Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
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COMBINED SCIENCE **0653/52**

Paper 5 Practical Test **February/March 2023**

1 hour 15 minutes

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

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 [ ].
- Notes for use in qualitative analysis are provided in the question paper.

For Examiner's Use	
1	
2	
3	
4	
Total	

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

[Turn over

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

You are going to investigate the effect of varying the concentration of the acid.

You are provided with some hydrochloric acid (labelled HC*l*), distilled water and milk.

Procedure

Step 1 Label five test-tubes **A**, **B**, **C**, **D** and **E**.

Step 2 Use a measuring cylinder to put 5 cm^3 of milk into each labelled test-tube.

Step 3 Set up a water-bath at approximately 30 °C using the hot water and cold water supplied.

(i) Measure the temperature of the water-bath.

temperature = ... °C [1]

Procedure

Step 4 Put the five test-tubes of milk into the water-bath.

Step 5 Label five beakers **A**, **B**, **C**, **D** and **E**.

Step 6 Use the 10 cm^3 syringes to add the volumes of hydrochloric acid and distilled water to the beakers as shown in Table 1.1.

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

Step 7 Mix the contents of each beaker with a glass rod.

Table 1.1

beaker	volume of 0.4 M HC*l* added / cm^3	volume of distilled water added / cm^3	resulting concentration of HC*l* / M
A	8	0	0.4
B	6	2	0.3
C	4	4	0.2
D	2	6	0.1
E	0	8	0.0

Step 8 Remove test-tube **A** from the water-bath.

Step 9 Use the 1 cm^3 syringe to transfer 1 cm^3 of the HC*l* from beaker **A** into test-tube **A**.

Step 10 Swirl the test-tube to mix the contents and put it back into the water-bath.

Step 11 Repeat **Step 8** to **Step 10** transferring HC*l* from beaker to test-tube for each of **B**, **C**, **D** and **E**.

(ii) Measure the temperature of the water-bath again.

temperature = ... °C [1]

Procedure

Step 12 Remove test-tube **A** from the water-bath and observe the contents. This can be done by tilting and rotating the test-tube as shown in Fig. 1.1.

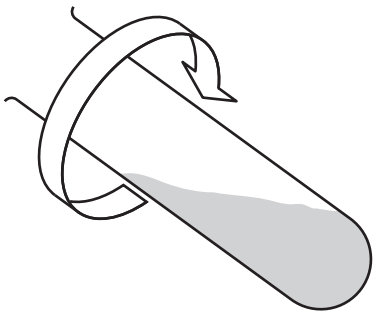


Fig. 1.1

Step 13 Observe the contents of test-tube **A** and decide 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 14 Repeat **Step 12** and **Step 13** with the other four test-tubes.

(iii) 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]

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

.....

..... [1]

(v) 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]

(vi) Use your measurements in **(a)(i)** and **(a)(ii)** to decide 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]

(vii) Identify **two other** possible sources of error in this investigation.

1 .....

.....

2 .....

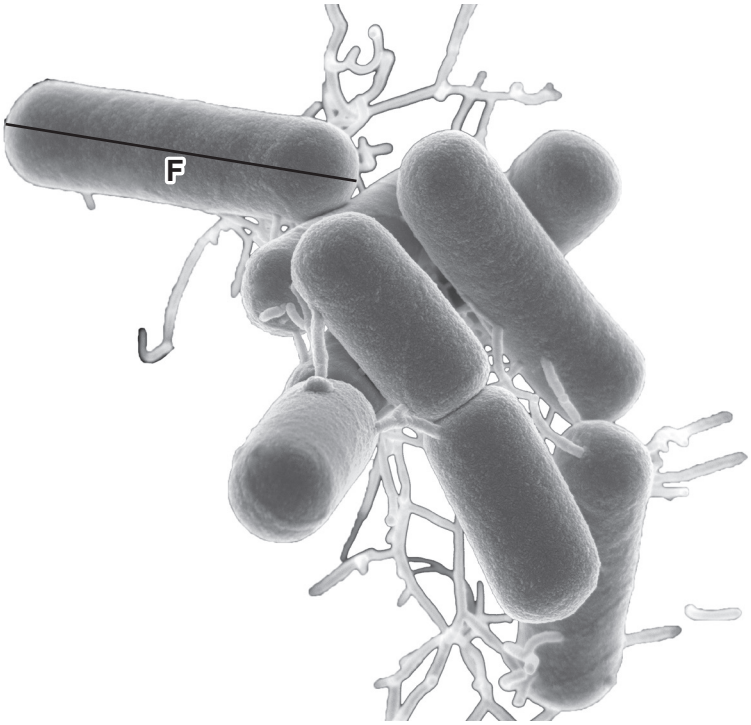
.....

[2]

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

Fig. 1.2 shows bacteria growing in the milk when viewed using a microscope.

Line **F** on Fig. 1.2 is the length of one bacterium.



magnification = ×15 000

Fig. 1.2

(i) Measure the length of line **F** on Fig. 1.2.

length = ... mm [1]

(ii) Calculate the actual length of the bacterium.

