Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

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9136342115

COMBINED SCIENCE **5129/32**

Paper 3 Experimental Skills and Investigations **October/November 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 **20** pages. Any blank pages are indicated.

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1 Starch is broken down by the enzyme amylase.

A student investigates the effect of changing the temperature on the time taken for starch to be broken down by amylase.

The student:

- places 10 cm^3 of starch solution into a test-tube
- places 2 cm^3 of amylase solution into a different test-tube
- places both test-tubes in a water-bath at 20 °C
- starts a stop-watch and mixes the two solutions together
- checks the temperature of the mixture and adds iodine solution
- records the time it takes for the starch to be broken down.

The student repeats this procedure at different temperatures of the water-bath.

(a) (i) The student checks the temperature of the water-bath before placing the test-tubes in it.

State the name of the apparatus that the student uses to check the temperature of the water-bath.

..... [1]

(ii) The volumes of the solutions stay constant for each repeat of this procedure.

State **two** other variables that must stay constant in this investigation.

variable 1 .....

variable 2 .....
[2]

(b) The student repeats the procedure at temperature intervals of 5 °C and records the results in the table shown as Table 1.1.

Table 1.1

temperature	time taken for starch to be broken down / s
20	180 seconds
25	120 seconds
30	90 seconds
35	60 seconds
40	60 seconds
45	90 seconds

(i) Identify **two** errors that the student makes in the table.

error 1 .....

.....

error 2 .....

.....

[2]

(ii) The student concludes that the amylase breaks down starch in the shortest time at a temperature between 35 °C and 40 °C.

Describe how the student now changes the investigation to find a more accurate value for this temperature.

.....

.....

.....

.....

.....

..... [3]

(c) The student uses the iodine solution to show that starch is present.

(i) State the colour that iodine solution turns in the presence of starch.

.....

..... [1]

(ii) Amylase breaks down starch into a reducing sugar.

State the test for a reducing sugar and the observation for a positive result.

test .....

observation .....

..... [2]

[Total: 11]

2 A student investigates the use of electrical energy to heat water.

Fig. 2.1 shows the apparatus used.

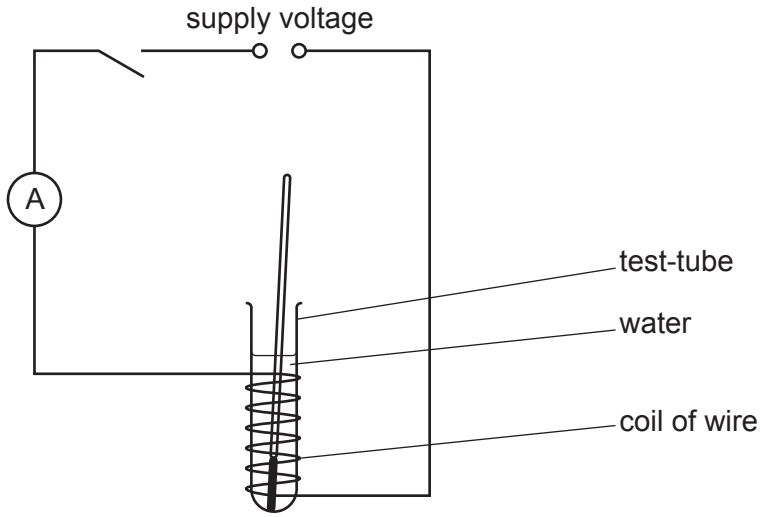

Fig. 2.1

A coil of wire is wrapped around the test-tube. When the switch is closed, there is a current in the circuit. The coil becomes hot and this heats water in the test-tube.

(a) A teacher suggests wrapping the test-tube and coil of wire with electrical insulating tape. Electrical insulating tape is shown in Fig. 2.2.

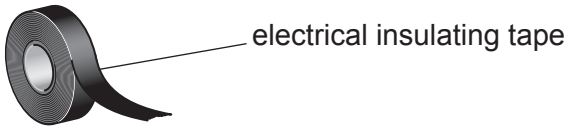

Fig. 2.2

Suggest why this is a suitable safety precaution.

.....

..... [1]

(b) State the name of the meter shown in Fig. 2.1 that measures the electrical current.

..... [1]

(c) The student sets the supply voltage at 4.0 V. Fig. 2.3 shows the reading on the meter shown in Fig. 2.1 on page 5.

