Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

6163718626

PHYSICAL SCIENCE **0652/51**

Paper 5 Practical Test **October/November 2022**

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.

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[Turn over

1 You are going to find the value of x in the formula of sodium carbonate crystals, $Na_2CO_3.xH_2O$.

A weighed sample of sodium carbonate crystals is heated until all of the water has been removed.

$$Na_2CO_3.xH_2O \rightarrow Na_2CO_3 + xH_2O$$

The anhydrous sample (sample with no water) is weighed.

The value of x can be calculated using the equation shown:

$$x = \frac{\text{amount } H_2O}{\text{amount } Na_2CO_3}$$

(a)
- Weigh the empty evaporating basin.
- Record the mass to the nearest 0.1 g in Table 1.1.
- Place the sample of sodium carbonate crystals into the evaporating basin.
- Record, in Table 1.1, the mass of the evaporating basin and sodium carbonate crystals to the nearest 0.1 g.
- Heat the sodium carbonate crystals carefully with a burner for 5 minutes.
- Allow the evaporating basin to cool for a few minutes.
- Weigh the evaporating basin and anhydrous sodium carbonate, Na_2CO_3.
- Record, in Table 1.1, the mass of the evaporating basin and anhydrous sodium carbonate to the nearest 0.1 g.

Table 1.1

mass of empty evaporating basin	.... g
mass of evaporating basin and sodium carbonate crystals ($Na_2CO_3.xH_2O$) before heating	.... g
mass of evaporating basin and anhydrous sodium carbonate (Na_2CO_3) after heating	.... g

[3]

(b) (i) Calculate the mass of anhydrous sodium carbonate, Na_2CO_3.

Use the equation:

mass anhydrous sodium carbonate = mass of evaporating basin and anhydrous sodium carbonate – mass of empty evaporating basin

mass of anhydrous Na_2CO_3 = ... g [1]

(ii) Calculate the amount (number of moles) of Na_2CO_3.

Use the equation:

$$\text{amount anhydrous } Na_2CO_3 = \frac{\text{mass anhydrous } Na_2CO_3}{106}$$

amount of anhydrous Na_2CO_3 = ... [1]

(iii) Calculate the mass of water, H_2O, given off.

Use the equation:

$$\text{mass water} = \text{mass of evaporating basin and sodium carbonate crystals} - \text{mass of evaporating basin and anhydrous sodium carbonate}$$

mass of H_2O = ... g [1]

(iv) Calculate the amount (number of moles) of H_2O.

Use the equation:

$$\text{amount } H_2O = \frac{\text{mass } H_2O}{18}$$

amount of H_2O = ... [1]

(v) Calculate the value of x in $Na_2CO_3.xH_2O$.

Use your answers to **(b)(ii)**, **(b)(iv)** and the equation:

$$x = \frac{\text{amount } H_2O}{\text{amount anhydrous } Na_2CO_3}$$

x = ... [1]

(c) **(i)** Explain in detail why repeating the experiment and calculating an average would increase the accuracy of the value of x.

....

....

.... [1]

(ii) Identify **two other** major sources of error in this experiment. For each source of error suggest how the experiment can be improved to make the value of x more accurate.

The changes suggested must be possible in a school or college laboratory.

error 1 ....

....

improvement 1 ....

....

error 2 ....

....

improvement 2 ....

....

[2]

[Total: 11]

Question 2 begins over the page

2 You are going to identify three colourless solutions, **A**, **B** and **C**.

(a)
- Pour about 1 cm depth of solution **A** in a clean test-tube.
- Add universal indicator.

Record the colour in Table 2.1.

- Repeat with solution **B** and solution **C**.

[1]

(b)
- Pour about 1 cm depth of solution **A** into two clean test-tubes.
- Add a few drops of dilute nitric acid followed by a few drops of aqueous silver nitrate to one test-tube.
- Add a few drops of dilute nitric acid followed by a few drops of aqueous barium nitrate to the second test-tube.

Record your observations in Table 2.1.

- Repeat with solution **B** and solution **C**.

[2]

Table 2.1

test	placed in solution **A**	placed in solution **B**	placed in solution **C**
colour of universal indicator			
dilute nitric acid and aqueous silver nitrate			
dilute nitric acid and aqueous barium nitrate			

(c) Identify solution **A**.

solution **A** is .... [1]

(d)
- Place the wooden splint soaked in solution **B** into a blue burner flame.

Record the first colour seen in Table 2.2.

There is no flame colour with solution **C**.

[1]

(e) • Place about 2 cm depth of solution **B** into a clean test-tube.

