Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME										
CENTRE NUMBER						CANDIDATE NUMBER				

6415714125

COMBINED SCIENCE **5129/32**

Paper 3 Experimental Skills and Investigations **May/June 2024**

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 (DE/CT) 336605/4

1 **(a)** Copper(II) sulfate crystals are a solid blue salt.

Copper(II) oxide is an insoluble black powder.

A student makes 3 different salts.

First, the student tries to make pure blue crystals of copper(II) sulfate.

The student:

- measures 25.0 cm^3 of dilute sulfuric acid into a flask as shown in Fig. 1.1

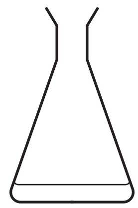

Fig. 1.1

- adds insoluble solid copper(II) oxide to the flask
- warms the mixture
- adds more solid copper(II) oxide until it is in excess
- separates the excess solid copper(II) oxide from the liquid
- heats the filtrate until all the water has evaporated.

(i) Name a piece of apparatus suitable to measure 25.0 cm^3 of dilute sulfuric acid.

.... [1]

(ii) Name the type of flask shown in Fig. 1.1.

.... [1]

(iii) Describe the appearance of the contents of the flask when excess solid copper(II) oxide has been added.

....

.... [2]

(iv) Name the process that the student uses to separate the excess copper(II) oxide from the mixture.

.... [1]

(v) There is an error in the student's method and a white powder is produced instead of blue crystals.

Identify the error in the method and suggest how the method is changed to make the blue crystals.

error ....

....

change to method ....

.... [2]

(b) Next, the student makes magnesium sulfate crystals by reacting excess magnesium oxide with dilute sulfuric acid.

Magnesium oxide is an insoluble white base.

(i) The student tests the sulfuric acid with universal indicator.

State the colour of universal indicator in the sulfuric acid.

.... [1]

(ii) The magnesium oxide neutralises the acid.

After the reaction, the student tests the mixture with universal indicator again.

State the colour of universal indicator in the mixture after the reaction.

.... [1]

(c) The third salt that the student makes is silver chloride.

The student:

- mixes aqueous silver nitrate with aqueous sodium chloride in a beaker
- filters the mixture.

(i) Describe the appearance of this mixture in the beaker.

.... [1]

(ii) Describe what the student must do to the residue after filtration to make sure it is pure.

....

.... [1]

[Total: 11]

2 Red cabbage is a vegetable which has red leaves. Fig. 2.1 is a drawing of a red cabbage.

Fig. 2.1

The cells in the leaves of red cabbage contain a red pigment. Damage to the cells in a leaf causes the red pigment to leak out.

A student investigates the effect of temperature on the loss of red pigment from red cabbage leaves.

The student:

- removes 1 leaf from a red cabbage
- puts 20 g of the leaf into each of three beakers
- adds water at a different temperature to each beaker
- leaves each beaker for 10 minutes, stirring every minute
- records the colour of the water in each beaker after 10 minutes.

The student's notebook with results is shown in Fig. 2.2.

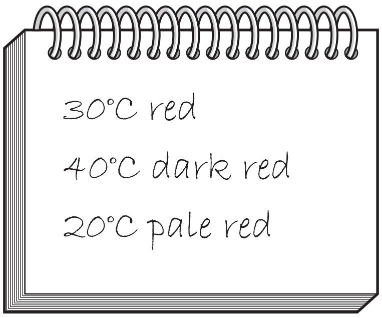

Fig. 2.2

(a) **(i)** Draw a table to show the results of this experiment.

Record the results shown in Fig. 2.2 in the table.

[2]

(ii) Explain why the student stirs the contents of each beaker.

....

....

.... [1]

(iii) Use the results shown in Fig. 2.2 to form a conclusion.

State your conclusion.

....

....

.... [1]

(b) Fig. 2.3 is a photograph of a leaf from a different cabbage plant.

Fig. 2.3

(i) In the space below, sketch a **large** drawing of the cabbage leaf in Fig. 2.3.

[4]

(ii) Measure the length of line **AB** on Fig. 2.3.

length of line **AB** = ... mm [1]

(iii) The actual length of the leaf is 300 mm.

