



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

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CO-ORDINATED SCIENCES

0654/63

Paper 6 Alternative to Practical

May/June 2019

1 hour 30 minutes

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 **15** printed pages and **5** blank pages.

- 1 A student investigates the movement of molecules.

She sets up the apparatus shown in Fig. 1.1. The partially permeable membrane allows small molecules such as water to pass through but does not allow large molecules such as sugar to pass through.

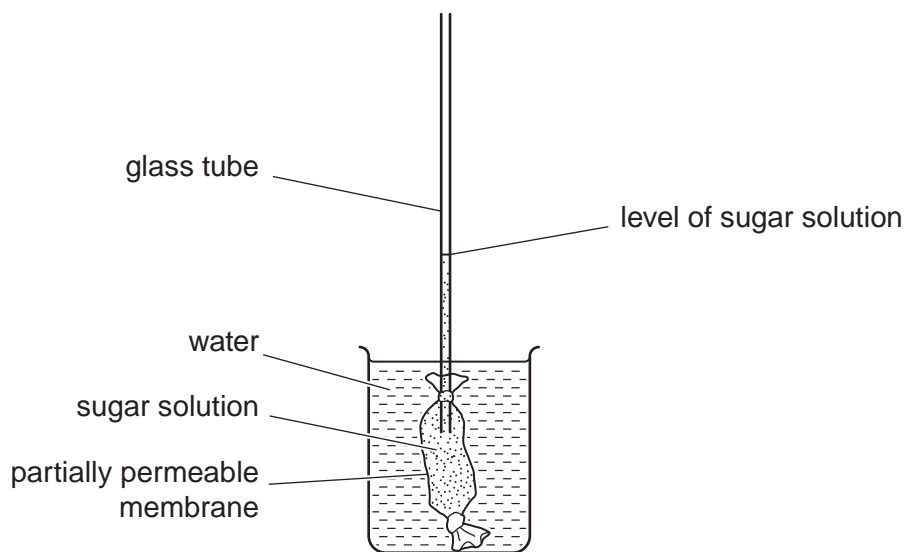


Fig. 1.1

- (a) She measures the height of the sugar solution in the glass tube.

Fig. 1.2 shows the initial height of the sugar solution in the glass tube.

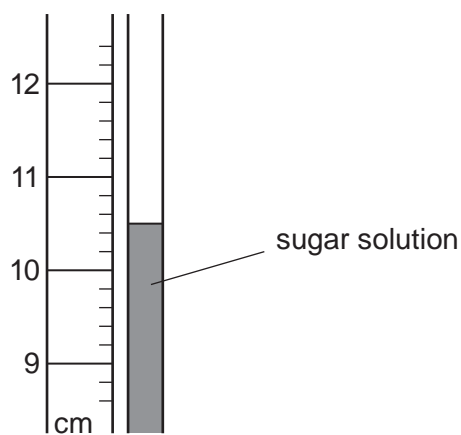


Fig. 1.2

3

- (i) Read and record this initial height **in millimetres** to the nearest millimetre.

initial height = mm [1]

- (ii) She leaves the apparatus for 30 minutes.

Fig. 1.3 shows the height of the sugar solution in the glass tube after 30 minutes.

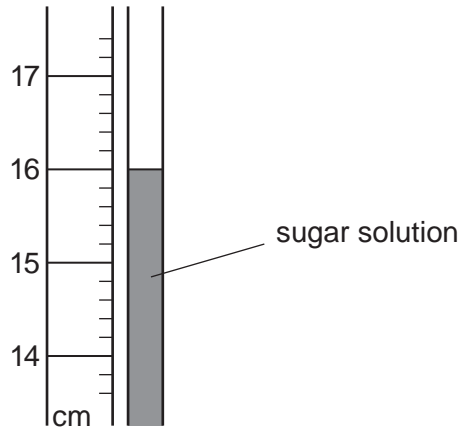


Fig. 1.3

Read and record this height **in millimetres** to the nearest millimetre.

height after 30 minutes = mm [1]

- (iii) Use your two values from **(a)(i)** and **(a)(ii)** to calculate the change in height of the sugar solution in the glass tube over the 30 minutes.

change in height = mm [1]

- (iv) Calculate the rate of movement of the sugar solution in millimetres per minute.

Give your answer to an appropriate number of significant figures.

rate = mm/minute [2]

- (b)** The values of height in **(a)** show that the sugar solution moves up in the glass tube.

Explain why the sugar solution moves in this direction.

.....

.....

.....

..... [3]

(c) The student tests the water in the beaker to find out if reducing sugar molecules have moved through the partially permeable membrane.

