Cambridge IGCSE

PHYSICAL SCIENCE 0652/62

Paper 6 Alternative to Practical **October/November 2016**

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.

CAMBRIDGE
International Examinations

[Turn over

1 A science teacher gives a student a sample of limestone. She wants the student to find the percentage of calcium carbonate in the sample. The student decides to carry out the experiment in four parts as follows:

1. find the mass of the sample of limestone,
2. add hydrochloric acid to react with the calcium carbonate,
3. measure the volume of the carbon dioxide given off,
4. filter off the residue and find its mass.

(a) Part 1 Finding the mass of the sample of limestone

Fig. 1.1 shows the balance reading for the mass of the sample of limestone. Read the scale and record the mass to the nearest 0.05 g.
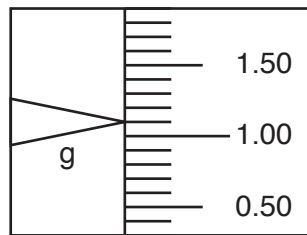

Fig. 1.1

mass of limestone = ... g [1]

(b) Part 2 Reacting the hydrochloric acid with the calcium carbonate

The student uses the apparatus shown in Fig. 1.2 to react the limestone with excess hydrochloric acid and collect the gas given off.
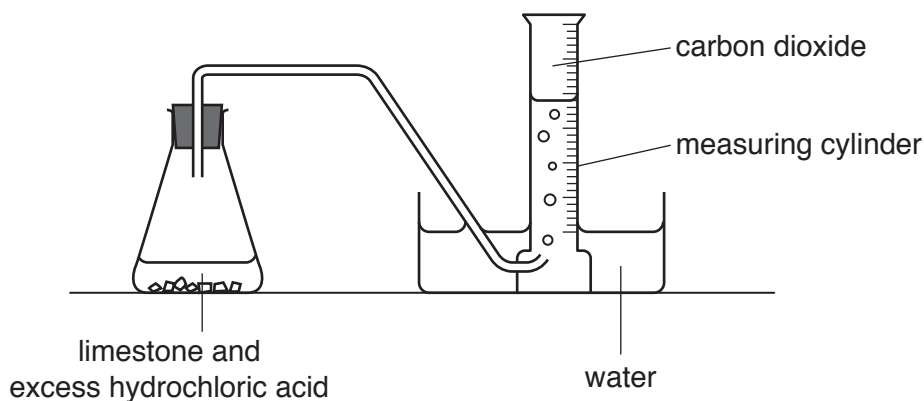
Fig. 1.2

State a reason why carbon dioxide gas can be collected over water in this way.

....

....[1]

(c) **Part 3** Measuring the volume of carbon dioxide

   (i) Fig. 1.3 shows the measuring cylinder from Fig. 1.2 at the end of the reaction.

   Read the scale and record the volume of carbon dioxide to the nearest $5\,cm^3$.
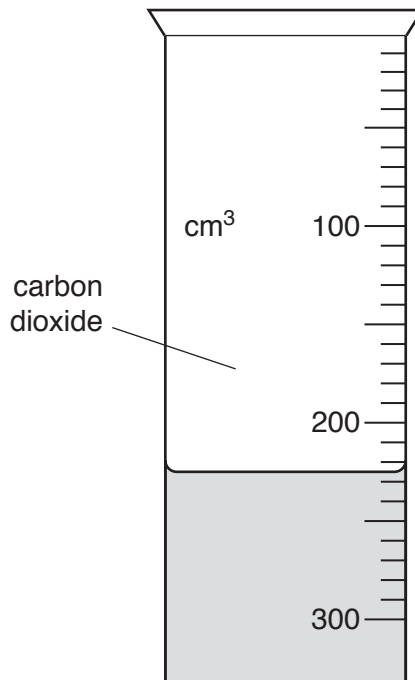
Fig. 1.3

volume of carbon dioxide = ... cm^3 [1]

   (ii) The teacher gives the student a formula to find the mass of calcium carbonate that produced this volume of carbon dioxide.