• Add aqueous copper(II) sulfate until it is in excess.

Record your observations in Table 2.2.

• Repeat with solution **C**.

[2]

Table 2.2

test	solution **B**	solution **C**
flame colour		none
add aqueous copper(II) sulfate until it is in excess		

(f) Identify solutions **B** and **C**.

solution **B** is ....

solution **C** is ....

[2]

[Total: 9]

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3 In this experiment, you will determine the resistance of a resistor **X**.

Fig. 3.1 shows most of a circuit that is set up for you. The circuit contains a slide wire to which a crocodile clip can be attached.

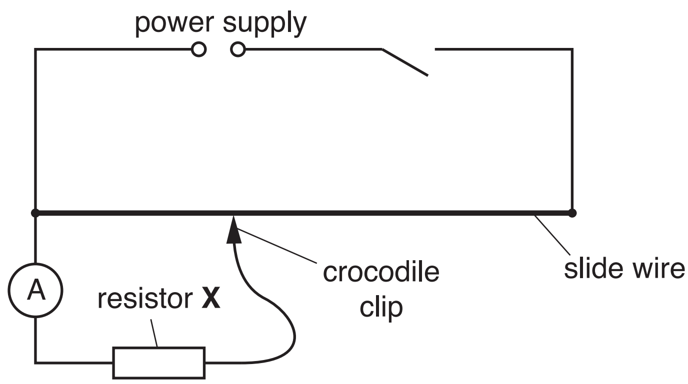

Fig. 3.1

A voltmeter in the circuit is used to measure the potential difference across resistor **X**.

(a) The voltmeter has been omitted from the diagram of the circuit in Fig. 3.1.

Complete the circuit diagram Fig. 3.1 by adding the symbol for a voltmeter in the correct position to measure the potential difference across resistor **X**. [1]

(b) **(i)**
- Close the switch.
- Adjust the position of the crocodile clip on the slide wire until the potential difference *V* across the resistor is 0.4 V.

Record the value of the current *I* in Table 3.1.

[1]

(ii)
- Repeat the procedure in **(b)(i)** for values of *V* = 0.6 V, 0.8 V, 1.0 V and 1.2 V.
- Open the switch.

[1]

Table 3.1

V / V	*I* / A
0.4	
0.6	
0.8	
1.0	
1.2	

(c) (i) Plot a graph of current I (vertical axis) against potential difference V.

[3]

(ii) Draw the line of best fit. [1]

(d) (i) Calculate the gradient G of the line.

Show all working and indicate clearly on your graph the points you use to calculate the gradient.

G = ... [2]

(ii) The resistance of resistor **X**, $R_{\mathbf{x}}$, is equal to $1/G$.

Use your value of G from **(d)(i)** to calculate $R_{\mathbf{x}}$.

Give your answer to a suitable number of significant figures.

$R_{\mathbf{x}}$ = ... Ω [2]

(iii) Resistor **X** was chosen from a selection of resistors with values 4.7 Ω or 5.1 Ω.

Use your value of $R_\mathbf{x}$ to identify the actual resistance of resistor **X** from the list.

Tick the box to indicate your choice.

☐ 4.7 Ω

☐ 5.1 Ω

☐ either of these

☐ neither of these

Explain your choice with reference to your calculated value for $R_\mathbf{x}$.

....

.... [1]

(e) The resistance of resistor **X** can be determined by taking a single pair of values of current I, and potential difference V from Table 3.1, and using the equation $R = V / I$.

Suggest **one** reason why plotting a graph gives a more accurate value of resistance.

....

.... [1]

[Total: 13]

4 A student suggests that the starting temperature of hot water affects its rate of cooling.

The following equipment is available to the student:

a supply of water
an electric kettle
thermometer
250 cm^3 beaker
250 cm^3 measuring cylinder
stopwatch
clamp, boss and stand.

Plan an experiment to investigate the relationship between the starting temperature of water and its rate of cooling.

Your plan should include:

- a brief description of the method, including how you will obtain a range of starting temperatures
- the measurements you will make
- the variables to control
- the table you will draw to record your results, with column headings (you are **not** required to enter any readings in the table)
- an explanation of how you would use your results to reach a conclusion.

A diagram is not required but you may draw one if it helps to explain your plan.

....

....

....

....

....

....

[7]

NOTES FOR USE IN QUALITATIVE ANALYSIS

Test 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.
bromide (Br^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream 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.

Test 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 (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

[Turn over

Test 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
copper(II) (Cu^{2+})	blue-green