www.dynamicpapers.com

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

6730332868

COMBINED SCIENCE **0653/62**

Paper 6 Alternative to Practical **February/March 2023**

1 hour

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

DC (CJ/CB) 314434/3
© UCLES 2023

[Turn over

www.dynamicpapers.com

1 When acid is added to milk, the milk clots, forming lumps.

A student investigates the effect of varying the concentration of the acid.

Procedure

The student:

Step 1 puts 5 cm^3 of milk into each of five labelled test-tubes, **A**, **B**, **C**, **D**, and **E**

Step 2 sets up a water-bath at 30 °C

Step 3 puts the five test-tubes of milk into the water-bath

Step 4 adds 1 cm^3 of 0.4 M hydrochloric acid to test-tube **A** and swirls to mix

(Note: M is a unit of concentration where 2 M is twice as concentrated as 1 M.)

Step 5 repeats **Step 4** with the four other test-tubes, using the different concentrations of hydrochloric acid as shown in Table 1.1

Table 1.1

test-tube	concentration of hydrochloric acid / M
A	0.4
B	0.3
C	0.2
D	0.1
E	0.0

Step 6 removes test-tube **A** from the water-bath and observes the contents

Step 7 decides on the clotting score using the scale in Table 1.2

Table 1.2

clotting score	description
1	no clotting
2	small lumps
3	large lumps
4	almost all solid
5	all solid

Step 8 repeats **Step 6** and **Step 7** with the four other test-tubes.

© UCLES 2023

www.dynamicpapers.com

The student's results are shown in Fig. 1.1.

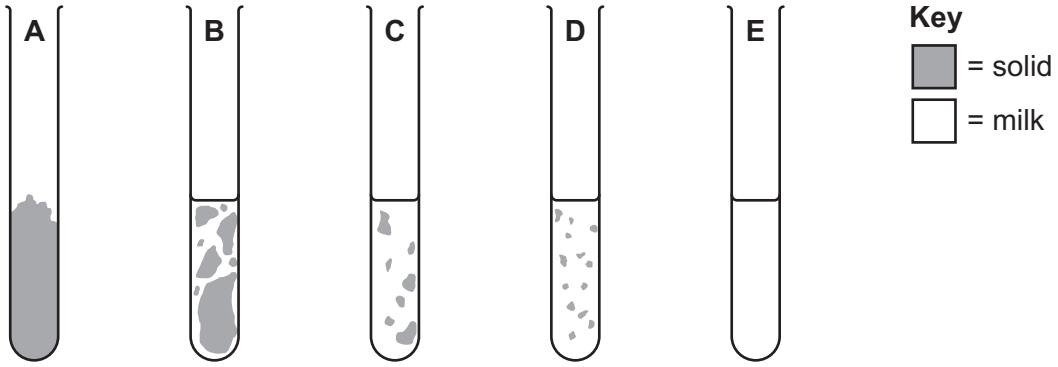


Fig. 1.1

(a) (i) Use Fig. 1.1 and Table 1.2 to determine the clotting score for each test-tube.

Record in Table 1.3 the clotting score for each test-tube.

Table 1.3

test-tube	concentration of hydrochloric acid / M	clotting score
A	0.4	
B	0.3	
C	0.2	
D	0.1	
E	0.0	

[3]

(ii) State the relationship between the concentration of hydrochloric acid and the clotting score of the milk.

.....

..... [1]

(iii) Hydrochloric acid changes the shape of protein molecules making them stick together.

Use this information and your results from Table 1.3 to state a conclusion for this investigation in terms of the milk and protein.

.....

.....

..... [1]

© UCLES 2023

[Turn over

www.dynamicpapers.com

(iv) The student measures the final temperature of the water-bath.

Fig. 1.2 shows the reading on the thermometer.

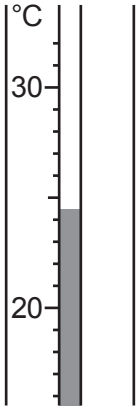


Fig. 1.2

Record this temperature to the nearest 0.5 °C.

temperature = ... °C [1]

(v) The starting temperature of the water-bath was 30 °C.

