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 [ ].

DC (CJ/CB) 314434/3

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.

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

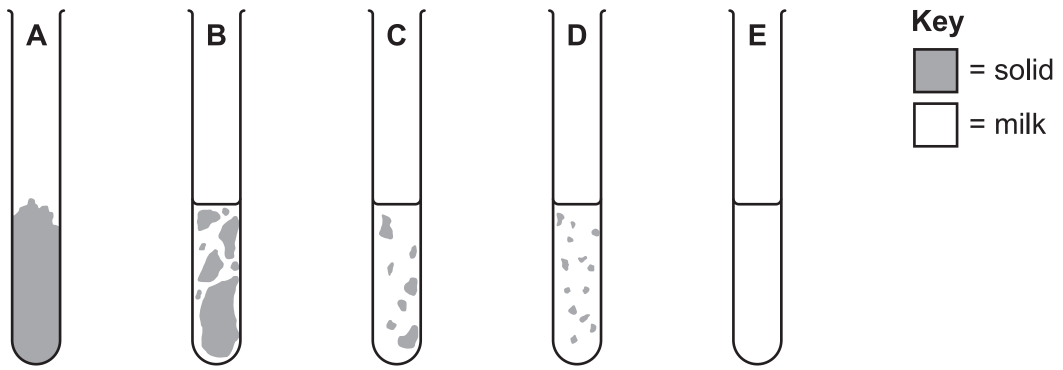


Fig. 1.1

(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]

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

Fig. 1.2 shows the reading on the thermometer.

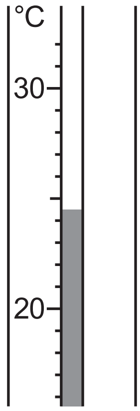


Fig. 1.2

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]

(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.

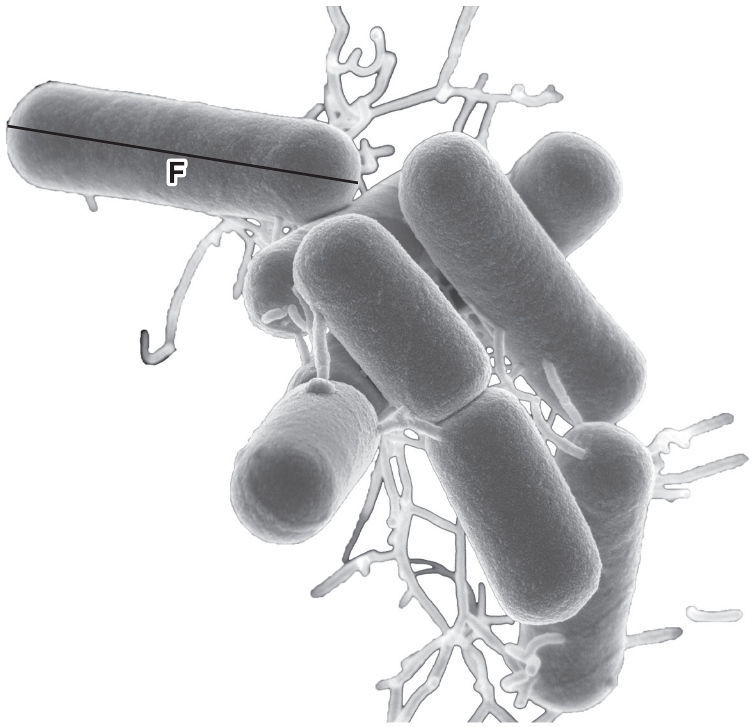
....

.... [1]

(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]

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

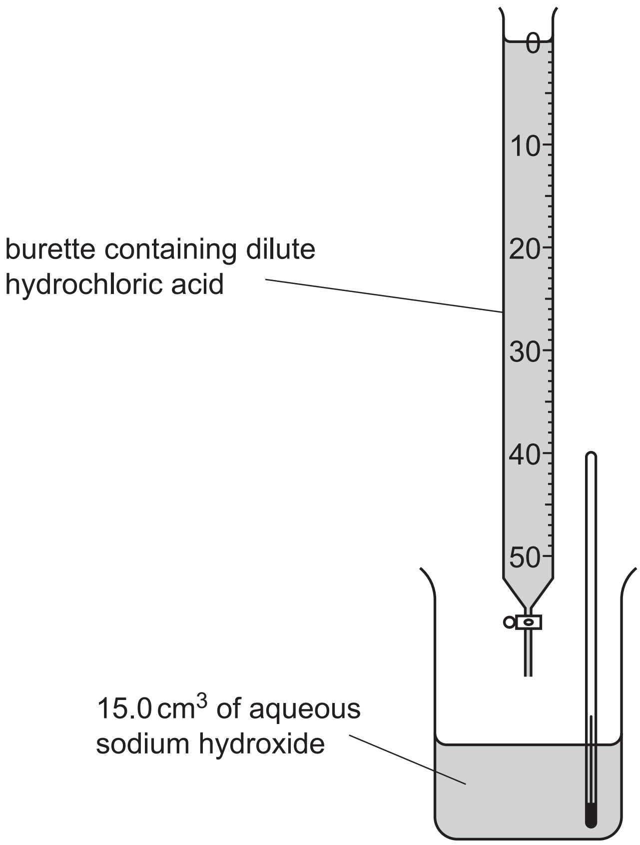


Fig. 2.1

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.