Calculate the magnification of the photograph using your measurement from **2(b)(ii)** and the equation:

$$\text{magnification} = \frac{\text{length of line } \mathbf{AB}}{\text{actual length of the leaf}}$$

Give your answer to two significant figures.

magnification = × .... [2]

[Total: 11]

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3 A student has 5 electrical cells. Each cell is labelled 1.5 V.

The student needs 3 new cells to make a 4.5 V battery for a torch.

The student does not know which of the 5 cells are new and which cells have been used.

(a) The student constructs a circuit containing a voltmeter to test each cell separately.

Draw the circuit diagram of this circuit.

[2]

(b) The student tests cell 1.

Part of the scale on the voltmeter is shown in Fig. 3.1.

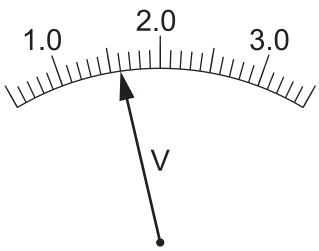

Fig. 3.1

(i) Read the scale and record the value for cell 1 in Table 3.1. [1]

(ii) The student repeats the test with the other cells.

The results are shown in Table 3.1.

Table 3.1

	cell 1	cell 2	cell 3	cell 4	cell 5
voltage / V	....	0.95	1.50	1.40	1.15

Deduce which **two** cells are **not** new and complete the sentence.

Cell number .... and cell number .... are not new. [1]

(c) The student:

- connects the 4.5 V battery across 1 torch lamp and measures the current I in the circuit
- attaches a second lamp in series with the first
- measures the current I again
- continues until there are 5 lamps in series.

For each number of lamps in series, the student calculates the value of $\frac{1}{I}$. The results are shown in Table 3.2.

Table 3.2

number of lamps in series	1	2	3	4	5
current I/A	0.90	0.76	0.59	0.52	0.47
$\frac{1}{I} / \frac{1}{\text{A}}$	1.11	1.32	1.69	1.92	2.13

On the grid provided in Fig. 3.2 on page 11, plot a graph of the number of lamps on the *x*-axis against $\frac{1}{I}$ on the *y*-axis. Start the *x*-axis at 0. Start the *y*-axis at 0.60.

Draw the straight line of best fit through your points. [3]

(d) **(i)** Extend your line of best fit until it crosses the *y*-axis.

Record the value of the *y*-axis intercept.

y-axis intercept = ... $\frac{1}{\text{A}}$ [1]

(ii) Use your answer to **(d)(i)** to predict the current I when there are **no** lamps in the circuit.

I = ... A [1]

(e) The student measures the current when there are no lamps in the circuit and compares the measured current with the current predicted in **(d)(ii)**. The measured current is **more** than the current predicted.

Suggest **one** possible cause of uncertainty in this experiment and an improvement to the procedure in **(c)** that you can make to reduce the uncertainty.

cause of uncertainty ....

....

improvement ....

....

[2]

[Total: 11]