Use the equation shown.

$$\text{actual length} = \frac{\text{length on Fig. 1.2}}{\text{magnification}}$$

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

actual length = ... mm [2]

[Total: 13]

[Turn over

2 You are going to investigate the properties of aqueous sodium hydroxide.

(a) Procedure

Step 1 Measure 15 cm^3 of aqueous sodium hydroxide in a 25 cm^3 measuring cylinder.

Step 2 Add this aqueous sodium hydroxide to a glass beaker.

Step 3 Measure the temperature of the aqueous sodium hydroxide to the nearest 0.5 °C.

(i) Record this temperature in the first row of Table 2.1. [1]

Step 4 Measure **5 cm^3** of hydrochloric acid in a 10 cm^3 measuring cylinder.

Step 5 Add this hydrochloric acid to the beaker containing aqueous sodium hydroxide.

Step 6 Stir the mixture.

Step 7 Measure and record in Table 2.1 the temperature of the mixture, to the nearest 0.5 °C.

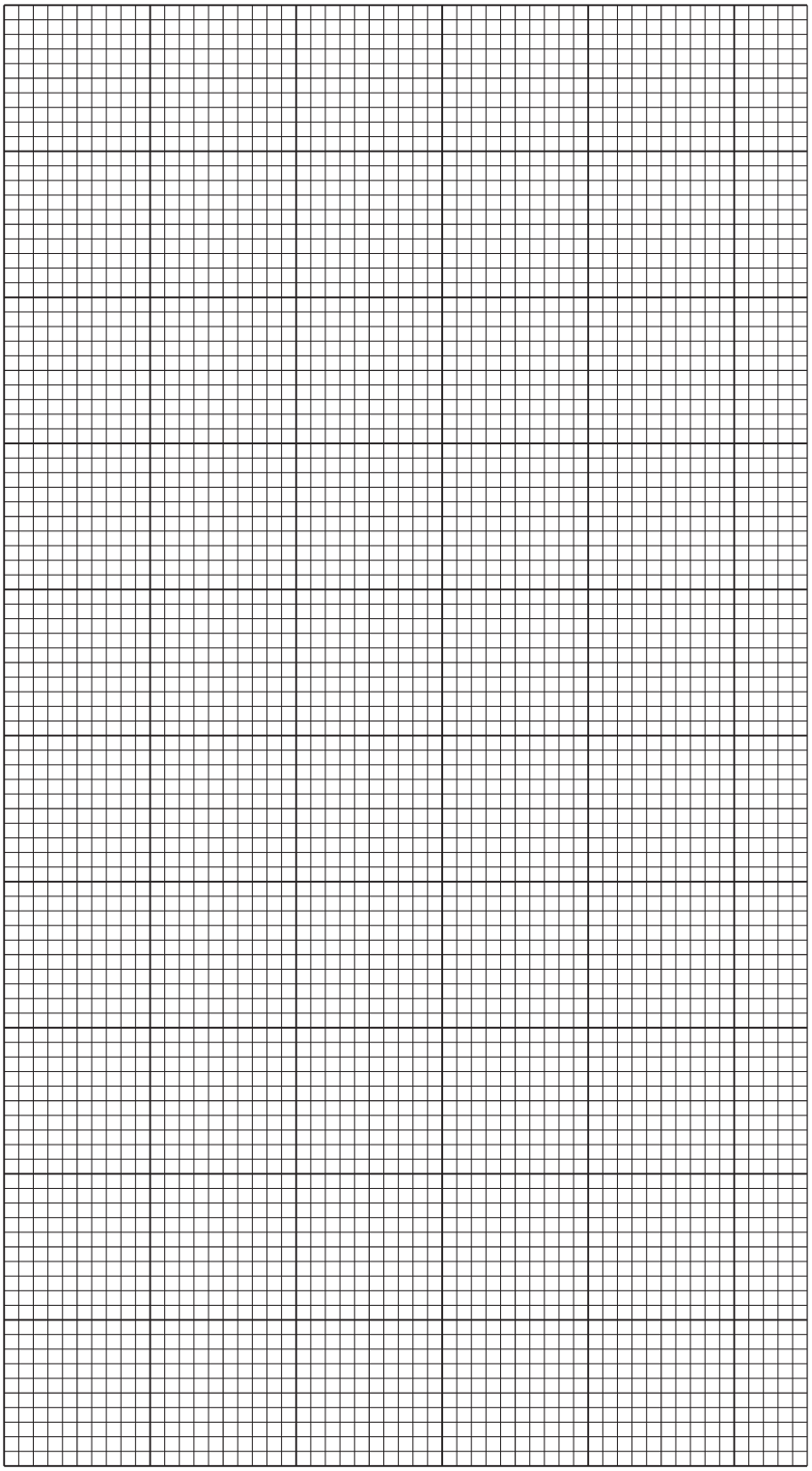
Table 2.1

total volume of hydrochloric acid added / cm^3	temperature of reaction mixture / °C
0	
5	
10	
15	
20	
25	

(ii) Repeat **Step 4** to **Step 7** until the total volume of hydrochloric acid added is 25 cm^3. [3]

(iii) 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]

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

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

.....

