



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

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**CO-ORDINATED SCIENCES**

**0654/62**

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.

This document consists of **20** printed pages.

- 1 A student investigates an enzyme-catalysed reaction. Hydrogen peroxide is broken down by catalase, an enzyme found in living cells such as celery cells. Oxygen gas is released during the reaction.
- The student places  $2\text{ cm}^3$  of hydrogen peroxide solution in a test-tube, adds a drop of detergent and mixes these together.
  - She adds some chopped celery to the hydrogen peroxide solution.
  - The oxygen released causes a foam to be produced at the top of the liquid as shown in Fig. 1.1.
  - She starts a stopwatch and records the height of the foam and liquid every 2 minutes for 10 minutes.

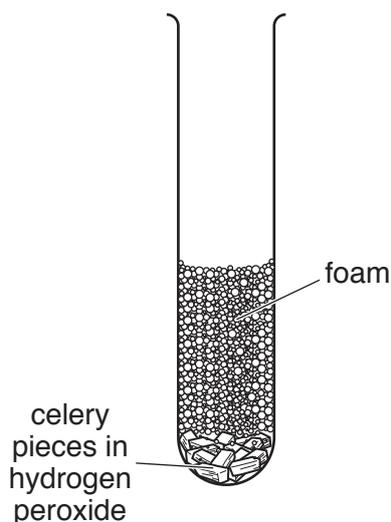


Fig. 1.1

(a) Table 1.1 shows some of the student's results.

Table 1.1

| time / minutes | height of foam and liquid / cm |
|----------------|--------------------------------|
| 0              | 0.0                            |
| 2              |                                |
| 4              | 4.6                            |
| 6              |                                |
| 8              | 6.6                            |
| 10             | 6.9                            |
| 12             | 6.9                            |

Use Fig. 1.2 to complete the rest of Table 1.1.

[2]

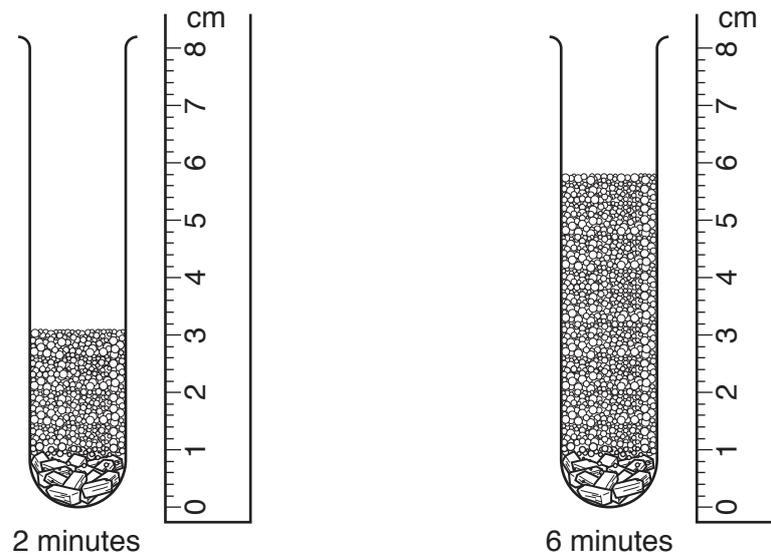
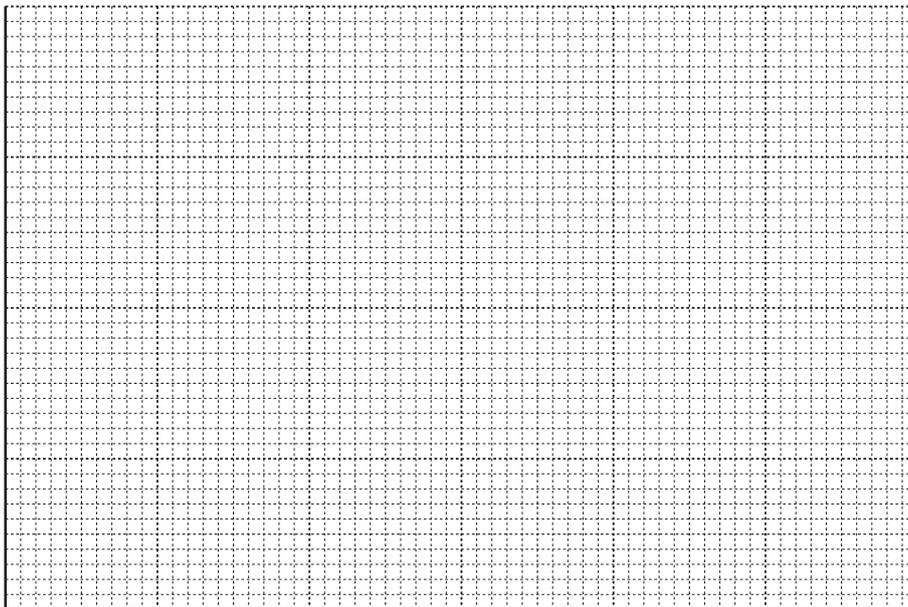


