



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
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**PHYSICAL SCIENCE**

**0652/62**

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 or graphs.

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	
<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<b>5</b>	
<b>6</b>	
<b>Total</b>	

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





- 1 The science teacher gives the students three pieces of rock of different kinds. Rock **A** is black, rock **B** is green and rock **C** is white. The rocks are shown in Fig. 1.1.

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rock **A**

rock **B**

rock **C**

**Fig. 1.1**

The students use the data in Table 1.1 to try to identify the rocks.

**Table 1.1**

name of rock	composition	colour	density in g/cm <sup>3</sup>
<b>basalt</b>	metal silicates	black	3.0
<b>coal</b>	mainly carbon	black	1.3
<b>gypsum</b>	calcium sulfate	white	2.8
<b>malachite</b>	copper carbonate	green	3.8
<b>marble</b>	calcium carbonate	white	2.6
<b>quartz</b>	silicon dioxide	white	2.6

The students do the following to find the densities of rock **A**, rock **B** and rock **C**.

- They weigh rock **A** to find its mass and record it in Table 1.2.
- They fill a displacement can full of water and wait until no more water runs out of the spout.
- They immerse rock **A** in the water and collect the displaced water in a measuring cylinder to find its volume. See Fig. 1.2. They record the volume in Table 1.2.
- They repeat the experiment with rock **B** and **C**.

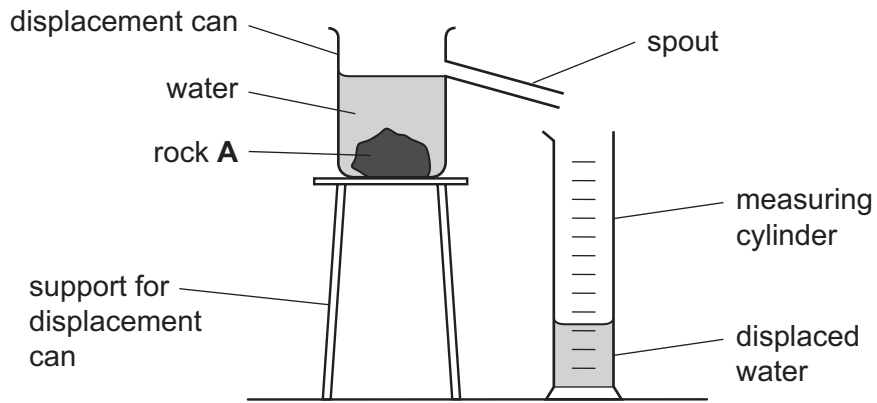


Fig. 1.2

Table 1.2

rock	mass/g	volume of water displaced/cm <sup>3</sup>	density g/cm <sup>3</sup>
<b>A</b>	55.9	43	1.3
<b>B</b>			
<b>C</b>			

- (a) The balance windows for the masses of rock **B** and **C** are shown in Fig. 1.3. Record the masses in Table 1.2. [2]

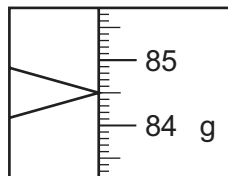
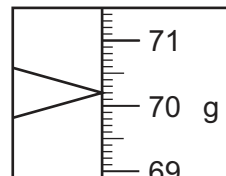
mass of rock **B**mass of rock **C**

Fig.1.3

- (b) The measuring cylinder scales for the volumes of water displaced by rocks **B** and **C** are shown in Fig. 1.4. Record the volumes in Table 1.2. [2]

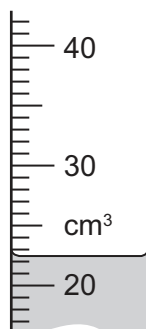
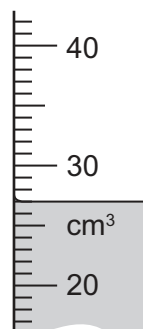
volume of rock **B**volume of rock **C**

Fig.1.4

- (c) (i) Calculate the density of rock **B**. Show how you calculate this value in the space below.

density of rock **B** ..... g/cm<sup>3</sup>

Record the density of rock **B** in Table 1.2. [1]

- (ii) Calculate the density of rock **C**. Show how you calculate this value in the space below.

density of rock **C** ..... g/cm<sup>3</sup>

Record the density of rock **C** in Table 1.2. [1]

- (d) (i) Use the information in Fig. 1.1 and Tables 1.1 and 1.2 to suggest the identity of rock **A**.

