Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

CO-ORDINATED SCIENCES **0654/62**

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 **16** printed pages and **4** blank pages.

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1 A student tests the nutrient content of three colourless solutions **A**, **B** and **C**. She tests each solution with each of the following:

- iodine solution
- biuret solution
- ethanol and water.

Solution **A** tests positive with the ethanol and water.

Solution **B** tests positive with the biuret solution.

Solution **C** tests positive with the iodine solution.

All other results are negative.

(a) **(i)** Use the information to complete Table 1.1 with the colours the student observes in each test.

You should include the observations for negative results.

Table 1.1

test solutions	solution **A**	solution **B**	solution **C**
biuret solution			
ethanol and water			
iodine solution			

[4]

(ii) Use the results to state the nutrient content of each solution.

Solution **A** contains ....

Solution **B** contains ....

Solution **C** contains ....
[3]

[Total: 7]

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2 A student carries out an experiment to find the concentration of a sample of hydrochloric acid by reacting it with sodium hydroxide solution of concentration 0.2 mol/dm^3.

- He adds 20 cm^3 of hydrochloric acid into a beaker.
- He places 5 drops of Universal Indicator solution in the beaker.
- He measures 25 cm^3 of sodium hydroxide solution in a measuring cylinder.
- He pours sodium hydroxide solution from the measuring cylinder into the beaker containing hydrochloric acid and Universal Indicator slowly whilst stirring the mixture.
- He stops adding sodium hydroxide solution as soon as the Universal Indicator shows a neutral colour.
- He records in Table 2.1, to an appropriate accuracy, the volume V_R of sodium hydroxide solution **remaining** in the measuring cylinder for experiment 1.
- He repeats this procedure three more times. These are experiments 2, 3 and 4.

Table 2.1

experiment	volume V_R of sodium hydroxide solution remaining in the measuring cylinder / cm^3	volume V of sodium hydroxide solution added to the beaker / cm^3
1	14.0	
2		
3	16.5	
4	14.5	

(a) (i) Fig. 2.1 shows the measuring cylinder containing the remaining sodium hydroxide solution for experiment 2.

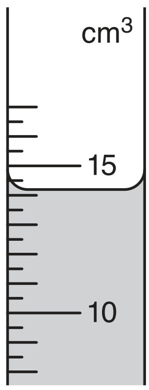

Fig. 2.1

Read the scale of the measuring cylinder in Fig. 2.1 and record in Table 2.1, to an appropriate accuracy, the volume V_R of sodium hydroxide solution **remaining**. [1]

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(ii) When the student pours the sodium hydroxide solution from the measuring cylinder into the hydrochloric acid, he finds it very difficult to add the exact amount needed to achieve a neutral solution.

State the name of a piece of apparatus he should use instead of the measuring cylinder to add an exact amount of sodium hydroxide solution.

....

.... [1]

(b) **(i)** For each experiment calculate the volume *V* of sodium hydroxide solution added to the beaker using the equation shown.

$$V = 25.0 - V_R$$

Record the values of *V* in Table 2.1. [1]

(ii) Select and record the values of *V* that should be used in calculating the average volume of sodium hydroxide solution used.

You should justify your selection.

values of *V* selected ....

....

explanation ....

....
[2]

(iii) Use the volumes you have selected in **(b)(ii)** to calculate the average volume V_A of sodium hydroxide solution added to the beaker to neutralise the hydrochloric acid.

V_A = ...cm^3 [1]

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(iv) Calculate the concentration C of the hydrochloric acid using the equation shown.

$$C = \frac{(\text{concentration of sodium hydroxide solution} \times V_A)}{\text{volume of hydrochloric acid used}}$$

$$= \frac{0.2 \times V_A}{20}$$

Give your answer to an appropriate number of significant figures.

C = ... mol/dm^3 [2]

(c) Suggest why the student uses Universal Indicator solution rather than litmus paper.

....

.... [1]

(d) Another student carries out the same experiment but uses sodium hydroxide solution of concentration 0.1 mol/dm^3 instead of 0.2 mol/dm^3.

Using **(b)(iii)** and **(b)(iv)**, predict the average volume V_A of sodium hydroxide solution that would be needed to neutralise the hydrochloric acid.

V_A using 0.1 mol/dm^3 sodium hydroxide = ... cm^3 [1]

[Total: 10]

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3 A student measures the resistance of an unknown resistor **R**.

She sets up the circuit as shown in Fig. 3.1.