(i) Name the solution she uses to test for reducing sugar.

..... [1]

(ii) State the colour she observes if the reducing sugar molecules have moved through the partially permeable membrane.

..... [1]

(iii) State the colour she observes if reducing sugar molecules have **not** moved through the partially permeable membrane.

..... [1]

(d) The student repeats the investigation using salt solution instead of sugar solution.

State **two** variables that the student needs to keep the same to make a valid comparison of the rate of movement of the sugar solution and salt solution.

variable 1

variable 2

[2]

[Total: 13]

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2 Solid **L** is a mixture of two compounds.

A student dissolves a sample of **L** in distilled water. He then carries out a series of tests to identify one of the cations and both anions.

The tests and his observations are shown in Table 2.1.

Table 2.1

test on solution of L		observations	conclusions
1	add ammonia solution	dark blue solution	
2	add dilute hydrochloric acid	bubbles	carbonate ion
3	add dilute sulfuric acid followed by a few drops of barium nitrate solution	white ppt.	sulfate

(a) Explain why it is important to use distilled water to make a solution of **L**.

.....
 [1]

(b) (i) Suggest the conclusion which can be made from the observation for test 1.

..... [1]

(ii) Another student carries out test 1 on **L**. Her observation is a blue ppt.

Suggest why the two students obtained different results.

.....
 [1]

(c) The student did not include how they identified the bubbles of gas as carbon dioxide in test 2.

(i) State the test for carbon dioxide gas and the observation for a positive result.

test

observation

[1]

(ii) Draw a labelled diagram of the apparatus used to test for carbon dioxide gas.

Include any required liquids in your diagram.

[2]

(d) The instructions for test 3 in Table 2.1 are incorrect for the test for a sulfate ion.

(i) Explain why test 3 will give a white precipitate even if the solution does not contain the sulfate ion.

.....

..... [1]

(ii) State one change to the chemicals in test 3 that needs to be made for a valid sulfate test.

.....

..... [1]

(e) When the student repeats test 3 no precipitate is formed.

He then carries out a test which confirms the presence of the chloride ion.

State the chemicals required for this chloride test.

.....

..... [1]

[Total: 9]

- 3 A student investigates the electrical resistance of different combinations of identical lamps. She sets up the circuit shown in Fig. 3.1. This is Circuit 1.

Circuit 1

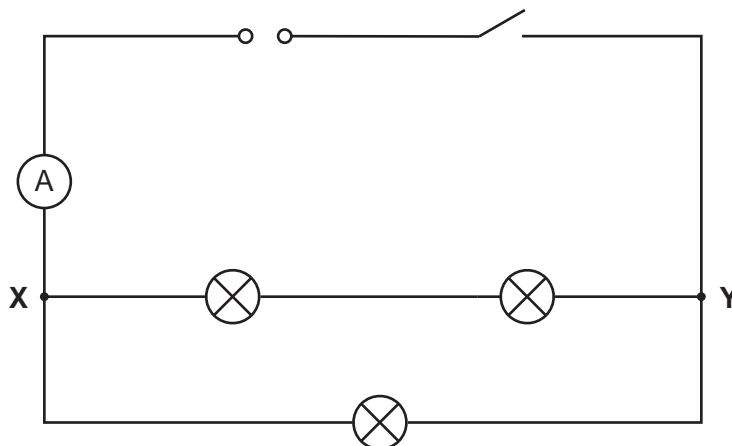


Fig. 3.1

- (a) On Fig. 3.1, draw the symbol for a voltmeter connected correctly to measure the potential difference between point X and point Y. [2]
- (b)
- She connects the voltmeter into Circuit 1 to measure the potential difference between X and Y.
 - She closes the switch.
 - She measures and records in Table 3.1 the potential difference V and the current I .
 - She opens the switch.

The voltmeter reading is shown in Fig. 3.2.

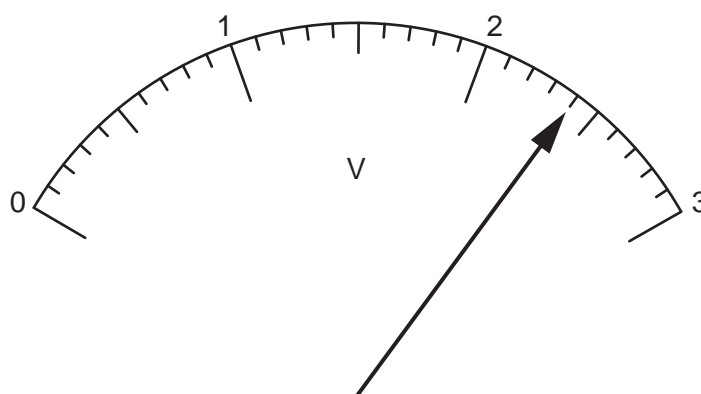


Fig. 3.2

Record in Table 3.1 the potential difference between X and Y.

