Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER							CANDIDATE NUMBER				
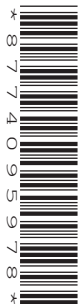
PHYSICAL SCIENCE 0652/61

Paper 6 Alternative to Practical **October/November 2021**

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 [ ].

[Turn over

1 A student investigates different arrangements of resistors.

The three resistors shown between **P** and **Q** in the circuit in Fig. 1.1 are identical. This circuit with this arrangement of resistors is called circuit **1**.

circuit **1**

Fig. 1.1

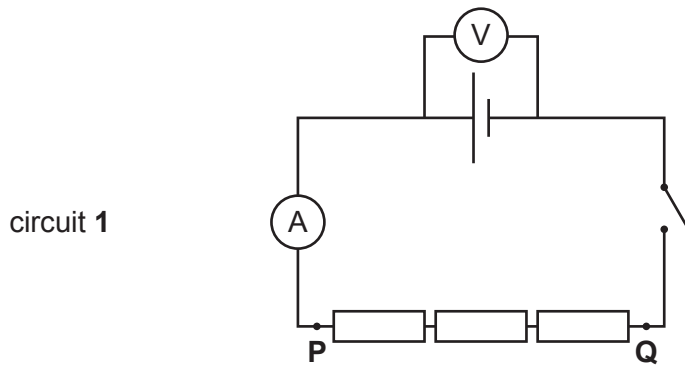**(a)** The student measures the potential difference V and the current I in circuit **1** in order to calculate the resistance R for this arrangement of resistors.

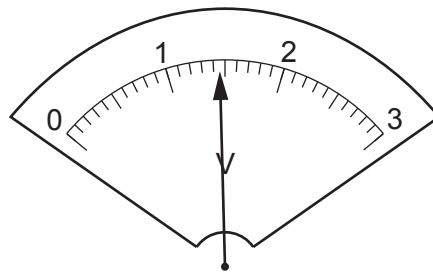Fig. 1.2 and Fig. 1.3 show the readings on the voltmeter and ammeter.

Fig. 1.2
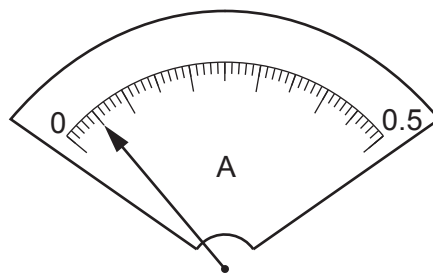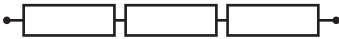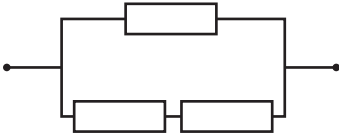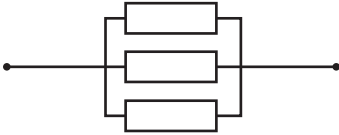
Fig. 1.3

(i) Record the values for potential difference V and current I in Table 1.1 in the row for circuit **1**. [2]

Table 1.1

circuit	resistor arrangement	V/...	I/...	R/...
1				
2		1.39	0.21	
3		1.34	0.40	

(ii) Complete the headings in Table 1.1 by adding the units for V, I, and R. [2]

(b) The student:

- rearranges the three resistors between **P** and **Q** to match the arrangement shown for circuit **2** in Table 1.1

- measures and records the new values of potential difference V and current I in Table 1.1 in the row for circuit **2**

- rearranges the three resistors between **P** and **Q** to match the arrangement shown for circuit **3** in Table 1.1

- measures and records the new values of potential difference V and current I in Table 1.1 in the row for circuit **3**.

Calculate the total resistance R for each circuit.

Use the equation:

$$R = \frac{V}{I}$$

Record, in Table 1.1, the values of R to a suitable number of significant figures. [2]

(c) The student repeats the procedure with an unknown arrangement **U** of resistors.

The values for potential difference V_U and current I_U of the unknown arrangement **U** are shown in Fig. 1.4.

V_u = 1.39
I_u = 0.20
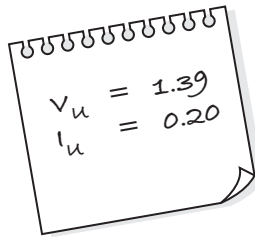
Fig. 1.4

Calculate the total resistance R_U for the unknown arrangement **U**.

