



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
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**COMBINED SCIENCE**

**0653/61**

Paper 6 Alternative to Practical

**October/November 2011**

**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 a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

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.

| For Examiner's Use |  |
|--------------------|--|
| 1                  |  |
| 2                  |  |
| 3                  |  |
| 4                  |  |
| 5                  |  |
| 6                  |  |
| Total              |  |

- 1 (a) A student carried out an investigation into the effect of high temperature on catalase enzyme activity. *Catalase* is an enzyme found in many tissues which catalyses the decomposition of hydrogen peroxide to produce a gas.

- The student labelled four large test-tubes tubes **A**, **B**, **C** and **D** and drew a line 1 cm from the top of each test-tube.
- He placed 10 cm<sup>3</sup> of hydrogen peroxide and a drop of detergent into each test-tube.
- He placed a 5g piece of **raw** liver into tubes **A**, **B** and **C**. This immediately caused a chemical reaction to occur and 'foam' was produced.
- He recorded the time it took for the foam to reach the pen line.

The stopclock readings are shown in Fig. 1.1 below.

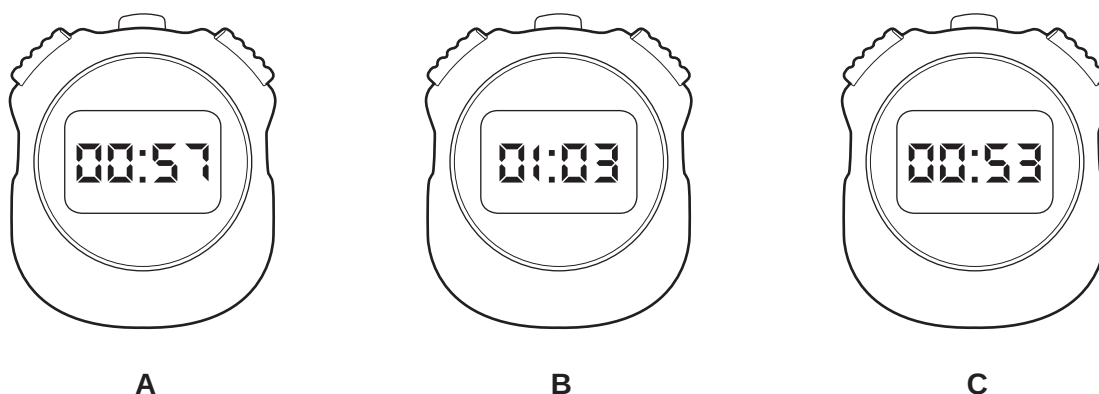


Fig. 1.1

- (i) Using Fig. 1.1, record in Table 1.1 the times taken, **in seconds**, for the foam to reach the pen line of test-tubes **A**, **B** and **C**.

Table 1.1

| liver type     | raw |   |   | boiled |
|----------------|-----|---|---|--------|
| test-tube      | A   | B | C | D      |
| time taken / s |     |   |   | N/R    |

[3]

- (ii) A glowing splint was placed into the 'foam'. The splint began to burn brightly again.  
Name the gas that was produced by the decomposition of the hydrogen peroxide.

..... [1]

- (iii) Calculate the average time taken, in seconds, for the foam to reach the pen mark in the reactions in tubes **A**, **B** and **C**.

..... [1]

The experiment was repeated using test-tube **D** and a 5 g piece of liver that had been **boiled** for one minute. A few bubbles were seen in the mixture. This was recorded in Table 1.1 as N/R (No reaction).

- (iv) Compare the results for the raw and boiled liver.

Explain the reasons for the difference in results.

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

- (b) (i) Suggest a reason why a few bubbles were produced in test-tube **D**.

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

- (ii) Suggest which conditions should be kept constant in this experiment.

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

- 2 The teacher has asked a student to investigate the speed of thermal decomposition of metal carbonates, **A**, **B** and **C**. Carbonate **C** contains the unknown metal **X**.

Fig. 2.1 shows the apparatus she is using. The metal carbonate decomposes when it is heated. The gas given off turns the limewater milky.

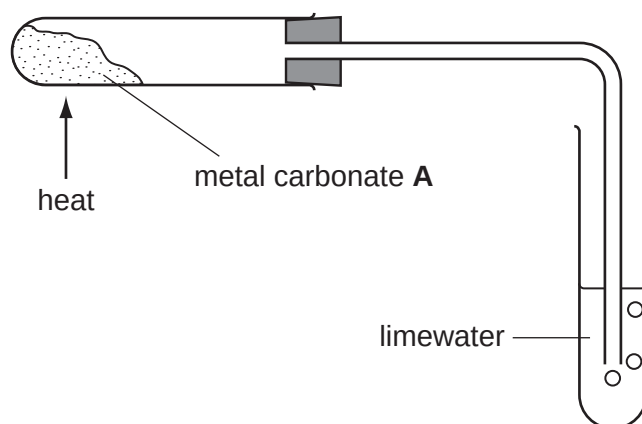


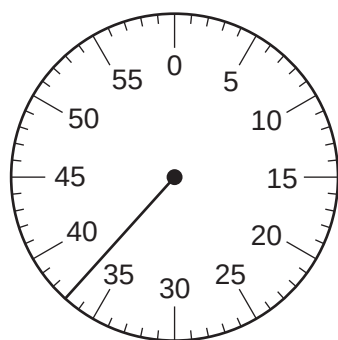
**Fig. 2.1**

- The student places about 1 cm depth of metal carbonate **A** in the hard-glass test-tube.
- She heats it and at the same time starts a stopclock.
- When the limewater turns milky, she stops the clock and records the result in Table 2.1.
- She records any colour change of the metal carbonate in Table 2.1.
- She repeats the experiment using metal carbonates **B** and **C**.

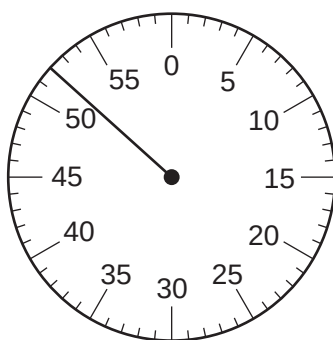
**Table 2.1**

| metal carbonate                              | time taken for limewater to turn milky/s | colour change                                                  |
|----------------------------------------------|------------------------------------------|----------------------------------------------------------------|
| <b>A</b> zinc carbonate                      |                                          | white at first, turns yellow and then becomes white on cooling |
| <b>B</b> magnesium carbonate                 |                                          | white at first, stays white                                    |
| <b>C</b> carbonate of unknown metal <b>X</b> |                                          | green at first, turns black                                    |

- (a) Fig. 2.2 shows the stopclocks used for each test. The dials show the time taken for each carbonate to decompose and turn the limewater milky.



metal carbonate  
**A**



metal carbonate  
**B**



metal carbonate  
**C**

**Fig. 2.2**

- (i) Read the stopclock dials and record the times in Table 2.1. [3]
- (ii) Write the letters **A**, **B** or **C**, listing the metal carbonates in order of their speed of thermal decomposition.
- 1 (fastest) .....
- 2 ..... [1]
- 3 (slowest) .....
- (b) The student wants to find out the name of the unknown metal **X** found in metal carbonate **C**. When the heated test-tube has cooled, she places the black residue in a beaker and adds 20 cm<sup>3</sup> of dilute sulfuric acid, stirring the mixture and then filtering it.
- (i) Draw a diagram to show how she filters the mixture.

The filtered solution is blue. She adds aqueous sodium hydroxide to  $2\text{cm}^3$  of the solution. There is a light blue precipitate.

- (ii) Suggest the name of the light blue precipitate.

..... [1]

- (iii) Suggest the name of the black residue left after metal carbonate **C** was heated.

..... [1]

- (c) The teacher gives the student a small piece of each of the three metals, zinc, magnesium and unknown metal **X**. She adds dilute hydrochloric acid to the metals in three separate test-tubes, shown in Fig. 2.3.

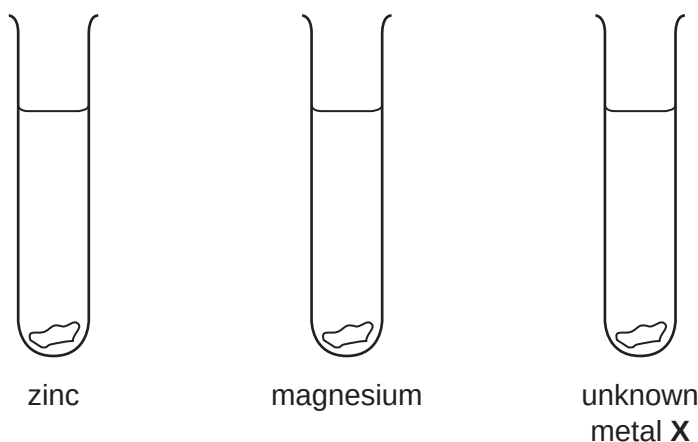


**Fig. 2.3**

On Fig. 2.3, draw the bubbles of gas, if any, that are produced in each test-tube. Your drawing should show clearly the different reactivity of each metal. [2]

- (d) Compare your drawing in Fig. 2.3 with your answer to part (a)(ii). Can the different reactivity of the metals be used to predict the speed of thermal decomposition of the metal carbonates?

Explain your answer.

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

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Please turn over for Question 3.

- 3 A student is investigating how  $T$ , the time for one swing of a pendulum, is affected by the angle of swing.

The pendulum is 30 cm long and suspended from a pin. The arrangement of apparatus is shown in Fig. 3.1.

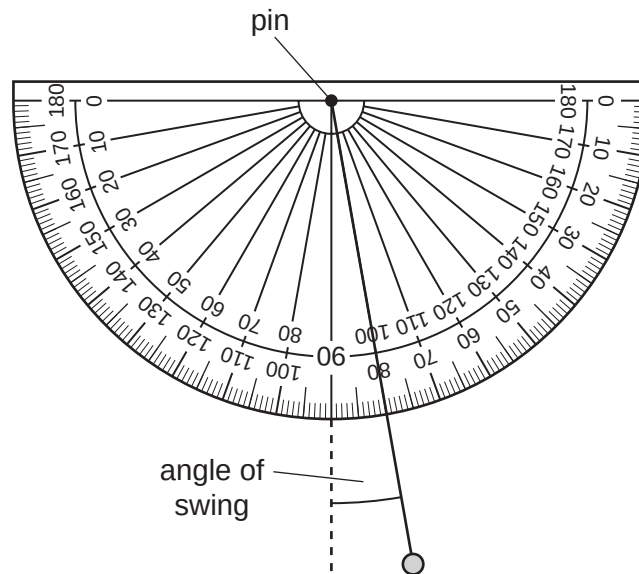


**Fig. 3.1**

- The student holds the pendulum so that the angle of swing is  $10^\circ$ , as in Fig. 3.1.
- He releases the pendulum and starts a stopclock.
- He allows the pendulum to swing 10 times.
- He records the time for 10 complete swings in Table 3.1.
- He repeats the experiment using different angles of swing.

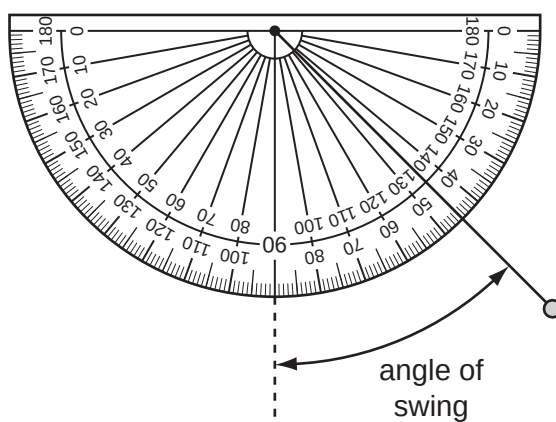
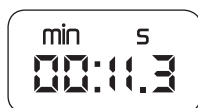
**Table 3.1**

| experiment              | 1    | 2    | 3    | 4    | 5 | 6 | 7 | 8    |
|-------------------------|------|------|------|------|---|---|---|------|
| angle of swing/degrees  | 10   | 25   | 35   | 40   |   |   |   | 85   |
| time for 10 swings/s    | 11.4 | 11.2 | 11.6 | 11.5 |   |   |   | 11.3 |
| time, $T$ for 1 swing/s |      |      |      |      |   |   |   |      |

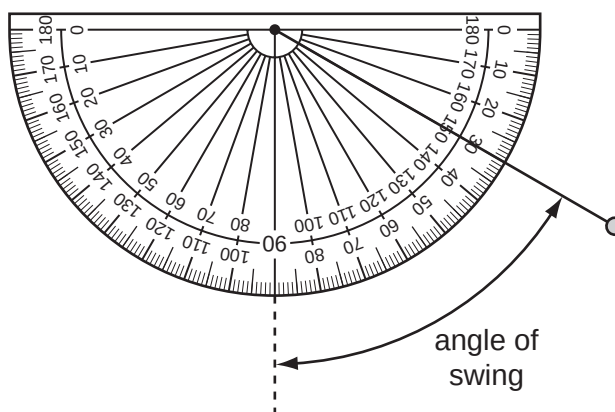
- (a) (i) Fig. 3.2 shows the angle of swing and the digital stopclock for three experiments.

