Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **5129/32**

Paper 3 Experimental Skills and Investigations **May/June 2025**

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 **20** pages. Any blank pages are indicated.

[Turn over

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1 Carrots are vegetables.

A student investigates the change in the mass of carrot cylinders placed in different concentrations of sodium chloride solution.

Fig. 1.1 shows a carrot and the carrot cylinder made from it.

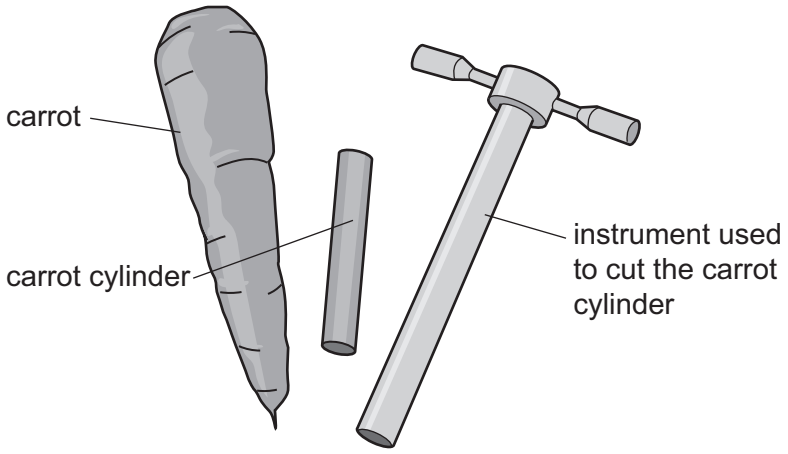

Fig. 1.1

Procedure

The student:

- cuts 5 carrot cylinders, each of the same length and diameter
- measures the mass of each carrot cylinder
- places each cylinder in a different concentration of sodium chloride solution for 2 hours
- removes the carrot cylinders from the solutions and dries them
- measures the final mass of each carrot cylinder.

(a) (i) State the name of the apparatus the student uses to measure the mass of a carrot cylinder.

..... [1]

(ii) The student's results are shown in Table 1.1.

The concentration of sodium chloride solution is measured in units of mol / dm^3.

Complete Table 1.1 by using the information in it to calculate:

- the final mass of the carrot cylinder placed in 0.6 mol / dm^3
- the percentage change in mass of the carrot cylinder placed in 0.8 mol / dm^3.

Use the equation:

$$\text{percentage change in mass} = \frac{\text{change in mass}}{\text{initial mass}} \times 100$$

for the second calculation.

Table 1.1

concentration of sodium chloride solution / mol / dm^3	initial mass / g	final mass / g	change in mass / g	percentage change in mass
0.0	8.2	9.3	+1.1	+13
0.2	8.9	9.0	+0.1	+1
0.4	9.0	8.2	–0.8	–9
0.6	8.5	.....	–1.2	–14
0.8	8.9	7.3	–1.6	.....

[2]

(iii) On the grid provided in Fig. 1.2 on page 5 plot a graph of the concentration of sodium chloride solution on the *x*-axis against the percentage change in mass on the *y*-axis.

Draw a line of best fit through your points.

Label both axes. [3]

