



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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COMBINED SCIENCE

0653/51

Paper 5 Practical Test

October/November 2011

1 hour 30 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed in Instructions to Supervisors.

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 pencil for any diagrams, graphs or rough working.

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DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Chemistry practical notes for this paper are printed on page 12.

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

Total

This document consists of **9** printed pages and **3** blank pages.



- 1 (a) You are going to compare the activity of the enzyme *catalase* in raw and boiled yeast. *Catalase* accelerates the decomposition of hydrogen peroxide and is found in the cells of many living cells.

- Label 5 large test-tubes **A**, **B**, **C**, **D**, and **E**. Use the permanent marker to draw a line on each tube 1 cm below the top.
- Place the large test-tubes into a rack and measure out 20 cm³ of hydrogen peroxide solution into each tube.
- (i)
 - Place a few drops of the **fresh** yeast suspension into the hydrogen peroxide in test-tube **A**.
 - Place a glowing splint into test-tube **A**, just above the hydrogen peroxide and yeast mixture.
 - Record your observation and state the name of the gas that has been produced.

observation

.....

name of gas produced [2]

- (ii)
 - Add two drops of detergent to the hydrogen peroxide in test-tubes **B**, **C** and **D**.
 - Measure out 5 cm³ of **fresh** yeast suspension into a syringe or dropping pipette. Place the yeast into the hydrogen peroxide in test-tube **B**.
 - Start the stop-clock as soon as the yeast makes contact with the hydrogen peroxide.
 - In Table 1.1, record the time taken **in seconds** for the foam to reach the pen line.
 - Repeat for tubes **C** and **D**. [2]

Table 1.1

yeast type	fresh			boiled
tube	B	C	D	E
time taken / s				

- (iii) Calculate the average time, **in seconds**, for the fresh yeast (tubes **B**, **C** and **D**).

[1]

- (b) (i) • Measure out 5 cm^3 of **boiled** yeast into a syringe or dropping pipette.
- Place the yeast suspension into the hydrogen peroxide in large test-tube **E**.
- Start the stop-clock and record, in Table 1.1, the time taken, in seconds, for the foam (if any) to reach the pen line on the test-tube.
- If no foam is produced, or the foam has not reached the line after two minutes, record 'No reaction' in Table 1.1. [1]

- (ii) Compare the results for the fresh and boiled yeast.

Explain the difference in the activity of the enzyme *catalase* in the fresh and boiled yeast.

.....

.....

.....

..... [2]

- (c) (i) Are the results for tubes **B**, **C** and **D** reliable?

Explain your answer.

.....

..... [1]

- (ii) Suggest **one** possible source of error in this experiment.

.....

..... [1]

- 2 You are going to investigate the thermal decomposition of three metal carbonates to identify an unknown metal.

- (a) (i) Place compound **A**, which is a metal carbonate, in a clean hard glass test-tube. Place about 3 cm³ of limewater in a second test-tube. Connect the bung of the delivery tube to the test-tube containing **A** and place the delivery tube into the limewater as shown in Fig. 2.1.

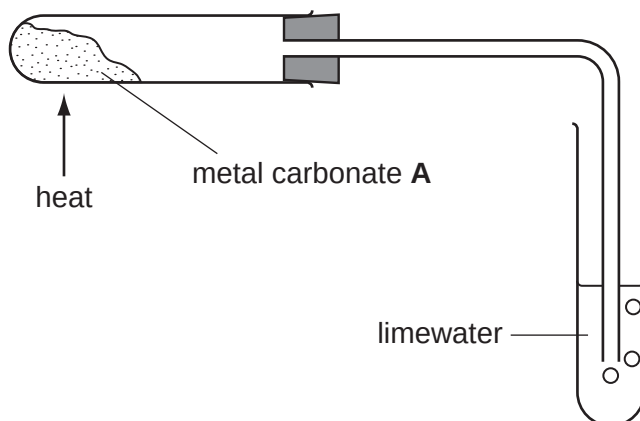


Fig. 2.1

- (ii) Heat the tube containing compound **A** with a hot flame, starting the clock as you do so. When the limewater becomes milky, stop the clock and **immediately** remove the delivery tube from the limewater.

Record the time taken, in seconds, for the limewater to become milky, as well as any colour change to the carbonate, in Table 2.1.