Read the angle of swing and the time for each angle of swing. Record the results in Table.3.1.

experiment 5



experiment 6



experiment 7

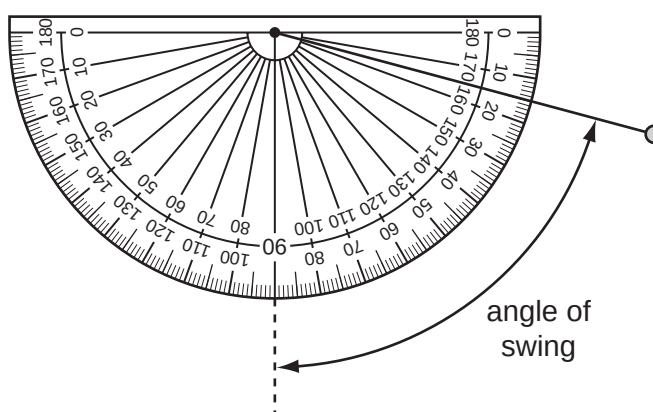
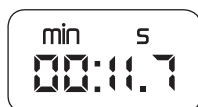


Fig. 3.2

[3]

- (ii) Complete Table 3.1 by finding the time,  $T$ , for one swing of the pendulum for each experiment. [1]

- (iii) Use the results for **T** in Table 3.1 to find the average time, **T<sub>av</sub>**, for one swing of the pendulum for all experiments.

$$T_{av} = \dots\dots\dots \text{ s} \quad [1]$$

- (b) Do the results show that **T**, the time for one swing, is affected by the angle of swing?

Explain your answer.

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

- (c) Explain how the student can make the results of his experiment more reliable.

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

- (d) The student is using a pendulum that is 30 cm long. Convert this value from centimetres to metres.

$$\text{length of pendulum, } l = \dots\dots\dots \text{ m} \quad [1]$$

- (e) Use the value of **l** from part (d), **T<sub>av</sub>** from part (a)(iii) and the formula below to calculate **g**, the acceleration due to gravity.

$$g = \frac{39.5 \times l}{(T_{av})^2}$$

$$g = \dots\dots\dots \text{ m/s}^2 \quad [2]$$

Please turn over for Question 4.

- 4 (a) A student was given a solution and was told that it contained the enzyme amylase. Amylase is found in saliva. It catalyses the breakdown of starch into sugar.

The student wanted to confirm that the solution contained amylase by testing whether it could break down starch solution.

- He put some starch solution into test-tubes **A** and **B**. He added amylase solution to tube **A**. He added an equal volume of water to test-tube **B** as a control.
- After waiting for 10 minutes he added a few drops of iodine solution to each test-tube.
- The results showed that the starch had been completely broken down in test-tube **A** but had not broken down in test-tube **B**.

Describe the colours of the solutions after testing with iodine.

test-tube **A** .....

test-tube **B** ..... [2]

- (b) The student believed that the activity of amylase is affected by the pH of solution. He did another experiment to confirm this as follows.

- He prepared starch solutions of 5 different pH values.
- He added amylase solution to the test-tube of pH 4.
- He started the timer.
- After 15 seconds he used a glass rod to remove a small sample of the test solution. He tested this with iodine.
- He used the iodine test to see if starch was still present. If starch was present he repeated the test after a further 15 seconds.
- He continued to test the solution every 15 seconds until the test showed that no starch remained. He entered the time taken for the starch to disappear in Table 4.1.
- He then repeated the procedure for the remaining pH values.

- (i) Read the stopclocks in Fig. 4.1 and enter the missing times, in seconds, in Table 4.1.

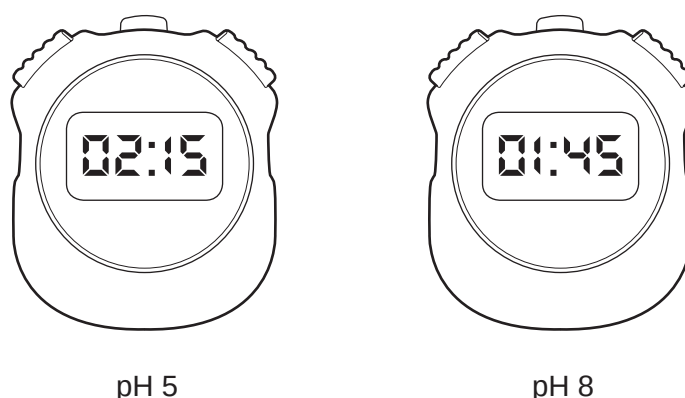


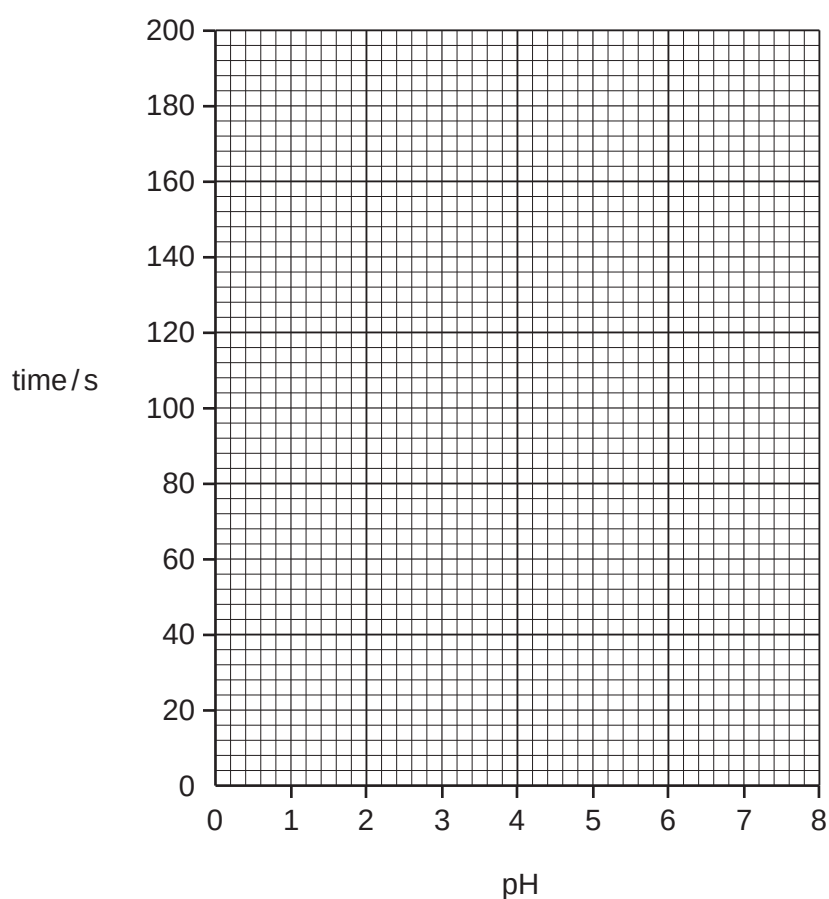
Fig. 4.1

Table 4.1

| pH | time for starch to disappear / s |
|----|----------------------------------|
| 4  | 195                              |
| 5  |                                  |
| 6  | 90                               |
| 7  | 90                               |
| 8  |                                  |

[2]

(ii) Plot a graph of time against pH. Draw a smooth curve through your points.



[2]

(iii) Over which pH range is the activity of the amylase greatest?

pH range = ..... [1]

- (c) (i) The student knew that the experiment could be improved to obtain a more accurate value of pH for the greatest activity.

List **two** improvements he could make to the experiment.

1 .....

2 ..... [2]

- (ii) Choose **one** of the improvements you have suggested. Explain why it would improve the accuracy of pH of greatest activity.

.....

.....

..... [1]

Please turn over for Question 5.

- 5 The teacher gives her students five gas-jars, each containing a different gas. The gases are labelled **A**, **B**, **C**, **D** and **E**. She also gives them a key to use to determine the name of each gas. The key is shown in Fig. 5.1.

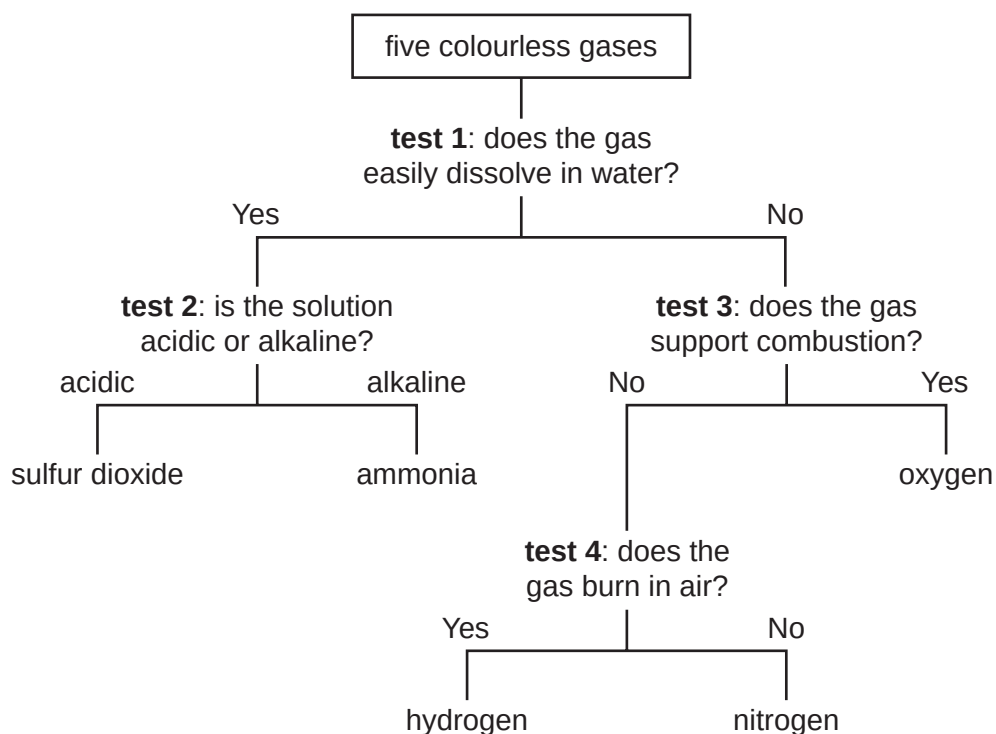


Fig. 5.1

Fig. 5.2 shows a gas-jar of gas that has been inverted and placed in a bowl of water with its lid still on.

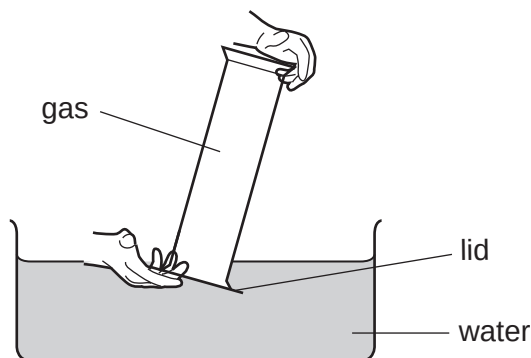


Fig. 5.2

One student is testing one of the gases to see if it will dissolve in water. He places the mouth of the gas-jar in the water as shown in Fig. 5.2. He then removes the lid of the gas-jar.

- (a) (i) Describe what he observes if the gas **does** dissolve in the water in the bowl.

..... [1]

- (ii) Explain why this happens.

