Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME
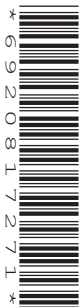
CENTRE NUMBER

CANDIDATE NUMBER

CO-ORDINATED SCIENCES 0654/52

Paper 5 Practical Test May/June 2019

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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.
Notes for Use in Qualitative Analysis for this paper are printed on page 20.

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 Assessment
International Education

[Turn over

1 You are going to test two solutions **A** and **B** for their nutrient content using iodine solution and biuret solution.

(a) To test each solution with iodine solution:

- use the dropping pipette to place 5 drops of solution **A** into a clean well in the spotting tile
- add 3 drops of iodine solution to the well containing solution **A**
- repeat this procedure with solution **B** using a clean well.

Record in the second row of Table 1.1 the colour observed in each well. [2]

(b) To test each solution with biuret solution:

- pour approximately 1 cm depth of solution **A** into a clean test-tube
- add an equal depth of biuret solution to the test-tube containing solution **A**
- repeat this procedure with solution **B** using a clean test-tube.

Record in the third row of Table 1.1, the colour observed in each test-tube. [2]

Table 1.1

test solution	observations	
	solution **A**	solution **B**
iodine solution		
biuret solution		

(c) Use the results in Table 1.1 to state the nutrient content of each solution.

Solution **A** contains ....

Solution **B** contains ....
[2]

(d) A student tests a sample of vegetable oil for the presence of fat.

She dissolves the oil in ethanol.

State the next step in the procedure.

.... [1]

[Total: 7]

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[Turn over

2 You are going to find the concentration of a sample of hydrochloric acid by reacting it with sodium hydroxide solution of concentration $0.2\,mol/dm^3$.

(a) (i) Procedure
- Use the large test-tube with a mark for $20\,cm^3$ to place $20\,cm^3$ of hydrochloric acid in a beaker.
- Add 5 drops of Universal Indicator solution into the beaker.
- Measure $25\,cm^3$ of sodium hydroxide solution in a measuring cylinder.
- Using a dropping pipette slowly add sodium hydroxide solution from the measuring cylinder to the beaker containing hydrochloric acid and Universal Indicator, whilst stirring the mixture.
- Stop adding sodium hydroxide solution as soon as the Universal Indicator shows a neutral (or slightly alkaline) colour.
- Record in Table 2.1, to an appropriate accuracy, the volume V_R of sodium hydroxide solution **remaining** in the measuring cylinder for experiment 1. [2]

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		
2		
3		

(ii) Repeat the procedure in **(a)(i)** twice and record in Table 2.1 the volumes V_R of sodium hydroxide solution **remaining** in the measuring cylinder for experiments 2 and 3. [1]

(b) (i) For each experiment calculate the volume, V of sodium hydroxide solution that has been added to the hydrochloric acid in the beaker using the equation shown.

$$V = 25.0 - V_R$$

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

(ii) Select the values of V that should be used in calculating the average volume of sodium hydroxide solution added to the beaker.

Explain 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]

(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 one improvement to this experiment which would give a more accurate value of C.

....

.... [1]

[Total: 10]