Rock **A** is ..... [1]

- (ii) Suggest an experiment that you could carry out to confirm the identity of rock **A**.

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

- (e) Using the data in Tables 1.1 and 1.2, the students still cannot name rock **C**.

Describe an experiment to decide the identity of rock **C**. State what you would do and give the results that you expect.

.....  
 .....  
 .....  
 .....  
 ..... [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.

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Table 2.1

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

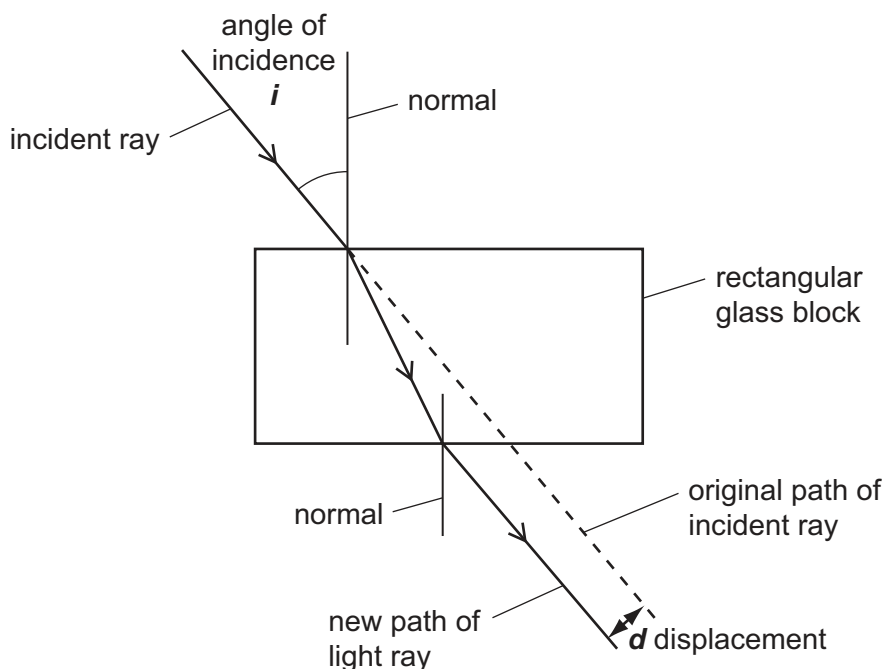
.....

[1]

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- 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.

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**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.