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

- (b) Assuming that the gas in the gas-jar in Fig. 5.2 has dissolved in the water, explain how you can carry out **test 2**, shown in Fig. 5.1, on the solution in the bowl. Give the results for an acidic gas and an alkaline gas.

test 2 ..... [1]  
 ..... [1]  
 result for acid gas ..... [1]  
 result for alkaline gas ..... [1]

- (c) Explain how you would carry out **test 3**, shown in Fig. 5.1, on a gas-jar of gas. Describe the result for oxygen.

test 3 ..... [1]  
 ..... [1]  
 result for oxygen ..... [1]

- (d) Explain how you would carry out **test 4**, shown in Fig. 5.1, on a gas-jar of gas. Describe the result for hydrogen.

test 4 ..... [1]  
 ..... [1]  
 result for hydrogen ..... [1]

The conclusions that the students made, after carrying out all of the tests, are shown in Table 5.1.

**Table 5.1**

| gas A  | gas B          | gas C    | gas D   | gas E    |
|--------|----------------|----------|---------|----------|
| oxygen | sulfur dioxide | nitrogen | ammonia | hydrogen |

- (e) Suggest the names of **two** of the gases listed in Table 5.1 that will react together, when mixed at room temperature and pressure, without using either a catalyst or a flame.

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

- 6 A student is comparing the electrical resistances of two pieces of resistance wire, **X** and **Y**. The wires are made from the same alloy but are different in length and thickness.

The pieces of wire are shown in Fig. 6.1.

wire **X**



wire **Y**



Fig. 6.1

- (a) Measure the lengths of wire **X** and wire **Y** in centimetres to the nearest millimetre. Record the lengths in Table 6.1.

Table 6.1

| wire                    | <b>X</b> | <b>Y</b> |
|-------------------------|----------|----------|
| length / cm             |          |          |
| thickness / millimetres | 0.2      | 0.9      |

[2]

The student uses the circuit shown in Fig. 6.2 to find the resistance of the wires.

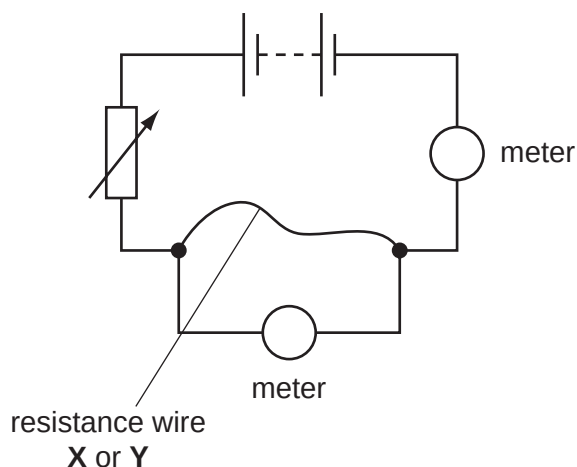


Fig. 6.2

- (b) (i) Complete the diagram in Fig. 6.2 by writing the letters **A** and **V** to show the ammeter and voltmeter in the correct places.

[1]

- (ii) Fig. 6.3 shows the voltmeter and ammeter readings when one of the wires is connected in the circuit.

Read the meters and record the readings in column 1 of Table 6.2.

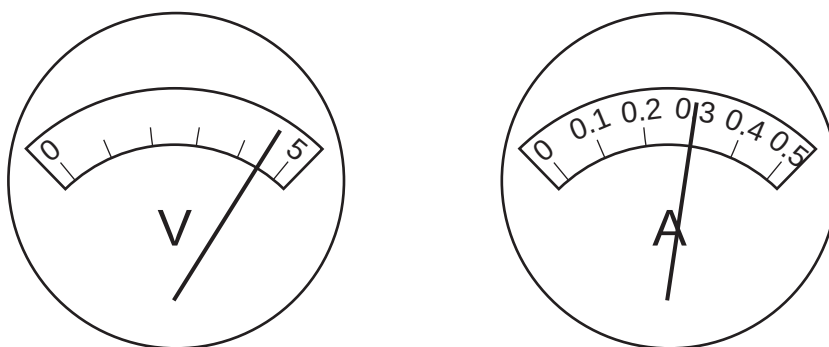


Fig. 6.3

Table 6.2

|                   | column 1 | column 2 |
|-------------------|----------|----------|
| current / amps    |          | 2.5      |
| voltage / volts   |          | 0.5      |
| resistance / ohms |          | 0.2      |

[2]

- (iii) Use the data in column 1 of Table 6.2 to calculate the resistance of this wire. Record the resistance in Table 6.2.

[2]

- (c) The student has forgotten which wire he used to record the data in each column of Table 6.2.

- (i) Decide which wire, **X** or **Y**, produced the results shown in column 1, and which wire produced the results shown in column 2.

Complete the sentences.

Column 1 shows the data for wire .....

Column 2 shows the data for wire .....

[1]

- (ii) Explain your choice in (c)(i) by stating how the lengths and thicknesses of the wires affect their electrical resistance.

.....

.....

.....

..... [2]



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**COMBINED SCIENCE**

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| 4     |  |
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| Total |  |

This document consists of **18** printed pages and **2** blank pages.



- 1 A student performed an experiment to investigate what affects the diffusion of acid into agar. Agar blocks of three different sizes (Fig. 1.1) were cut. The agar contained phenolphthalein indicator and alkali and so was pink in colour.

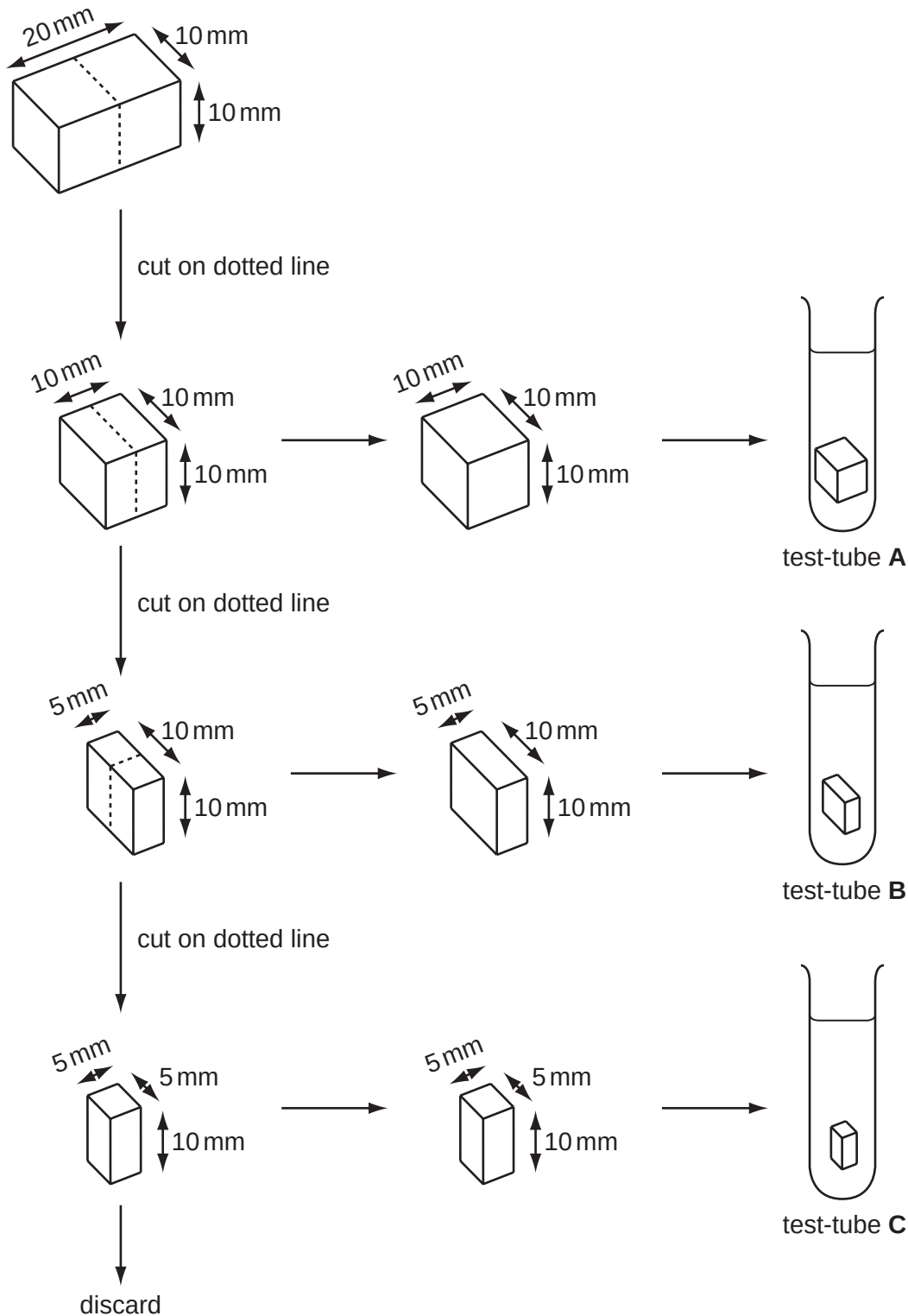


**Fig 1.1**

He placed each agar block into 20 cm<sup>3</sup> hydrochloric acid in separate test-tubes labelled **A**, **B** and **C**. The time taken for each block to become colourless (see Fig. 1.2) was then recorded. This is the point at which the acid reaches the centre of the block (Fig. 1.3).

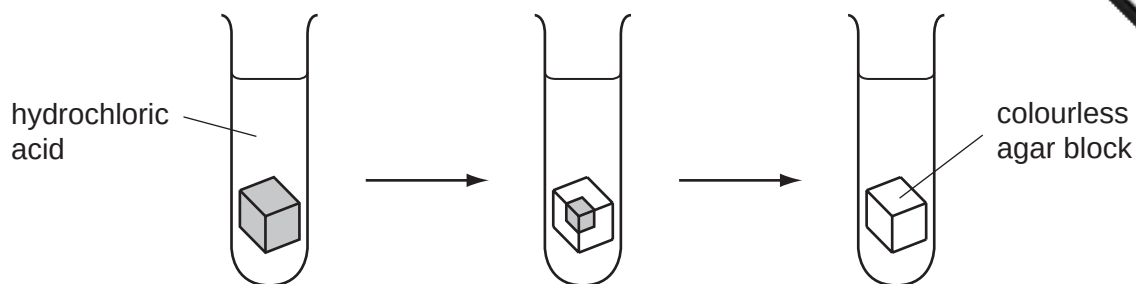


Fig. 1.2



Fig. 1.3

- (a) (i) Use the stopclocks shown in Fig. 1.3 to record, in Table 1.1, the times taken, in **seconds**, for the blocks to become colourless. [2]

Table 1.1

| tube                                    | A            | B           | C          |
|-----------------------------------------|--------------|-------------|------------|
| cube dimensions/mm                      | 10 x 10 x 10 | 10 x 10 x 5 | 10 x 5 x 5 |
| volume of block/mm <sup>3</sup>         | 1000         | 500         | 250        |
| surface area of block/mm <sup>2</sup>   | 600          | 400         | 250        |
| surface area/volume ratio               |              |             |            |
| time taken for block to go colourless/s |              |             |            |

- (ii) Explain why the blocks go colourless.

.....

.....

..... [2]

- (iii) Calculate the surface area : volume ratio for each block using the formula and record them in Table 1.1.

$$\text{ratio} = \frac{\text{surface area of block/mm}^2}{\text{volume of block/mm}^3}$$

[1]

- (iv) Explain the effect that decreasing the volume of the blocks has on the time taken for the blocks to become colourless.

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

- (b) Fig. 1.4 shows a cross section through the human ileum and a magnified image of one villus.

Using your answer to (a)(iv) and your own knowledge, explain how rapid diffusion of substances into the blood is ensured by the structure of the ileum and villi.