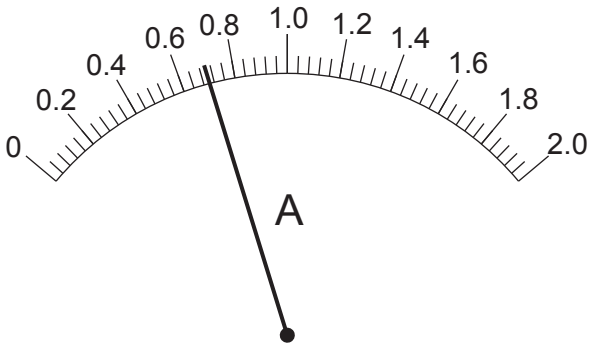

Fig. 2.3

(i) Read and record the current.

current = ... A [1]

(ii) Calculate the electrical power in the coil of wire when the voltage is set at 4.0 V. Use the equation:

power = voltage × current

Record your answer in Table 2.1.

[1]

(d) The student:

- measures the time for the temperature of the water in the test-tube to increase by 5.0 °C
- calculates the power
- repeats the procedure using fresh water and supply voltages between 6.0 V and 12.0 V.

The results are shown in Table 2.1.

Table 2.1

voltage / V	power / W	time / s
4.0	.....	130
6.0	6.0	80
8.0	10.7	40
10.0	17.0	25
12.0	24.0	20

Plot a graph of time on the *y*-axis against power on the *x*-axis on the grid provided in Fig. 2.4.

Draw the curved line of best fit through your points. [4]

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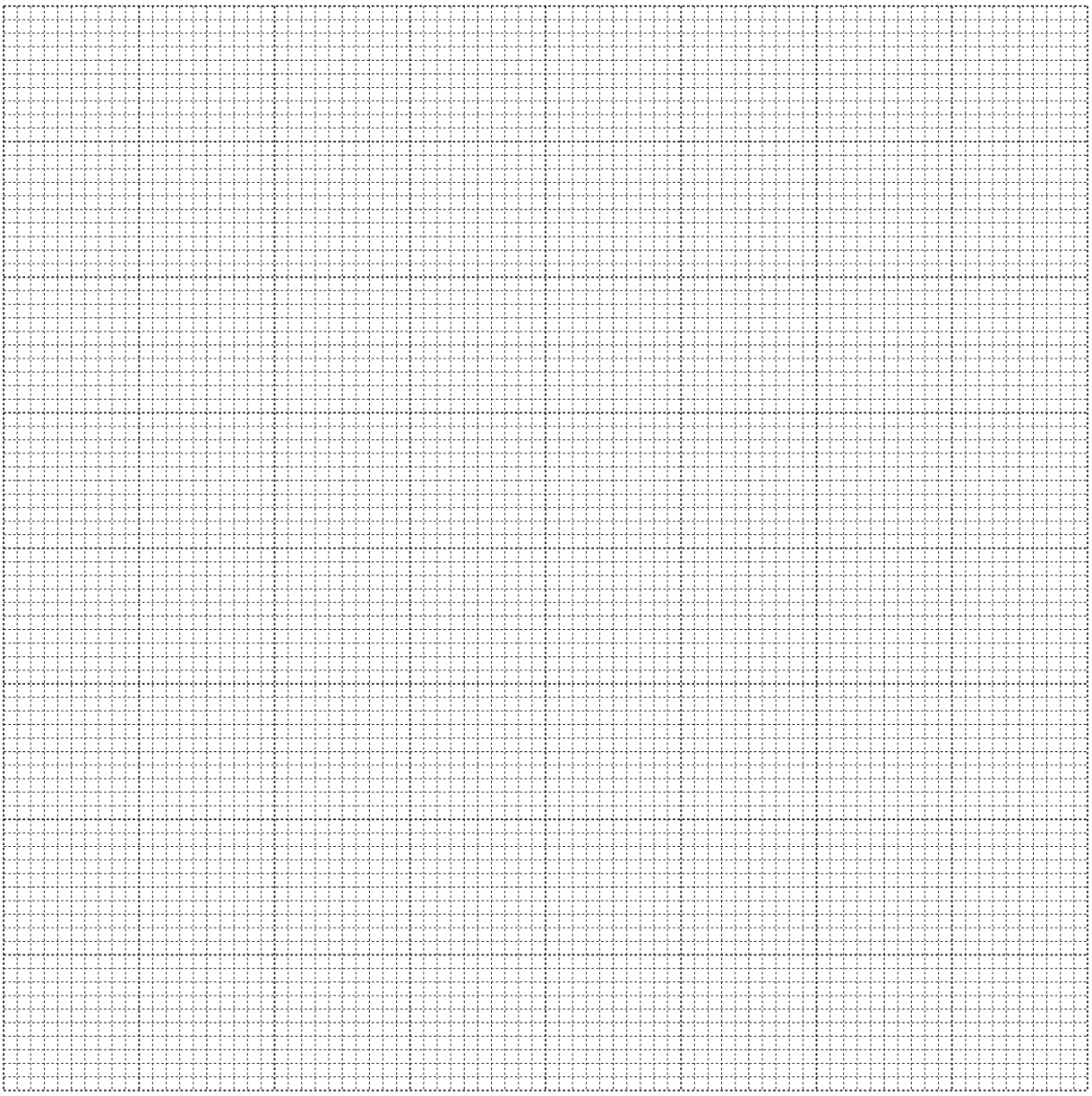