Fig. 1.2

(b) On the grid provided, plot a graph of foam and liquid height (vertical axis) against time (horizontal axis).

Draw a best-fit curve.

[4]



(c) (i) Describe in detail the shape of the curve.

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

(ii) Explain what the shape of the curve tells you about the rate of reaction.

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

(d) Describe how you could confirm that oxygen is produced in this reaction.

test .....

observation .....

[2]

**Please turn over for Question 2.**

- 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 $T_i / ^\circ\text{C}$ | highest temperature $T_h / ^\circ\text{C}$ | temperature change $\Delta T / ^\circ\text{C}$ |
|-------------------------------------|--|--|--|
| 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  $24\text{cm}^3$  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.

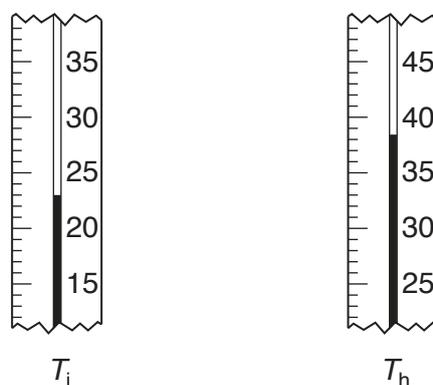
- (i) State the identity of the brown solid.

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 0.25 X

**Fig 2.1**

- (b) (i) Calculate the temperature change  $\Delta T$  during the reaction for each concentration of copper sulfate solution.

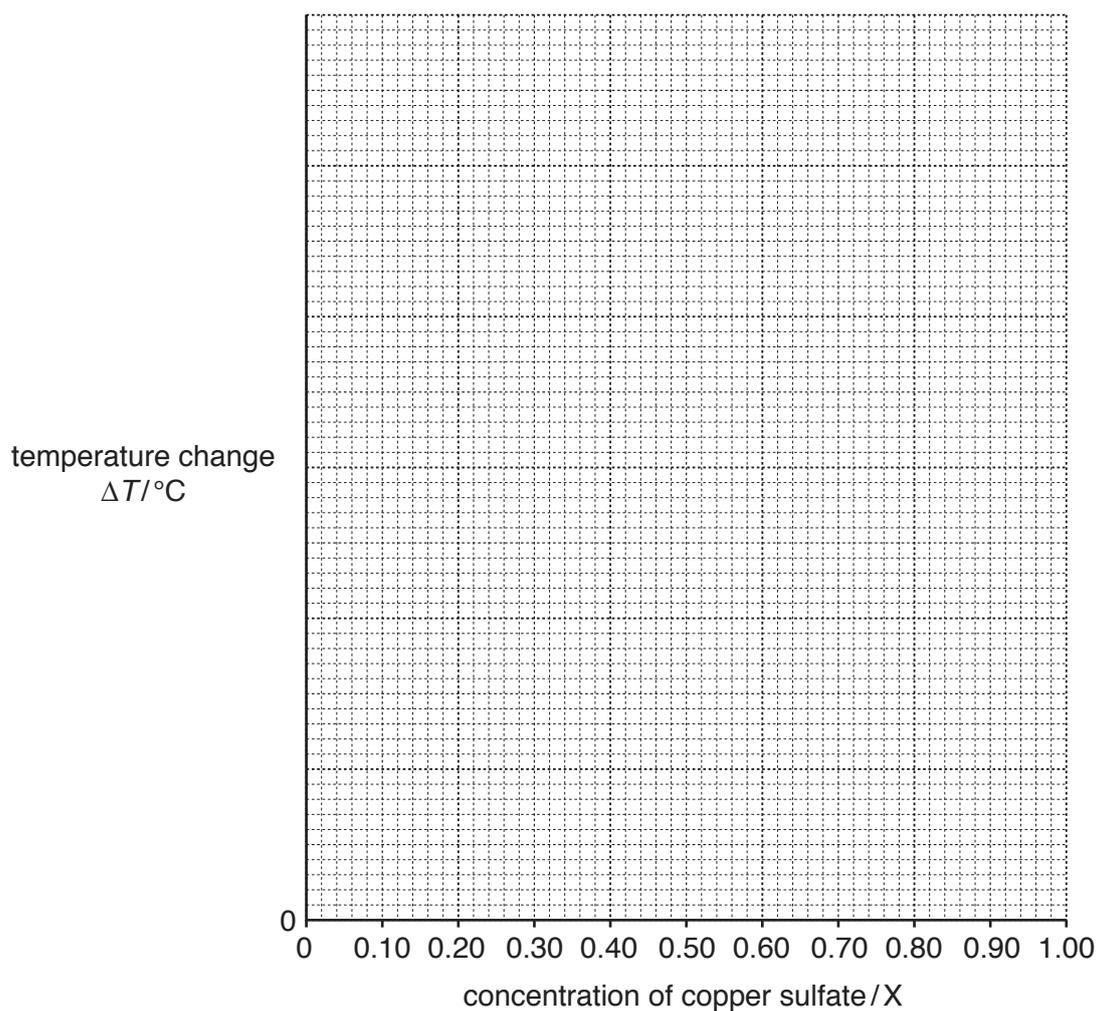
Record these values in the last column of Table 2.1.