Table 2.1

compound	name and formula	time / s	colour change
A	zinc carbonate, ZnCO_3		
B	magnesium carbonate, MgCO_3		
C	unknown metal carbonate, XCO_3		

[1]

- (iii) Repeat (a)(i) and (a)(ii) with the compounds **B** and **C**, using fresh limewater each time. Record the results in Table 2.1. [2]

Keep the test-tube containing the result of heating compound **C** for part (b).

- (iv) List the metal carbonates in order of their speed of turning limewater milky (of thermal decomposition).

1 (fastest)

2

3 (slowest)

[1]

- (v) Name the gas produced by the thermal decomposition of a metal carbonate.

name

[1]

- (b) Empty the contents of the test-tube in which compound **C** was heated into a beaker. Add about 10 cm³ of dilute sulfuric acid and stir well. Filter the resulting mixture into **two** clean test-tubes. Keep the filtrate for parts (b)(i) and (b)(ii).

- (i) Carefully add dilute sodium hydroxide to the filtrate in one of the test-tubes until there is no further change.

Record your observation.

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

- (ii) To the other test-tube containing the filtrate, add a piece of zinc.

Record your observations.

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

- (iii) Identify metal **X** and state **two** pieces of evidence to support this.

metal **X** is

evidence 1

.....

evidence 2

..... [2]

- 3 You are going to investigate how the angle of swing, θ , affects the time period of oscillation, T , of a simple pendulum. You will also use your results to calculate the acceleration due to gravity, g .

- (a) Set up your pendulum as in Fig. 3.1, using the apparatus provided, such that the length, l , is 30 cm.

Clamp the cork and secure the protractor card to the cork with the short pin. Attach the protractor to the card as shown, using the long pin. Suspend the pendulum from the long pin.

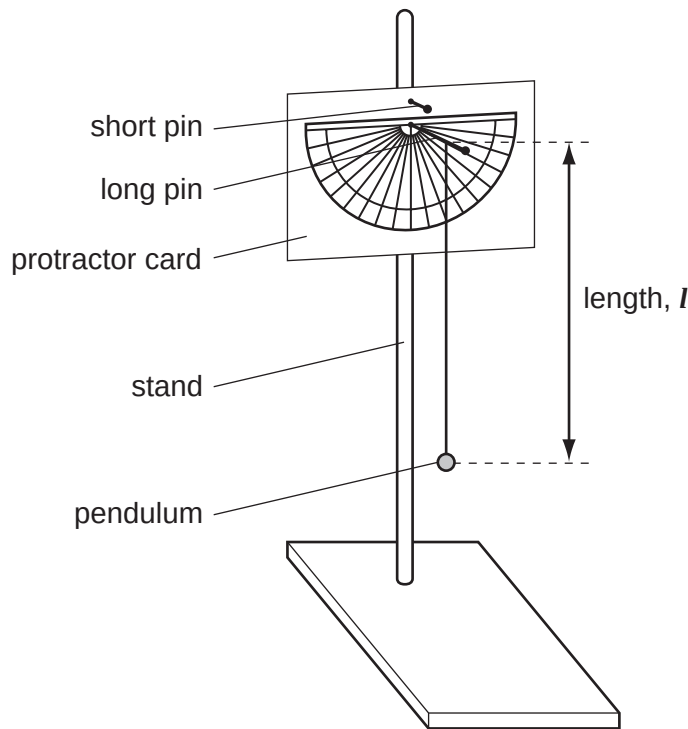


Fig. 3.1

Displace the pendulum by $\theta = 10^\circ$ as shown in Fig. 3.2.

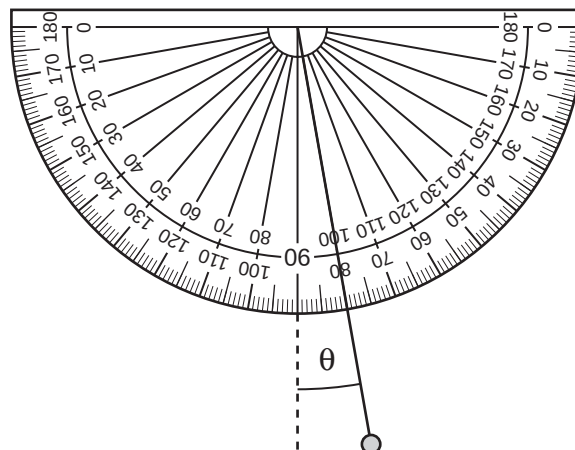


Fig. 3.2

- (i) Release the pendulum and start the clock at the same time. Stop the clock when the pendulum has completed ten oscillations. (One oscillation is swinging away from and back to the release point). Record the time in Table 3.1 to 0.1 second.