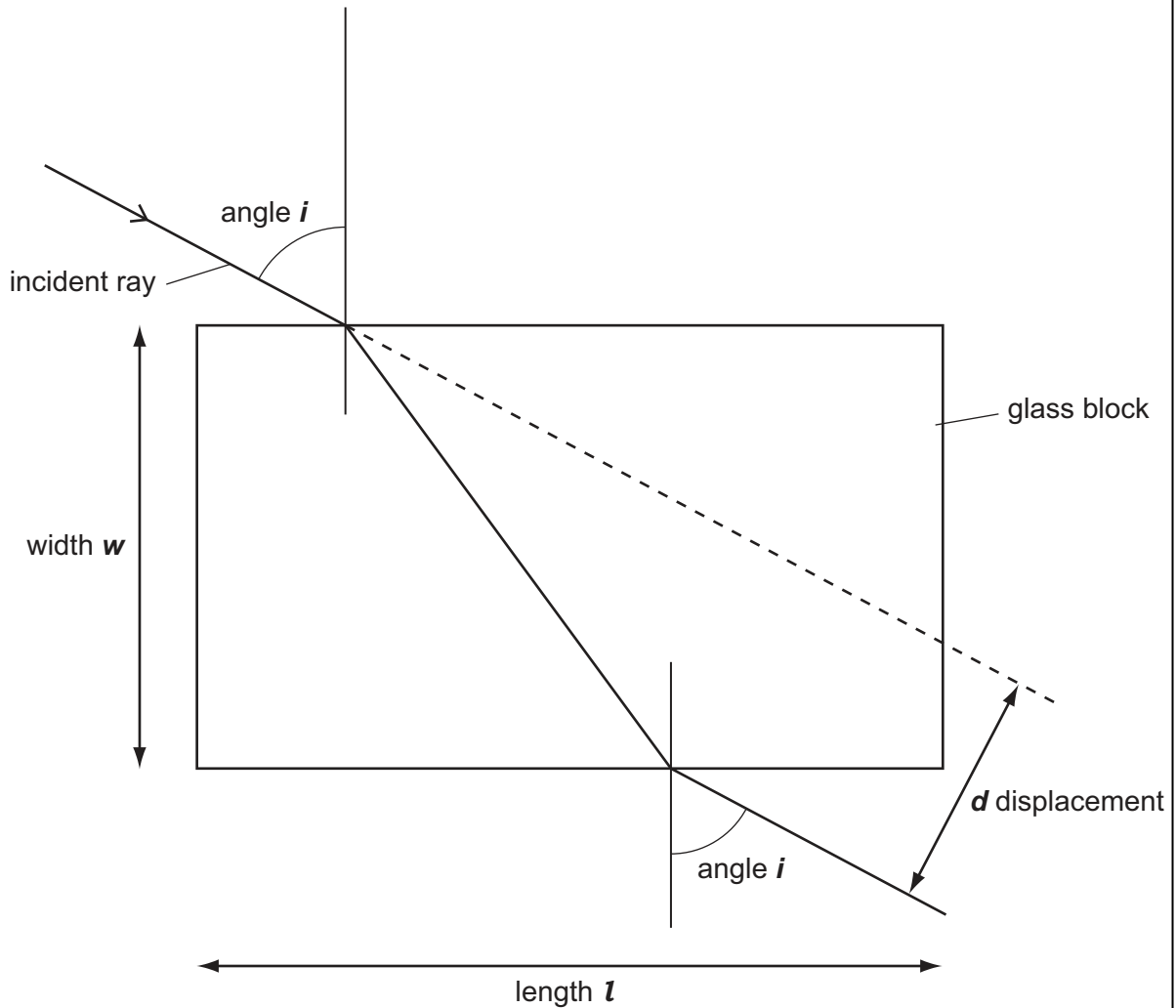
**Table 3.1**

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.

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**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.