3 You are going to measure the resistance of an unknown resistor **R**.

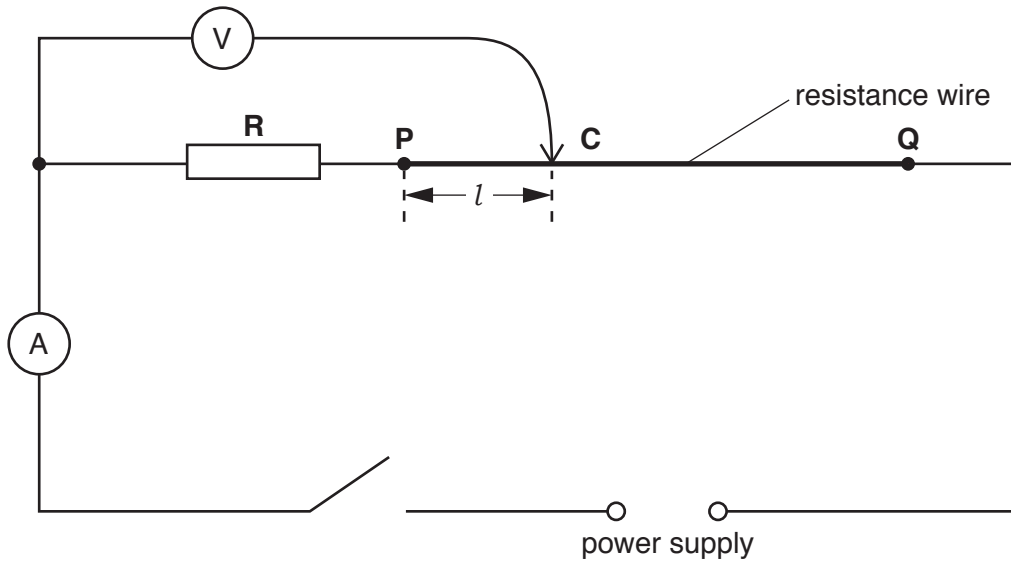A circuit has been set up for you as shown in Fig. 3.1.

Fig. 3.1

(a) (i) Procedure
- Place the sliding contact **C** at a distance of l = 10.0 cm from end **P** of the resistance wire.

- Close the switch.

- Measure and record in Table 3.1, the reading V on the voltmeter.

- Open the switch. [1]

Table 3.1

l/cm	V/V
10.0	
30.0	
50.0	
70.0	
90.0	

(ii) Repeat the procedure in **(a)(i)** using values of l of 30.0 cm, 50.0 cm, 70.0 cm and 90.0 cm. [1]

(iii) Close the switch.

Measure the current I in the circuit for l = 90.0 cm.

I = ... A [1]

(b) On the grid provided, plot a graph of V/V (vertical axis) against l/cm. Start both axes from the origin (0, 0). Draw the best-fit straight line.

V/V

l/cm
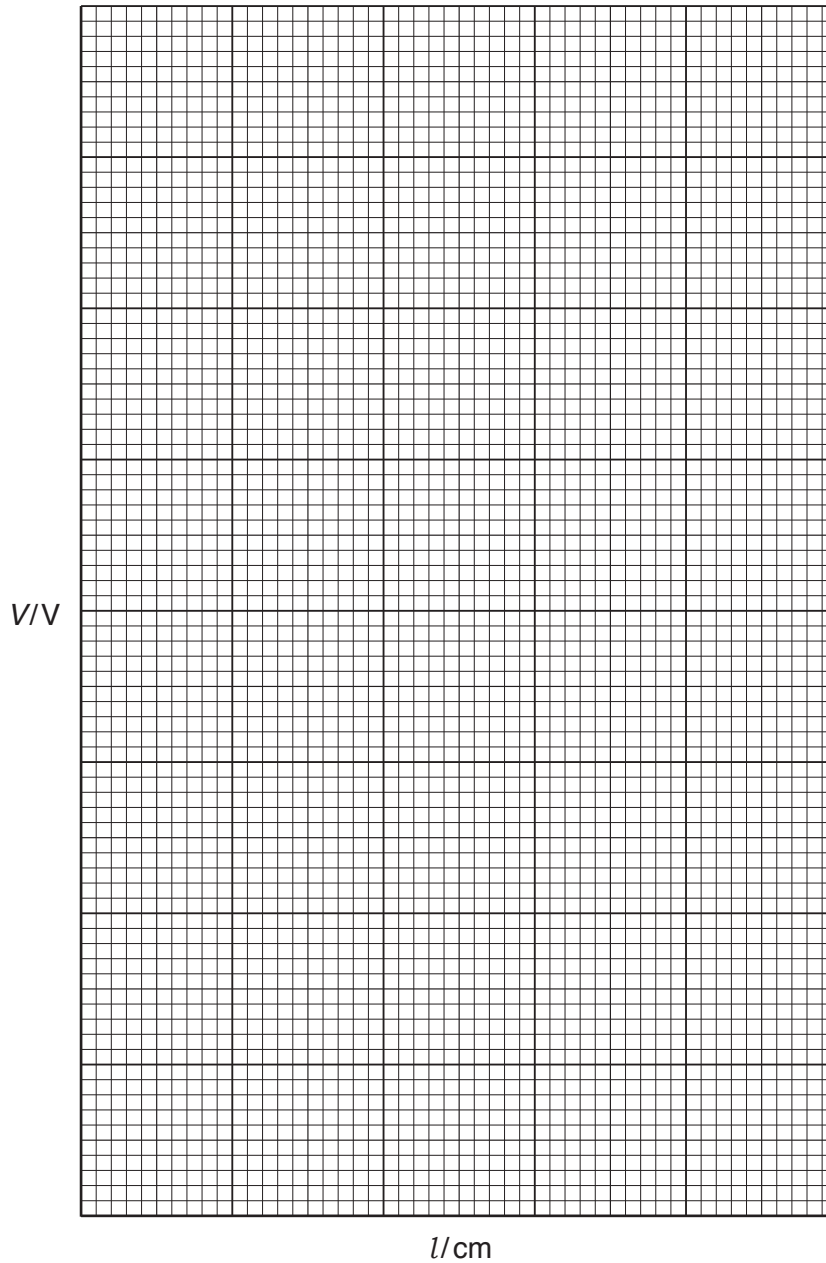
[3]