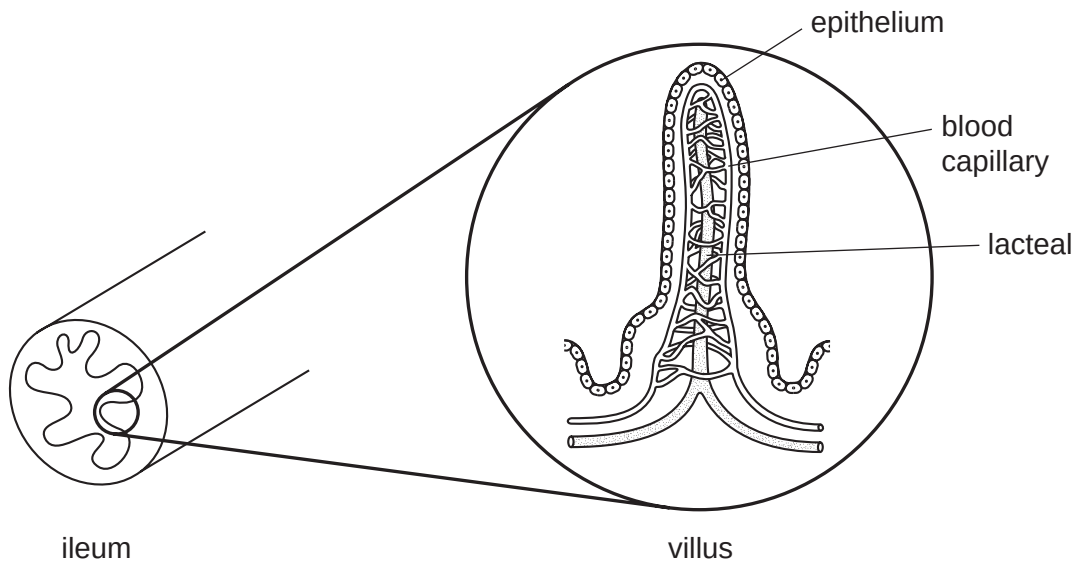


**Fig. 1.4**

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

Please turn over for Question 2.

- 2 A student carries out the following tests on solid **X**, which contains two metal salts.

Complete Table 2.1, which shows the tests on solid **X** and the student's observations and conclusions.

Table 2.1

| test                                                                                                                                                             | observation                             | conclusion                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------|
| (a) Mix one spatula full of solid <b>X</b> with solid calcium hydroxide in a test-tube. Heat gently.                                                             |                                         |                                   |
| (i) Test the gas with moist red litmus paper.                                                                                                                    | .....<br>[1]                            | ammonia gas is given off          |
| (ii) Hold a glass rod dipped in concentrated hydrochloric acid in the gas.                                                                                       | white smoke                             | .....<br>[1]<br>is formed.        |
| (b) Prepare a dilute solution of <b>X</b> in distilled water.                                                                                                    |                                         |                                   |
| (i) To a portion of the solution of <b>X</b> , add dilute sodium hydroxide until there is no further reaction.                                                   | .....<br>[2]                            | solid <b>X</b> contains zinc ions |
| (ii) Acidify a fresh portion of the solution of <b>X</b> with dilute nitric acid, then add barium chloride solution.                                             | white precipitate                       | .....<br>[1]                      |
| (iii) Acidify a fresh portion of the solution of <b>X</b> with dilute nitric acid, then add silver nitrate solution. Allow the tube to stand in bright sunlight. | white precipitate<br>which turns<br>[1] | .....<br>[1]                      |

(c) Suggest the names of **two** salts that may be contained in solid **X**.

1 .....

2 ..... [2]

(d) Write a balanced symbol equation for the chemical reaction seen in test (a)(ii).

..... [1]

- 3 When a light ray passes through a rectangular glass block, the ray is displaced from its original path onto a new path. This is shown in Fig. 3.1.

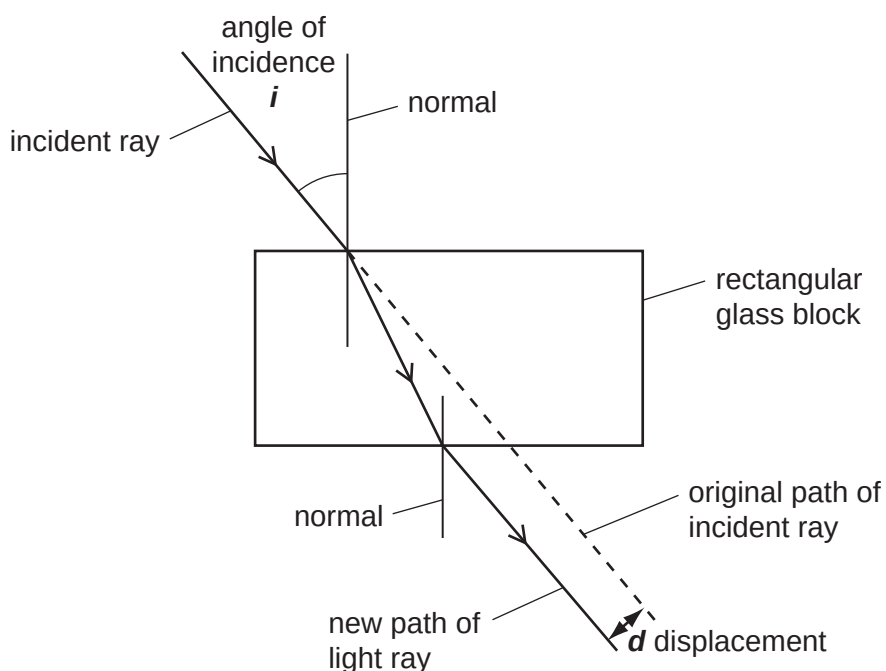


**Fig. 3.1**

A student is doing an experiment to find out how the value of the displacement distance,  $d$ , varies with  $i$ , the angle of incidence.

- He places a glass block on a sheet of paper and draws the outline of the block on it.
- He shines a narrow beam of light through the glass block.
- He marks the path of the incident ray on the paper.
- He measures  $i$ , the angle of incidence, and records the value in Table 3.1.
- He marks the new path of the light ray on the opposite side of the block.
- He removes the glass block from the paper and extends the line showing the original path of the light ray.
- He measures the displacement distance,  $d$ , shown in Fig. 3.1, to the nearest millimetre and records it in Table 3.1.
- He repeats the experiment, each time using a different angle of incidence, and records the results in Table 3.1.

**Table 3.1**

| experiment number              | 1  | 2  | 3  | 4 | 5  |
|--------------------------------|----|----|----|---|----|
| angle of incidence, $i/^\circ$ | 15 | 28 | 46 |   | 77 |
| displacement, $d/\text{mm}$    | 5  | 11 | 20 |   | 47 |

(a) Fig. 3.2 shows his diagram for experiment 4.

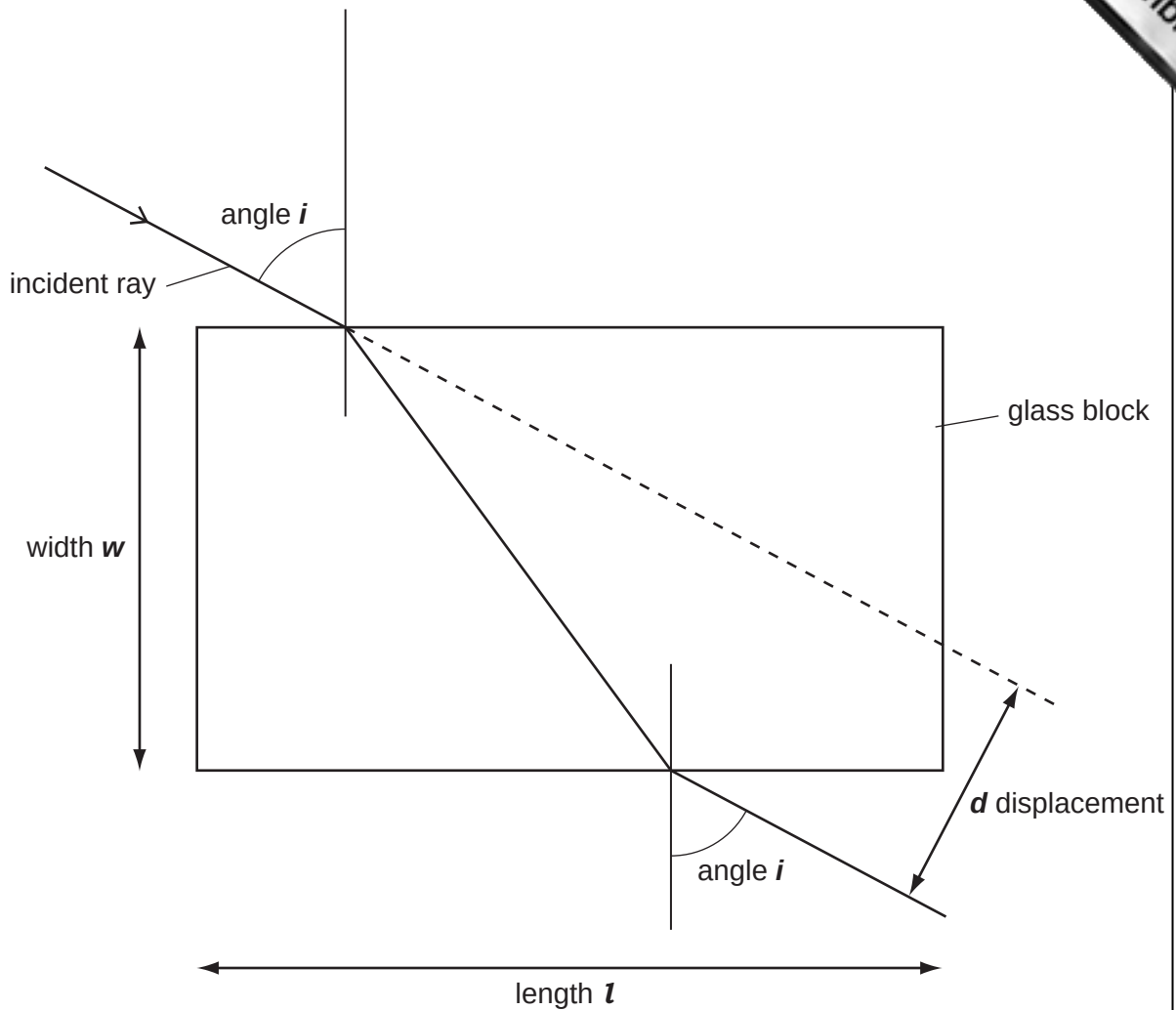


**Fig. 3.2**

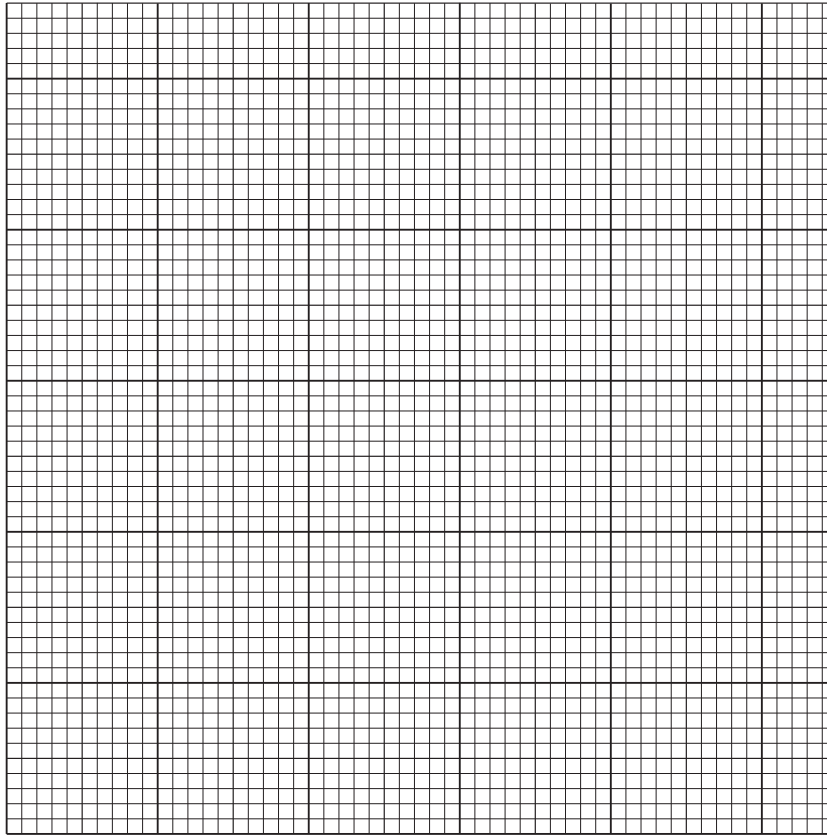
- (i) On Fig. 3.2, measure  $i$ , the angle of incidence, to the nearest degree. Record it in Table 3.1. [1]
- (ii) On Fig. 3.2, measure the displacement distance,  $d$ , in millimetres to the nearest millimetre, and record it in Table 3.1. [1]
- (iii) On Fig. 3.2, measure the length,  $l$ , and the width,  $w$ , of the glass block in millimetres to the nearest millimetre.