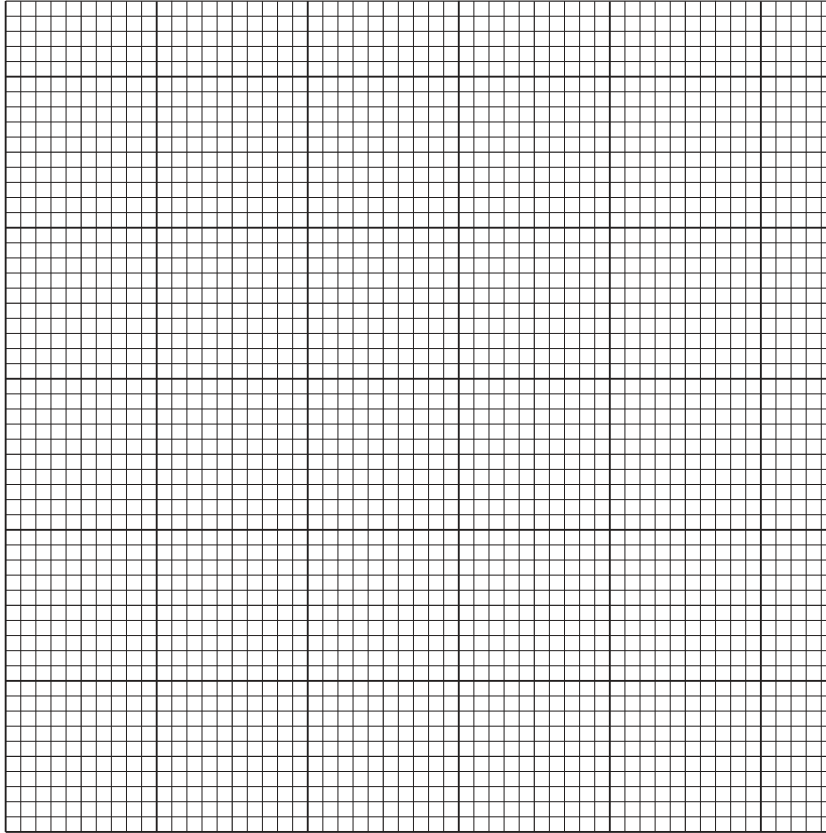
$l =$  ..... mm

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

- (b) (i) On the graph grid provided, plot a graph of the displacement distance,  $d$ , (vertical 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.

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Use

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°.

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]

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- 4 The science teacher is showing the class an experiment. She is using a steel ball and a runway as shown in Fig. 4.1. The runway consists of a 1 metre long sloping section (**AB**) and a 5 metre long horizontal section (**BC**). There is a smooth flexible hinge at point **B**. Contacts for an automatic timer are placed at point **B** and point **C**.

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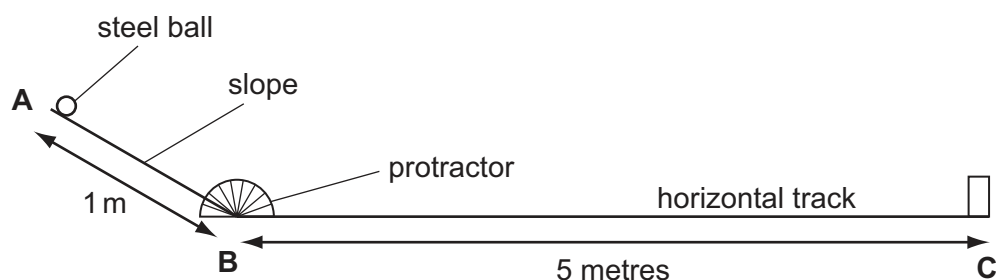


Fig. 4.1

- Using a large protractor, the teacher sets the angle of the slope at 5 degrees.
- She places the steel ball at point **A** and releases it.
- The steel ball rolls down the slope and at point **B** the timer switches on automatically.
- When the ball reaches point **C** the timer switches off. The teacher records the reading on the timer in Table 4.1.
- She then changes the angle of the slope and repeats the experiment four more times.

Table 4.1

experiment number	angle of slope / degrees	time taken from point B to point C / s
1	5	3.95
2		2.50
3		2.00
4	30	1.60
5	45	1.35

Fig. 4.2 shows the contacts of the automatic timer switch at point **B**. The timer starts when the circuit is completed.

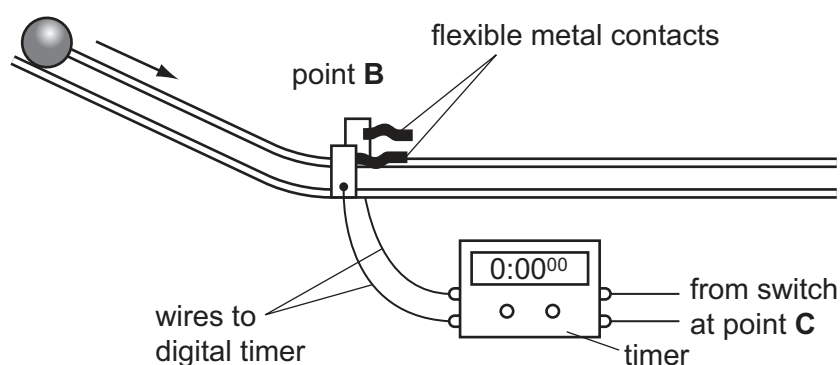


Fig. 4.2

(a) Explain how the steel ball switches on the timer as it passes point B.

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

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(b) Fig. 4.3 shows the protractor readings for the two missing values in Table 4.1.

