suggest how the experiment could be changed to prevent the oil drop for flask **A** moving.

.....
 [1]

- (d) Explain why the oil drop in flask **B** moves further than in flask **A**.

.....

 [3]

- (e) Suggest how the results of this experiment would change if twice as many woodlice were used in flask **B**.

..... [1]

- 5 The science class compares the reactivity of two metals with acid. The apparatus they use is shown in Fig. 5.1.

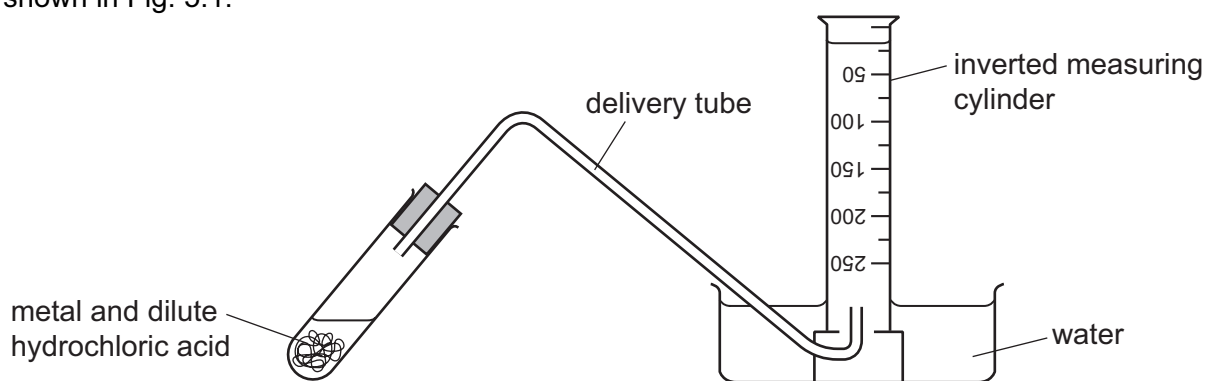


Fig. 5.1

experimental method

- The inverted measuring cylinder is filled with water.
- Magnesium is added to 10 cm^3 of hydrochloric acid and a stopclock is started.
- The volume of hydrogen collected in the measuring cylinder is recorded every 30 seconds for two minutes.
- The experiment is repeated using the same mass of zinc instead of magnesium.
- A graph of volume of hydrogen against time is plotted for each metal.

Fig. 5.2 shows the graph for magnesium.

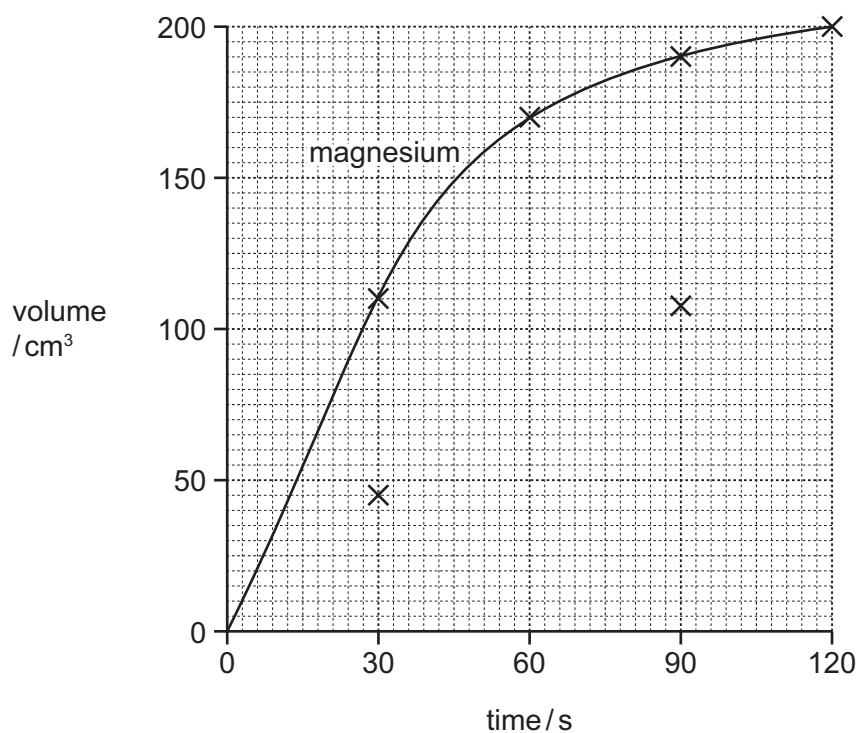


Fig. 5.2

The student has not finished plotting the data for zinc.

Fig. 5.3 shows the measuring cylinder for the reaction of zinc with hydrochloric acid at 60 and 120 seconds.

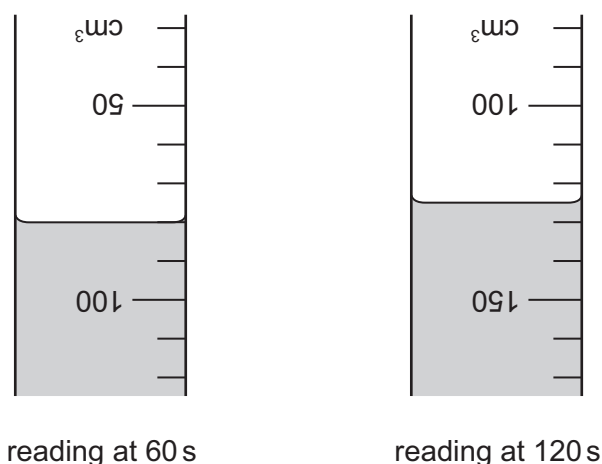


Fig. 5.3

- (a) (i)** Read the scales of the measuring cylinders in Fig. 5.3 and record the volumes of gas.

volume of gas at 60 s = ... cm^3

volume of gas at 120 s = ... cm^3 [2]

- (ii)** Use the readings from **(a)(i)** to complete the graph for zinc.