[1]

Table 3.1

Circuit	V/\dots	I/\dots	R/\dots
1		0.42	
2	2.5	0.36	
3	2.6	0.88	

(c) Complete the column headings in Table 3.1, by giving the appropriate units. [1]

(d) • She reconnects the lamps between X and Y as shown in Fig. 3.3. This is Circuit 2.

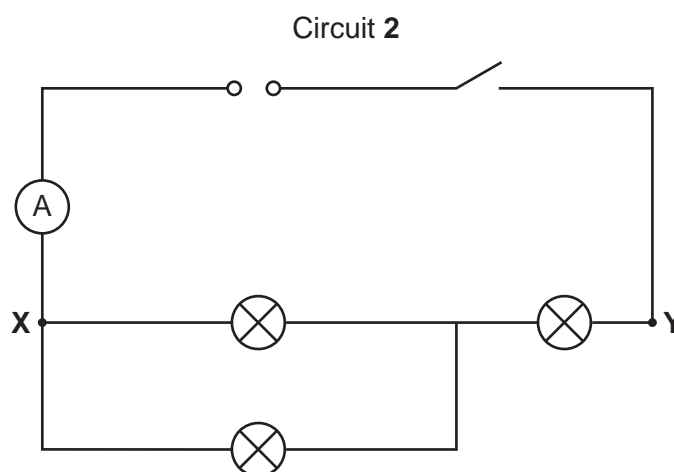


Fig. 3.3

- She repeats the steps described in (b) for Circuit 2.
- She reconnects the lamps between X and Y as shown in Fig. 3.4. This is Circuit 3.

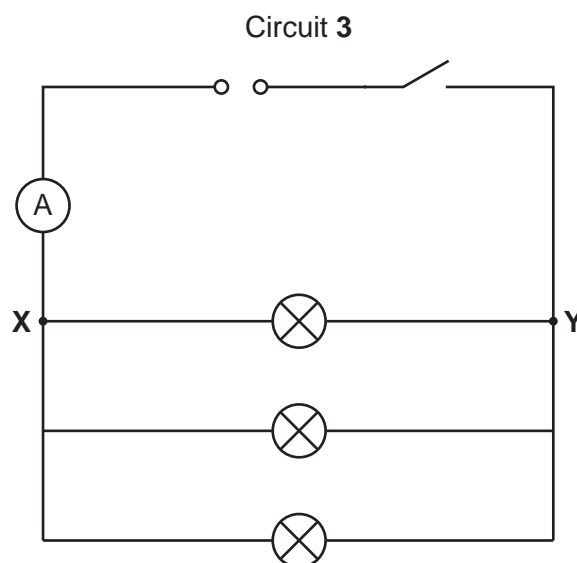


Fig. 3.4

- She repeats the steps described in (b) for Circuit 3.

- (i) State why the student opens the switch between taking readings.

.....
 [1]

- (ii) Calculate and record in Table 3.1, the total resistance R measured between **X** and **Y** for each combination of lamps. Use the equation shown.

$$R = \frac{V}{I} \quad [2]$$

- (iii) State which of Circuit 1, Circuit 2 or Circuit 3 will have the brightest lamps.

circuit [1]

- (e) A student makes the following suggestion.

“If each lamp has the same resistance, the total resistance between **X** and **Y** in Circuit 1 should be twice the total resistance between **X** and **Y** in Circuit 3.”

State whether your results support the student’s suggestion. Justify your statement by using the values of R you have calculated in Table 3.1.

.....

 [2]

- (f) The student wishes to investigate the resistance of the three lamps when they are connected in series.

- (i) Draw a circuit diagram to show the three lamps connected in series with the power supply. Include an ammeter to measure the current in the lamps.

[2]

- (ii) State how the brightness of the lamps in this series circuit compares with the brightness of the lamps in Circuit 3.

..... [1]

[Total: 13]

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- 4 Fig. 4.1 shows two guard cells and the stoma formed by them.