Suggest if temperature is a source of error in this investigation.

Tick (✓) the appropriate box.

- temperature **is not** a source of error ☐
- temperature **is** a source of error ☐

Give a reason for your answer.

.....

..... [1]

(vi) Identify **one other** possible source of error in this investigation.

.....

..... [1]

© UCLES 2023

www.dynamicpapers.com

(b) The student filters the contents of each test-tube and measures the mass of any solid in the filter paper.

The results are shown in Table 1.4.

Table 1.4

test-tube	concentration of hydrochloric acid / M	mass of solid / g
A	0.4	4.9
B	0.3	3.4
C	0.2	2.8
D	0.1	1.2
E	0.0	0.0

(i) Calculate the percentage of milk clotted in test-tube **B**.

Use the equation shown where 5.1 is the mass (g) of the 5 cm^3 of milk.

$$\text{percentage of milk clotted} = \frac{\text{mass of solid in test-tube } \mathbf{B}}{5.1} \times 100$$

percentage clotted = ... [1]

(ii) Suggest if the results in Table 1.4 support the relationship in **(a)(ii)**.

Explain your answer.

.....

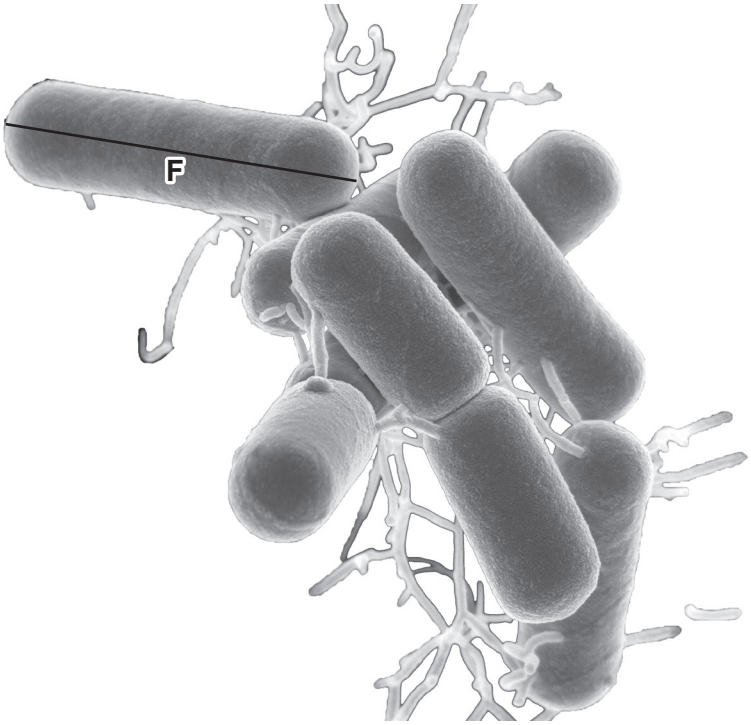
..... [1]

www.dynamicpapers.com

(c) A student notices that milk removed from a refrigerator clots after several days.

Fig. 1.3 shows bacteria growing in the milk when viewed using a microscope.

Line **F** on Fig. 1.3 is the length of one bacterium.



magnification = ×15 000

Fig. 1.3

(i) Measure the length of line **F** on Fig. 1.3.

length = ... mm [1]

(ii) Calculate the actual length of the bacterium.