- (ii) Repeat the experiment for $\theta = 10^\circ$ a further four times and record the results in Table 3.1.
- (iii) Now carry out the experiment five times each for angles of swing $\theta = 20^\circ$ and $\theta = 30^\circ$ recording all results in Table 3.1.

Table 3.1

	time for 10 oscillations /s		
	$\theta = 10^\circ$	$\theta = 20^\circ$	$\theta = 30^\circ$
1			
2			
3			
4			
5			
average for 10 oscillations /s			
period, T/s			

[5]

- (b) (i) Calculate the average time for 10 oscillations for each angle of swing, θ . Record your averages in Table 3.1. [1]
- (ii) Calculate the period, T (the time for one oscillation), from the average for 10 oscillations for each angle of swing, θ . Record values of T in Table 3.1. [1]

- (c) Use the period T for $\theta = 10^\circ$ in Table 3.1 to calculate the acceleration due to gravity, g , using the formula below.
(the length of the pendulum, l , must be in metres).

$$g = \frac{39.5 \times l}{T^2}$$

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

- (d) Explain why you timed 10 oscillations in your experiments rather than timing just one oscillation to obtain the period, T , directly.

.....
 [1]

CHEMISTRY PRACTICAL NOTES

Test for anions

<i>anion</i>	<i>test</i>	<i>test result</i>
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify then add aqueous barium chloride <i>or</i> aqueous barium nitrate	white ppt.

Test for aqueous cations

<i>cation</i>	<i>effect of aqueous sodium hydroxide</i>	<i>effect of aqueous ammonia</i>
ammonium (NH_4^+)	ammonia produced on warming	-
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

Test for gases

<i>gas</i>	<i>test and test results</i>
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	“pops” with a lighted splint
oxygen (O_2)	relights a glowing splint



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3

Total

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- 1 You are going to investigate what affects the diffusion of hydrochloric acid into agar. You are provided with an agar block (of dimensions 20 mm x 10 mm x 10 mm) that contains a phenolphthalein indicator and an alkali. Phenolphthalein is purple in pH greater than 8 and colourless in pH less than 8.

- (a) (i)
- Cut the agar block in half, producing two blocks of size 10 mm x 10 mm x 10 mm (as shown in Fig. 1.1).
 - Keep one of these blocks intact (this is block **A**) and cut the other in half again (as shown in Fig. 1.1).
 - Keep one of these blocks intact (this is block **B**) and cut the other in half again. Discard one of these (as shown in Fig. 1.1.) The remaining block is block **C**.
 - You will now have three agar blocks of different surface areas.
 - Label the test-tubes **A**, **B**, and **C**.
 - Place about 20 cm³ of dilute hydrochloric acid in each of the three test-tubes **A**, **B** and **C**.
 - Using tweezers, drop each block into separate test-tubes (as shown in Fig. 1.1) as quickly as possible and start the stopclock.
 - Record the time taken, in Table 1.1, for each block to go completely colourless (as shown in Fig. 1.2). [3]

While you are waiting for the blocks to become colourless, you can be performing the calculations needed to complete Table 1.1.