$$\text{mass of calcium carbonate (g)} = \frac{\text{volume of carbon dioxide } (cm^3)}{240}$$
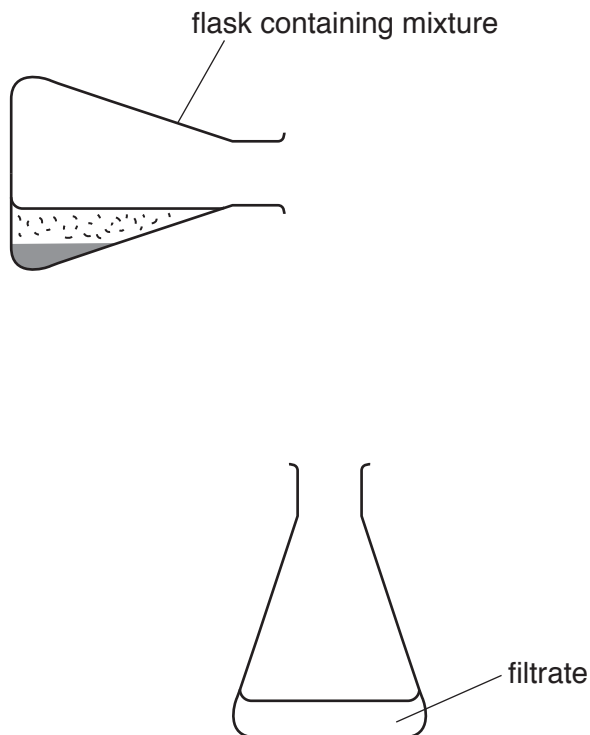
   Use the formula and your answer from **(c)(i)** to find the mass of calcium carbonate in the original sample of limestone.

mass of calcium carbonate = ... g [1]

(d) Part 4 Filtering off and finding the mass of the residue

The student finds the mass of a filter paper.
She filters the mixture from part **2**.

(i) Complete Fig. 1.4 to show how she filters the mixture. Include labels in your drawing.

flask containing mixture

filtrate

Fig. 1.4 [1]

(ii) The student dries the filter paper and residue and finds their mass.

Complete the calculation to find the mass of the residue.

mass of residue + filter paper = ...0.75...... g

mass of filter paper = ...0.59...... g

mass of residue = ... g
[1]

(iii) Use the answers to **(a)** and **(d)(ii)** to calculate the actual mass of calcium carbonate in the original sample of limestone.

mass of calcium carbonate = ... g [1]

(e) (i) Calculate the **percentage** of calcium carbonate in the sample of limestone (purity) using the formula below and the answers to **(a)** and **(c)(ii)**.

$$\text{percentage} = \frac{\text{mass of calcium carbonate}}{\text{mass of limestone}} \times 100$$

percentage of calcium carbonate = ... % [1]

(ii) Calculate the **percentage** of calcium carbonate in the sample of limestone (purity) using the answers to **(a)** and **(d)(iii)**.

percentage of calcium carbonate = ... % [1]

(f) One of the impurities in the limestone is magnesium carbonate. This makes the calculated percentage of calcium carbonate too high.

Explain this statement.

....

....[1]

2 A student investigates the reaction between magnesium and copper sulfate solution. She wants to find out how the reaction depends on the concentration of the copper sulfate solution.

She is provided with copper sulfate solution of concentration 1.00X, where X is a unit of concentration.

(a) The student uses a thermometer to measure the initial temperature T_i of the copper sulfate solution. She records in Table 2.1 T_i **to the nearest half degree** for concentration 1.00X.

Table 2.1

concentration of copper sulfate/X	initial temperature $T_i/°C$	highest temperature $T_h/°C$	temperature change $\Delta T/°C$
1.00	22.0	76.0	
0.75	22.0	63.5	
0.50	22.0	52.0	
0.25			

- The student transfers a sample of magnesium powder into a plastic cup.
- She measures $24\,cm^3$ of copper sulfate solution and adds this quickly to the magnesium in the plastic cup.
- She stirs the mixture thoroughly and measures the highest temperature T_h reached.
- She records in Table 2.1 T_h **to the nearest half degree** for concentration 1.00X.
- She observes that the solid in the mixture turns brown.

(i) State the identity of the brown solid.

solid ....[1]

She then repeats the experiment using copper sulfate solutions of different concentrations, 0.75X, 0.50X, 0.25X.

She records in Table 2.1 the values of T_i and T_h **to the nearest half degree** for concentrations 0.75X and 0.50X.

(ii) Read the thermometers in Fig. 2.1 and record **to the nearest half degree** in Table 2.1 the values of T_i and T_h for magnesium and 0.25X copper sulfate solution. [2]
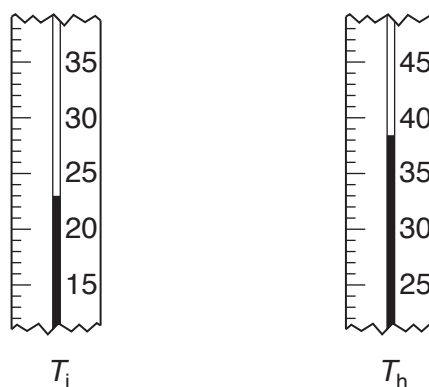
thermometers for 0.25X

Fig 2.1

(b) (i) Calculate the temperature change ΔT during the reaction for each concentration of copper sulfate solution.