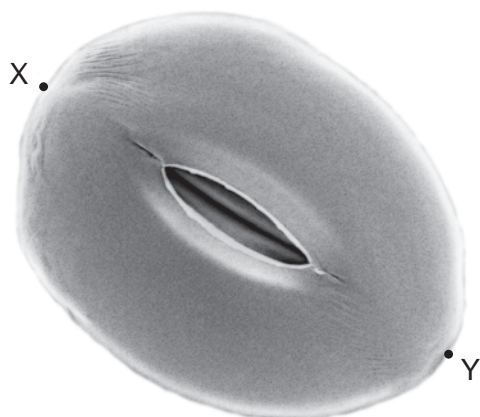


Fig. 4.1

- (a)** In the box, make an enlarged pencil drawing of the two guard cells and label the stoma.

[4]

- (b) (i)** Draw a straight line joining the points labelled X and Y on Fig. 4.1.

Measure this line XY on Fig. 4.1 in millimetres to the nearest millimetre.

length of the line XY on Fig. 4.1 = mm [1]

13

- (ii) Draw the line XY on your drawing in the same position as the line XY in Fig. 4.1.

Measure the line on your drawing in millimetres to the nearest millimetre.

length of line XY on drawing = mm [1]

- (iii) Use lengths in (b)(i) and (b)(ii) to calculate the magnification of your drawing.

Give your magnification to the nearest whole number.

magnification [1]

[Total: 7]

5 A student carries out an experiment to find the maximum amount of thermal energy produced when dilute sodium hydroxide reacts with dilute hydrochloric acid.

- She measures and records in Table 5.1 the initial temperature T_i of the dilute hydrochloric acid to the nearest 0.5°C .
- She places 5cm^3 dilute hydrochloric acid in a beaker and adds 55cm^3 dilute sodium hydroxide.
- She stirs the mixture and measures the highest temperature reached T_{max} .
- She records this temperature to the nearest 0.5°C in Table 5.1.
- She repeats the above procedure for different volumes of dilute sodium hydroxide V_{NaOH} and dilute hydrochloric acid V_{HCl} as shown in Table 5.1.

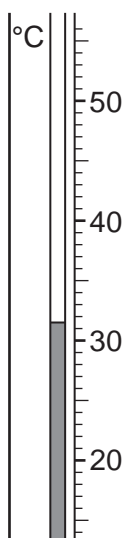
Table 5.1

volume of dilute hydrochloric acid, $V_{\text{HCl}}/\text{cm}^3$	volume of dilute sodium hydroxide, $V_{\text{NaOH}}/\text{cm}^3$	initial temperature of acid $T_i/^\circ\text{C}$	highest temperature of mixture $T_{\text{max}}/^\circ\text{C}$	temperature increase $\Delta T/^\circ\text{C}$
5	55	21.5	23.5	2.0
15	45	21.5	27.5	6.0
25	35	21.5		
35	25	21.5	32.0	
45	15	21.5	28.0	6.5
55	5	21.5	24.0	2.5

(a) (i) The thermometer in Fig. 5.1 shows the highest temperature reached T_{max} for $V_{\text{HCl}} = 25\text{cm}^3$.

Read and record this temperature to the nearest 0.5°C in Table 5.1.

[1]