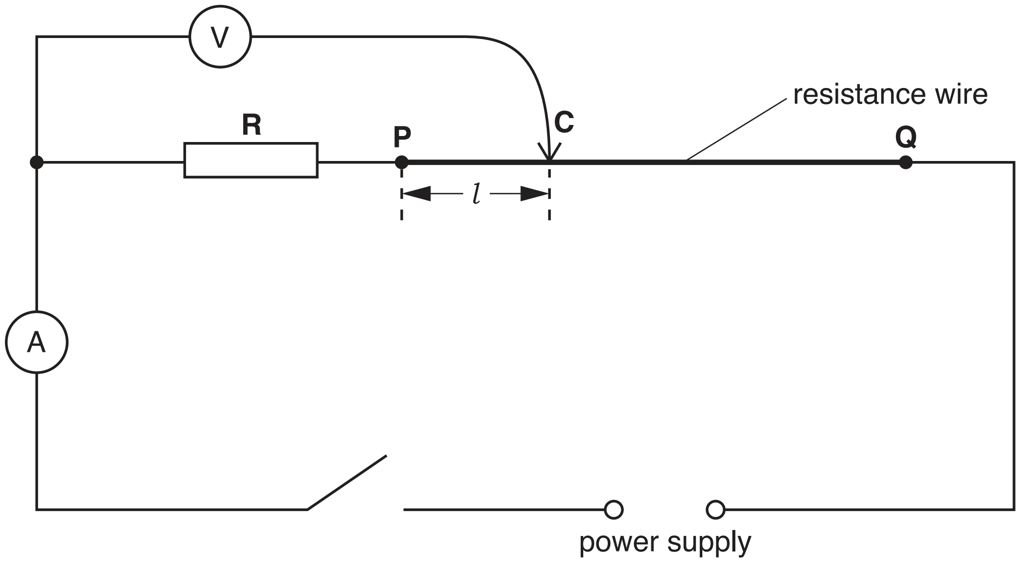

Fig. 3.1

(a)
- She places the sliding contact **C** at a distance of l = 10.0 cm from end **P** of the resistance wire.
- She closes the switch.

Fig. 3.2 shows the reading on the ammeter and Fig. 3.3 shows the reading on the voltmeter.

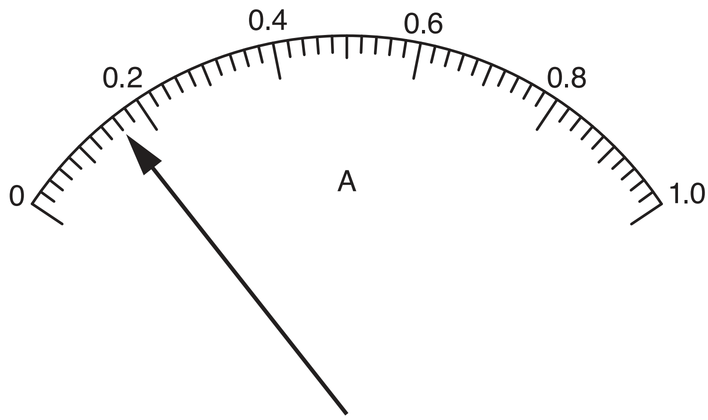

Fig. 3.2

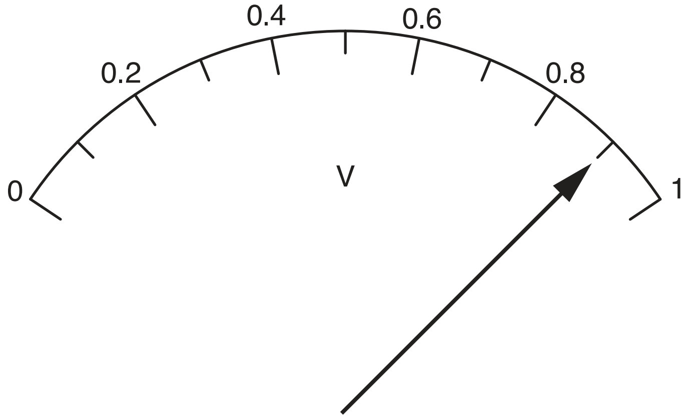

Fig. 3.3

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(i) Read the ammeter scale and record the current I in the circuit.

I = ...A [1]

(ii) Read the voltmeter scale and record, in Table 3.1, the reading V on the voltmeter. [1]

Table 3.1

l / cm	V / V
10.0	
30.0	1.15
50.0	1.40
70.0	1.65
90.0	1.90

(b) (i)
- She repeats the procedure using values of l of 30.0 cm, 50.0 cm, 70.0 cm and 90.0 cm.
- She opens the switch.