Record these values in the last column of Table 2.1.

[1]

(ii) Plot a graph of temperature change ΔT against concentration of copper sulfate solution on the grid provided.

Draw the best-fit straight line through the origin. [3]

temperature change
$\Delta T / °C$

concentration of copper sulfate / X

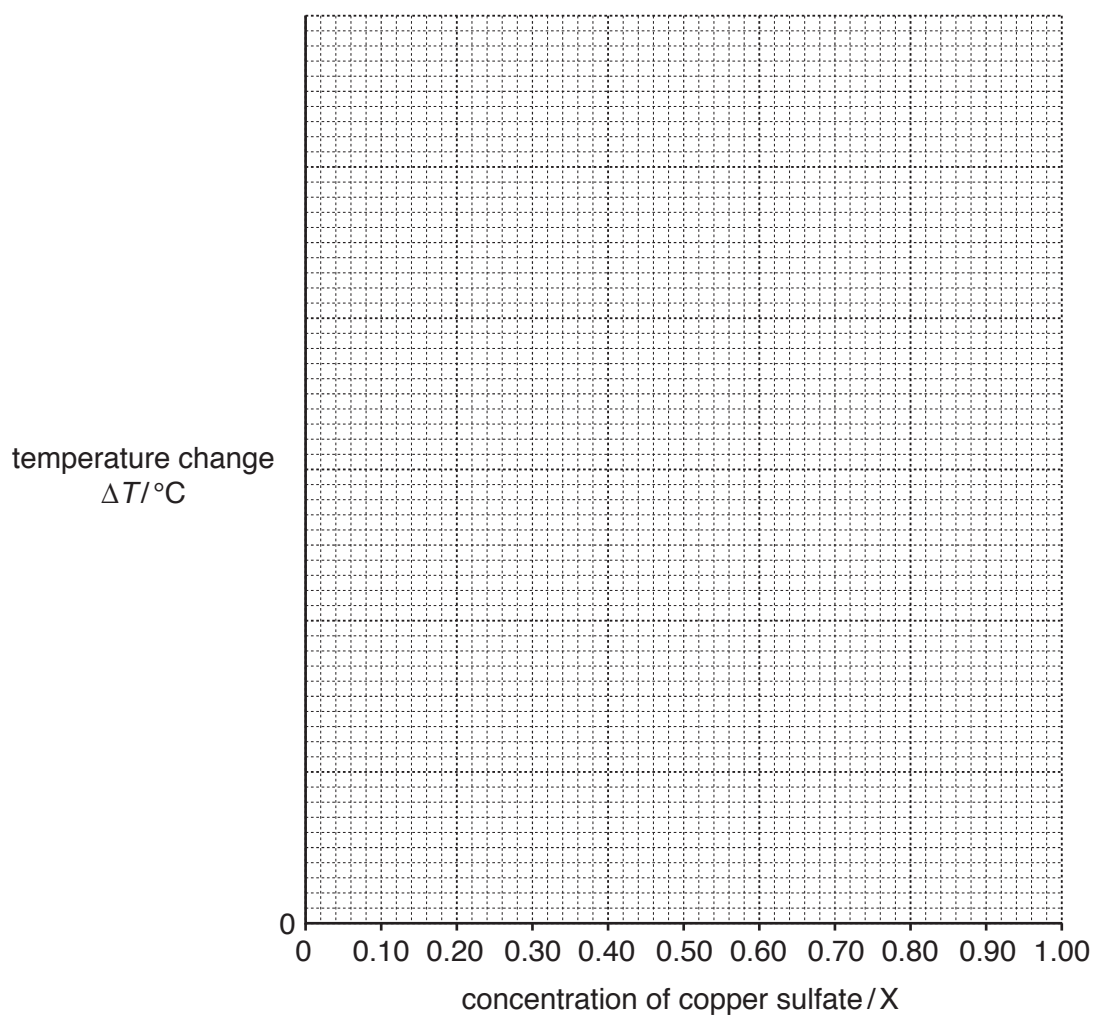**(iii)** A student states that the temperature change ΔT for this experiment is directly proportional to the concentration of the copper sulfate solution used.

Suggest whether this statement is supported by the data and justify your answer.

....

....

....[1]

(c) (i) Using the data in Table 2.1, state the name of this type of chemical reaction.

....[1]

(ii) Suggest **one** change to this procedure to improve the accuracy of the results.

....