Use the equation shown.

$$\text{actual length} = \frac{\text{length on Fig. 1.3}}{\text{magnification}}$$

Give your answer to **two** significant figures.

actual length = ... mm [2]

[Total: 13]

© UCLES 2023

www.dynamicpapers.com

2 A student investigates the properties of aqueous sodium hydroxide.

(a) Procedure

The student:

Step 1 pours 15.0 cm^3 of aqueous sodium hydroxide into a glass beaker

Step 2 records in Table 2.1 the temperature of the aqueous sodium hydroxide to the nearest 0.5 °C

Step 3 fills a burette to the 0.0 cm^3 mark with dilute hydrochloric acid as shown in Fig. 2.1

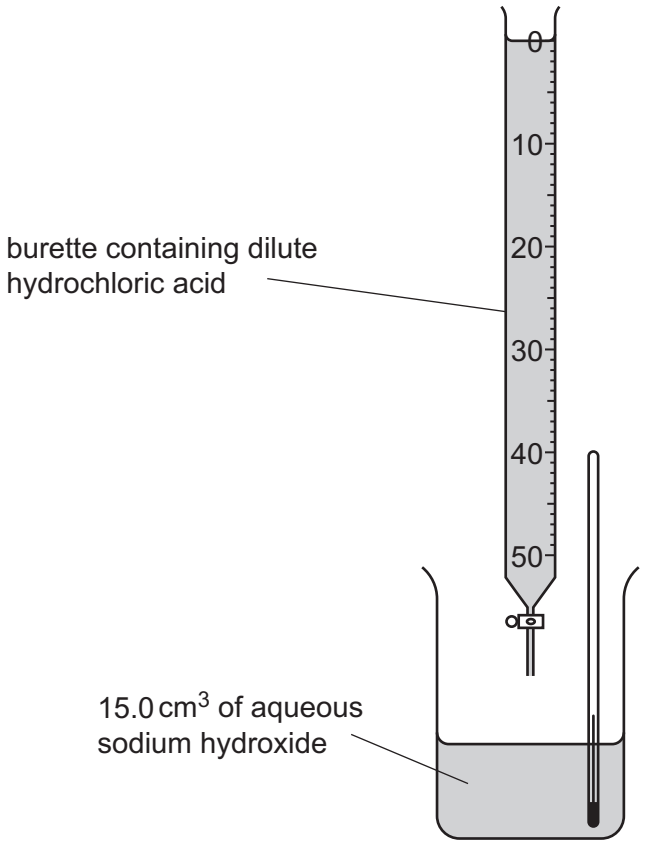


Fig. 2.1

Step 4 adds 5.0 cm^3 of dilute hydrochloric acid from the burette to the beaker containing aqueous sodium hydroxide

Step 5 stirs the mixture

Step 6 records in Table 2.1 the temperature of the contents of the beaker to the nearest 0.5 °C

Step 7 repeats **Step 4** to **Step 6** until a total of 25.0 cm^3 of dilute hydrochloric acid is added.

© UCLES 2023

[Turn over

www.dynamicpapers.com

(i) Fig. 2.2 shows the thermometer reading in **Step 2**.

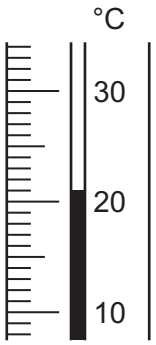


Fig. 2.2

Record in Table 2.1 this temperature to the nearest 0.5 °C.

Table 2.1

total volume of hydrochloric acid added / cm^3	temperature of reaction mixture / °C
0.0	
5.0	28.0
10.0	32.0
15.0	34.5
20.0	33.0
25.0	31.5