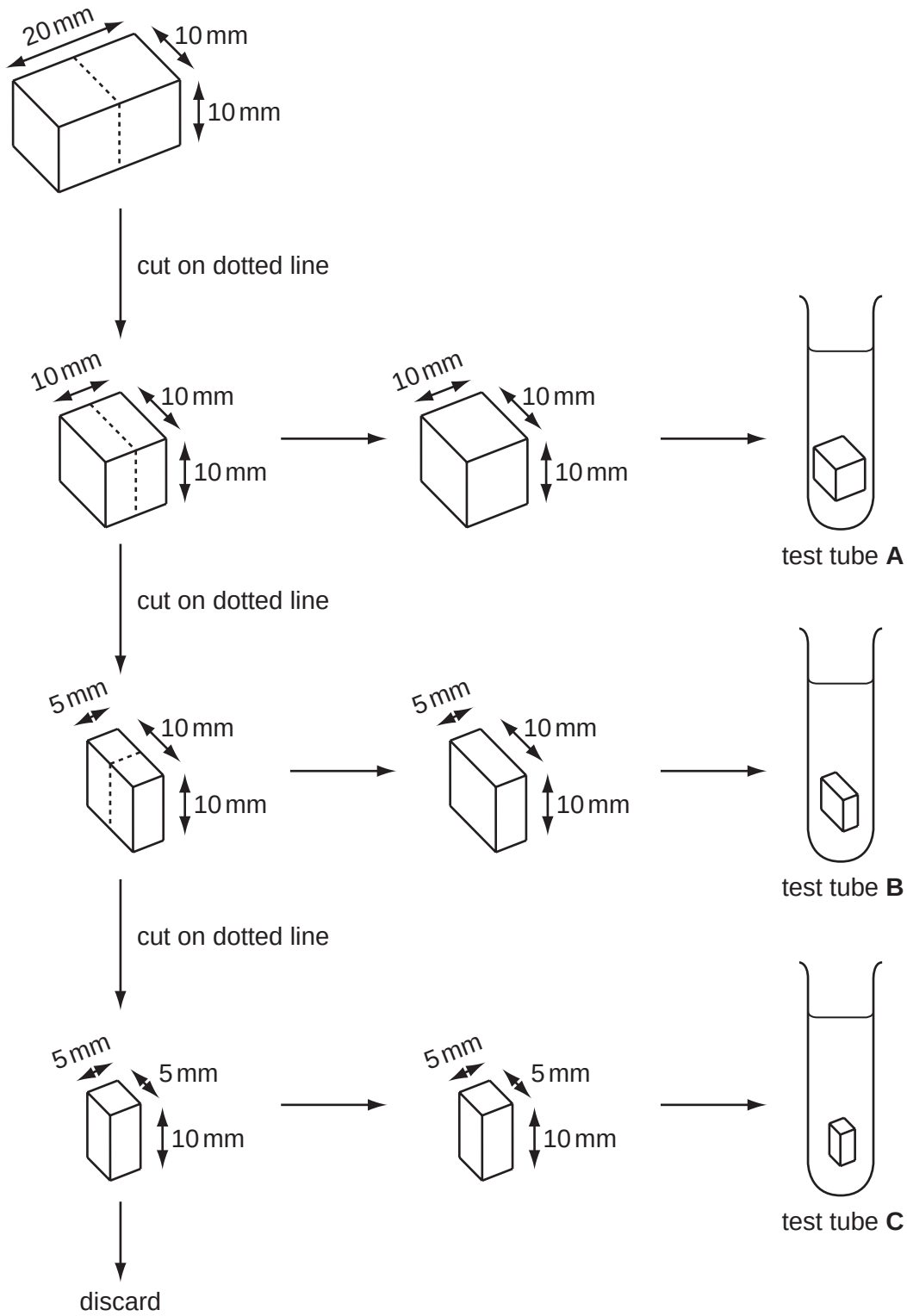


Fig. 1.1

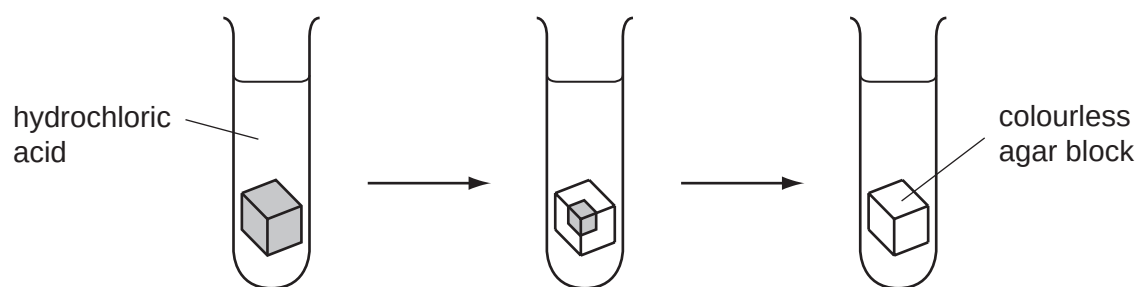


Fig. 1.2

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 ³			
surface area of block/mm ²	600	400	250
surface area to volume ratio /mm ⁻¹			
time taken for block to go colourless/s			

(ii) Calculate the volume of each block. Record the volumes in Table 1.1.