....[1]
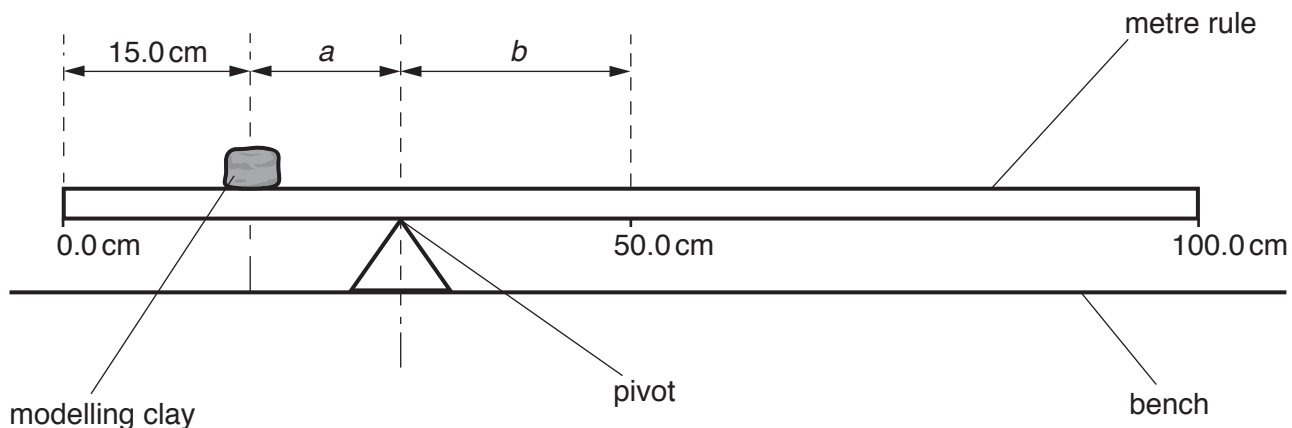
Please turn over for Question 3.

 [Turn over

3 A student finds the mass of a piece of modelling clay using a balancing method.

She moulds the piece of modelling clay until it is roughly cube-shaped.

She places the modelling clay on a metre rule so that its centre is 15.0 cm from the zero end of the rule, as shown in Fig. 3.1.

Fig. 3.1 (not to scale)

(a) Describe how the student ensures that the centre of the modelling clay is directly above the 15.0 cm mark on the rule. You may draw a diagram to help your answer.

....

....

....[1]

(b) The student adjusts the position of the pivot so that the rule balances on it as shown in Fig. 3.2 (seen from above).
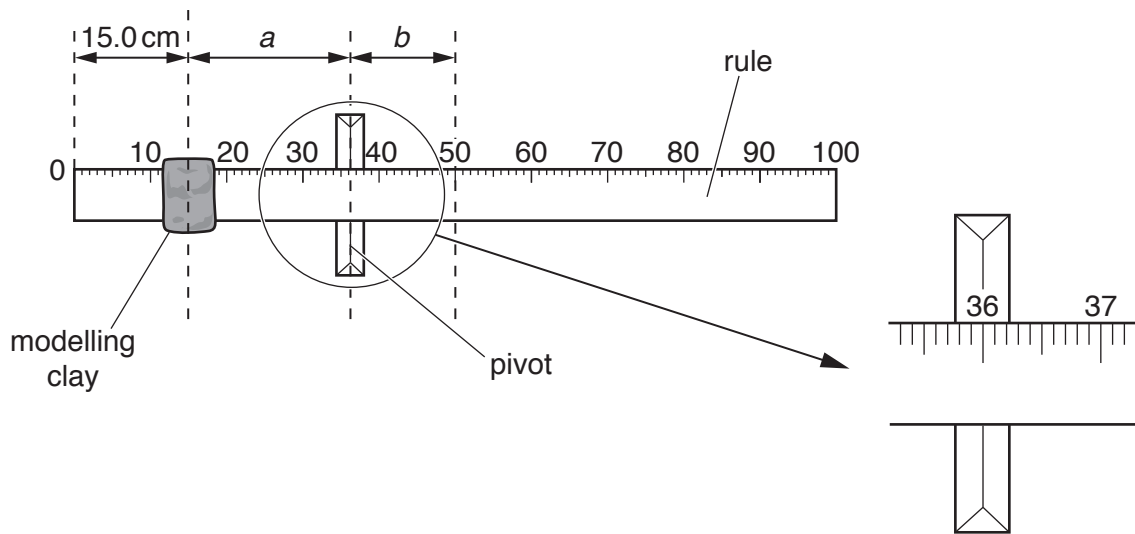
Fig. 3.2

(i) Record the position of the pivot on the rule to the nearest 0.1 cm.

position of pivot = ... cm [1]

(ii) Calculate the distance *a*.

a = ... cm [1]

(iii) Calculate the distance *b*.

b = ... cm [1]

(c) The student then uses a balance to measure the mass *M* of the metre rule. Fig. 3.3 shows the reading on the balance.

$$84.43 \, g$$

Fig. 3.3

(i) Write down the mass *M* of the metre rule to the nearest 0.1 g.