[1]

- (ii) Plot a graph of temperature change  $\Delta T$  against concentration of copper sulfate solution on the grid provided.

Draw the best-fit straight line through the origin.

[3]



- (iii) A student states that the temperature change  $\Delta T$  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.

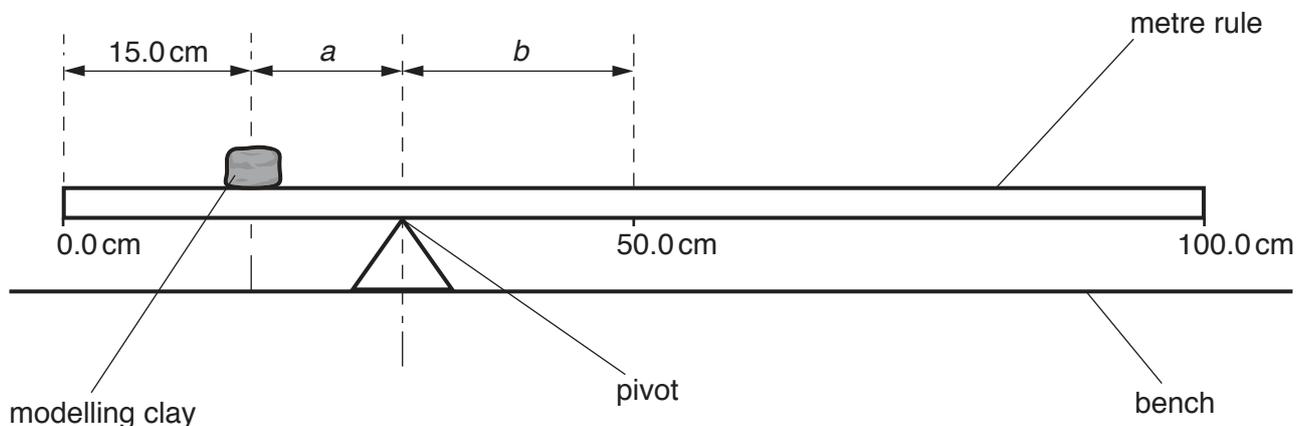
.....  
.....[1]

**Please turn over for Question 3.**

- 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).