[1]

(iii) The surface to volume ratio is calculated using the following formula:

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

Calculate the surface area to volume ratio for each block and record it in Table 1.1.

[1]

- (iv) Explain why the blocks go colourless when placed in the acid.

.....

.....

.....

..... [2]

- (v) Describe and explain the effect that the decrease in volume of the block has on the time taken for the colour to change.

.....

.....

.....

..... [2]

- (b) Suggest **one** potential source of error in the experiment.

.....

.....

.....

..... [1]

- 2 Carry out the following tests on solid **X** which is a mixture of two salts.

Record your observations and conclusions in the appropriate boxes in Table 2.1.

Table 2.1

test	observation	conclusion
(a) Mix one spatula full of solid X with two spatulas full of calcium hydroxide in a hard glass test-tube. Heat gently. Test any gas with moist blue and red litmus papers.		
	 [1]	 [1]
(b) Prepare about 20 cm ³ of a dilute solution of X in water for use in the tests below.		
(i) To a portion of the solution of X , in a test-tube, slowly add aqueous sodium hydroxide until there is no further change.	 [1]	 [1]
(ii) Acidify another portion of the solution of X with dilute nitric acid, then add barium nitrate solution.	 [1]	 [1]
(iii) Acidify another portion of the solution of X with dilute nitric acid, then add silver nitrate solution.	 [1]	 [1]

- (c) Suggest names for the two salts in mixture **X**.

..... and [2]

- 3 (a) You are going to investigate how the displacement of light passing through a rectangular glass block depends on the angle of incidence.