Read the protractors and record the angles in Table 4.1. [2]

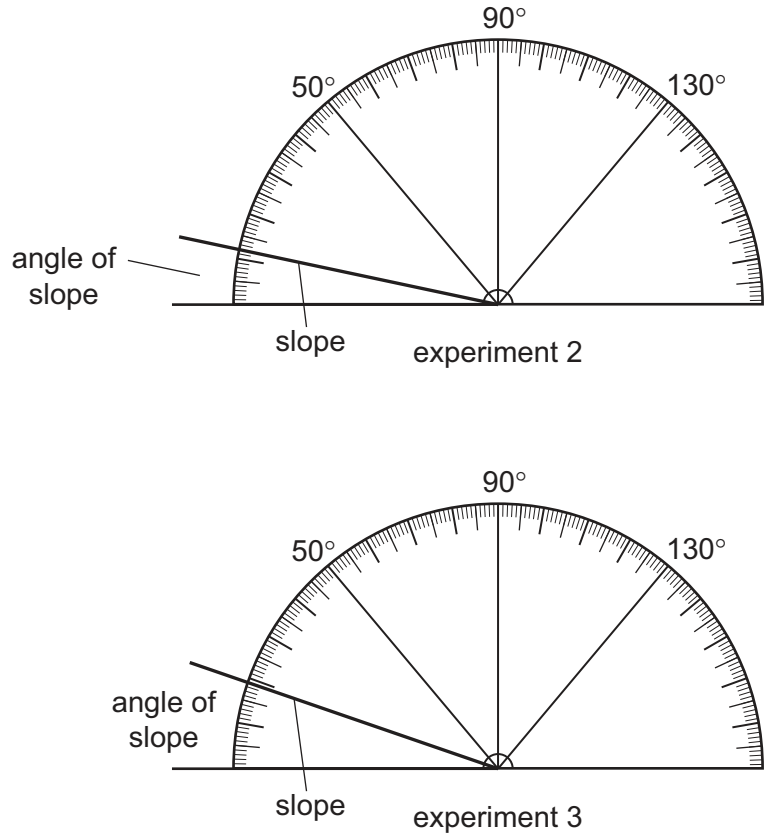
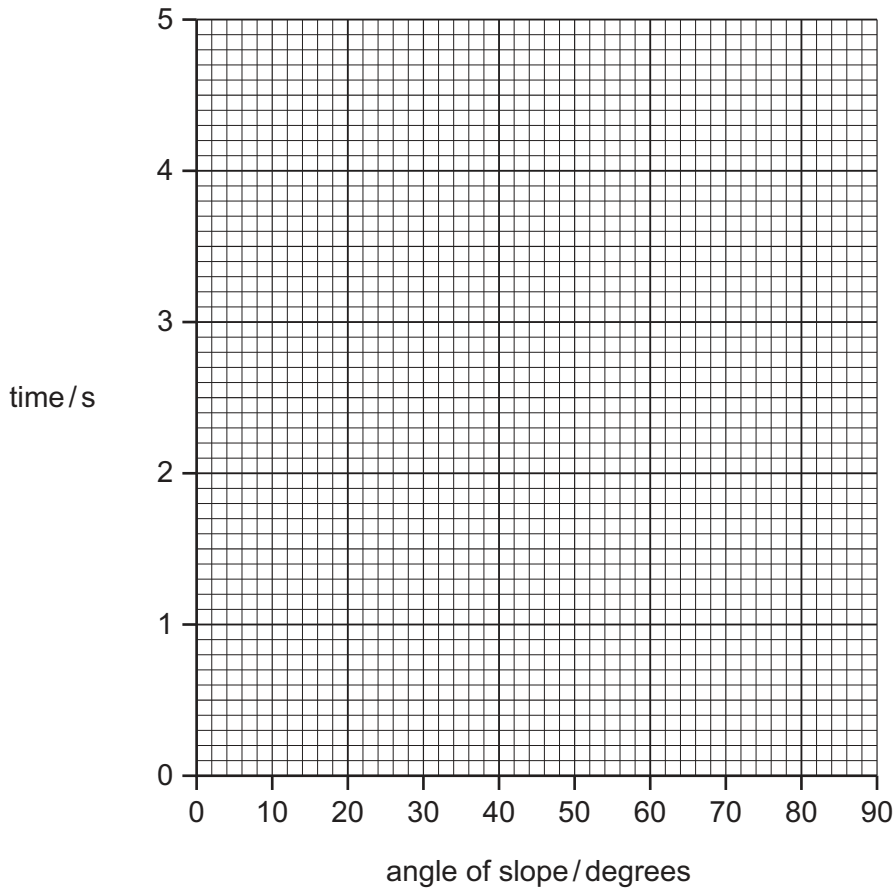