Use the equation:

$$R_U = \frac{V_U}{I_U}$$

Record your value of R_U on the answer line.

R_U = ... [1]

(d) The unknown arrangement **U** may be the same as one of the arrangements in circuits **1**, **2** or **3**.

Use the values in Table 1.1 and your answer to **1(c)** to determine which arrangement, if any, represents the unknown arrangement **U**.

Tick the box to show your answer.

☐ circuit **1**

☐ circuit **2**

☐ circuit **3**

☐ none of the above circuits

Justify your choice with reference to the values shown in Table 1.1.

....

....

.... [1]

(e) A student suggests that there are other possible arrangements of the three resistors that can be investigated.

Draw **one** arrangement of the three resistors that is **different** to the resistor arrangements in circuits **1**, **2** and **3**.

[1]

[Total: 9]

6

2 A student determines the mass of a metre rule using a balancing method.

Fig. 2.1 shows the arrangement of the apparatus used.
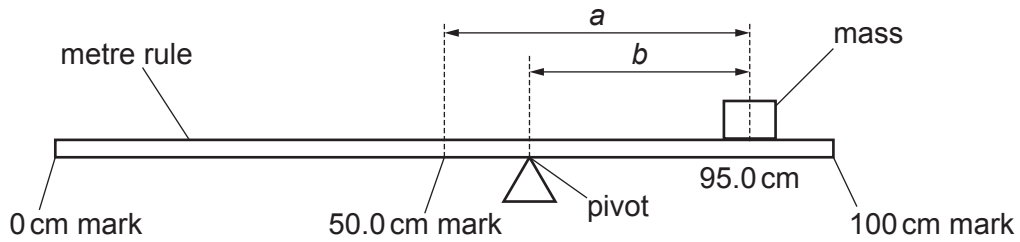
Fig. 2.1

(a) The student:

- places the mass on the metre rule, with its centre at the 95.0 cm mark
- adjusts the position of the metre rule on the pivot until the metre rule is as near to being balanced as possible
- records in Table 2.1 the position of the pivot
- repeats the procedure with the centre of the mass positioned at the 90.0 cm, 85.0 cm, 80.0 cm and 75.0 cm marks.

Table 2.1

position of the mass/cm	a/cm	position of the pivot/cm	b/cm
95.0	45.0	79.2	
90.0	40.0	76	14.0
85.0	35.0	72.8	12.2
80.0	30.0	69.5	10.5
75.0	25.0	66.2	8.8

(i) State the mistake the student has made in recording the data for the position of the pivot.

....

....

.... [1]

(ii) Calculate the distance *b* between the centre of the mass and the pivot for the first set of values in the table.

Use the equation:

  b = position of the mass – position of pivot

Record the result in Table 2.1. [1]

(b) (i) On the grid, use the data in Table 2.1 to plot a graph of *a*/cm (vertical axis) against *b*/cm.

You do not have to start your graph at the origin (0, 0).
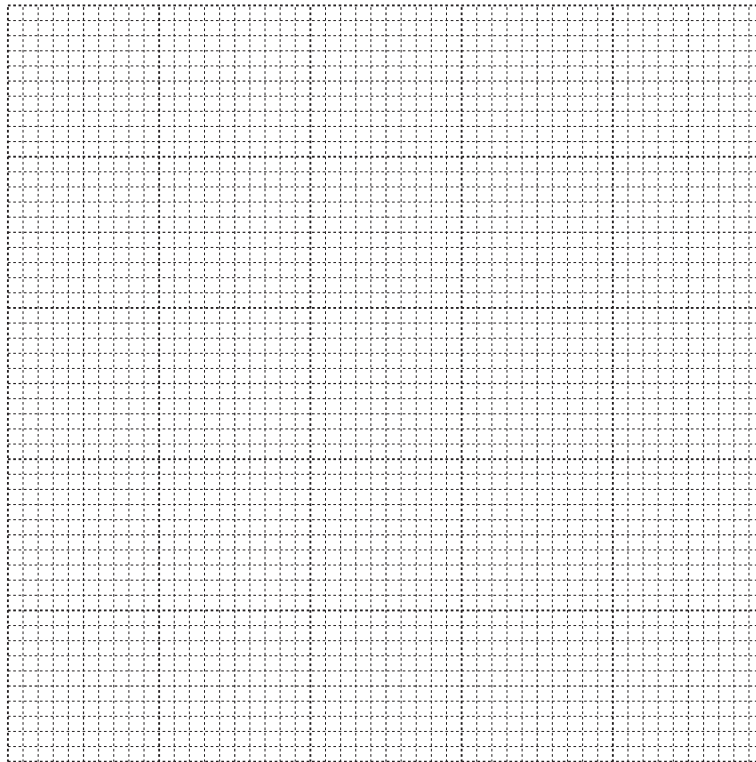
[3]