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

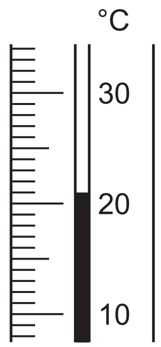


Fig. 2.2

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.

[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]

(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]

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.

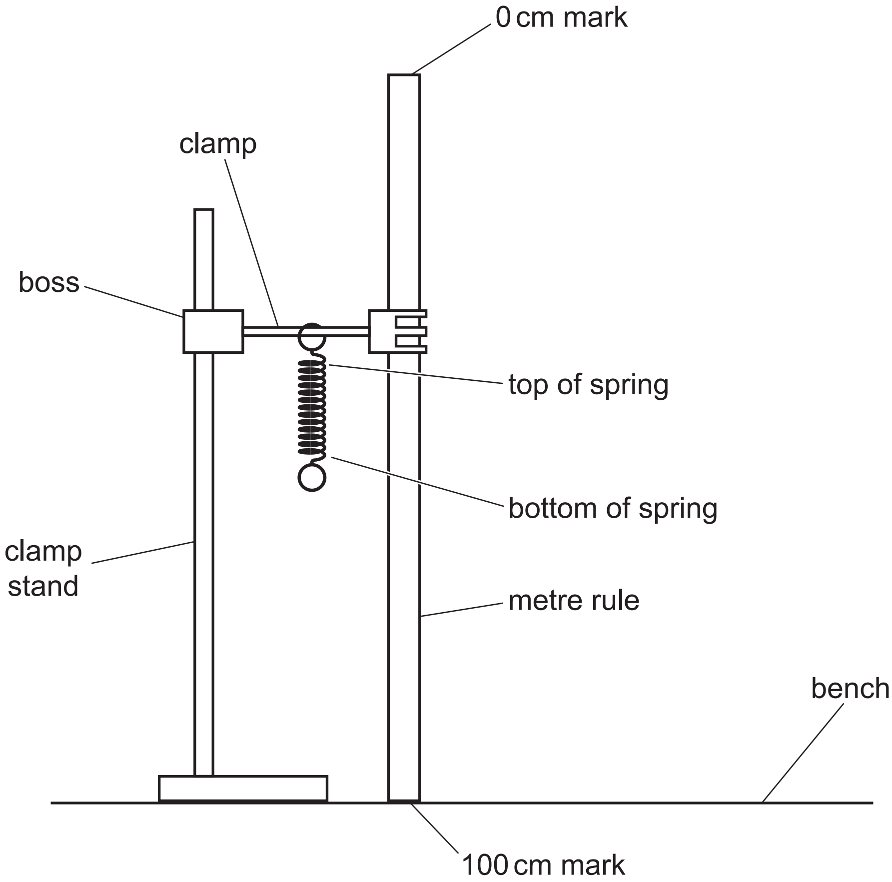


Fig. 3.1

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

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

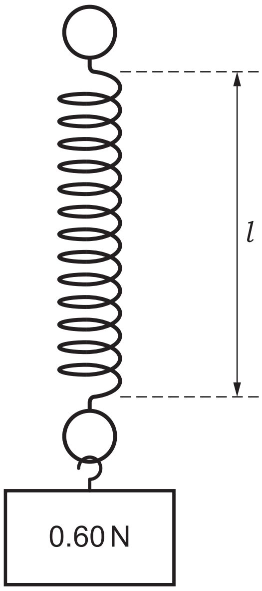
(a) State **one** practical precaution that the student takes to ensure that the value of l_0 is as accurate as possible.

....

.... [1]

(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]

(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]

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.

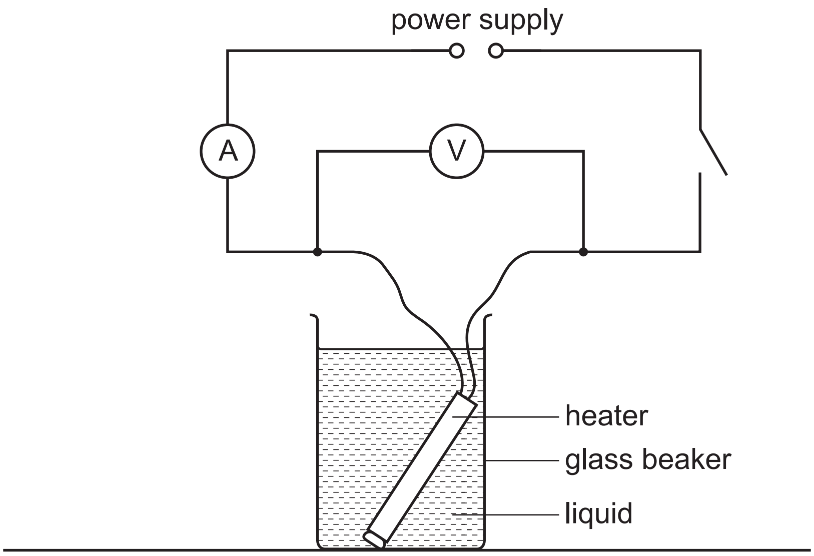


Fig. 4.1

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.

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.... [7]

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