Fig. 2.4

(e) Describe the relationship shown in the graph.

.....

..... [1]

(f) The teacher states that, due to convection, the water in the test-tube is hotter at the top.

(i) Suggest why this may be a cause of uncertainty in the student's measurements.

.....

..... [1]

(ii) Suggest **one** improvement to the procedure to ensure that the water is at an even temperature throughout the test-tube.

.....

..... [1]

[Total: 11]

3 A student investigates the reaction between dilute hydrochloric acid and copper(II) carbonate.

Dilute hydrochloric acid is a colourless solution.

Copper carbonate is a green solid.

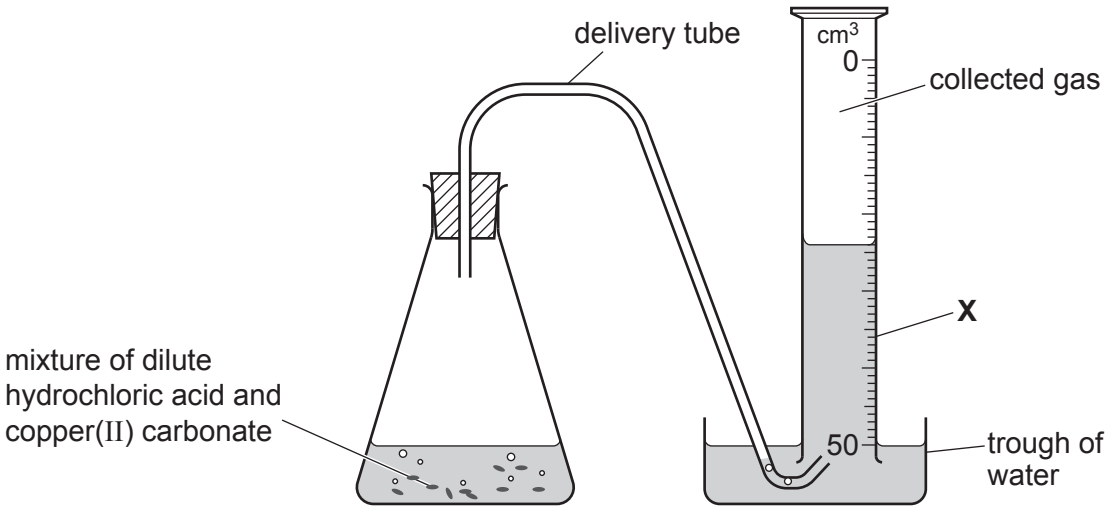
The student:

- places dilute hydrochloric acid in a conical flask
- adds 1.0 g of copper(II) carbonate solid into the flask
- quickly attaches a bung connected to a delivery tube.

Bubbles of gas are seen (effervescence).

A green solid and a blue solution are left in the flask at the end of the experiment.

The apparatus is arranged as shown in Fig. 3.1. This is apparatus **A**.



Apparatus **A**

Fig. 3.1 (not to scale)

A gas is collected.