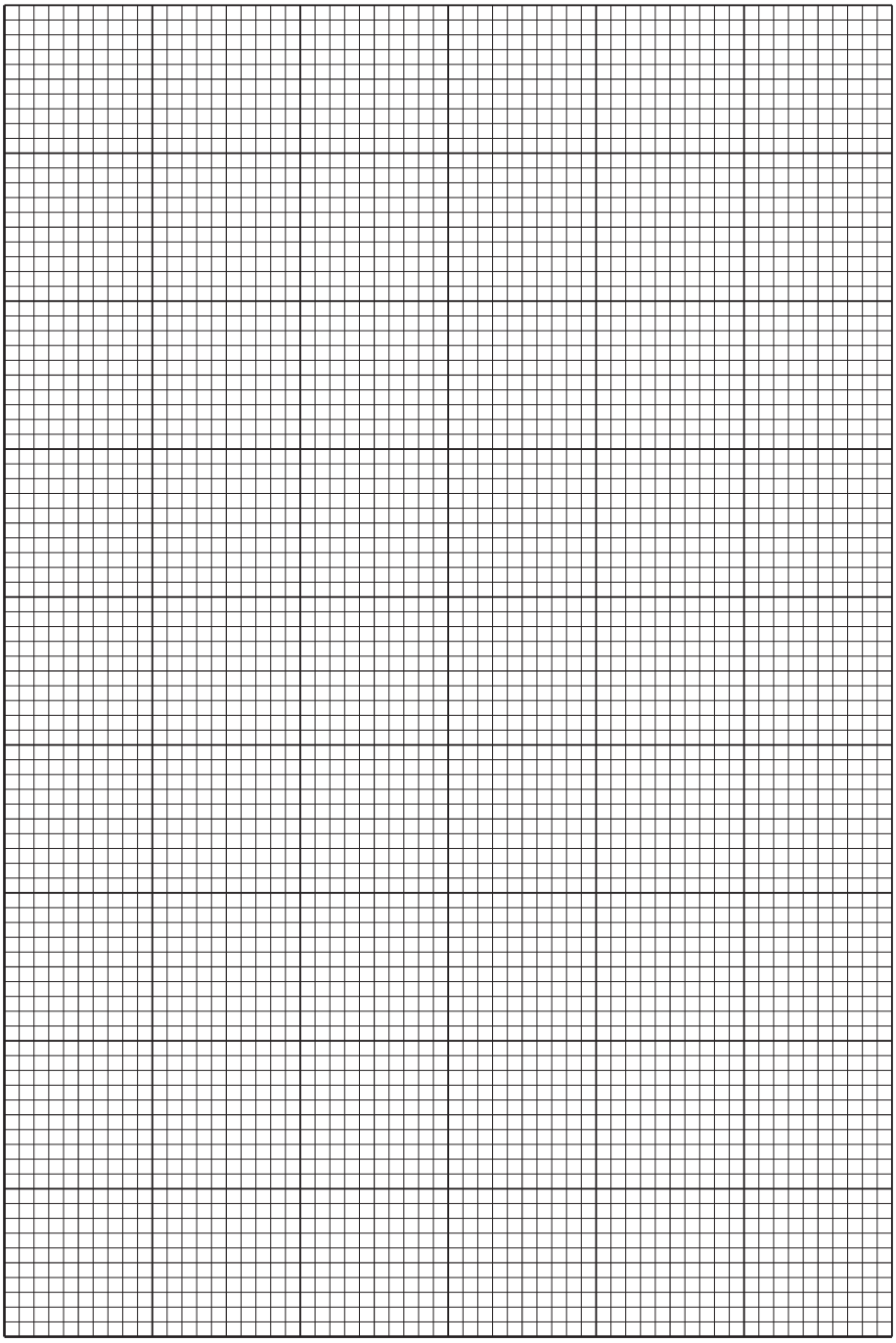
[1]

(ii) On the grid, plot a graph of temperature of reaction mixture (vertical axis) against the total volume of hydrochloric acid added.

Do **not** start the temperature scale at 0 °C.

© UCLES 2023

www.dynamicpapers.com



[3]

(iii) Draw the curve of best fit. [1]

(iv) Describe the relationship between the temperature of the reaction mixture and the total volume of hydrochloric acid added.

.....

.....

..... [2]

www.dynamicpapers.com

(v) Explain why in **Step 5** the mixture in the beaker is stirred before the temperature is measured.

..... [1]

(vi) Another student repeats the investigation.

This student uses a measuring cylinder to measure each of the 5.0 cm^3 volumes of dilute hydrochloric acid instead of a burette.

Explain **one** advantage of using a burette other than the precision of measurement.

.....

..... [1]

(vii) Thermal energy (heat) is lost from the reaction mixture during the experiment.

Describe **one** change in the apparatus to reduce this loss of thermal energy.

..... [1]

(b) Procedure

The student:

- puts some aqueous sodium hydroxide into a clean test-tube
- adds about 20 drops of an unknown solution **G** to the aqueous sodium hydroxide.