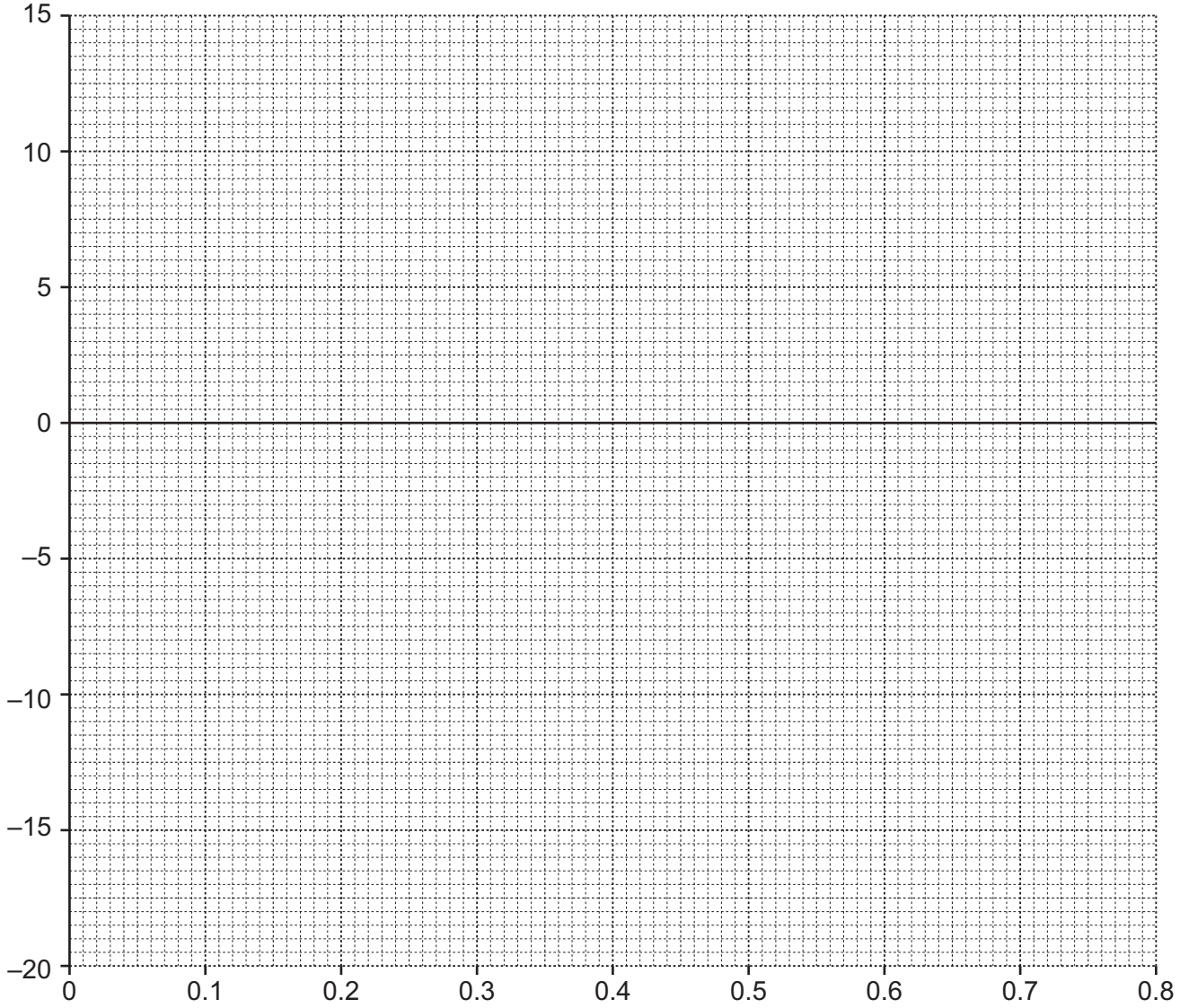

Fig. 1.2

(b) Suggest how the student can improve the accuracy of the measurements.

.....

..... [1]

(c) The student tests the carrots for the presence of glucose and starch.

She obtains a **positive** result for glucose and a **negative** result for starch.

(i) State the name of the test for glucose, and describe what the student observes for a **positive** result.

name of the test for glucose .....

observation for a **positive** result .....

.....

[2]

(ii) State the name of the test for starch, and describe what the student observes for a **negative** result.

name of test for starch .....

observation for a **negative** result .....

.....

[2]

[Total: 11]

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2 A student investigates the reaction of powdered copper with air.

Procedure

The student:

- measures the mass of an empty glass tube
- adds a sample of powdered copper to the glass tube and measures the new mass
- heats the glass tube containing the powdered copper
- passes 50 cm^3 of air through the glass tube while it is heated
- allows the apparatus to cool and observes the contents of the glass tube
- measures the final mass of the glass tube and its contents.

Fig. 2.1 shows the apparatus the student uses.