.....

..... [2]

(vi) A student repeats the investigation.

The student adds the dilute hydrochloric acid from a burette rather than using a measuring cylinder each time.

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

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..... [1]

(b) Procedure

- Put about 3 cm depth of aqueous sodium hydroxide into a clean test-tube.
- Add about 20 drops of solution **G** to the aqueous sodium hydroxide.

(i) Describe your observations.

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..... [1]

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

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

[Total: 13]

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3 In this experiment you will measure the extension of a spring as different loads are suspended from the spring.

Your equipment is already assembled as shown in Fig. 3.1. Do **not** change the position of the metre rule during the experiment.

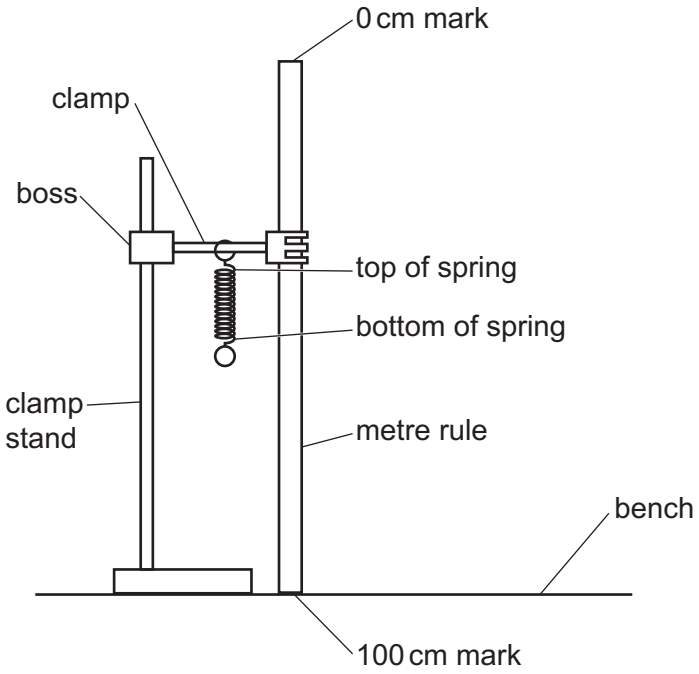

Fig. 3.1

(a) (i) Record the reading on the ruler at the top of the spring and at the bottom of the spring. Do **not** include the loops at each end of the spring in your measurement.

top of spring ..... mm

bottom of spring ..... mm
[1]

(ii) Calculate the length of the unstretched spring in mm. This is l_0.

Record l_0 in Table 3.1.

Table 3.1

L / N	l / mm	e / mm	k / N per mm
0.00	l_0 = ...	0	–
0.20			
0.40			
0.60			
0.80			

[1]

(b) (i) Suspend a load of 0.20 N from the spring and record the new length of the spring, l, in Table 3.1.

Calculate the extension, e, of the spring.

Use the equation shown.

$$e = l - l_0.$$

Record the value of e in Table 3.1.

[1]

(ii) Repeat **(b)(i)** using loads of 0.40 N, 0.60 N and 0.80 N.

Record the values for l and e in Table 3.1.

[2]

[Turn over

(iii) The spring constant, k, of the spring is a measure of its elastic stiffness.
Calculate the spring constant, k, for loads of 0.20 N, 0.40 N, 0.60 N and 0.80 N.

Use the equation shown.

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

Record the values of k in Table 3.1.

[1]

(c) Suggest what you can do to have more confidence in your results.

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..... [1]

[Total: 7]

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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.

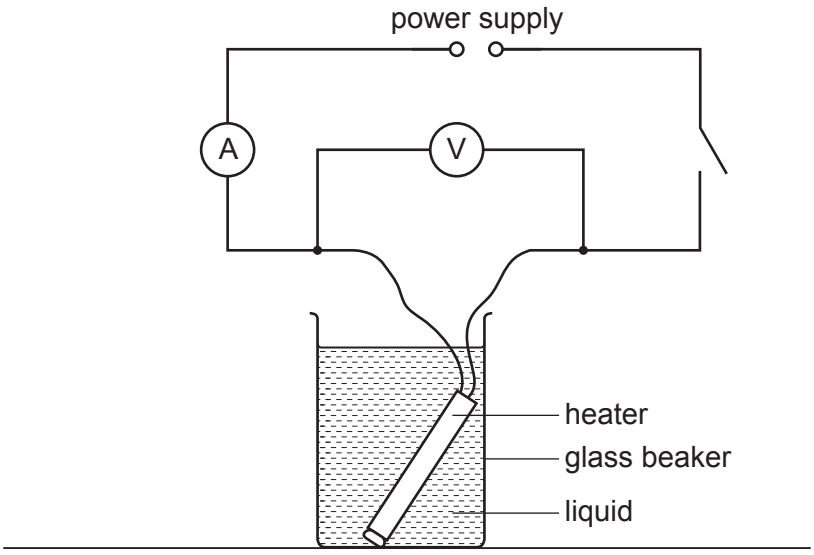

Fig. 4.1

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.

You are not required to do this investigation.

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]

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.
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 (II) (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