Draw the best fit curve for zinc. [3]

- (b)** State a property of hydrogen gas that enables the student to collect it over water.

.....
 [1]

- (c)** Explain why the graph for magnesium is steep for the first 30 seconds, then becomes less steep, nearly levelling out towards the end.

.....

 [3]

- (d)** Suggest why the graph for zinc is lower than the graph for magnesium.

.....
 [1]

- 6 A student investigates how the volume of a gas changes as the temperature changes. He sets up the apparatus as shown in Fig. 6.1.

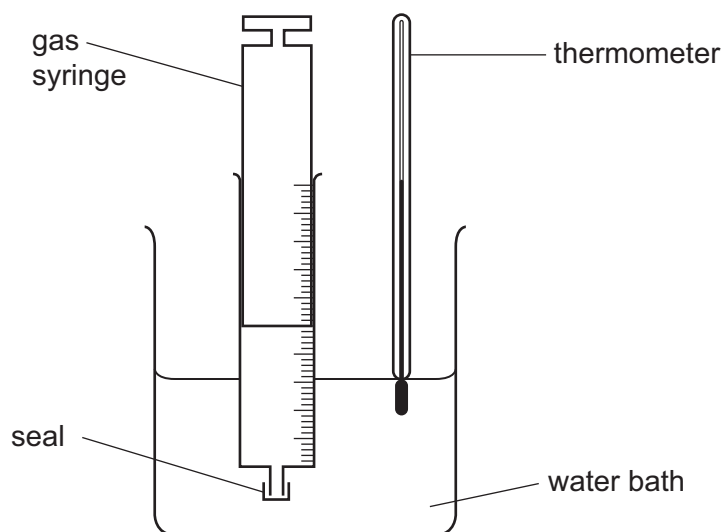


Fig. 6.1

- The student draws 50 cm^3 of dry air at room temperature into a gas syringe and seals the syringe.
- He measures the room temperature and records in Table 6.1 the temperature and volume of air, to the nearest 1°C and 1 cm^3 .
- He places the syringe in a warm water-bath and leaves it for several minutes.
- He records in Table 6.1 the temperature of the water-bath and the volume of the air.
- He increases the temperature of the water-bath and after several minutes he records the temperature and volume as before.
- Finally, he cools the syringe to a temperature of 0°C and finds the new volume of the air.

Table 6.1

volume of air / cm^3	70			64
temperature / $^\circ\text{C}$	21			0

- (a) Fig. 6.2 shows the syringe and thermometer readings missing from Table 6.1.

Read the scales and record the readings in Table 6.1, to the nearest 1°C and 1 cm^3 .

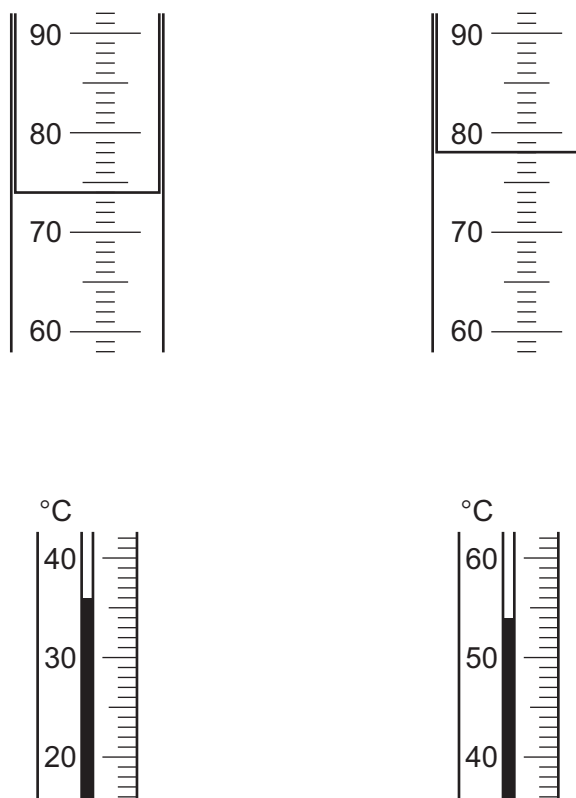


Fig. 6.2

[2]

- (b) (i) Suggest a reason why the student leaves the syringe in the water at the higher temperatures for several minutes.

.....
 [1]

- (ii) Suggest how the student can cool the syringe down and keep it at a temperature of 0°C . He has supplies of ice and salt.

.....
 [1]

- (c) Explain why a **rise** in the temperature of the air causes its volume, measured at atmospheric pressure, to increase.

.....

 [2]

- (d) The student repeats all the steps of this experiment using 50 cm^3 of gas **G** instead of 50 cm^3 of air. He uses the same temperatures as before.

He finds that the volumes of gas **G** at the higher temperatures are the same as the volumes of air.

The syringe reading for gas **G** at 0°C is close to 0 cm^3 .

Suggest a reason why the volume of gas **G** at 0°C was close to zero.

..... [1]

- (e) Study Fig. 6.1 again and identify **two** sources of error in the student's experiment.

error 1

error 2

[2]

- (f) Mark on Fig. 6.1, with the letter C, where the student should clamp the syringe. [1]

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