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

Y = ... [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)(iii)**.

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

resistance of **R** = ... Ω [2]

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

....

.... [1]

[Total: 10]

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4 You are provided with a nut in its shell.

(a) In the box, make an enlarged detailed pencil drawing of the nut.
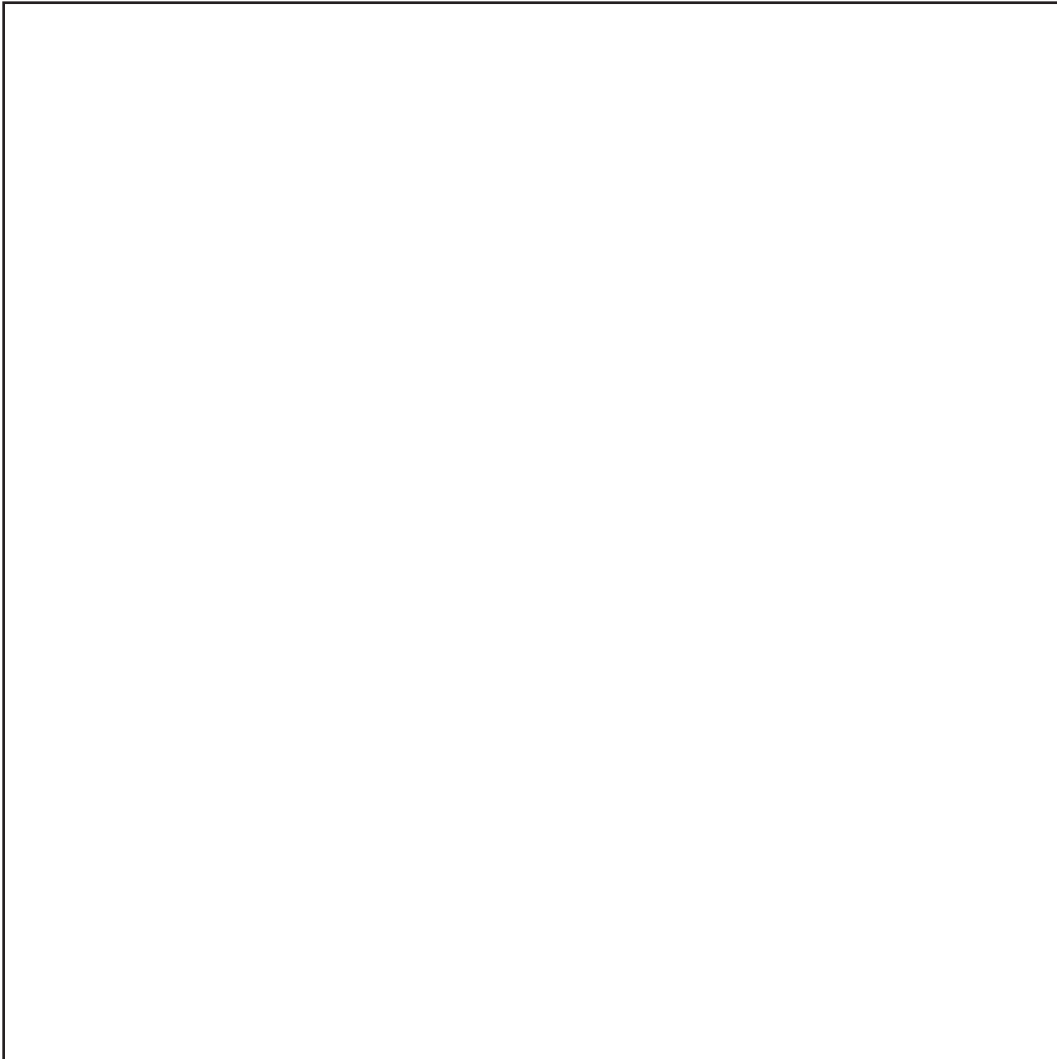
[2]