(i) The student observes a green precipitate.

(Circle) the metal ion present in solution **G**.

aluminium **calcium** **iron(II)** **iron(III)** **zinc** [1]

(ii) The student does **not** measure the volumes of the two solutions.

Explain why measuring the volumes is **not** important in this procedure.

.....

..... [1]

(iii) The student repeats the procedure but this time uses 20 drops of aqueous copper(II) sulfate instead of solution **G**.

Describe what the student observes in the test-tube.

..... [1]

[Total: 13]

© UCLES 2023

www.dynamicpapers.com

3 A student investigates the extension of a spring as different loads are suspended from the spring.

The student uses the apparatus shown in Fig. 3.1.

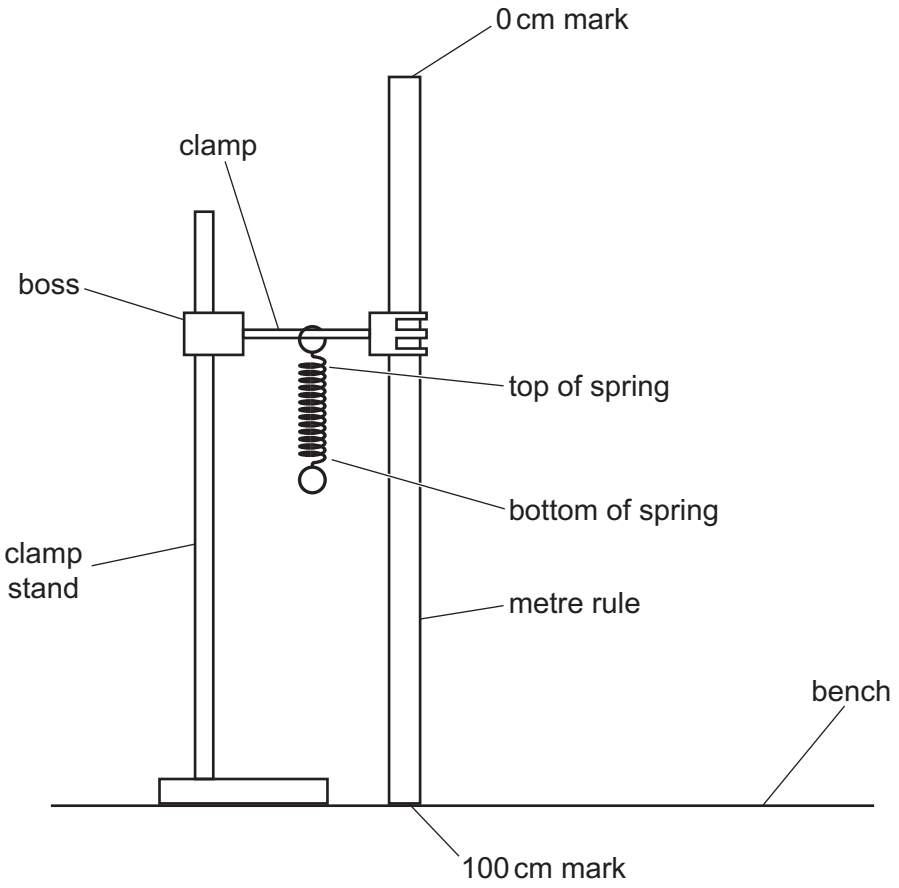


Fig. 3.1

The student measures the length of the spring, l_0, with no load suspended from it.

$$l_0 = 23\,\text{mm}$$

(a) State **one** practical precaution that the student takes to ensure that the value of l_0 is as accurate as possible.

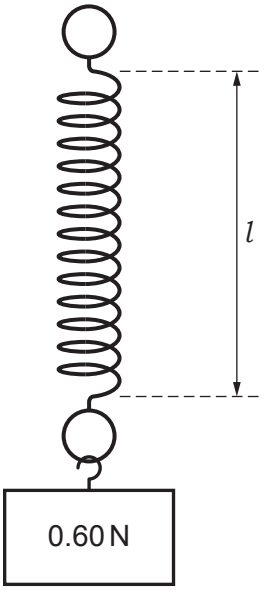
.....