$l =$  ..... mm

$w =$  ..... mm [2]

- (b) (i) On the graph grid provided, plot a graph of the displacement distance,  $d$ , (y-axis) in millimetres against the angle of incidence,  $i$ . Use values of  $i$  from 0 to 90° and values of  $d$  from 0 to 80 mm.

Draw a smooth curve through the points and extend the line to the point  $i = 90^\circ$ .



[3]

- (ii) Use your graph to find the value of the displacement distance,  $d_{90}$ , when the angle of incidence is  $90^\circ$ .

Show how you do this on the graph.

$d_{90} = \dots\dots\dots$  mm [2]

- (c) Compare your answers to parts (a)(iii) and (b)(ii).

Complete this sentence.

**“In theory, if the angle of incidence of a light ray passing through a rectangular glass block is equal to 90 degrees, the displacement distance is equal to the ..... of the block.”**

[1]

- 4 (a) A student was studying cells under a microscope. She prepared cells from epidermis, placed them onto a slide and stained them using iodine solution.

The student wanted to measure the average length of epidermis cells. She placed a ruler with a millimetre scale on the stage of the microscope to find the diameter of the field of view. She looked down the microscope and saw the field of view in Fig. 4.1.

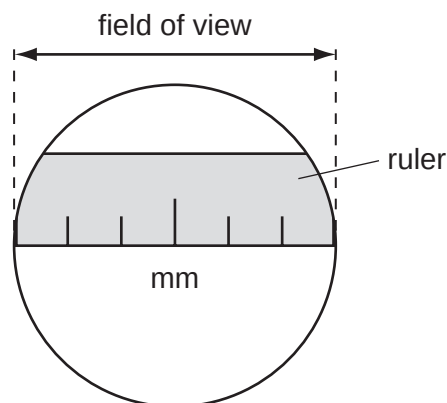


Fig. 4.1

- (i) How wide is the field of view of the microscope? ..... mm [1]
- (ii) The student removed the ruler and placed her slide under the microscope. She counted 15 cells end to end across the field of view.

Use your answer to (a)(i) to calculate the average length of an onion cell.

Show your working.

length of cell ..... mm [2]

- (b) A group of cells is shown in Fig. 4.2.

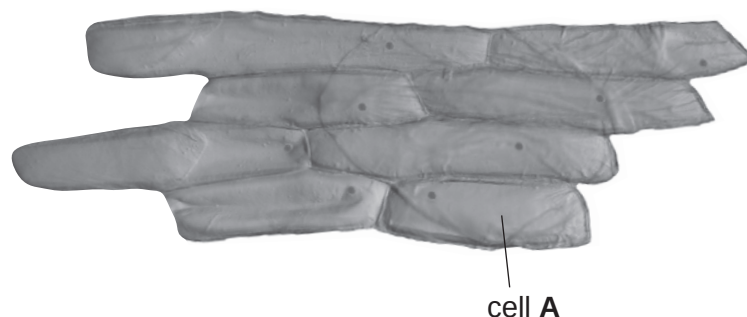


Fig. 4.2

- (i) Make a large drawing of cell **A** in the space provided. Label the nucleus and cell wall.

[1]

- (ii) Measure the length of cell **A** on **your** diagram at the longest part. See Fig. 4.3.

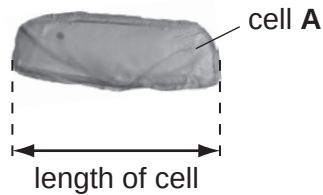


**Fig. 4.3**

length of cell **A** on **my** diagram ..... mm

Using the value for the average cell length from **(a)(ii)** and the length of cell **A** on your diagram, calculate the magnification of your drawing.

magnification = ..... [3]

- (c) The student looked at a diagram of a plant cell in a text book. This cell came from a leaf. It is shown in Fig. 4.4.

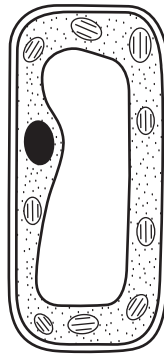


**Fig. 4.4**

- (i) Label **one** structure on Fig. 4.4 that is **not present** in onion epidermis cells. [1]
- (ii) Suggest a reason why this structure is missing from onion epidermis cells.

.....

..... [1]

- (iii) Label **one** structure on Fig. 4.4 that is present in onion epidermis cells but **not** visible in Fig. 4.2 or Fig. 4.3. [1]

Please turn over for Question 5.

- 5 The science teacher has asked the class to plan an experiment to compare the amount of citric acid in an orange, a lemon and a grapefruit. The acid in these fruits is citric acid.

The students have made a list of the steps in the experiment.

- Cut the orange with a knife and squeeze out the juice.
- Filter the juice and place it in a conical flask.
- Add a few drops of indicator.
- Add sodium hydroxide solution from a burette until the indicator changes colour.
- Note the volume of sodium hydroxide solution used.
- Repeat the steps above using a lemon and a grapefruit.

- (a) (i) Name an indicator suitable to use in this experiment and give its colours in acid and in alkali.

name of indicator ..... [1]

colour in acid .....

colour in alkali ..... [1]

- (ii) Suggest the name of the salt formed when citric acid reacts with sodium hydroxide.

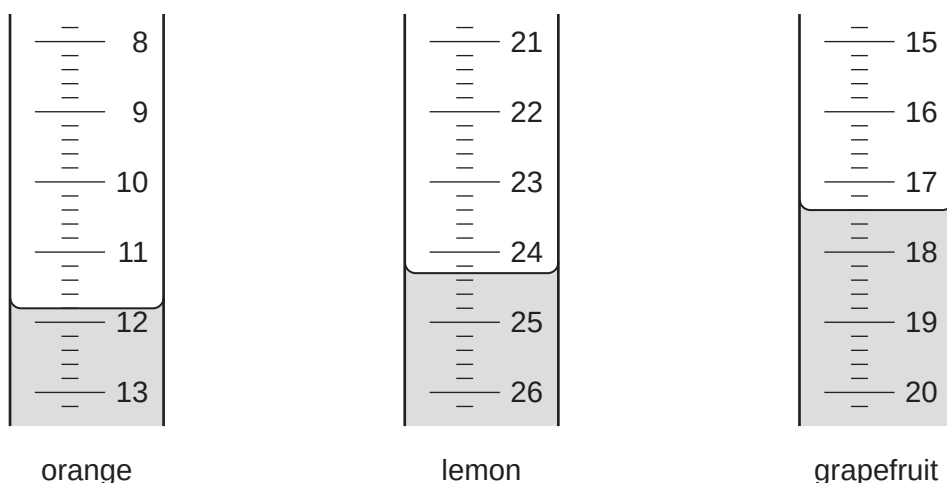
..... [1]

- (b) The students carry out the experiment. Table 5.1 shows the results.

**Table 5.1**

| juice                                   | orange | lemon | grapefruit |
|-----------------------------------------|--------|-------|------------|
| first burette reading / cm <sup>3</sup> | 0      | 0.8   | 4.7        |
| second reading / cm <sup>3</sup>        |        |       |            |
| volume added / cm <sup>3</sup>          |        |       |            |

- (i) Fig. 5.1 shows the burette scales for the second readings. Read the burette and record the results in Table 5.1.



second readings of burette

**Fig. 5.1**

- (ii) Complete Table 5.1 to show the volumes of sodium hydroxide added. [1]
- (iii) List the three fruits in order of the amount of acid they contain, with the fruit containing the most acid first.
- 1 (most acid) .....
- 2 .....
- 3 (least acid) ..... [1]
- (c) Suggest **two** ways in which this experiment must be modified so that the concentration of acid in the fruit juices may be measured, assuming that the same kind of acid is contained in each fruit.
- 1 .....
- 2 .....
- ..... [2]

- 6 The teacher is showing the class an apparatus for investigating the expansion of metals. For  
 A metal bar is heated to a known temperature to find the increase in its length. Fig. 6.1 shows the apparatus.

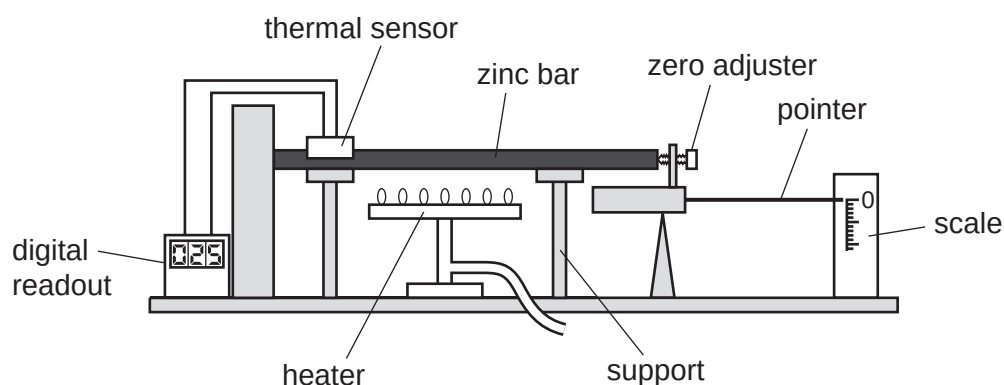


Fig. 6.1

Fig. 6.2 shows how the pointer measures the increase in length of the bar.

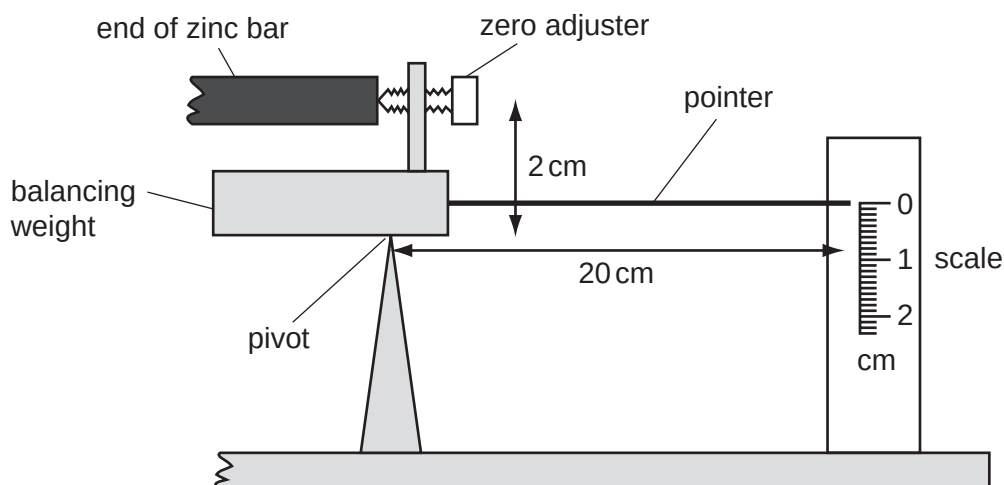


Fig. 6.2

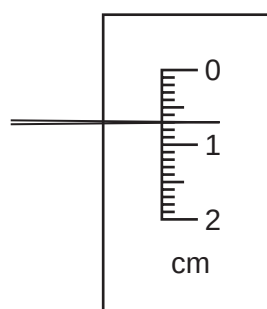
- The teacher places a zinc bar of length 20 centimetres on the supports.
- He adjusts the pointer until the scale reads 0 cm.
- He slowly heats the bar until the thermal sensor reads 300 °C.
- He reads the position of the pointer on the scale and records it in Table 6.1.
- He repeats the experiment with bars of three other metals.

Table 6.1

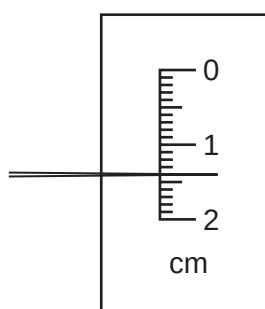
| metal                | zinc | iron | aluminium | copper |
|----------------------|------|------|-----------|--------|
| pointer reading / cm | 1.8  |      |           |        |
| expansion / mm       |      |      |           |        |

- (a) The pointer and scale for the metals iron, aluminium and copper are shown in Fig. 6.3.

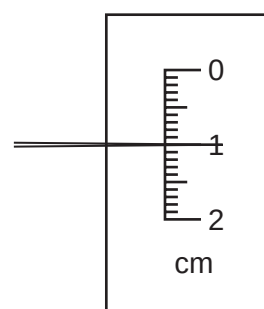
Read the scales. In Table 6.1, record the readings in centimetres to the nearest millimetre. [3]



pointer reading  
for iron bar



pointer reading  
for aluminium bar



pointer reading  
for copper bar

**Fig. 6.3**

- (b) (i) Explain why the expansion of the bar is found by dividing the pointer reading by 10. Use Fig. 6.2 to help you.