(ii) Draw the straight line of best fit for the plotted points. [1]

(c) (i) Calculate the gradient *G* of the line.

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

G = ... [2]

(ii) Calculate the mass M in g of the metre rule.

Use the equation:

$$M = \frac{200}{G-1}$$

Record the value for M on the answer line.

$M = $ ....g [1]

(d) Suggest **two** reasons why the calculated value of the mass of the metre rule is unlikely to be the same as the actual mass of the metre rule.

reason 1 ....

....

reason 2 ....

....

[2]

[Total: 11]

3 In an investigation, a student:

- investigates the colours that make up universal indicator
- determines the relative concentrations of three alkalis
- performs tests to identify two of the alkalis.

(a) A student performs a chromatography experiment to find the colours in universal indicator.

The apparatus used is shown in Fig. 3.1.
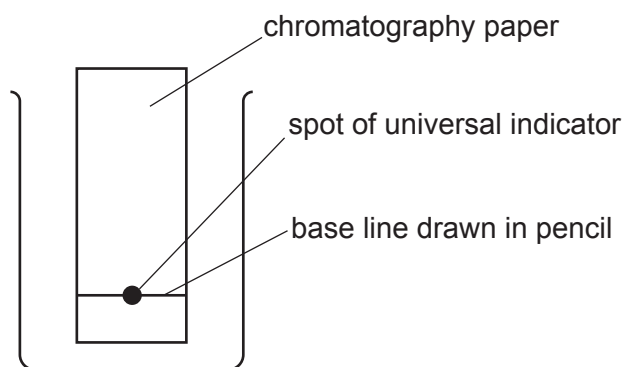
Fig. 3.1

Colours which are not soluble stay on the base line and those that are soluble move up the paper and are separated. More soluble colours can travel further than less soluble colours.

(i) A solvent is needed for chromatography. It is not shown on the diagram.

Draw a line on the diagram in Fig. 3.1 to show the level of solvent in the beaker. [1]

(ii) Suggest why the base line is drawn in pencil rather than in ink.

....

.... [1]

(iii) The chromatogram obtained by the student is shown in Fig. 3.2.
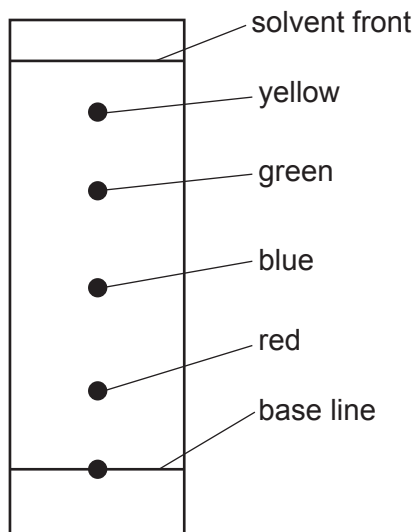
Fig. 3.2

State how many colours are shown to be in the universal indicator and suggest which colour is the most soluble in water.

number of colours ....

most soluble colour .... [2]

(iv) The colour can be identified by its R_f value.

The R_f value can be calculated using the formula shown.

$$R_f = \frac{\text{distance from the base line to the centre of the colour}}{\text{distance from the base line to the solvent front}}$$

Calculate the R_f value of the blue colour in the chromatogram.

[3]

(v) The R_f value of the blue dye Blue Haze in the data book is 0.45.

If an R_f value is within 10% of the value in the data book it is said to be the same within the limits of experimental error.

Suggest whether the blue colour in the chromatogram is Blue Haze.

Explain your answer.

....

....

.... [1]

(b) Solutions **X**, **Y** and **Z** are samples of cleaning fluids. They are all alkalis.

A student performs an experiment to place them in order of concentration by neutralising them exactly with dilute hydrochloric acid.