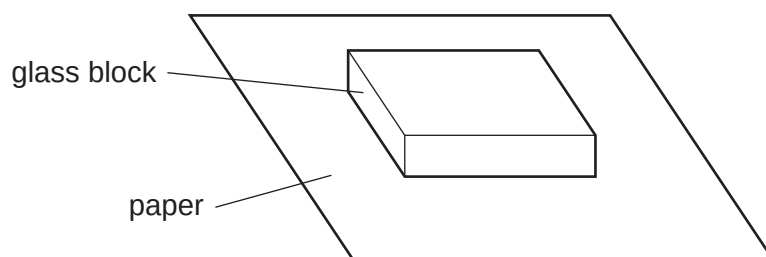


Fig. 3.1

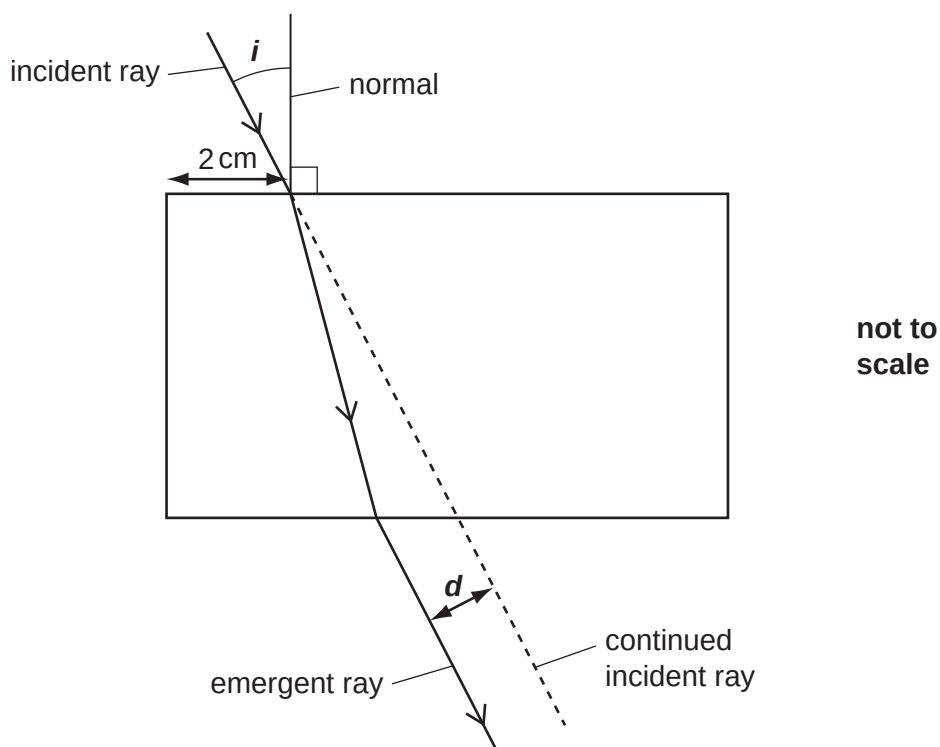


Fig. 3.2

- Place the glass block on the centre of the paper as shown in Fig. 3.1. Using a pencil, draw carefully around the block.
- Remove the block and construct a normal, 2 cm from the end of one of the long sides as shown in Fig. 3.2. Using a protractor, draw and label lines to represent incident rays with angles of incidence i of 20° , 40° , 60° and 80° .
- Replace the block carefully in the area marked on the paper. Place two pins about 4 cm apart on the incident ray for angle $i = 20^\circ$.
- Look through the block from the other side and place two more pins (on the emergent ray) in line with the pins on the incident ray.
- Remove the block and draw a line to represent the emergent ray. Then continue the incident ray as shown by the dotted line in Fig. 3.2. Now measure the displacement d of the incident ray as shown in Fig. 3.2. Record the value of d in mm in Table 3.1.
- Repeat for the other angles of incidence $i = 40^\circ$, 60° , and 80° .

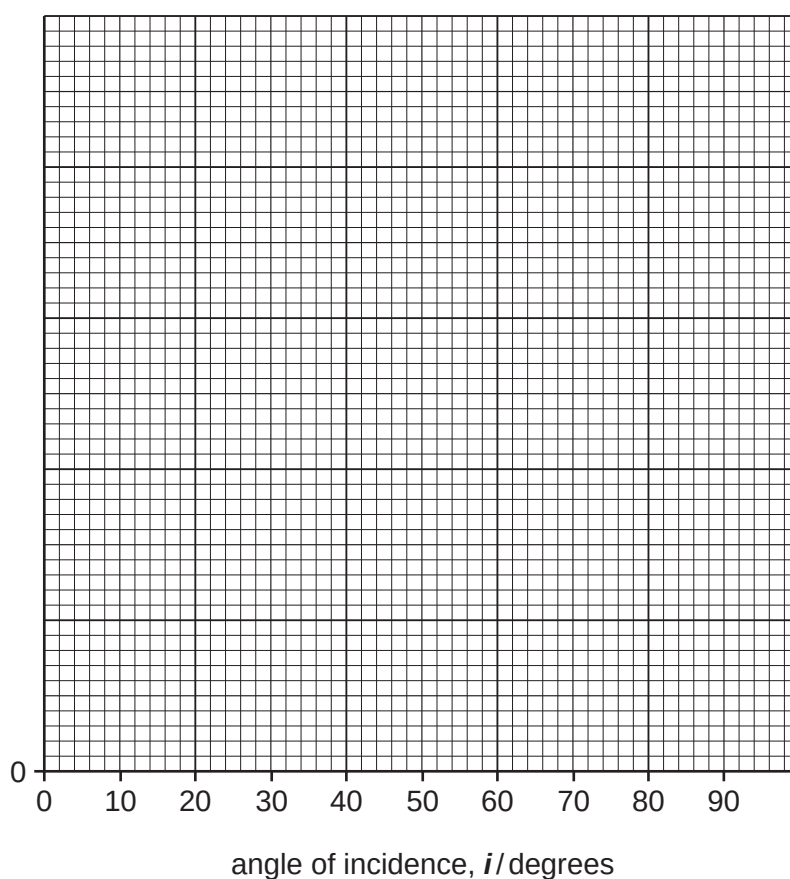
Table 3.1

angle of incidence $i/^\circ$	displacement d/mm
0	0
20	
40	
60	
80	

[5]

- (b) (i) Plot a graph of displacement d (vertical axis) against angle of incidence i . You will need to extend the axes to include $i = 90^\circ$. Draw the best **curve** through your points extending the curve to $i = 90^\circ$.

displacement,
 d/mm



[2]

- (ii) Using your graph, find the value of the displacement, d_{90} , when $i = 90^\circ$.

Show how you did this on the graph.

$d_{90} =$ mm [2]

- (c) Identify **one** source of error in your experiment.

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

CHEMISTRY PRACTICAL NOTES

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Test for aqueous cations

<i>cation</i>	<i>effect of aqueous sodium hydroxide</i>	<i>effect of aqueous ammonia</i>
ammonium (NH_4^+)	ammonia produced on warming	-
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
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