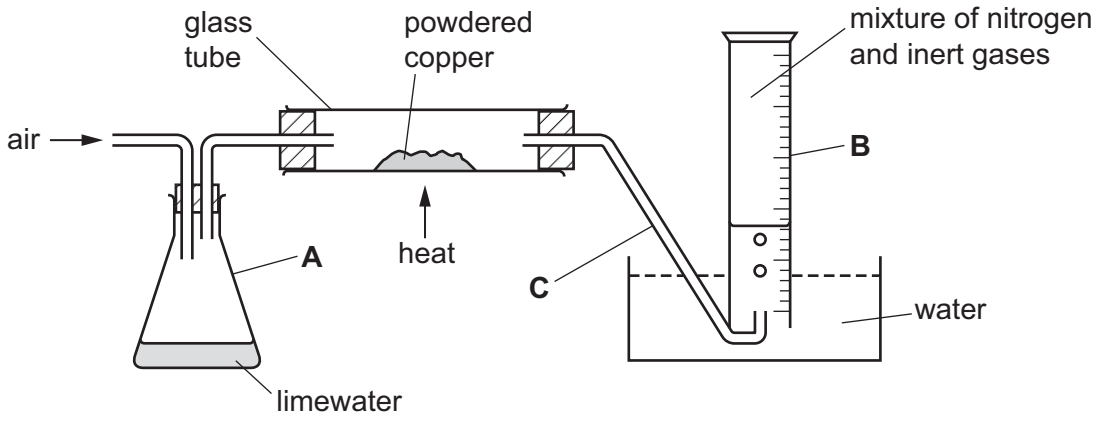

Fig. 2.1

The student observes that the contents of the tube have changed from powdered copper to a black solid.

(a) Name the apparatus labelled **A**, **B** and **C**.

A .....

B .....

C .....

[3]

(b) (i) The results are shown in Table 2.1.

Table 2.1

mass of empty glass tube / g	29.0
mass of glass tube and powdered copper before heating / g	34.9
mass of glass tube and black solid after heating / g	35.1
mass of powdered copper before heating / g	.....
mass of the black solid in the glass tube after heating / g	.....
increase in the mass of the contents of the glass tube / g	.....

Complete Table 2.1 by calculating:

- the mass of powdered copper before heating
- the mass of the black solid in the glass tube after heating
- the increase in the mass of the contents of the glass tube.

[2]

(ii) Suggest why there is an increase in the mass of the contents of the glass tube.

.....

.....

..... [2]

(c) (i) On Fig. 2.2, draw **one** improvement to the arrangement of the apparatus so that the air passes through the limewater.

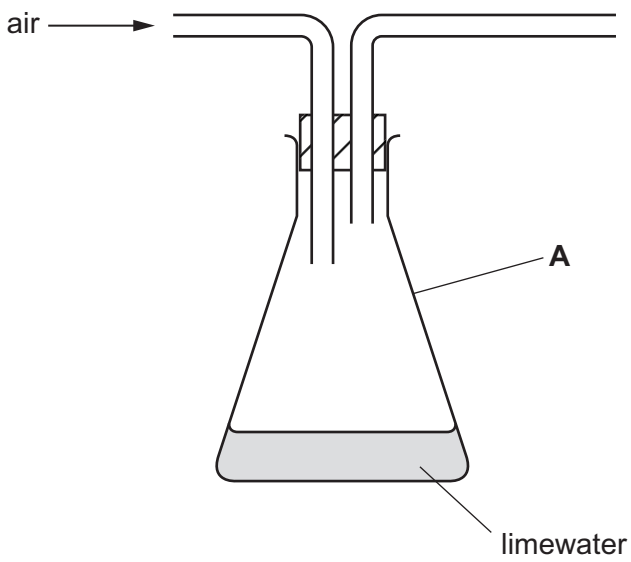

Fig. 2.2

[1]

(ii) The student improves the apparatus so that the limewater turns milky when air passes through it.

State what causes the limewater to turn milky.

..... [1]

(d) (i) Fig. 2.3 shows apparatus **B** at the end of the experiment.