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

- (ii) Calculate the expansion of the bars **in millimetres** and complete Table 6.1.

[1]

- (c) Use the data in Table 6.1 and place the metals in order of the amount that they expanded.

1 (most expansion) .....  
 2 .....  
 3 .....  
 4 (least expansion) .....

[1]

(d) Fig.6.4 shows atoms in a solid metal.

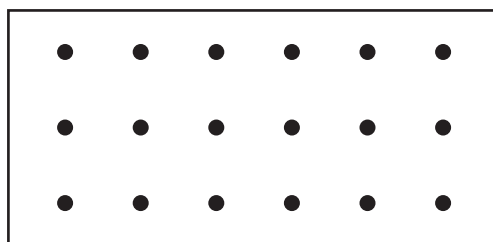


**Fig. 6.4**

- (i) Describe the motion of the atoms in a solid metal. You may draw on Fig. 6.4 to help your description.

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

- (ii) Explain why heating the metal causes it to expand.

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



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**COMBINED SCIENCE**

**0653/63**

Paper 6 Alternative to Practical

**October/November 2011**

**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 a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

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.

| For Examiner's Use |  |
|--------------------|--|
| 1                  |  |
| 2                  |  |
| 3                  |  |
| 4                  |  |
| 5                  |  |
| 6                  |  |
| Total              |  |

This document consists of **18** printed pages and **2** blank pages.





- 1 Fig. 1.1 shows the upper and lower surfaces of a leaf after being placed into boiling water.

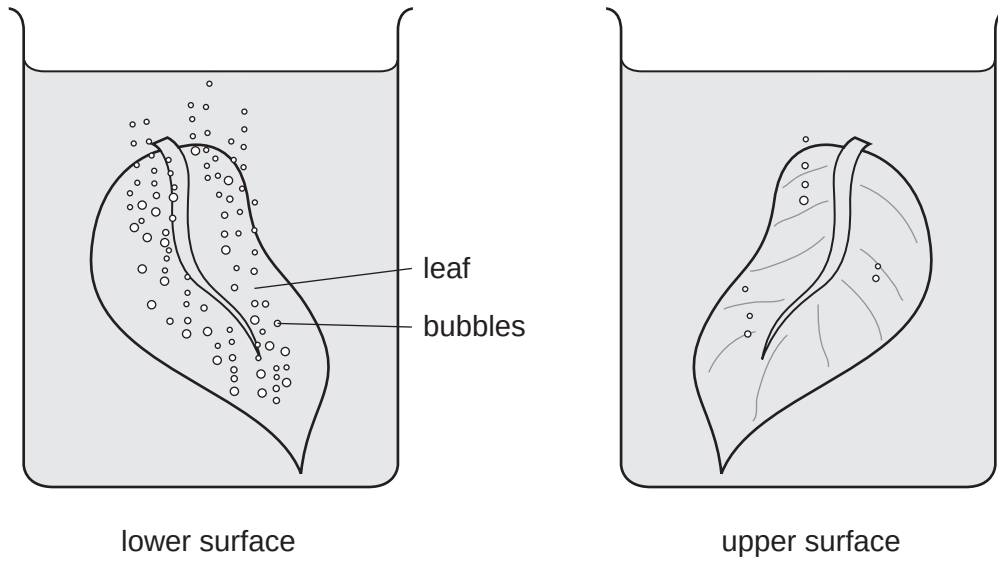


**Fig. 1.1**

- (a) (i) Explain why bubbles are produced.

.....

.....

..... [2]

- (ii) A second leaf was taken and its outline traced onto a piece of 15 cm x 15 cm squared paper. This tracing is shown in Fig. 1.2.

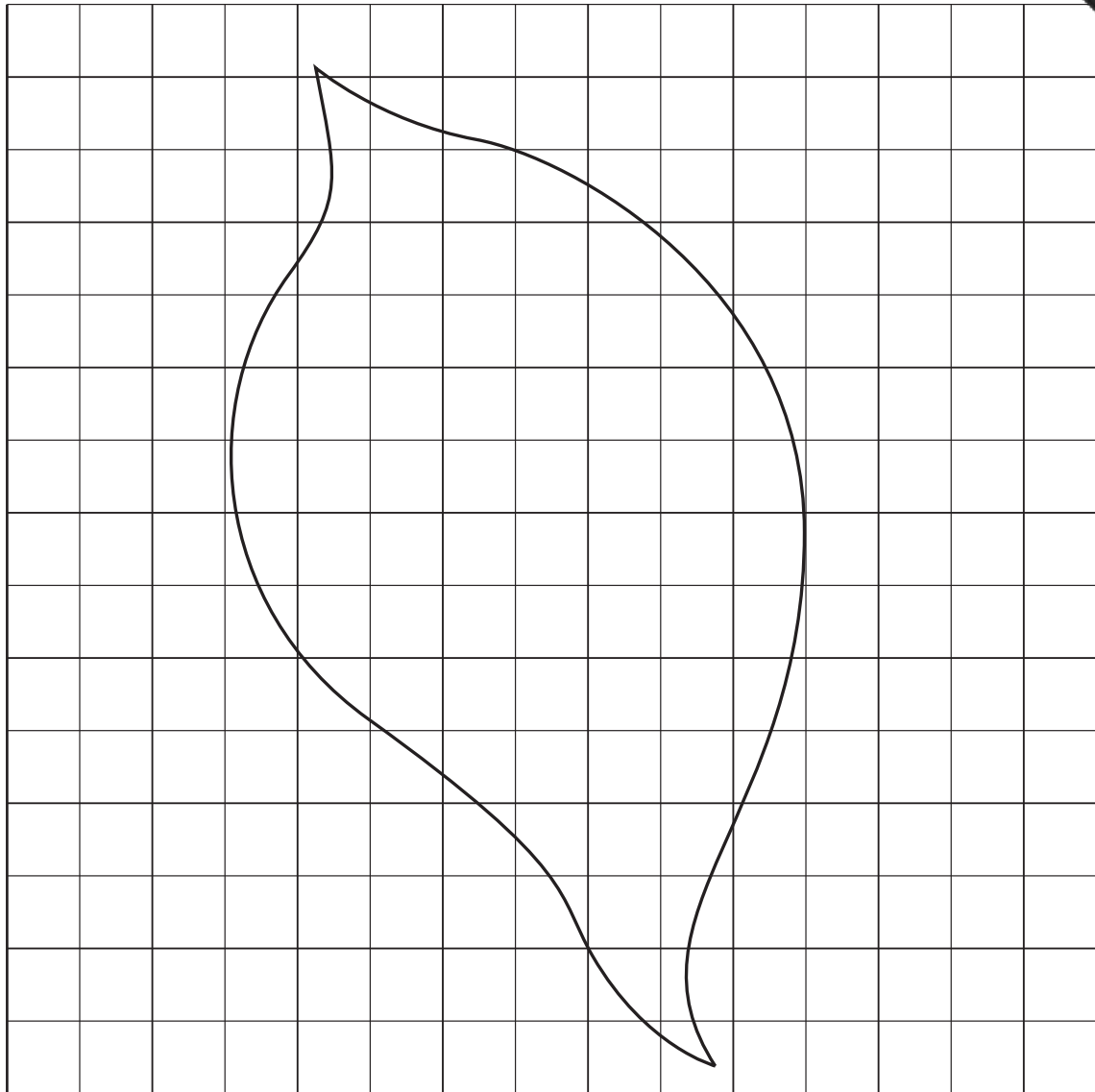


Fig. 1.2

- Write the letter **C** in the **complete** squares. Count the number of complete squares.

number of complete (**C**) squares = ..... [1]

- Write the letter **P** in any incomplete squares that have an area of half a square or more.

number of incomplete (**P**) squares = ..... [1]

- Ignore the rest of the squares.
- Add **C** + **P** to estimate the area of the leaf. You will use your answer in (a)(iii).

leaf area = ..... cm<sup>2</sup>

- (iii) There are approximately 100 stomata per **square millimetre** on the lower surface of this leaf.

Using the leaf surface area you have determined **(a)(ii)**, calculate the total number of stomata found on the lower surface of the leaf.

area of leaf in  $\text{mm}^2$  = .....

total number of stomata = ..... [2]

- (iv) There are usually fewer stomata found on the upper surface of a leaf.

Suggest why this is beneficial to a plant.

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

- (b) Fig. 1.3 shows an outline cross section of a piece of celery. The celery has been placed into red dye for 4 hours.

On Fig. 1.3, shade the areas to show where you would expect the red dye to be found.

Label the shaded areas with the correct name for this tissue.

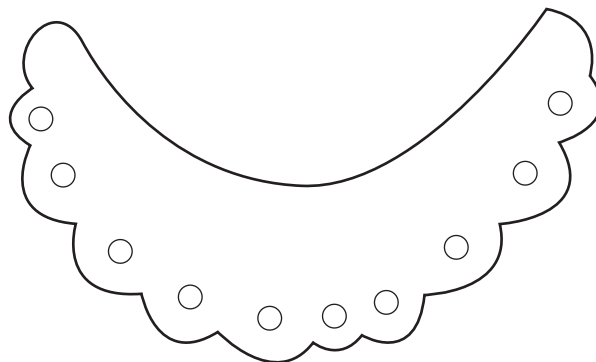


Fig. 1.3

[2]

- 2 The science class is investigating the properties of carbon dioxide. They are using the apparatus shown in Fig. 2.1 to make and test the gas. They carry out three experiments.

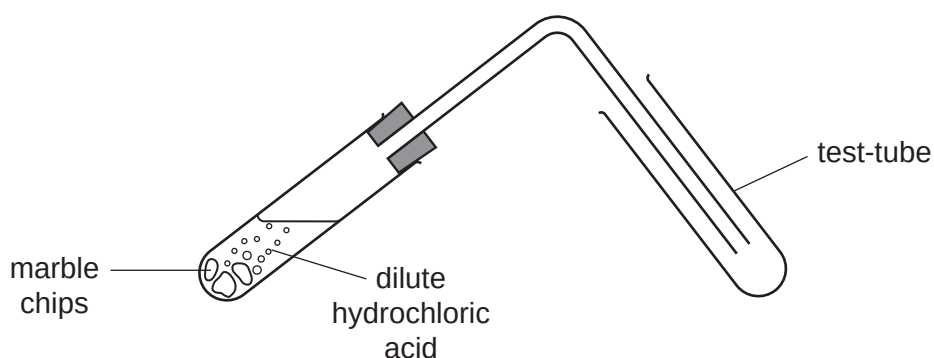


Fig. 2.1

### Experiment 1

They place about  $3\text{ cm}^3$  of distilled water in a test-tube and add a few drops of Universal Indicator. They then let the carbon dioxide bubble through the water and Universal Indicator. They see a colour change. They decide that a weak acid has been formed in the test-tube.

(a) (i) The colour changes from ..... to ..... [2]

(ii) Name the weak acid in the test-tube.

..... [1]

## Experiment 2

They wash out the test-tube and half-fill it with limewater. They bubble in carbon dioxide.

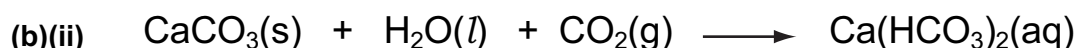
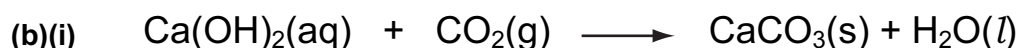
(b) (i) What does the class observe in the tube at first?

..... [1]

(ii) What does the class observe in the tube after more carbon dioxide has been bubbled in?

..... [1]

The teacher gives the class two equations for the reactions they observed in (b)(i) and (b)(ii).



(iii) Explain the meaning of the symbols used in the equations.

(aq) means .....

(g) means .....

(s) means ..... [3]

(iv) Insert **one** word to complete the following sentence, to explain what happens when carbon dioxide is bubbled into limewater.

There is a ..... of calcium carbonate which dissolves  
when more carbon dioxide is bubbled in. [1]

## Experiment 3

The class use the apparatus in Fig. 2.1 to collect carbon dioxide in a clean dry test tube. They insert a lighted splint into the test-tube of carbon dioxide. The flame is extinguished.

(c) Choose **two** correct statements from lines **A**, **B**, **C** and **D** below.