(b) (i) Draw a line on your drawing from one side of the nut to the other to represent the diameter of the nut.

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

d_1 = ... mm [1]

(ii) Use the string and ruler provided to measure the circumference of the nut in its shell.

Record this circumference C in millimetres to the nearest millimetre.

C = ... mm [1]

(iii) Use your answer in **(b)(ii)** to calculate the diameter d_2 of the nut using the equation shown.

$$d_2 = \frac{C}{3.14}$$

d_2 = ...mm [1]

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

magnification = ... [1]

[Total: 6]

5 You are going to investigate how the concentration of hydrochloric acid affects its reaction with marble chips (calcium carbonate).

You are provided with hydrochloric acid which has a concentration of $2.0\,mol/dm^3$.

(a) Procedure
- Half fill the small test-tube with water and add one drop of detergent. Place this test-tube in the beaker.

- Place 5 marble chips into the large test-tube.

- Add $10.0\,cm^3$ hydrochloric acid to the marble chips.

- Quickly connect the large test-tube to the test-tube containing water and detergent using a delivery tube as shown in Fig. 5.1.

- Immediately start the stopclock.

- Stop the stopclock when the bubbles of detergent reach the top of the small test-tube.
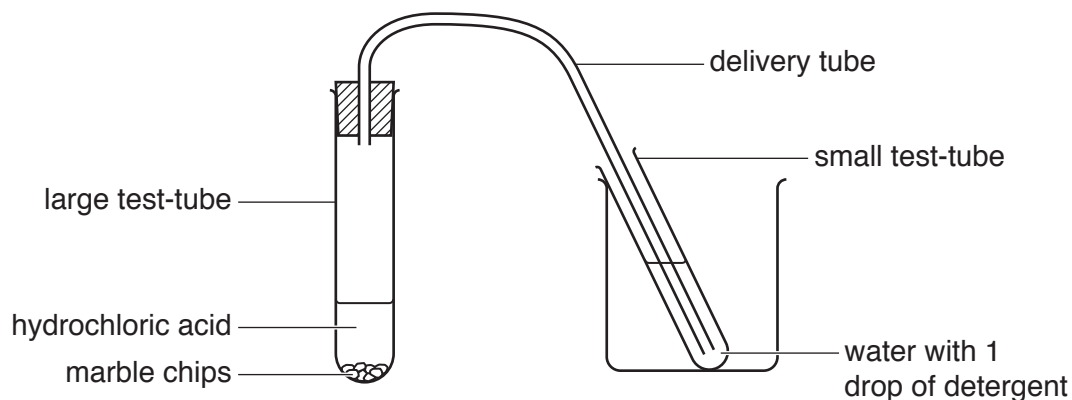
Fig. 5.1

(i) Record in Table 5.1 the time taken in seconds to the nearest second for the bubbles to reach the top of the small test-tube. [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	
7.5	2.5	1.5	
5.0	5.0	1.0	

(ii) Procedure
- Discard the contents of the test-tubes into the waste beaker.