Fig. 4.3

(c) (i) On the graph grid below, plot the data from Table 4.1. Draw a smooth curve to join the points.

For  
Examiner's  
Use



[2]

(ii) Use the graph to suggest how long the steel ball will take to travel from point **B** to point **C** if the angle of slope is 70 degrees. Show how you do this on the graph.

time taken = ..... s [2]

(d) What type of energy does the steel ball have when it is at

(i) point **A**, ..... [1]

(ii) point **B**? ..... [1]

(e) Describe the motion of the ball as it travels from point **A** to point **B**.

..... [1]

**Please turn over for Question 5.**

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

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Use

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.

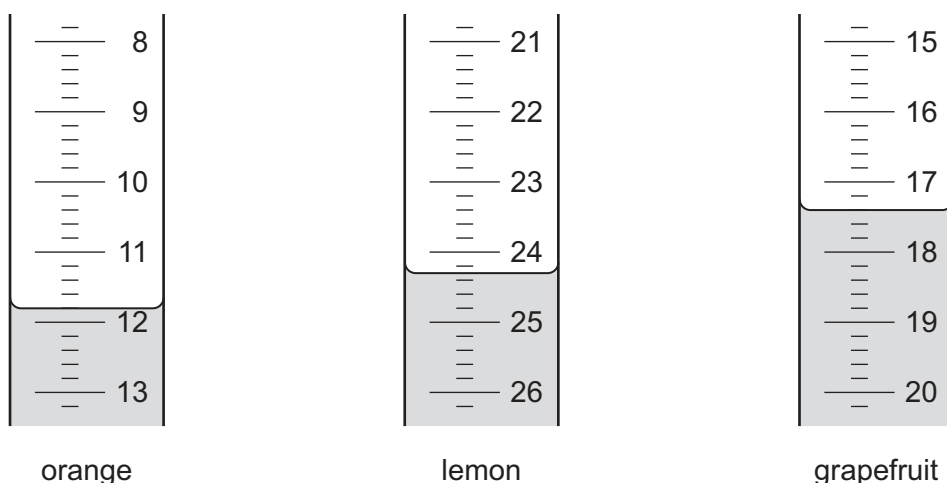
**Table 5.1**

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 scales and record the results in Table 5.1. [3]

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Use



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.

A metal bar is heated to a known temperature to find the increase in its length. Fig. 6.1 shows the apparatus.

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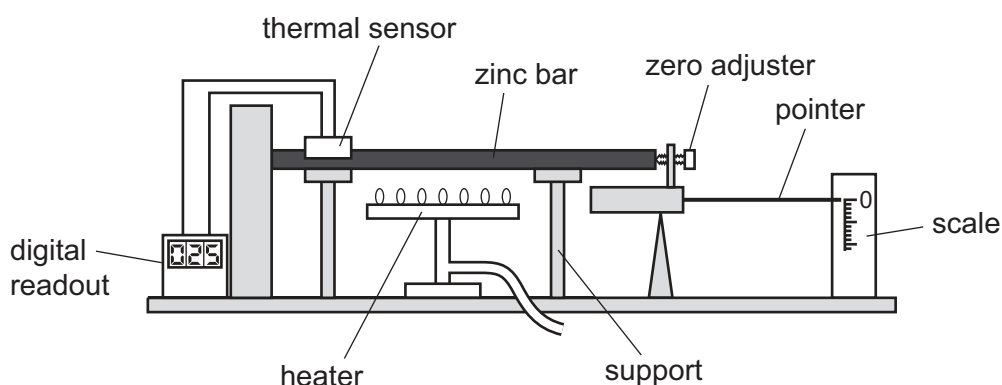