M = ... g [1]

(ii) She uses the equation, shown below, to calculate the mass *m* of the modelling clay.

$$m = M \times \frac{b}{a}$$

Calculate the mass of the modelling clay, giving your answer to an appropriate number of significant figures.

m = ... g [2]

(d) Even if the student carried out the experiment very carefully, her value for the mass of the modelling clay will only be approximate.

Suggest **two** reasons, based upon the practical method used, why this might be so. Assume that the balance used to find the mass of the rule is accurate.
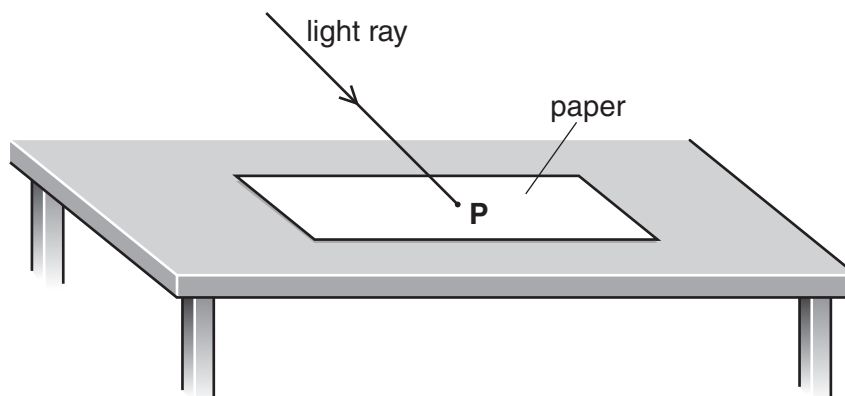
1 ....

....

2 ....

....
[2]

(e) The experiment is repeated with a heavier piece of modelling clay. State how the distances *a* and *b* will change.

....

....[1]

4 The science class compares the passage of light rays through water and through glass.
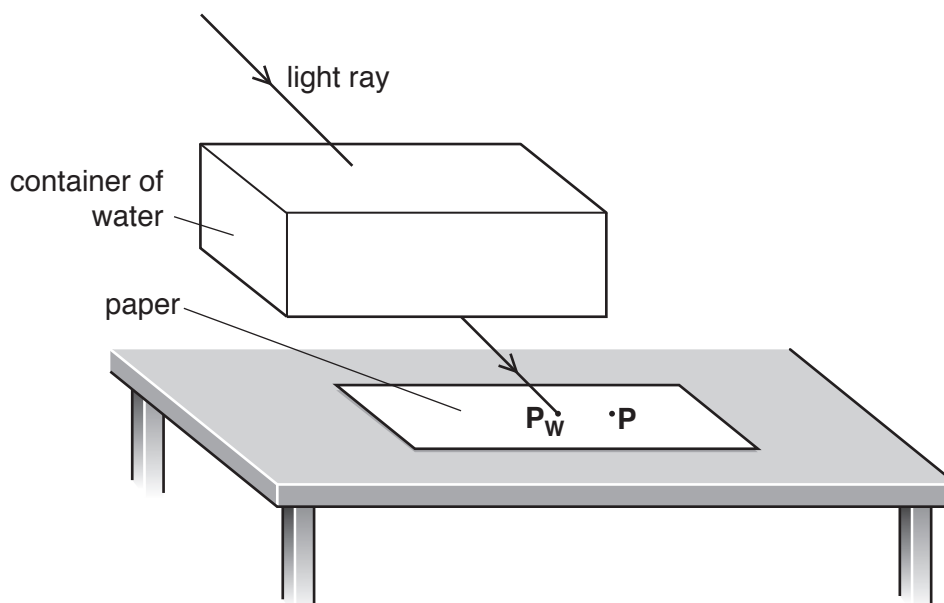Fig. 4.1 shows some of the apparatus that they use.

Fig. 4.1

First, the students shine a light ray towards the paper at an angle of 45°. They mark the position where the light ray hits the paper with a **P**, as shown in Fig. 4.1.

Then they place a container of water in the path of the light ray.

They mark the new position where the light ray hits the paper with a **P$_W$**, as shown in Fig. 4.2.

Fig. 4.2

(a) (i) Describe how the students use a lamp to produce a narrow light ray.

....

....

....

....[1]

(ii) Fig. 4.3 shows a side view of the light ray, container of water and paper.