Her results are shown in Table 3.1.

On the grid provided, plot a graph of V (vertical axis) against l.

Start both axes from the origin (0, 0). [3]

(ii) Draw the best-fit straight line. [1]

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(c) Extend your line until it crosses the vertical axis. Measure the intercept Y that your line makes on the vertical axis.

Y = ...V [1]

(d) The resistance of the unknown resistor **R** is given by the equation shown.

$$\text{resistance} = \frac{Y}{I}$$

I is the current that you measured in part **(a)(i)**.

Use this equation to calculate a value for the resistance of **R**.

resistance of **R** = ... Ω [2]

(e) Suggest one practical reason why, despite the student carrying out the experiment with care, her value for the resistance of **R** is only approximate.

....

.... [1]

[Total: 10]

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4 Fig. 4.1 shows a life size photograph of a walnut.

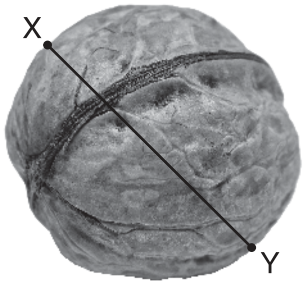

Fig. 4.1

(a) In the box below, make an enlarged detailed pencil drawing of the walnut in Fig. 4.1.

[2]

(b) **(i)** Draw the line XY on your drawing. XY is an estimate of the diameter of the walnut in your drawing.

Measure and record this diameter d_1 of the drawing of the walnut in millimetres to the nearest millimetre.

d_1 = ... mm [1]

(ii) Measure and record the length of the line XY on Fig. 4.1 in millimetres to the nearest millimetre. This is an estimate of the diameter, d_2 of the actual walnut.

d_2 = ... mm [1]

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(iii) Use your values for d_1 (drawing) and d_2 (actual walnut) to calculate the magnification of your drawing.

magnification = ... [1]

(c) Explain why d_2 is not an accurate measurement of the diameter of the actual walnut.

.... [1]

[Total: 6]

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5 A student investigates how the concentration of hydrochloric acid affects its reaction with marble chips (calcium carbonate).

She uses hydrochloric acid which has a concentration of 2.0 mol/dm^3.

- She half fills a small test-tube with water and adds one drop of detergent.
- She places this test-tube in a beaker.
- She places 2 marble chips into a large test-tube.
- She adds 10.0 cm^3 hydrochloric acid to the marble chips.
- She quickly connects the bung of a delivery tube to the large test-tube containing the hydrochloric acid and marble chips, so that the gas produced bubbles through the water and detergent.
- She immediately starts the stopclock.
- She stops the stopclock when the bubbles in the water and detergent reach the top of the small test-tube.
- She records in Table 5.1 this time in seconds to the nearest second.

(a) Draw a labelled diagram to show the apparatus connected together as in the procedure.

[2]

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(b) The student makes 10.0 cm^3 of hydrochloric acid of concentration 1.5 mol/dm^3 by adding 2.5 cm^3 of water to 7.5 cm^3 of the original hydrochloric acid and mixing well.

These volumes are shown in Table 5.1.

Table 5.1

volume of hydrochloric acid / cm^3	volume of water / cm^3	concentration of hydrochloric acid / mol per dm^3	time / s
10.0	0	2.0	48
7.5	2.5	1.5	
5.0	5.0	1.0	109

She repeats the procedure using this acid of lower concentration (1.5 mol/dm^3) instead of the original acid (2.0 mol/dm^3).

The reading on the stopclock is shown in Fig. 5.1.

Fig. 5.1

(i) Read the time on the stopclock in Fig. 5.1 and record this time in Table 5.1. [1]

(ii) The student repeats the procedure with hydrochloric acid of concentration 1.0 mol/dm^3, and records the information in Table 5.1.

Use the results in Table 5.1 to deduce the relationship between rate of reaction and concentration of hydrochloric acid for this reaction.

....

.... [1]

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(c) **(i)** Another student suggests that three concentrations for the hydrochloric acid is not enough to deduce a valid relationship between rate of reaction and concentration of hydrochloric acid.

Suggest why this student may be correct.

....

.... [1]

(ii) The student decides to repeat the procedure using hydrochloric acid of 0.5 mol/dm^3.

State the volumes of the original hydrochloric acid (2.0 mol/dm^3) and water required to make hydrochloric acid of concentration 0.5 mol/dm^3.

volume of original hydrochloric acid (2.0 mol/dm^3) = ... cm^3

volume of water = ... cm^3

[1]

(iii) Suggest two further improvements for this procedure, other than testing more different concentrations of hydrochloric acid.

