Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5024575149

PHYSICAL SCIENCE **0652/62**

Paper 6 Alternative to Practical **October/November 2022**

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 [ ].

DC (DE) 318990

1 A student performs an experiment 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)
- She weighs the empty evaporating basin and records the mass in Table 1.1.
- She places a sample of sodium carbonate crystals into the evaporating basin. She records the mass of the evaporating basin and sodium carbonate crystals in Table 1.1.
- She heats the sodium carbonate crystals with a Bunsen burner for 5 minutes.
- She allows the evaporating basin to cool for a few minutes.
- She weighs the evaporating basin and anhydrous sodium carbonate, Na_2CO_3, and records this mass in Table 1.1.

Fig. 1.1 shows the balance readings for the mass of the evaporating basin and sodium carbonate crystals before heating and the mass of the evaporating basin and anhydrous sodium carbonate after heating.

Read the masses and record them to the nearest 0.1 g in Table 1.1. [2]

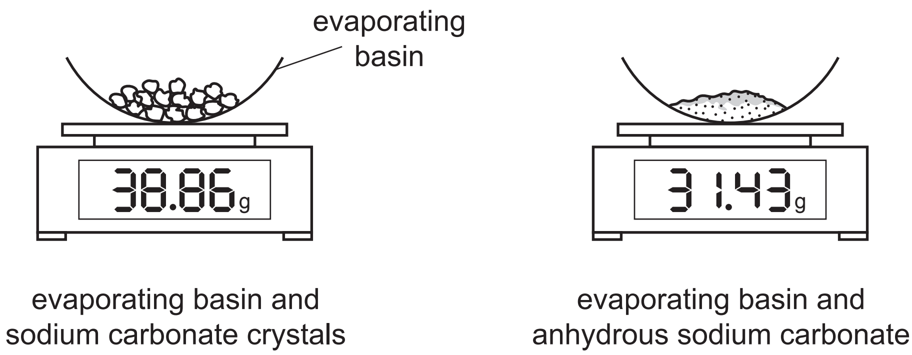

Fig. 1.1

Table 1.1

mass of empty evaporating basin	26.8 g
mass of evaporating basin and sodium carbonate crystals ($Na_2CO_3.xH_2O$)	.... g
mass of evaporating basin and anhydrous sodium carbonate (Na_2CO_3)	.... g

(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:

mass water = mass of evaporating basin and sodium carbonate crystals – 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 the answers to **(b)(iv)**, **(b)(ii)** 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 the 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: 10]

2 A student performs tests to identify three colourless solutions, **A**, **B** and **C**.

(a)
- He pours about 1 cm depth of solution **A** in a test-tube.
- He adds universal indicator and records the colour in Table 2.1.
- He repeats with solutions **B** and **C**.
- He places about 1 cm depth of solution **A** into two test-tubes.
- He adds a few drops of dilute nitric acid followed by a few drops of aqueous silver nitrate to one test-tube and records his observations in Table 2.1.
- He adds a few drops of dilute nitric acid followed by a few drops of aqueous barium nitrate to the second test-tube and records his observations in Table 2.1.
- He repeats with solutions **B** and **C**.

Solution **A** gives a positive test for chloride ions. All of the other tests involving nitric acid are negative for **A**, **B** and **C**.

Record the **observations** for each test in Table 2.1. [2]

Table 2.1

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

(b) Identify solution **A**.

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

(c) The student now performs a flame test on each of the solutions and records his observations in Table 2.2 on page 6.

Describe in detail how to perform a flame test and explain how contamination of the flame colour is avoided.

....

....

.... [2]

(d) The student thinks that solution **B** is aqueous sodium hydroxide and that solution **C** is aqueous ammonia.

Explain how the test results in Table 2.1 and the flame test results in Table 2.2 suggest that the student is correct.

....

....

.... [1]

(e) The student pours about 2 cm depth of solution **B** into a test-tube.

- He adds aqueous copper(II) sulfate until it is in excess.
- He repeats this for solution **C**.

Record in Table 2.2 the observations if solution **B** is aqueous sodium hydroxide and solution **C** is aqueous ammonia. [2]

Table 2.2

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

(f) The student says that solution **C** contains ammonium ions.

Describe a test and give the result which confirms that solution **C** contains ammonium ions.

test ....

positive result ....

....
[2]

[Total: 10]

3 A student measures the resistance of an unknown resistor **X**.

Fig. 3.1 shows the circuit used. A voltmeter has been omitted from the diagram.

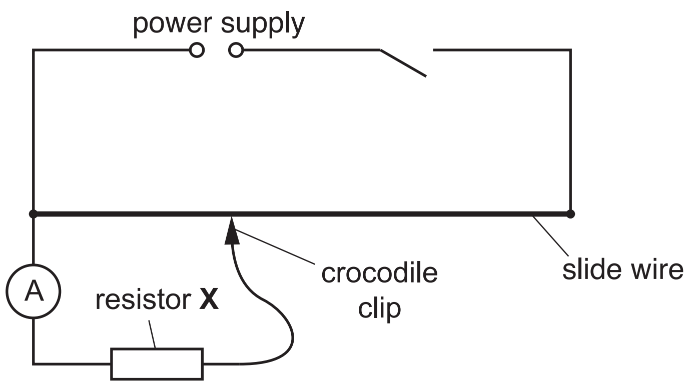

Fig. 3.1

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

(b) The student connects the crocodile clip at different positions on the slide wire to change the potential difference V across the resistor.

He measures the current I and potential difference V for each position.

Fig. 3.2 shows the ammeter reading for the value $V = 2.6\,V$.

Read the value of I and record it in Table 3.1. Record the value to 2 significant figures. [2]

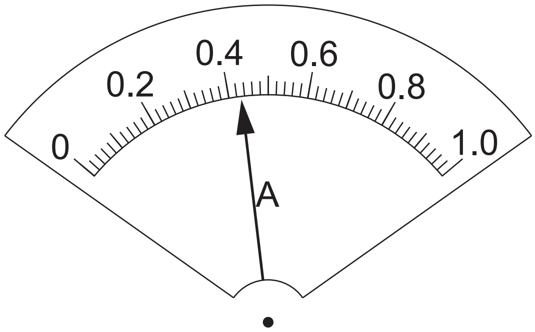

Fig. 3.2

Table 3.1

V/V	I/A
0.2	0.09
0.8	0.16
1.4	0.26
2.0	0.35
2.6	

(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_x, is equal to $1/G$.

Use your value of G from **(d)(i)** to calculate R_x.

Give your answer to a suitable number of significant figures.

R_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_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_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.

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