Complete the diagram in Fig. 4.3 to show the path of the light ray as it passes through the water to hit the paper at position P_W. [2]
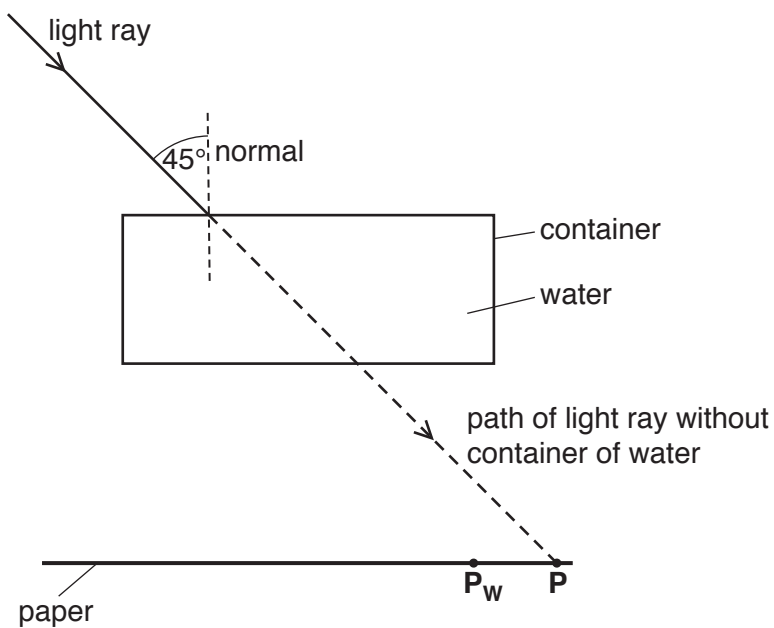
light ray

45° normal

container

water

path of light ray without
container of water

P_W P

paper

Fig. 4.3

(iii) Use a ruler to measure to the nearest 0.1 cm the distance between **P** and P_W in Fig. 4.3.

distance = ... cm [1]

(iv) On Fig. 4.3, label with an **I** the angle of incidence and an **R** the angle of refraction where the ray of light meets the water. [1]

The students replace the water with a glass block of the same thickness and repeat the experiment.

The light ray now hits the paper at position P_G as shown in Fig. 4.4.
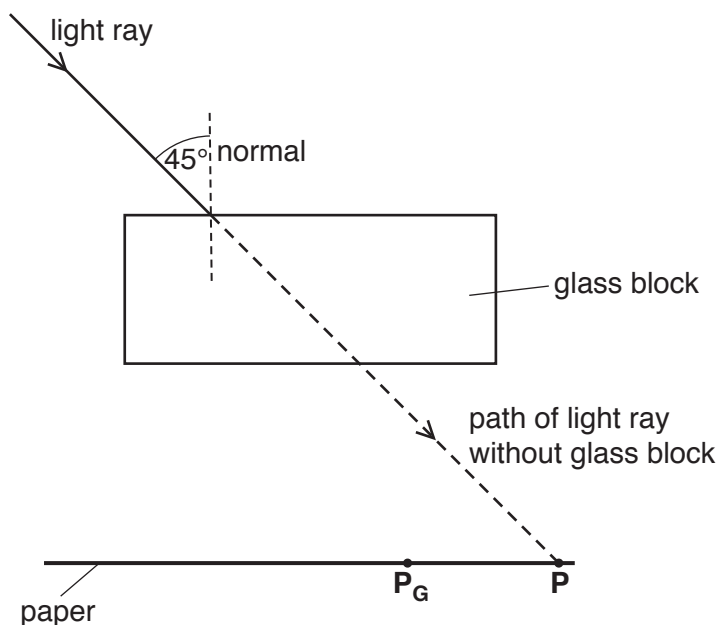

Fig. 4.4

(v) Use a ruler to measure to the nearest 0.1 cm the distance between **P** and P_G in Fig. 4.4.

distance = ... cm [1]

(vi) Compare your answers to **(a)(iii)** and **(a)(v)**.
Explain why P_W and P_G are different distances from point **P**.

....

....

....[1]

(b) Using the glass block, the students now change the angle between the light ray and the normal to 70°.

The point where the light ray hits the paper is dimmer with the glass block than without the glass block. This is because some of the light ray is reflected at the upper surface of the glass block.

(i) Complete Fig. 4.5 to show this reflection and mark the angle of reflection with an **r**.   [2]

light ray

glass block
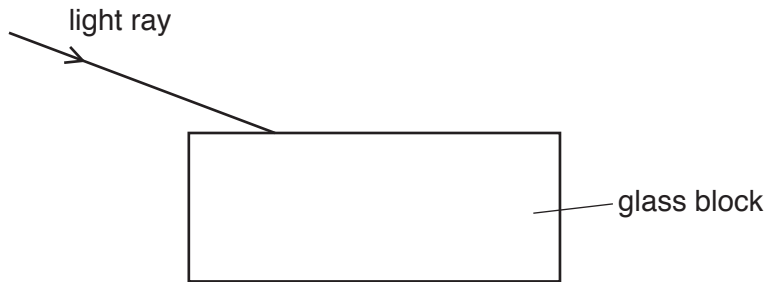
Fig. 4.5

(ii) State the expected value of the angle of reflection.

angle = ... ° [1]

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5 The teacher gives a student five unlabelled bottles. The bottles contain dilute solutions of the following.