1 ....

....

2 ....

....

[2]

(d) Suggest an alternative method for measuring the rate of the reaction between hydrochloric acid and marble chips (calcium carbonate).

You must include what is timed in your answer.

....

....

....

.... [2]

[Total: 10]

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6 A student investigates the cooling rates of different volumes of hot water in a beaker.

He pours 200 cm^3 of hot water into a beaker.

He places a thermometer into the water and when the reading stops rising, measures the temperature θ_0 of the hot water and starts a stopwatch.

The initial temperature of the hot water is shown in Fig. 6.1.

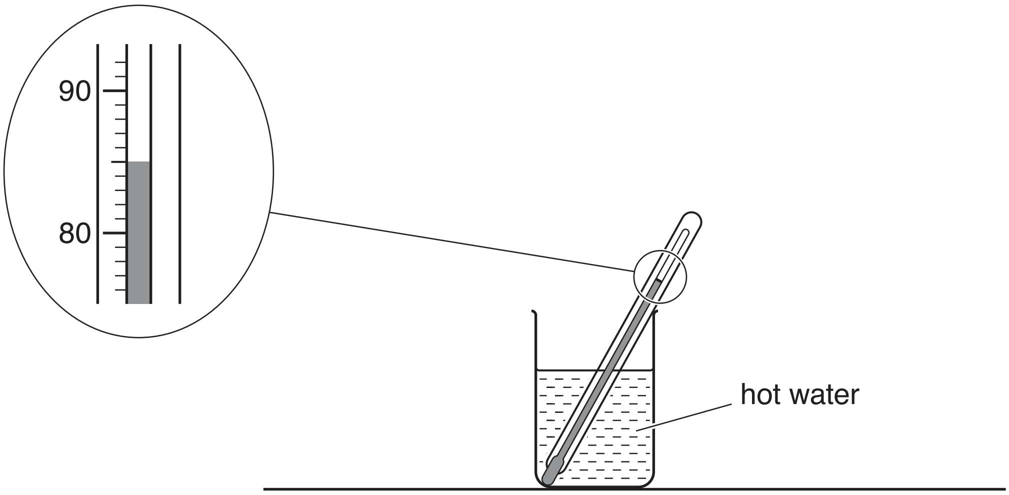

Fig. 6.1

(a) Read and record, in the second column of Table 6.1, the temperature θ_0 at time t = 0. [1]

Table 6.1

time t /	temperature of 200 cm^3 of water θ /	temperature of 100 cm^3 of water θ / ......
0		87.0
	83.0	84.0
	81.0	81.0
	79.0	78.5
	77.5	76.0
	76.0	74.0
180	74.5	72.5

(b) The student measures the temperature of the hot water every 30 s for 180 s. He records his results in Table 6.1.

(i) Complete the headings in Table 6.1 by inserting the correct units. [1]

(ii) Complete the time column in Table 6.1. [1]

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(c) State **one** precaution that the student should take to ensure that the temperature readings are as accurate as possible.

....

.... [1]

(d) **(i)** Calculate the fall in temperature θ_X of the 200 cm^3 of hot water during the 180 s for which it cooled.

θ_X = ...°C [1]

(ii) Calculate the average rate of fall in temperature R_1 of the 200 cm^3 of hot water over the 180 s. Use your answer to **(d)(i)** and the equation shown.

$$R_1 = \frac{\theta_X}{180}$$

R_1 = ... °C/s [1]

(e) The student empties the hot water from the beaker and repeats the experiment using 100 cm^3 of hot water instead of 200 cm^3.

He records his results in the third column of Table 6.1.

Calculate the average rate of fall in temperature R_2 of the 100 cm^3 of hot water over the 180 s.

R_2 = ... °C/s [1]

(f) Write a conclusion stating how the volume of hot water affects its rate of cooling.

Justify your conclusion by referring to the results.

....

....

.... [2]

(g) Refer to Table 6.1. Suggest one improvement that could be made to the investigation to make it a fairer comparison of the cooling rates of the two different volumes of water.

....

.... [1]

[Total: 10]

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7 A student has three solutions containing different concentrations of reducing sugar.

Plan an investigation to test the three solutions for the presence of reducing sugar and place them in order of concentration.

In your answer, include:

- a brief description of the method
- which variables you will keep the same and any safety precautions
- the observations for positive and negative results
- how you would use the results to place them in order of concentration of reducing sugar.

....

....

....

....

....

....

....

....

....

....

....

.... [7]

[Total: 7]

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