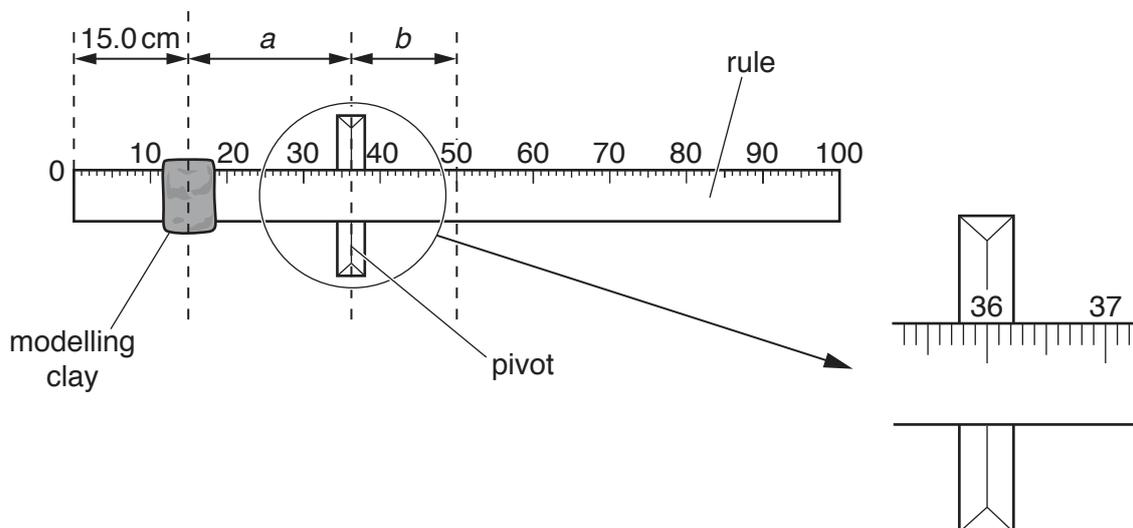


Fig. 3.2

(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.



Fig. 3.3

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

$M = \dots\dots\dots$  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.

$m = \dots\dots\dots$  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 A student investigates the movement of water molecules through a membrane.  
He sets up the apparatus shown in Fig. 4.1.

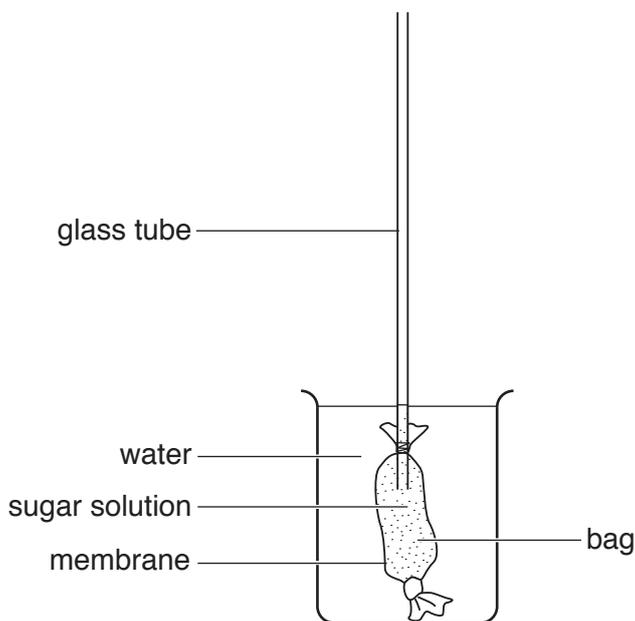


Fig. 4.1

The membrane allows water molecules to pass through it, but sugar molecules are too big to pass through.

The student takes measurements of the level of the sugar solution in the tube.

Fig. 4.2 shows the position of the sugar solution in the glass tube when he took his initial reading.

- (a) (i) Use Fig. 4.2 to read the initial position of the sugar solution in the glass tube and record this to the nearest 0.1 cm.

..... cm [1]

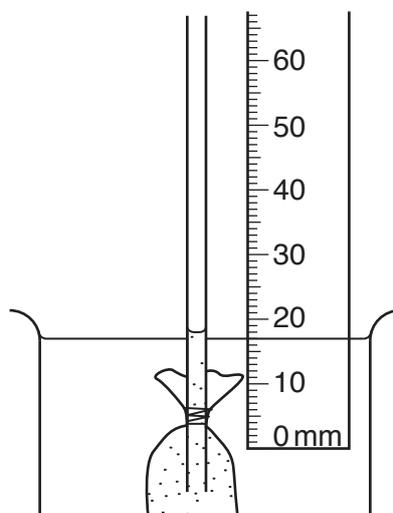


Fig. 4.2

- (ii) The apparatus is left for 2 hours. Fig. 4.3 shows the position of the sugar solution after this time. Use Fig. 4.3 to read the position of the sugar solution in the glass tube and record this to the nearest 0.1 cm.

..... cm [1]

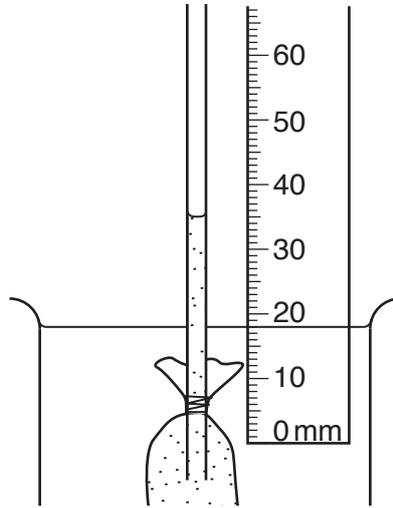


Fig. 4.3

- (b) (i) Use your answers to parts (a)(i) and (a)(ii) to calculate how far the water has moved in the two hours.