> hydrochloric acid
> nitric acid
> sulfuric acid
> ammonia
> sodium hydroxide

(a) Identifying the solutions

The student must identify each solution.

He carries out the following tests.

(i) The student correctly identifies one of the solutions by its smell.

Name the solution.

....[1]

(ii) The student adds barium nitrate solution to $1\,cm^3$ of each of the solutions and correctly identifies the bottle containing sulfuric acid.

State the observation that enables him to identify the sulfuric acid.

....

....[1]

(iii) The student uses a chemical test to identify the hydrochloric acid.

Suggest the test that he uses and the observation that he makes.

test ....

observation ....

....
[2]

(iv) The student puts $1\,cm^3$ of copper(II) sulfate into a test-tube. He then adds one of the remaining solutions drop by drop until it is in excess.

State the observation that proves that this solution is sodium hydroxide.

....

....[1]

(b) Making a salt

The teacher asks the student to prepare a solid sample of the salt, sodium chloride, from the hydrochloric acid and sodium hydroxide solutions.

- The student measures out $25\,cm^3$ of hydrochloric acid and adds two drops of an indicator.
- He adds sodium hydroxide solution until the mixture is neutral.
- He records the volume of sodium hydroxide solution used as $18\,cm^3$.
- He washes out the glassware.
- He now adds $18\,cm^3$ sodium hydroxide solution to $25\,cm^3$ hydrochloric acid without any indicator.
- From this mixture the student obtains a solid sample of sodium chloride.

(i) Name a piece of apparatus that the student can use to accurately measure $25\,cm^3$ of hydrochloric acid.

....[1]

(ii) Suggest the name of an indicator that he can use and the colour change that takes place when the acid is neutralised.

name of indicator ....

colour change, from .... to ....
[2]

(iii) Explain why the student repeated the reaction without the indicator.

....

....[1]

(iv) State how the student obtains the sample of solid sodium chloride from the reaction mixture.

....

....[1]

6 A student is comparing the conduction of heat through two different materials. He has two containers labelled **F** and **G**. The containers are made from different materials.

- The student places 200 cm³ of water at about 85 °C in container **F**.
- He allows the contents of container **F** to cool to 80 °C.
- He places 400 cm³ of water at exactly 20 °C in a large beaker.
- When the temperature of the water in container **F** is 80 °C, he puts the container into the large beaker as shown in Fig. 6.1.
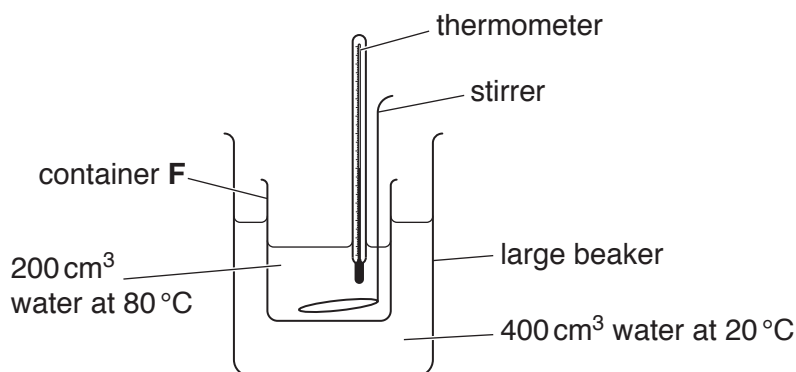
Fig. 6.1

- He immediately starts a stopclock.
- Every 30 seconds he measures and records the temperature of the water in container **F**.
- He repeats this procedure using container **G**.
- Some of his results are shown in Table 6.1.