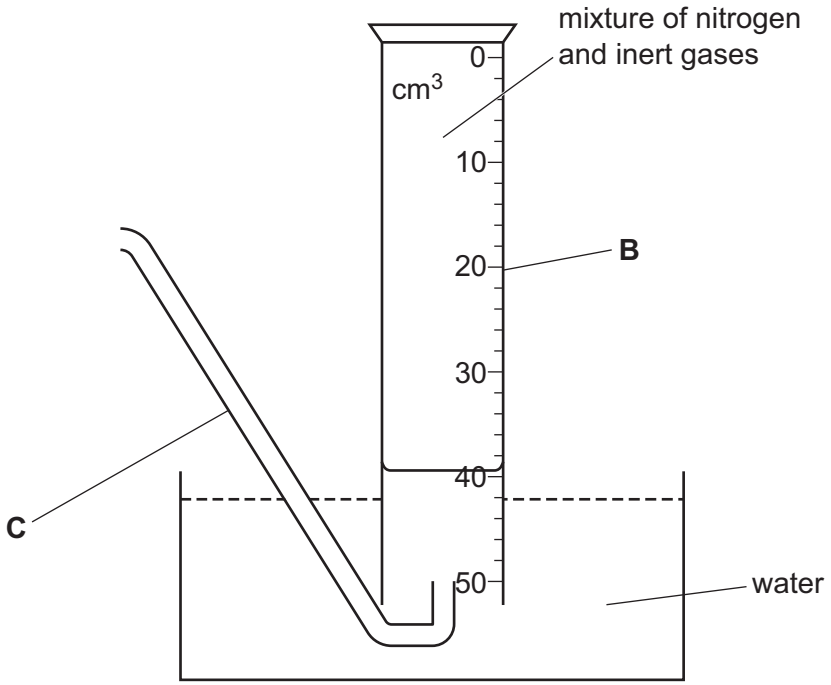

Fig. 2.3

Determine the volume of nitrogen and inert gases in apparatus **B**.

volume of nitrogen and inert gases = ... cm^3 [1]

(ii) Initially, 50 cm^3 of air is passed into the apparatus.

Use your answer to **(d)(i)** to calculate the percentage of nitrogen and inert gases in the air.

percentage of nitrogen and inert gases = ... [1]

[Total: 11]

3 Fig. 3.1 shows the symbol for a solar cell.

Fig. 3.1

(a) A student uses a voltmeter to measure the voltage produced by the solar cell.

(i) Draw a circuit diagram of the arrangement of voltmeter and solar cell that the student uses. Include a switch to turn the voltmeter reading on and off.

[1]

(ii) Fig. 3.2 shows the reading on the voltmeter when the switch is closed.

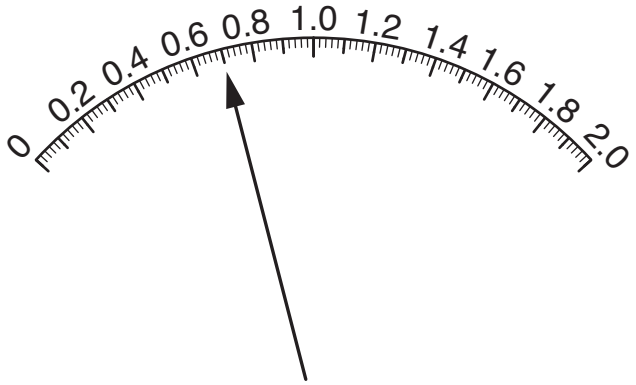

Fig. 3.2

Record the voltage.

voltage = ... V [1]

(iii) One source of experimental inaccuracy in reading the scale of the voltmeter is parallax (line-of-sight) error.

Tick the box that describes parallax error.

measurement ☐ random ☐ systematic ☐

[1]

(iv) Describe **one** other possible source of inaccuracy in the measurement of the voltage.

..... [1]

(b) The student investigates the relationship between the voltage produced by the solar cell and the distance between the solar cell and a light source.

The dependent variable is the voltage produced by the solar cell.

The independent variable is the distance between the solar cell and the light source.

(i) Predict the relationship between the two variables that will be shown by this investigation.

.....

..... [1]

(ii) Prepare a results table for this investigation.

In your table include:

- a suitable range and number of measurements for the independent variable
- a suitable number of columns or rows to allow repeat measurements for the dependent variable to ensure the accuracy of the results
- suitable units for each variable in the heading of the table.

[4]

(c) Describe how the student uses a graphical method to identify any anomalous results.

.....

.....

..... [2]

[Total: 11]

4 A student investigates the reaction between dilute hydrochloric acid and solid calcium carbonate.

The word equation for the reaction is shown.

hydrochloric acid + calcium carbonate → calcium chloride + carbon dioxide + water

The carbon dioxide produced is a gas which escapes into the atmosphere.

The student states that the greater the concentration of hydrochloric acid used, the greater the mass lost per second in the reaction.

Plan an investigation to test whether this statement is true.

You are provided with solid calcium carbonate, dilute hydrochloric acid and any apparatus usually available in a school laboratory.

Include in your answer:

- the apparatus you will use
- a brief description of the method and the measurements you will make
- what you will keep constant and what you will change
- how you will use your results to draw a conclusion.

A diagram of apparatus and a results table are **not** required but you may include them if it helps to explain your plan.

.....

.....

.....

.....

.....

[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, then test for carbon dioxide gas	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.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium, Al^{3+}	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium, NH_4^+	ammonia produced on warming	–
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III), Cr^{3+}	green ppt., soluble in excess	green ppt., insoluble in excess
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, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
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