Highest temperature T_{max} for $V_{\text{HCl}} = 25\text{cm}^3$

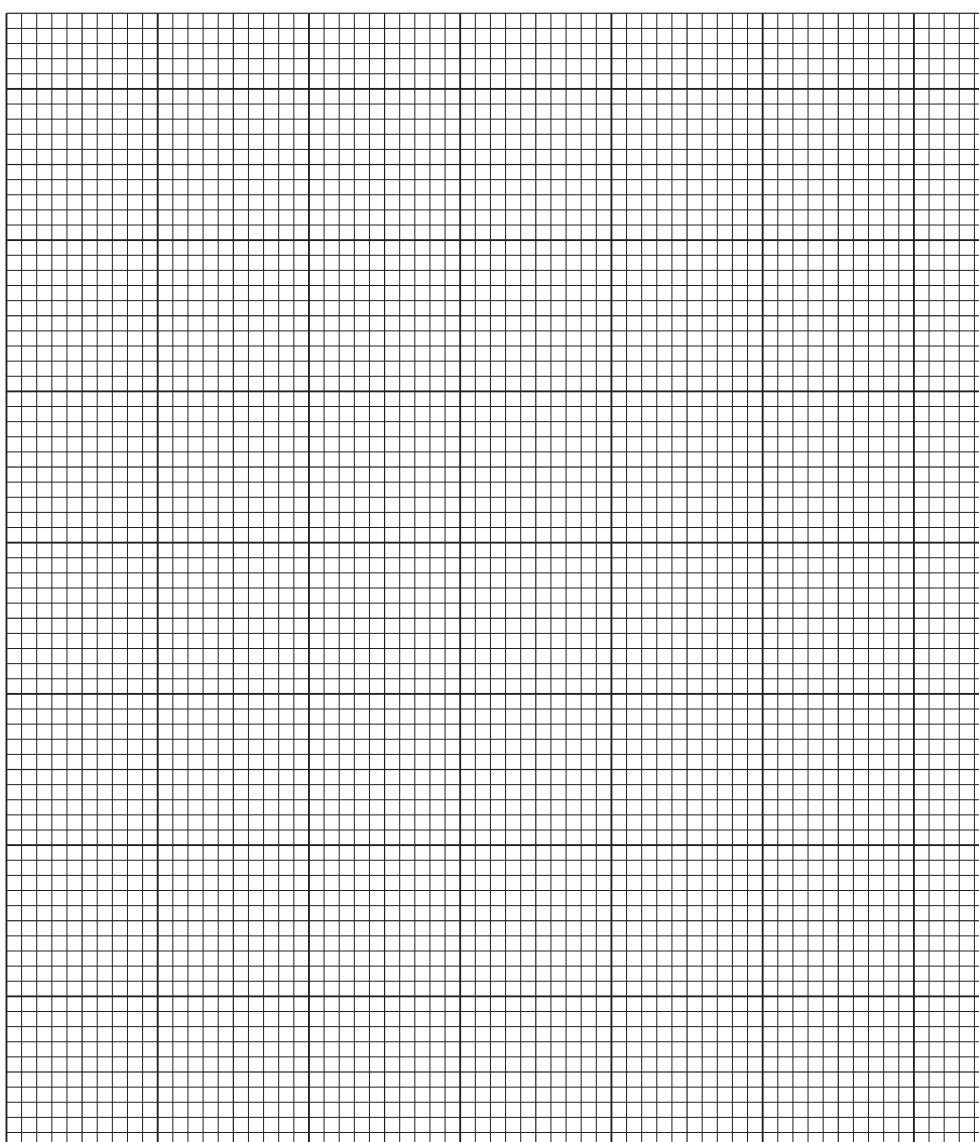
Fig. 5.1

- (ii) Calculate and record in Table 5.1 the temperature increase ΔT for the volumes of hydrochloric acid $V_{\text{HCl}} = 25$ and 35 cm^3 .

[1]

- (b) (i) Plot a graph of temperature increase ΔT (vertical axis) against **volume of hydrochloric acid** V_{HCl} .

The vertical scale should extend to at least 13.0.



[3]

- (ii) Draw the best-fit straight line through the points for $V_{\text{HCl}} = 5, 15$ and 25 cm^3 .

Draw a second best-fit straight line through the points for $V_{\text{HCl}} = 35, 45$ and 55 cm^3 .

[1]

- (iii) Extend the two straight lines you have drawn on the graph until they intersect.

Read and record the value of V_{HCl} where the two lines intersect.

$$V_{\text{HCl}} = \dots\dots\dots \text{cm}^3$$

Read and record the value of ΔT where the two lines intersect. This is the maximum temperature increase ΔT_{max} for the reaction.

$$\Delta T_{\text{max}} = \dots\dots\dots ^\circ\text{C}$$

[2]

- (iv) Use the data in Table 5.1 to deduce the volume of dilute sodium hydroxide V_{NaOH} which would be required to react with the value of V_{HCl} in **(b)(iii)** to produce the maximum temperature increase ΔT_{max} .

Use the equation shown.

$$V_{\text{NaOH}} = 60 - V_{\text{HCl}}$$

$$V_{\text{NaOH}} \dots\dots\dots \text{cm}^3 \quad [1]$$

- (c) (i) Calculate the amount of thermal energy E released by the reaction. Use your answer for ΔT_{max} in **(b)(iii)** and the equation shown.

$$E = 60 \times 4.2 \times \Delta T_{\text{max}}$$

$$E = \dots\dots\dots \text{J} \quad [1]$$

- (ii) Suggest one reason why this value of E is less than the actual amount of thermal energy released.

.....
 [1]

[Total: 11]

- 6 A student investigates the thermal insulating properties of three different materials: cotton wool, cardboard and cloth.

He has samples of the insulating materials and the following apparatus:

supply of hot water
250 cm³ beaker
measuring cylinder
thermometer
stopwatch.

Plan an experiment to investigate which material is the best thermal insulator.

You should:

- explain briefly how you would carry out the investigation
- state the variables you would keep the same
- draw one or more tables with column headings to show how you would present your results (you are not required to enter any readings in the tables)
- explain how you would use your results to decide which material is the best thermal insulator.

You may draw a diagram if it helps to explain your answer.

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..... [7]

[Total: 7]

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