Table 6.1

	time / s						
	0	30	60	90	120	150	180
temperature in **F** / °C	80	71		59	54	51	49
temperature in **G** / °C	80	64	55		45	42	40

(a) Fig. 6.2 shows the thermometer readings for the temperatures missing from Table 6.1. Read the thermometer scales to the nearest 1°C and record these readings in Table 6.1. [2]
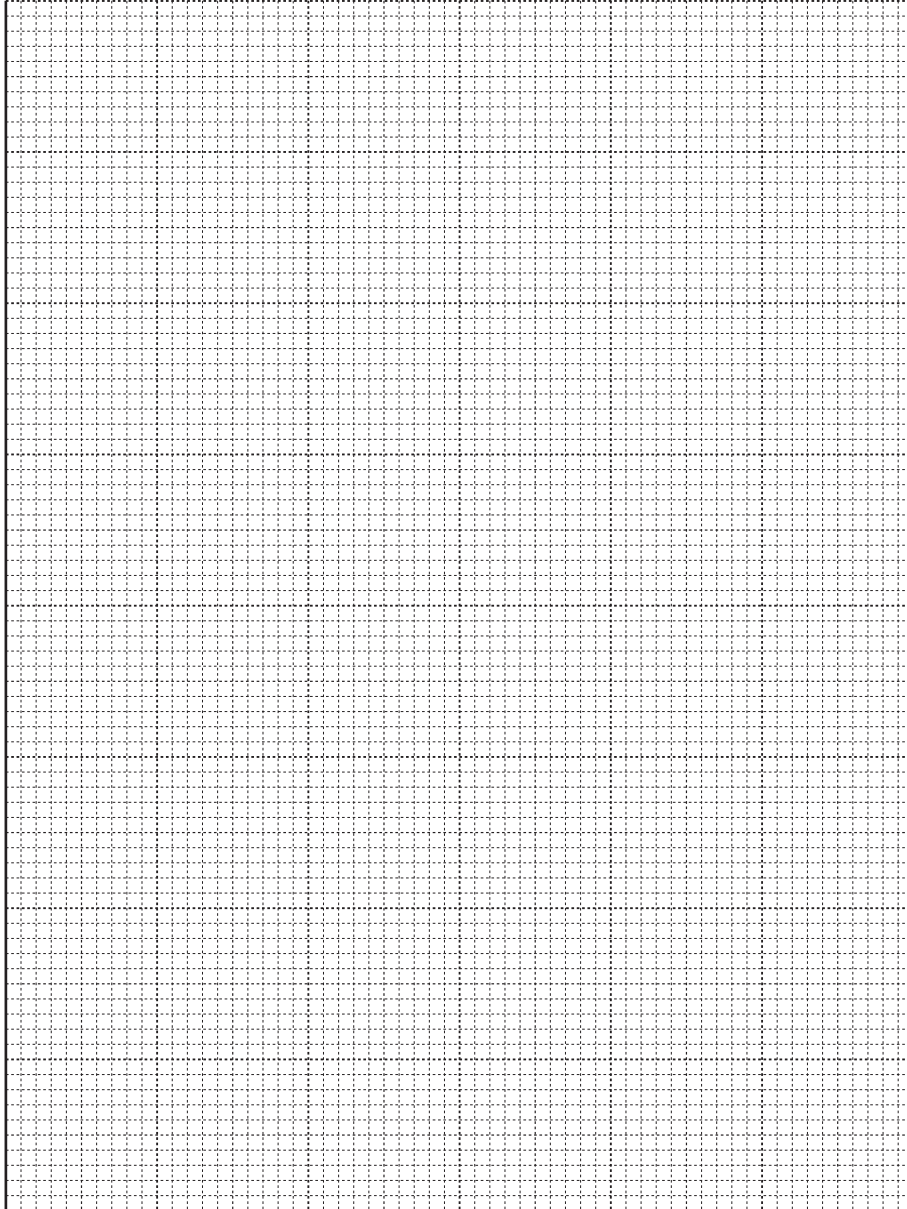

F   G
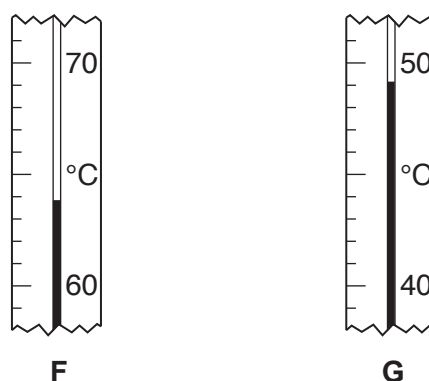
Fig. 6.2

(b) Plot graphs of the temperatures (vertical axis) in containers **F** and **G** against time (horizontal axis) on the grid provided.

The temperature axis does not need to start at zero.

Draw a best-fit curve for each container. [4]

(c) (i) State which container, **F** or **G**, is made of a material that is the better conductor of heat. Explain your answer.

container ………........

reason ....

....

[1]

(ii) Use your knowledge of the conduction of heat to suggest possible materials from which containers **F** and **G** are made.

container **F** ....

container **G** ....　[2]

(d) Immediately after the final temperature reading in container **G**, the student measures the temperature of the water in the large beaker.

Suggest a value for this temperature.

.... ˚C [1]

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