..... cm [1]

- (ii) Calculate the average speed of movement of the sugar solution up the glass tube in mm/hour.

speed = ..... mm/hour [1]

- (iii) Suggest an explanation for the movement of the sugar solution up the tube.

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

(c) Describe a chemical test to confirm that the sugar molecules have not passed out of the bag into the beaker of water.

sample tested .....

test procedure .....

.....

expected observation .....

[4]

(d) Predict what would happen if the experiment is set up as in Fig. 4.4 with the water inside the bag and the sugar solution in the beaker.

.....

.....[1]

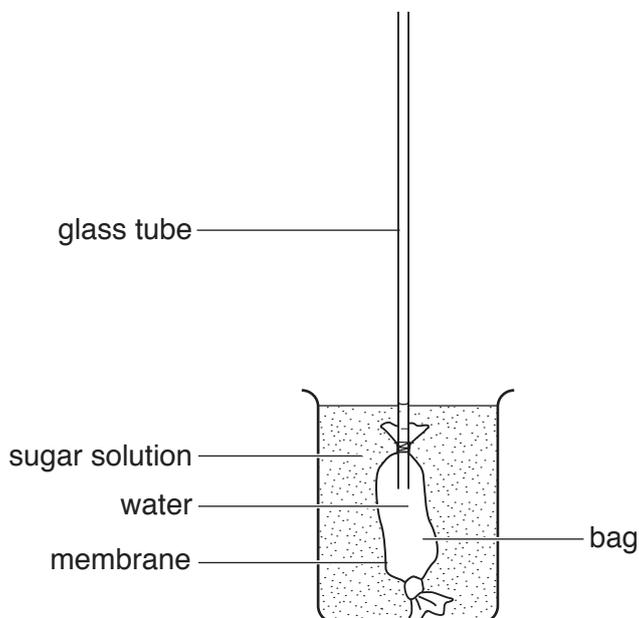


Fig. 4.4

- 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.

- (i) The student is told that one of the solutions has a pungent smell.

Name the solution.

.....[1]

He carries out the following tests.

- (ii) The student adds barium nitrate solution to  $1\text{ cm}^3$  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  $1\text{ cm}^3$  of copper(II) sulfate solution 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 25cm<sup>3</sup> 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 18cm<sup>3</sup>.
- He washes out the glassware.
- He now adds 18cm<sup>3</sup> of sodium hydroxide solution to 25cm<sup>3</sup> of 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 25cm<sup>3</sup> 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]

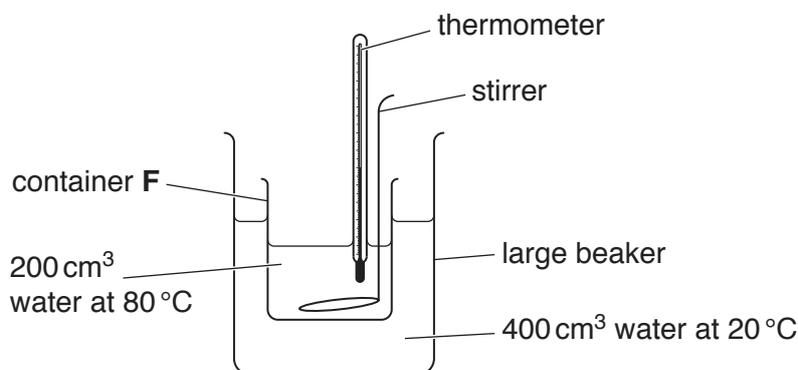
**(iv)** State how the student obtains the sample of solid sodium chloride from the reaction mixture.

.....

.....[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  $200\text{cm}^3$  of water at about  $85^\circ\text{C}$  in container **F**.
- He allows the contents of container **F** to cool to  $80^\circ\text{C}$ .
- He places  $400\text{cm}^3$  of water at exactly  $20^\circ\text{C}$  in a large beaker.
- When the temperature of the water in container **F** is  $80^\circ\text{C}$ , he puts the container into the large beaker as shown in Fig. 6.1.