Fig. 6.1

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

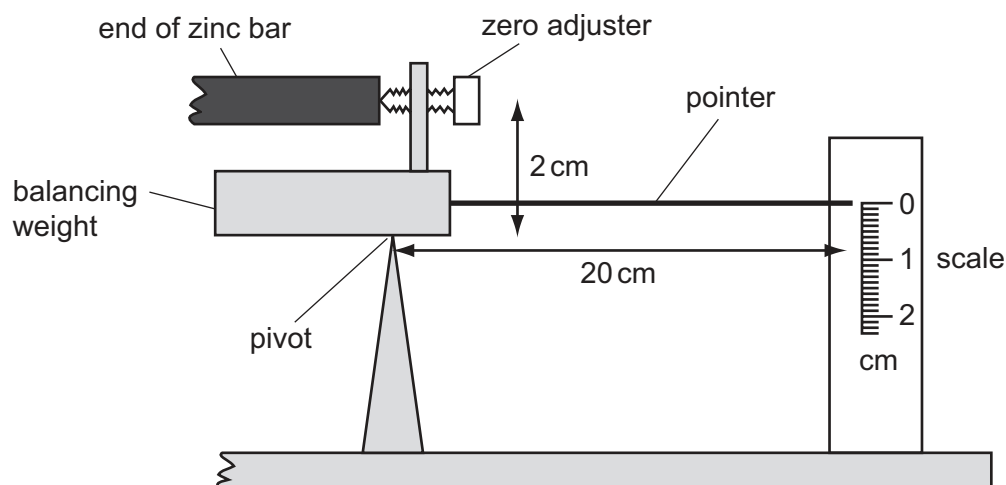


Fig. 6.2

- 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]

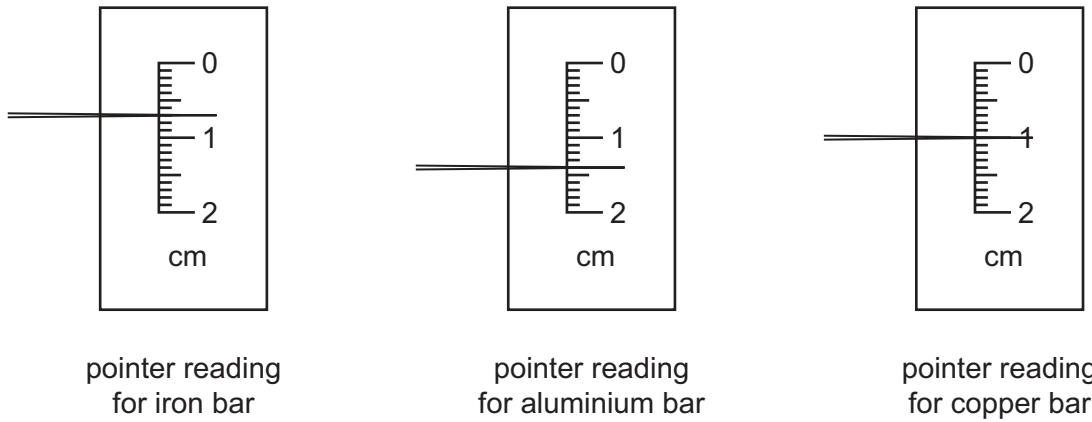


Fig. 6.3

(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.

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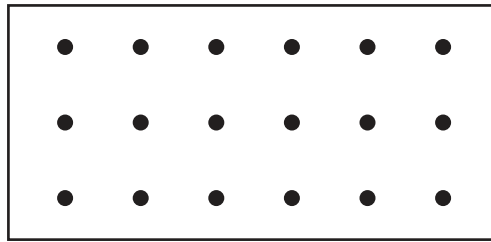


Fig. 6.4

(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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