- Wash out the test-tubes.

- Place $7.5\,cm^3$ hydrochloric acid and $2.5\,cm^3$ water into a small beaker. Mix well.

- This makes $10.0\,cm^3$ of hydrochloric acid of concentration $1.5\,mol/dm^3$.

These volumes are shown in Table 5.1.

Repeat the procedure in **(a)** using this more dilute acid.

Record the time in Table 5.1. [1]

(iii) Procedure
- Discard the contents of the test-tubes into the waste beaker.

- Wash out the test-tubes and the small beaker.

- Place $5.0\,cm^3$ hydrochloric acid and $5.0\,cm^3$ water into a test-tube. Mix well.

This makes $10.0\,cm^3$ of hydrochloric acid of concentration $1.0\,mol/dm^3$.

Repeat the procedure in **(a)** using this more dilute acid.

Record the time in Table 5.1. [1]

(iv) State the volumes of hydrochloric acid and water required to make hydrochloric acid of concentration $0.5\,mol/dm^3$.

Do not make up this solution.

volume of hydrochloric acid = ... cm^3

volume of water = ... cm^3
[1]

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

....

.... [1]

(ii) A student suggests that three different concentrations of hydrochloric acid is not enough to deduce the relationship between rate of reaction and concentration of hydrochloric acid.

Suggest why the student may be correct.

....

.... [1]

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

1 ....

....

2 ....

....

[2]

(c) 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 You are going to investigate the cooling rates of different volumes of hot water in a beaker.

(a) Procedure
- Pour 200 cm^3 of the hot water provided into the beaker.

- Place the thermometer into the water and when the reading stops rising, measure the temperature θ_0 of the hot water and start the stopwatch.

(i) Record, in the second column of Table 6.1, the temperature θ_0 at time $t = 0$. [1]

Table 6.1

time t/s	temperature of 200 cm^3 of water θ/°C	temperature of 100 cm^3 of water θ/°C
0		
30		
60		
90		
120		
150		
180		

(ii) Measure the temperature of the hot water every 30 s for 180 s.

Record, in Table 6.1, your results to the nearest 0.5°C. [2]

(b) State **one** precaution that you took to ensure that the temperature readings were as accurate as possible.

....

.... [1]

(c) (i) Calculate the fall in temperature θ_X of the hot water during the 180 s for which it cooled.

$\theta_X =$ .... °C [1]

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

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

$R_1 =$ .... °C/s [1]

(d) Procedure
- Empty the hot water from the beaker.

- Repeat **(a)** using $100\,cm^3$ of the hot water provided instead of $200\,cm^3$.

- Record, in the third column of Table 6.1, your results. [1]

(e) Calculate the average rate of fall in temperature R_2 of the hot water over 180 seconds.

R_2 = ... °C/s [1]

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

Justify your answer by referring to your results.

....

....

.... [2]

[Total: 10]

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 how to place them in order of concentration of reducing sugar.

Do not carry out this investigation.

In your answer, include:

- a brief description of the method and any safety precautions
- which variables you will keep the same
- 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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NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	test	test result
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.
bromide (Br^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream 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 nitrate	white ppt.

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt., or very slight white ppt.
copper (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

Tests for gases

gas	test and test result
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

Flame tests for metal ions

metal ion	flame colour
lithium (Li^+)	red
sodium (Na^+)	yellow
potassium (K^+)	lilac
copper(II) (Cu^{2+})	blue-green