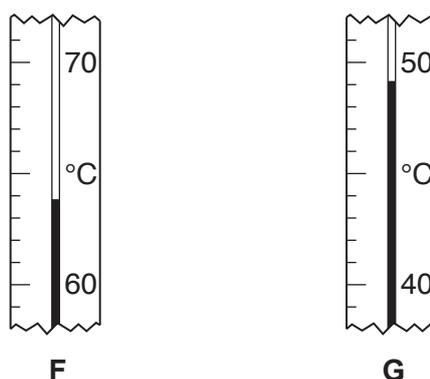
**Fig. 6.1**

- He immediately starts a stopwatch.
- 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 <b>F</b> / °C | 80       | 71 |    | 59 | 54  | 51  | 49  |
| temperature in <b>G</b> / °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  $1^\circ\text{C}$  and record these readings in Table 6.1. [2]



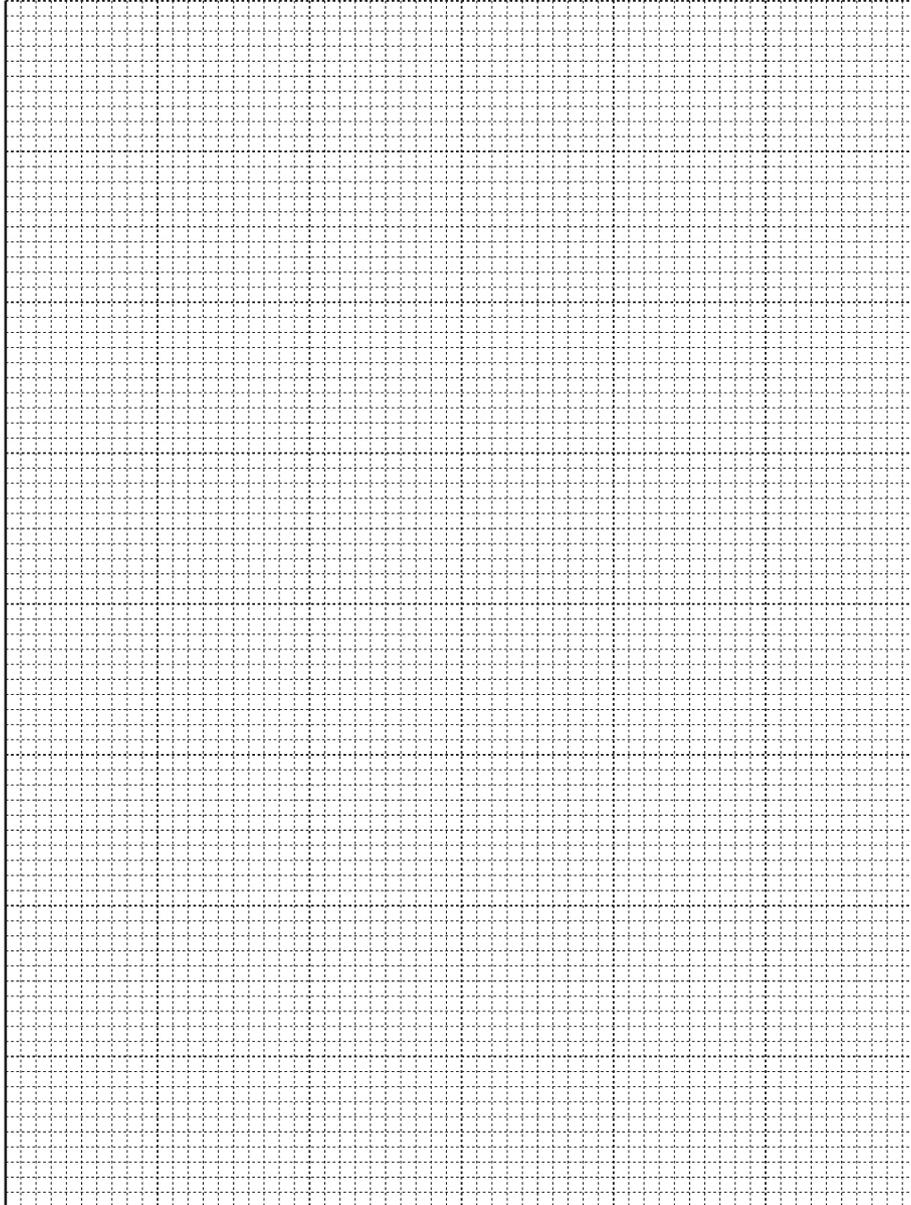
**Fig. 6.2**

- (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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