**A** Carbon dioxide burns in air.

**B** Carbon dioxide does not support combustion.

**C** Carbon dioxide does not burn in air.

**D** Carbon dioxide supports combustion.

The two correct statements are lines ..... and ..... [1]



- 3 A student is finding the resistances of single and parallel wires using the circuit shown in Fig. 3.1.

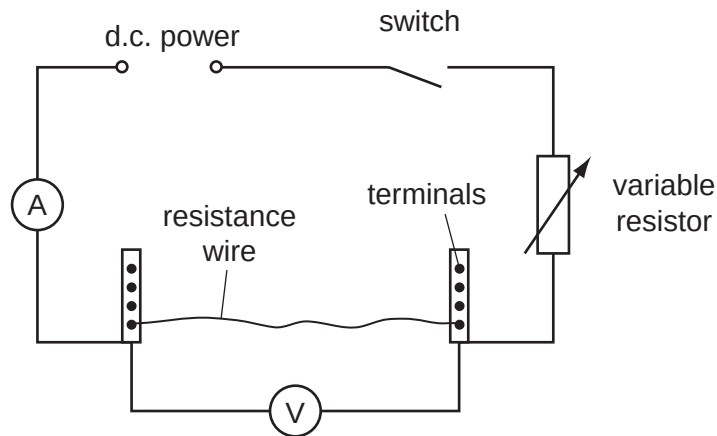


**Fig. 3.1**

- She connects a 25 cm length of resistance wire between the terminals.
- She closes the switch and notes the readings on the ammeter and voltmeter, and records them in Table 3.1.
- She opens the switch and then connects a second piece of resistance wire so that there are 2 identical wires in parallel between the terminals.
- She closes the switch and records the new ammeter and voltmeter readings.
- She finds the ammeter and voltmeter readings using 3 and 4 wires in parallel, recording them in Table 3.1 over the page.

(a) The ammeter and voltmeter readings for 2 wires in parallel are shown in Fig. 3.2.

(i) Read the ammeter and voltmeter and record the values in Table 3.1.

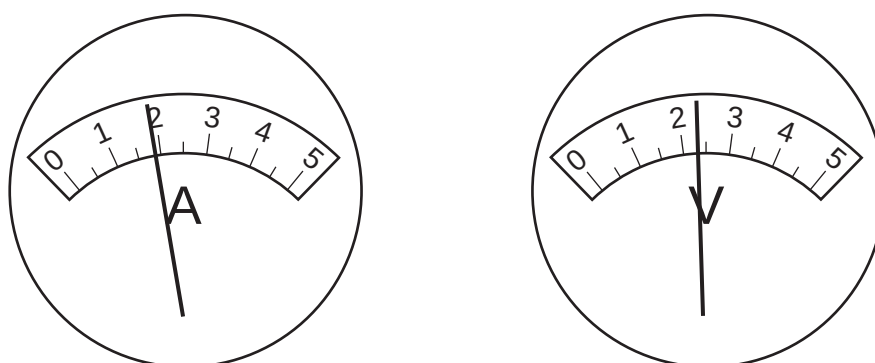


**Fig. 3.2**

(ii) Calculate the resistances for 2 wires and 3 wires in parallel.

Record them in the last column of Table 3.1.

Use the formula

$$\text{resistance in ohms} = \frac{\text{potential difference in volts}}{\text{current in amps}}$$

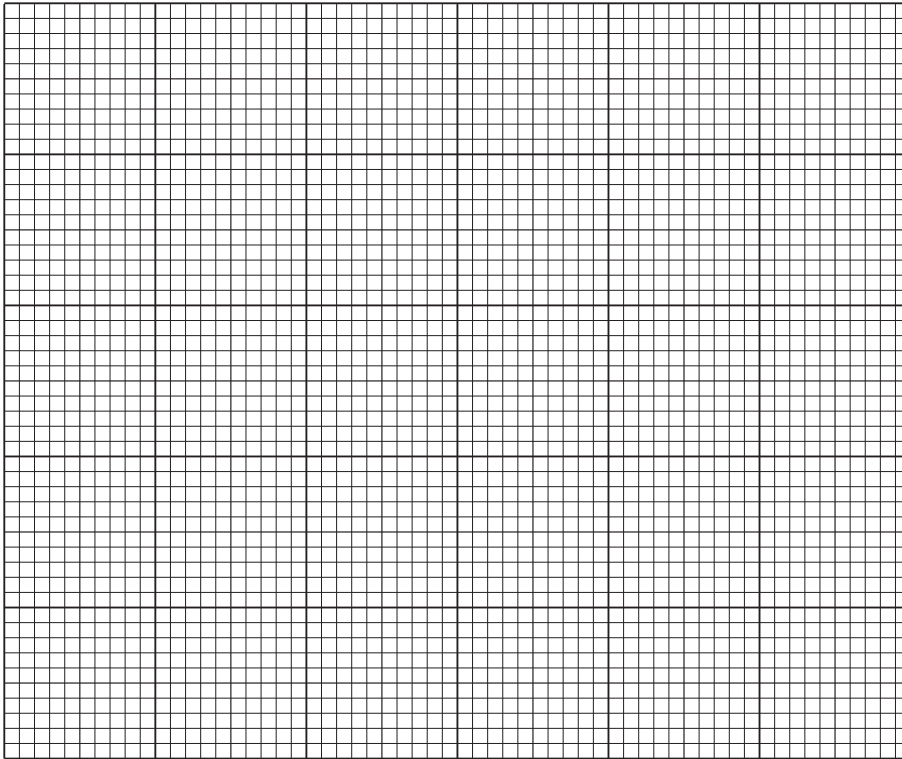
[2]

**Table 3.1**

| number of<br>resistance wires | current / A | potential<br>difference / V | total resistance /<br>ohms |
|-------------------------------|-------------|-----------------------------|----------------------------|
| 1                             | 1.0         | 2.5                         | 2.5                        |
| 2                             |             |                             |                            |
| 3                             | 2.5         | 2.0                         |                            |
| 4                             | 3.2         | 1.9                         | 0.6                        |

- (b) (i) Plot a graph of total resistance/ohms (vertical axis) against number of wires.

Draw a smooth curve, extending it so that the resistance of 5 wires in parallel can be read.



[3]

- (ii) Use your graph to find the resistance of 5 wires in parallel.

Show how you do this on the graph.

resistance of 5 wires in parallel = ..... ohms [2]

- (c) The student is not satisfied that the resistance she calculated for 1 wire is accurate.

Suggest how she can find a more reliable value using the same apparatus.

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

- 4 (a) A student carried out an experiment to investigate the effect of change of temperature on the activity of the enzyme pepsin.

Pepsin breaks down protein in the stomach. Its activity can be measured by timing how long it takes to break down a cloudy protein solution. The solution becomes clear.

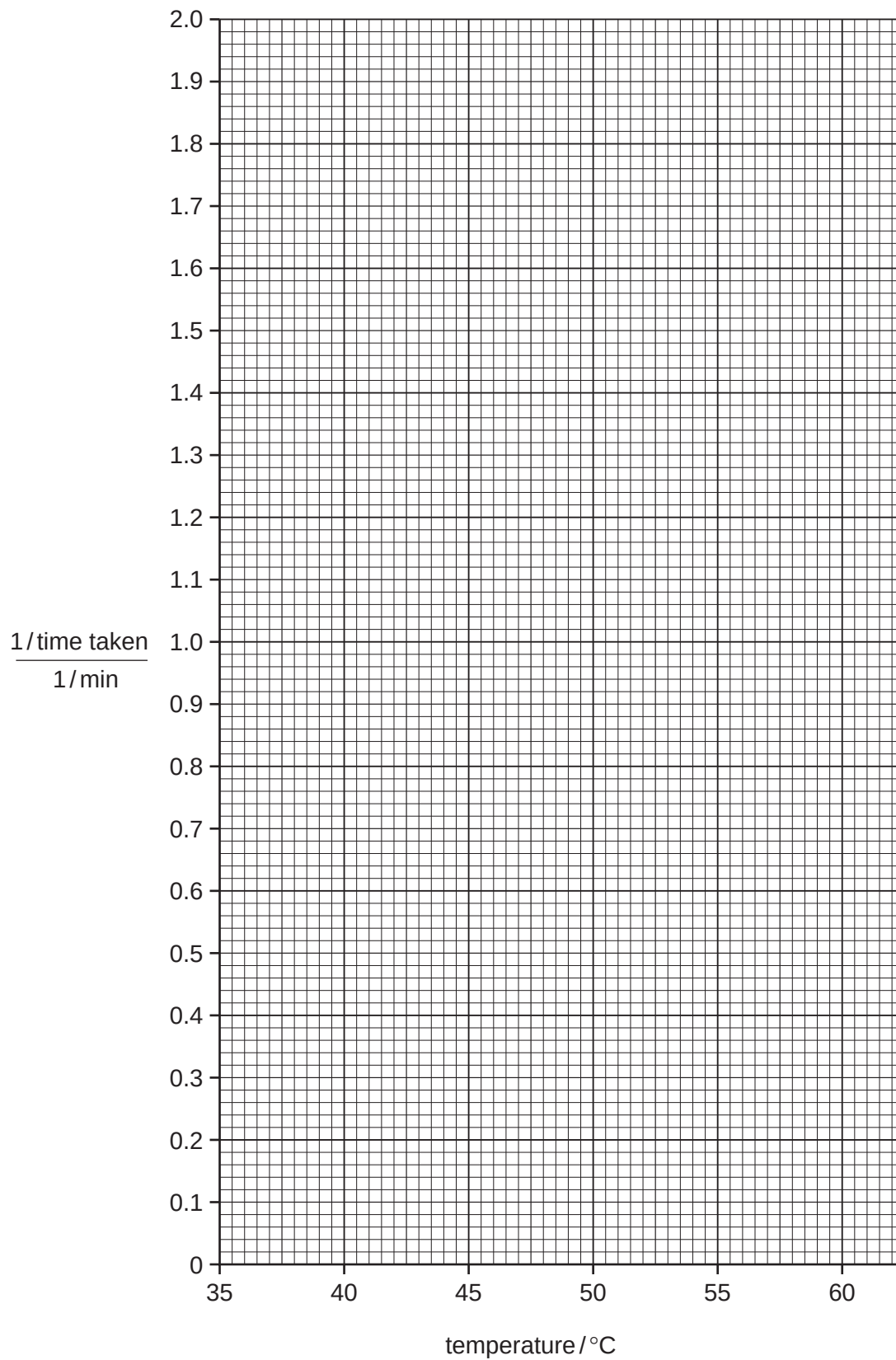
- The student put  $5.0 \text{ cm}^3$  of the protein solution into a test-tube and added  $1.0 \text{ cm}^3$  hydrochloric acid.
- He put  $1 \text{ cm}^3$  of pepsin solution into another test-tube.
- He put both test-tubes into a water bath set at  $35^\circ\text{C}$  until they both reached this temperature.
- He then poured the pepsin solution into the protein solution and timed how long it took for the mixture to go clear. He recorded his results in Table 4.1.
- The student repeated this procedure for each temperature.

**Table 4.1**

| temperature / $^\circ\text{C}$ | time taken for mixture to go clear / min | $\frac{1}{\text{time taken}} / \frac{1}{\text{min}}$ |
|--------------------------------|------------------------------------------|------------------------------------------------------|
| 35                             | 6.8                                      | 0.15                                                 |
| 40                             | 2.9                                      | 0.34                                                 |
| 45                             | 1.3                                      |                                                      |
| 50                             | 0.5                                      | 2.00                                                 |
| 55                             | 2.0                                      |                                                      |
| 60                             | 7.2                                      | 0.14                                                 |

Find the reciprocal of the time taken ( $1 / \text{time taken}$ ) for the temperatures  $45^\circ\text{C}$  and  $55^\circ\text{C}$ . This is a measure of the rate of reaction. Enter your results in Table 4.1.

- (b) (i) Plot the points to draw a graph of  $1/\text{time taken}$  against temperature on the grid provided. Draw a smooth curve through your points.



- (ii) Use the graph to estimate the optimum temperature for the activity of pepsin.

..... °C [1]

- (iii) Explain why you cannot be sure that this is an accurate optimum temperature.

..... [1]

- (c) Use your knowledge of enzyme action to explain the results

- (i) between 35 - 45 °C,

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

- (ii) between 55 - 60 °C.

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

- (d) The student suggested that there should be another two tubes set up for each temperature.