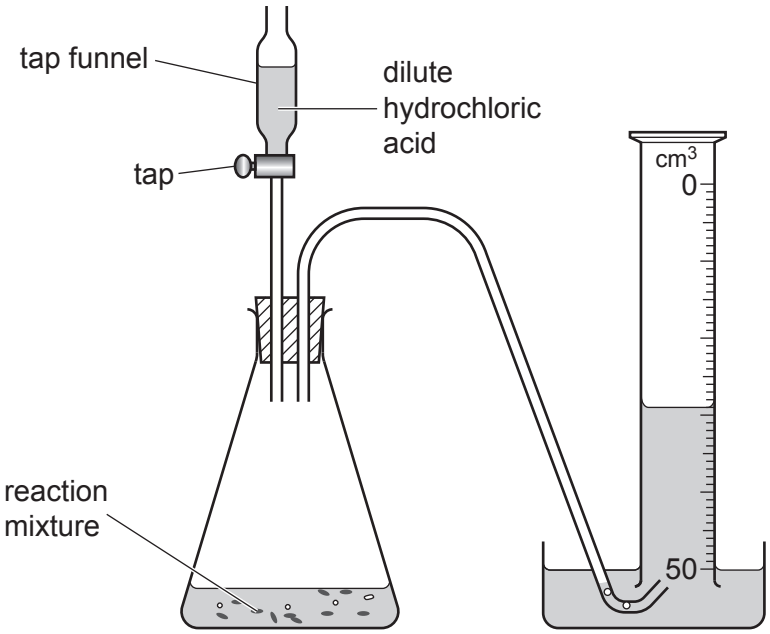
(a) (i) State the name of the piece of apparatus labelled **X**.

..... [1]

(ii) State the volume of the gas collected in Fig. 3.1.

volume of gas collected = ... cm^3 [1]

(b) The student repeats the experiment using a tap funnel as shown in Fig. 3.2. This is apparatus **B**.



apparatus **B**

Fig. 3.2 (not to scale)

The dilute hydrochloric acid is added to the funnel and then the tap is turned to allow acid to drop into the flask. The same volume of acid is added to apparatus **B** as is added to apparatus **A**.

Apparatus **B** collects more gas than apparatus **A** when all the other variables are kept constant.

Explain why.

.....

.....

..... [1]

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(c) The student tests the collected gas.

Table 3.1 shows the tests and the observations made for the collected gas.

Table 3.1

test	observation
damp universal indicator paper is placed in the gas	the indicator turns yellow
a lighted splint is placed in the gas	the flame goes out
the gas is passed through limewater	the limewater turns milky

Name the collected gas.

..... [1]

(d) At the end of the experiment, the student:

- separates the green solid from the mixture in the flask
- washes and dries the green solid
- measures its mass.

(i) State the method that is used to separate the green solid from the liquid in the mixture.

..... [1]

(ii) Suggest a possible mass of the solid that is obtained.

Explain the reason for your suggestion.

possible mass of solid = ... g

explanation .....

.....

.....

[1]

(e) The student then investigates the effect of changing the concentration of hydrochloric acid on the volume of gas produced in 60 seconds.

Table 3.2 shows the results.

Table 3.2

concentration of hydrochloric acid / g/dm^3	volume of gas produced in 60 seconds / cm^3
4.1	9
6.0	15
7.9	10
9.8	25
.....	30
13.6	35
15.5	41

(i) One of the concentrations of dilute hydrochloric acid is not recorded in the table.

Suggest the concentration of dilute hydrochloric acid used to obtain 30 cm^3 of gas in 60 seconds.

Give a reason for your answer.

suggested concentration = ... g/dm^3

reason .....

.....

.....

[2]

(ii) The student thinks that one of the results is an anomaly.

State the concentration of hydrochloric acid which gives an anomalous result.

Explain how the data shows that this result is an anomaly.

concentration of hydrochloric acid with anomalous result = ... g/dm^3

explanation .....

.....

.....

[2]

(iii) Describe the relationship between the concentration of hydrochloric acid and the **rate** at which the gas is produced.

.....

.....

..... [1]

[Total: 11]

4 Chlorine, bromine and iodine are halogens.

A student predicts that:

- chlorine is more reactive than bromine and iodine
- bromine is more reactive than iodine.

Use the information provided to plan an investigation to show that the student is correct.

Information:

A more reactive halogen will displace a less reactive halogen from an aqueous solution of its compound.

An equation showing a displacement reaction is shown.

In this reaction a halogen, chlorine, displaces iodine from the compound potassium iodide.

chlorine + potassium iodide ⟶ potassium chloride + iodine

You are provided with the solutions in Table 4.1.

Table 4.1

colourless chlorine water	colourless potassium chloride
red-brown iodine water	colourless potassium iodide
orange bromine water	colourless potassium bromide

You may plan to use any apparatus commonly found in a school laboratory.

Include in your answer:

- the apparatus you will use
- any safety precautions you will take
- the observations you will make
- 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.

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[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

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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

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