(i) Procedure

The student:

- measures 25 cm³ of solution **X** in a measuring cylinder and pours this into a conical flask
- adds 5 drops of bromophenol blue indicator to the conical flask
- adds drops of dilute hydrochloric acid to the conical flask and swirls the flask after each addition until the bromophenol blue just turns green
- records the number of drops in a tally chart.

The student repeats the procedure with solution **Y** and solution **Z**.

Fig. 3.3 shows the tally chart in the student's notebook.
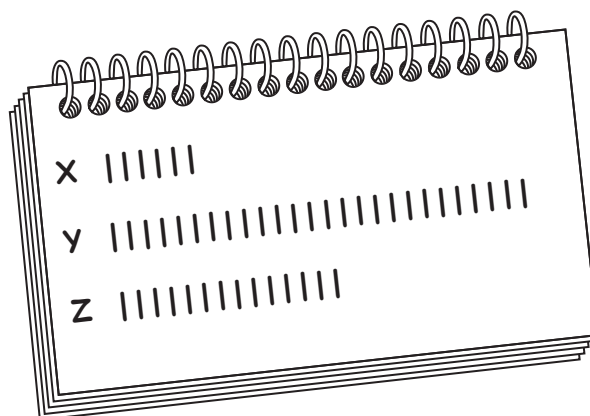
Fig. 3.3

Record the number of drops used for each solution in Table 3.1.

Table 3.1

solution	number of drops of dilute hydrochloric acid added
X	
Y	
Z	

[1]

    (ii) List the three solutions in order of concentration, starting with the most concentrated.

most concentrated ....

....

least concentrated ....

[1]

(c) The student performs a series of tests on the solutions **X**, **Y** and **Z**.

The tests and the student's results are shown in Table 3.2.

Table 3.2

test	appearance		
	solution **X**	solution **Y**	solution **Z**
few drops aqueous copper sulfate	blue precipitate	blue precipitate	blue precipitate
excess aqueous copper sulfate	blue precipitate	blue precipitate	deep blue solution
aqueous zinc nitrate	white precipitate	white precipitate	white precipitate
aqueous iron(II) nitrate	green precipitate	green precipitate	green precipitate
flame test	lilac	yellow	yellow

(i) Using the data from Table 3.2, determine which test can be used to identify solution **Z**.

Describe this test.

test ....

....

.... [1]

(ii) Using the data from Table 3.2, determine which test can be used to identify solution **X**.

Describe this test.

test ....

....

.... [1]

(iii) The teacher now says that the flame test colour for solution **Z** given in Table 3.2 is incorrect.

The flame test for solution **Z** should have no colour.

Use the other results in Table 3.2 and this new information to suggest the identity of solution **Z**.

.... [1]

[Total: 13]

4   When fuels burn they give out energy. This energy can be used for heating.

Ethanol and propanol are two alcohols which give out energy when they burn. They are both liquids.

Plan an experiment to compare the amount of thermal (heat) energy given out by each fuel when it burns.

You will need to use a spirit burner, as shown in Fig. 4.1.

A spirit burner is a glass bottle containing a volume of fuel to be burnt and a string wick dipping into the fuel.

The fuel soaks the wick. When the wick is lit the fuel burns from the wick. More fuel moves up the wick to replace the fuel that is burnt.

wick

metal safety cap

glass container
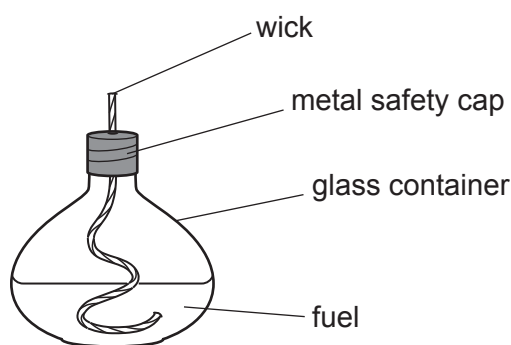
fuel

Fig. 4.1

You will also need samples of the fuels ethanol and propanol, and a supply of water. You may also use any apparatus commonly found in a school laboratory in your plan.

Your plan should include:

- the apparatus used
- a brief description of the method
- the variables to control
- the measurements you will make
- an explanation of how you will use your results to reach a conclusion.

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

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

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