**tube 1**

5.0 cm<sup>3</sup> of the protein solution + 1 cm<sup>3</sup> water + 1 cm<sup>3</sup> pepsin solution

**tube 2**

5.0 cm<sup>3</sup> of the protein solution + 1 cm<sup>3</sup> hydrochloric acid + 1 cm<sup>3</sup> water

Explain the purposes of **tube 1** and **tube 2**.

tube 1 .....  
 .....  
 .....

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

- 5 A student is investigating the dyes contained in three inks, 1, 2 and 3.

He has put spots of the inks on the start line that he has marked on a piece of chromatography paper. He has formed the paper into a tall cylinder. His arrangement is shown in Fig. 5.1.

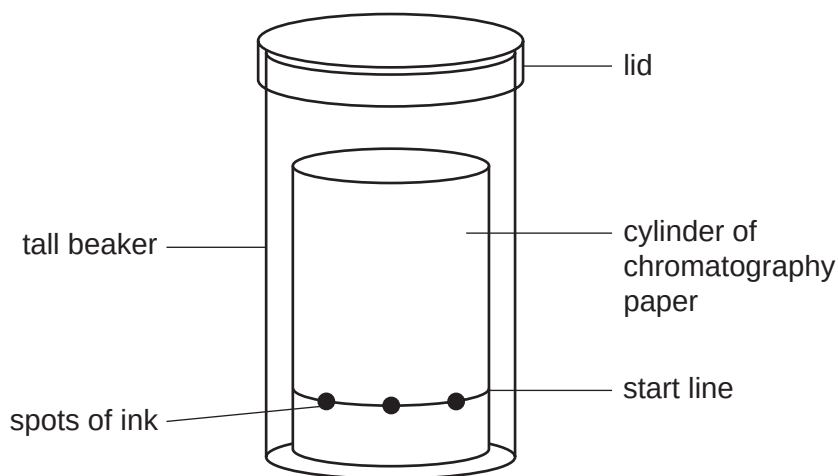


**Fig. 5.1**

The student is now ready to pour some liquid into the tall beaker to separate the dyes in the inks.

- (a) (i) Name a liquid that he can use to separate the dyes in the inks.

..... [1]

- (ii) On Fig. 5.1, draw a line to show how much of this liquid the student must place in the beaker. [1]

- (iii) Explain why a lid must be placed on the beaker.

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

- (iv) Suggest the length of time that should be allowed for the dyes to separate.

..... mins [1]

Fig. 5.2 shows the results of the experiment.

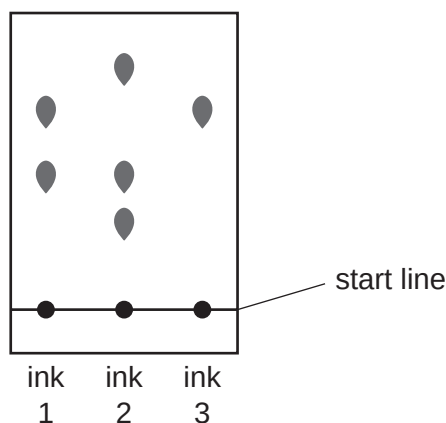


**Fig. 5.2**

**(b)** Suggest **one** conclusion that can be made by comparing the spots obtained from each of

**(i)** ink 1 and ink 2,

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

**(ii)** ink 2 and ink 3.

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

**(c)** The student thinks that one of the three dyes contained in ink 2 may act as an acid-base indicator.

Describe how he can find out which of the three dyes will act as an indicator.

Name **two** reagents that he can use in this experiment.

reagent 1 .....

reagent 2 .....

.....  
 .....  
 .....  
 .....  
 ..... [4]

- 6 The bending of light when it travels from air into a liquid, or from a liquid into the air, is known as refraction.

A student is trying to compare the refraction of light by salty water and by fresh water. He has placed a coin at the bottom of an empty bucket. A ruler is placed vertically a short distance from the bucket.

The student notes the position of his eye next to the ruler when he can just see the coin above the rim of the empty bucket. This is shown in Fig. 6.1.

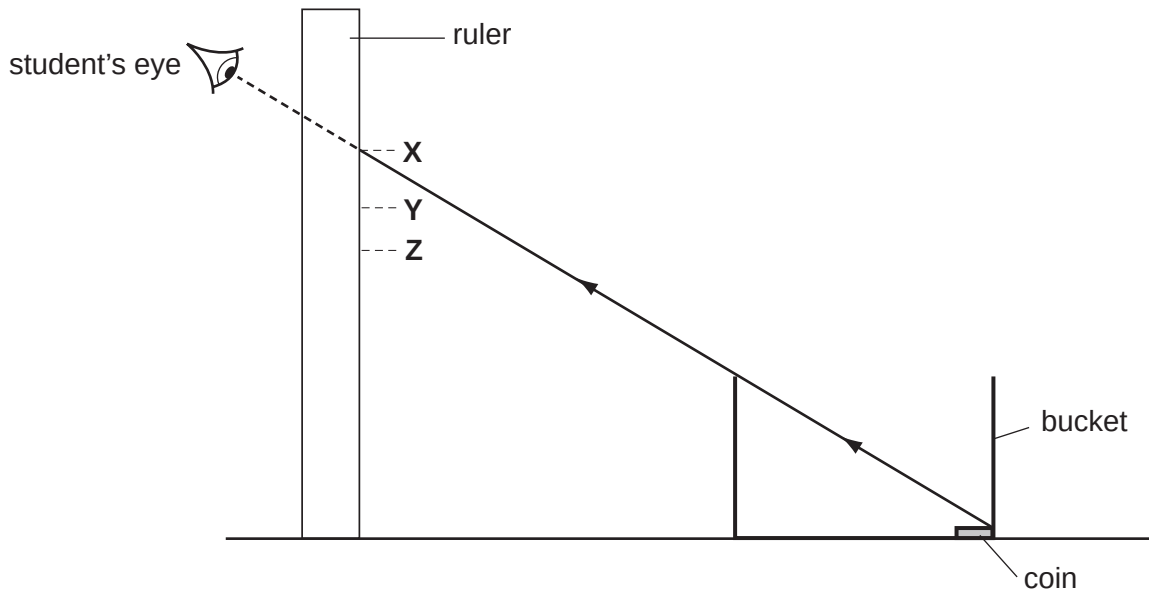


Fig. 6.1

- He records the position of his eye, point **X**, in Table 6.1.
- He fills the bucket with fresh water.
- He finds and records the new position of his eye when he can just see the coin, point **Y**.
- He empties the bucket and refills it with salty water.
- He finds and records point **Z** when he can just see the coin.

Fig. 6.2 shows a scale diagram of the experiment.

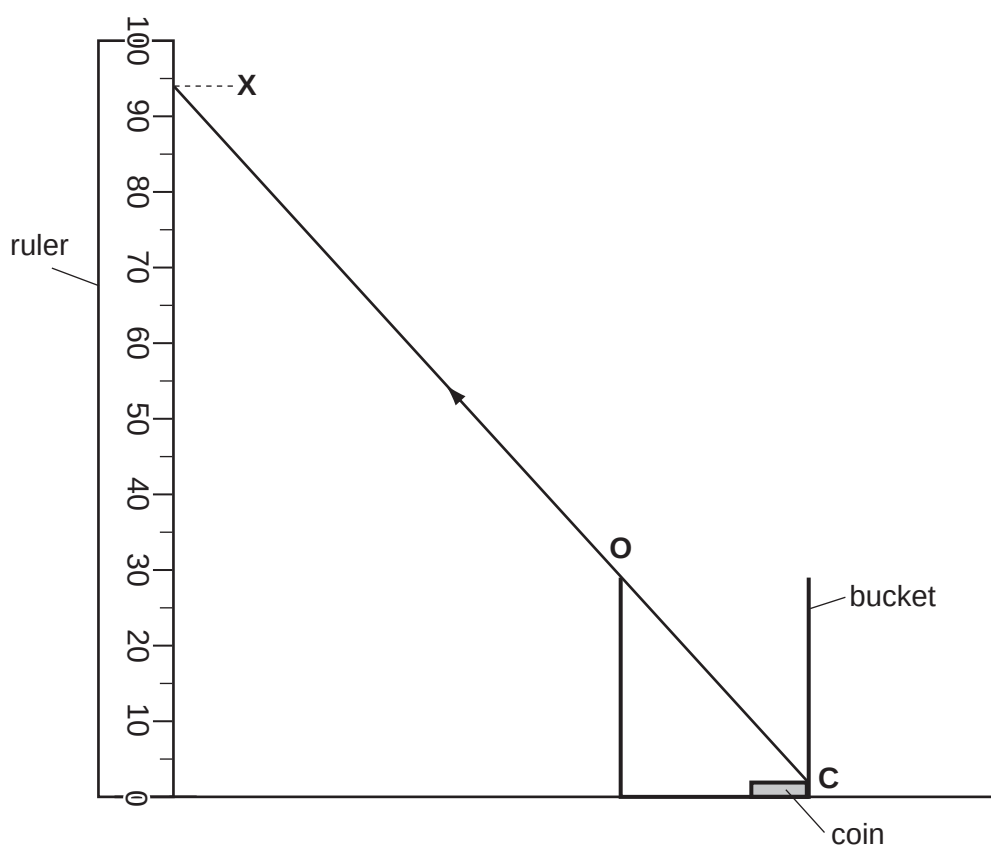


Fig. 6.2

The line **XC** shows a ray of light travelling from the coin to the student's eye. Point **O** is on this ray, just above the rim of the bucket.

- (a) On the ruler in Fig. 6.2, mark and label the points **Y** and **Z**. Use the data from Table 6.1. [2]

Table 6.1

| contents of the bucket | point    | position on ruler/cm |
|------------------------|----------|----------------------|
| air                    | <b>X</b> | 94                   |
| fresh water            | <b>Y</b> | 58                   |
| salty water            | <b>Z</b> | 51                   |

- (b) On Fig. 6.2, draw the straight lines **YO** and **ZO**. See Fig. 6.1. [1]

- (c) Measure and record, to the nearest millimetre, the length of the lines that you have drawn on Fig. 6.1, and the length of line **XO**.

(i) **YO** ..... mm [1]

(ii) **ZO** ..... mm [1]

(iii) **XO** ..... mm [1]

- (d) The refractive index of a liquid is a measure of the bending of light as it enters or leaves the liquid.

- (i) Calculate the refractive index of fresh water using the formula below.

$$\text{refractive index} = \frac{\text{length of the line } \mathbf{XO} / \text{mm}}{\text{length of the line } \mathbf{YO} / \text{mm}}$$

refractive index of fresh water = ..... [1]

- (ii) Calculate the refractive index of salty water using the formula below.

$$\text{refractive index} = \frac{\text{length of the line } \mathbf{XO} / \text{mm}}{\text{length of the line } \mathbf{ZO} / \text{mm}}$$

refractive index of salty water = ..... [1]

- (e) (i) A bird is trying to catch a fish that is swimming below the surface of a fresh river. The bird and the fish are shown in Fig. 6.3.

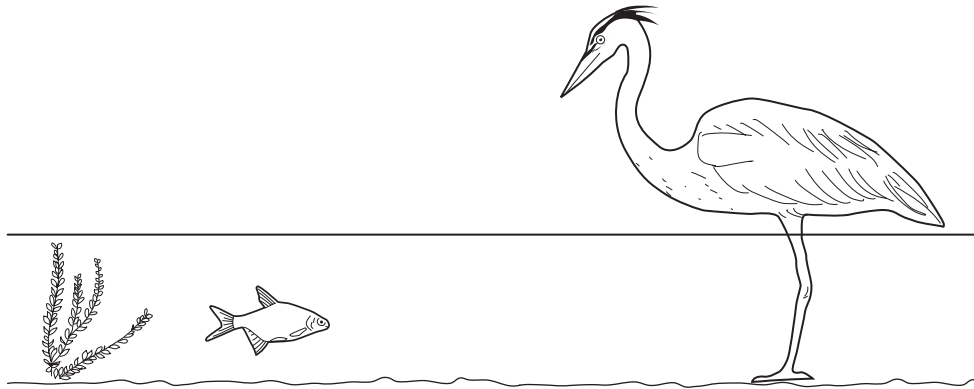


Fig. 6.3

Should the bird aim his beak above or below the position at which he sees the fish?

Explain your answer.

.....

.....

..... [1]

- (ii) How should the aim of the bird change if the fish is swimming in salty seawater instead of fresh water?

Explain your answer.

.....

.....

..... [1]