..... [1]

www.dynamicpapers.com

(b) The student suspends loads of 0.20 N, 0.40 N, 0.60 N and 0.80 N from the spring. For each load, L, the length, l, is measured and recorded in Table 3.1.

(i) Fig. 3.2 shows the spring with a load of 0.60 N suspended from it.



(drawn actual size)

Fig. 3.2

Measure the length, l, of the spring.

Record l in Table 3.1.

Table 3.1

L / N	l / mm	e / mm	k / N per mm
0.00	23	0	–
0.20	27	4	0.05
0.40	35	12	0.03
0.60			
0.80	49	26	0.03

[1]

© UCLES 2023

www.dynamicpapers.com

(ii) Calculate the extension e of the spring for the load of 0.60 N.

Use the equation shown.

$$e = l - l_0.$$

Record this value of e in Table 3.1.

[1]

(iii) The spring constant, k, of the spring is a measure of its elastic stiffness.

Calculate the spring constant, k, for the load of 0.60 N.

Use the equation shown.

$$k = \frac{L}{e}$$

Record this value of k in Table 3.1.

[1]

(c) One of the values of k is anomalous.

State which value is anomalous. Give a reason for your answer.

anomalous value ..... N per mm

reason .....

.....

[2]

(d) Suggest what the student can do to have more confidence in their values of l.

.....

..... [1]

[Total: 7]

www.dynamicpapers.com

4 Plan an investigation to find out how much (electrical) energy is required to increase the temperature of different liquids.

You are provided with:

- four different liquids: water, salt solution, vegetable oil and vinegar
- an electric heater and power supply, assembled as shown in Fig. 4.1.

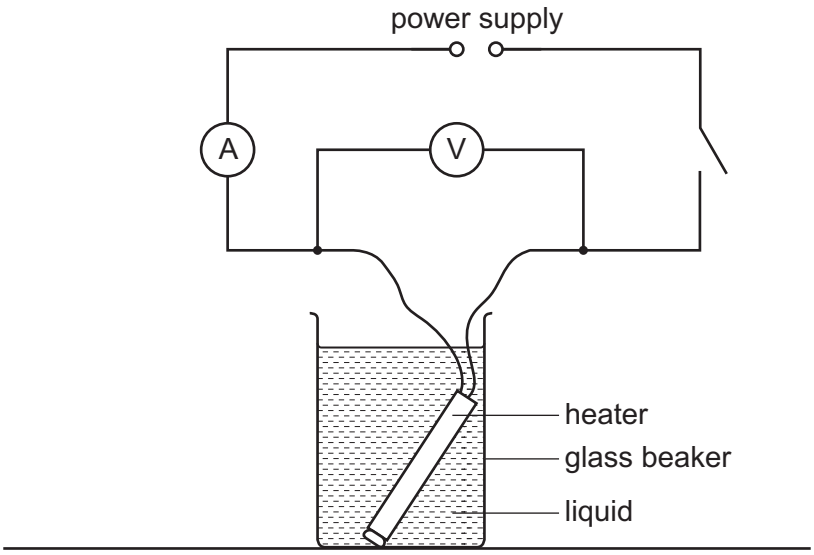


Fig. 4.1

The energy, E, transferred by the heater is calculated using the equation shown

$$E = V \times I \times t$$

where V is the potential difference across the heater
I is the current through the heater
t is the time in seconds that the heater is switched on

You may use any common laboratory apparatus in your plan.

In your plan, include:

- any other apparatus needed
- a brief description of the method, including what you will measure and how you will make sure your measurements are accurate
- the variables you will control
- a results table to record your measurements (you do **not** need to enter any readings in the table)
- how you will process your results to draw a conclusion.

© UCLES 2023

www.dynamicpapers.com

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [7]

www.dynamicpapers.com

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

© UCLES 2023