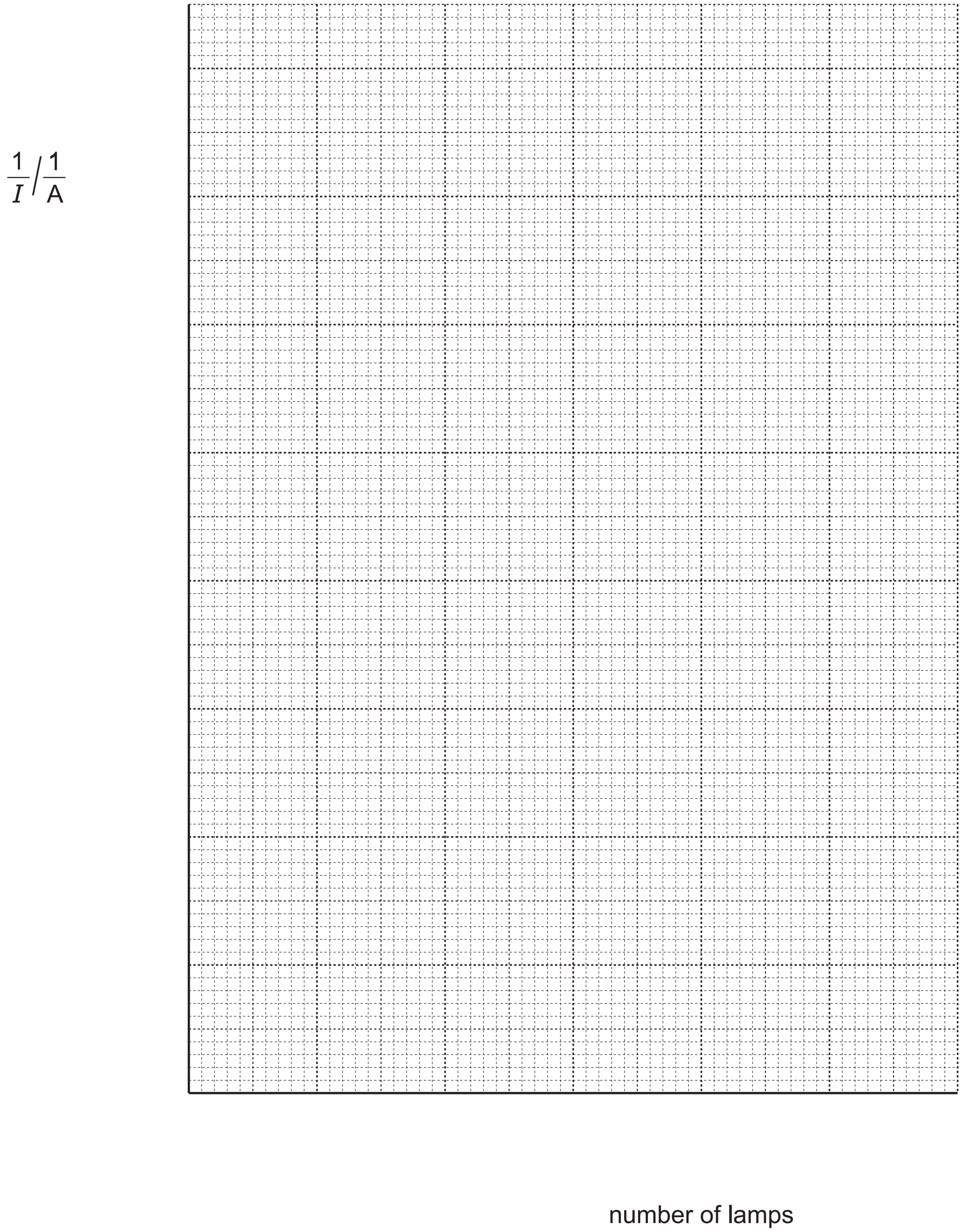

Fig. 3.2

4 Fig. 4.1 shows a cooked bird's egg.

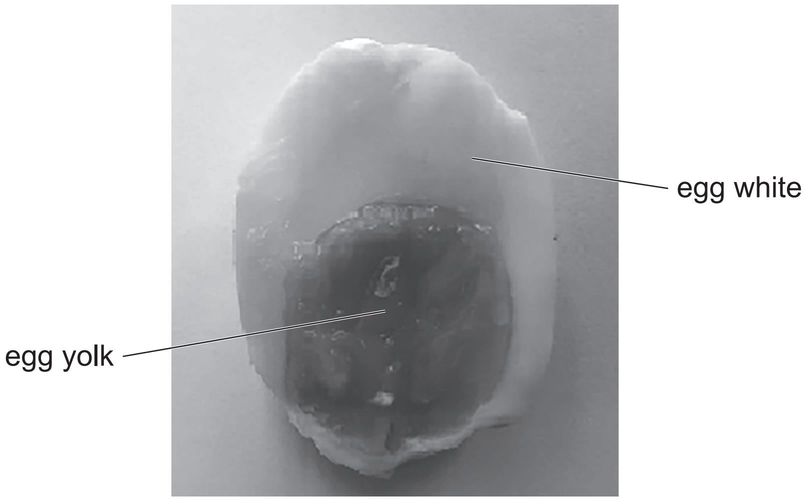

Fig. 4.1

The egg white is broken down by the enzyme protease to produce a colourless liquid.

A student states:

"The egg white is broken down faster in acidic solutions than in neutral or alkaline solutions."

Plan an investigation to test whether this statement is correct.

You are provided with acidic, neutral and alkaline solutions and as much cooked egg white as you need.

You can also use other apparatus that is usually available in a school laboratory.

Include in your answer:

- a brief description of the method
- the measurements that you will make
- the key variables you will keep constant
- how you will use your results to draw a conclusion.

A diagram of your apparatus is not required but if it helps you to explain your plan then you may include one.

[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