Topical Practice IGCSE PHYSICS Paper 4

Chapters 11 - 14

EDITION • Volum • STUDENT

CONTENTS

| Chapter | Topic | Pages |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 11 & 13 | ELECTRICAL QUANTITIES, ELECTRONICS, AND ELECTRIC CIRCUITS Electric Field Electrons, Charging by Induction, Conductors and Insulators Charge and Current EMF and Potential Difference Resistance (and Factors) Power and Energy, P = IV, E = IVt Series and Parallel Circuits Dangers of Electricity High-Voltage Transmission (Power Loss) Circuit Components and Diagrams | 3 - 57 |
| 12 | ELECTROMAGNETISM Magnetism (Such as: Magnetic Fields and Forces, Materials, Induced Magnetism, Demagnetisation, Electromagnets) Electromagnetism (EM Induction and Effects) AC Generator and DC Motor Transformer | 58 - 59 |
| 14 | ATOMIC PHYSICS Atomic Model The Nucleus, Nuclear Fission and Fusion Radioactivity (Detection, Decay, Half-Life) Alpha, Beta, and Gamma Emissions Safety Precautions | - |

Chapters 11&13: Electrical Quantities, Electronics, and Electric Circuits

1 The IGCSE class is determining the resistance of a fixed resistor in a circuit.

The circuit is shown in Fig. 3.1.

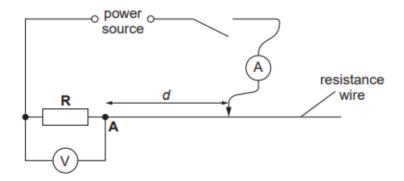


Fig. 3.1

(a) A student places the sliding contact on the resistance wire at a distance d = 10.0 cm from point A. He measures the current I in the circuit and the p.d. V across the resistor R. He repeats the procedure using d values of 30.0 cm, 50.0 cm, 70.0 cm and 90.0 cm.

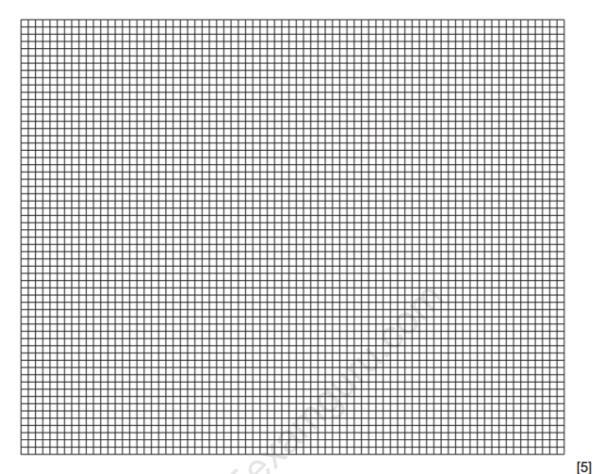
The readings are shown in Table 3.1.

Table 3.1

| 4 | V/V | I/A |
|------|-----|------|
| 10.0 | 1.7 | 1.13 |
| 30.0 | 1.3 | 0.87 |
| 50.0 | 1.0 | 0.67 |
| 70.0 | 0.8 | 0.53 |
| 90.0 | 0.7 | 0.47 |

(i) Complete the column headings in the table.

(ii) Plot a graph of V/V (y-axis) against I/A (x-axis). You do not need to include the origin (0,0) on your graph.



(iii) Determine the gradient *G* of the graph. Show clearly on the graph how you obtained the necessary information.

G =[3]

(b) The gradient G of the graph is numerically equal to the resistance R of the resistor R.
Write a value for the resistance R to a suitable number of significant figures for this experiment.

R =[2]

[Total: 10]

2 The IGCSE class is investigating resistor combinations in circuits.

The first circuit used is shown in Fig. 3.1.

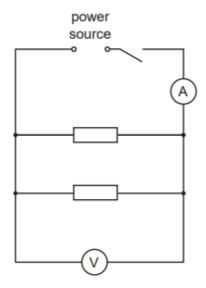


Fig. 3.1

(a) A student measures the potential difference V_1 across the resistors and the current I_1 in the circuit. The readings are shown in Figs. 3.2 and 3.3.

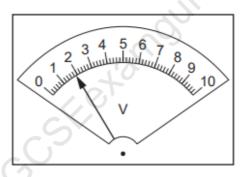


Fig. 3.2

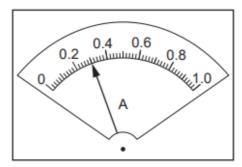


Fig. 3.3

(i) Record the potential difference V_1 and the current I_1 .

| | (ii) | Calculate the total resistance $R_{\rm P}$ of the combination of the two resistors arranged in |
|-----|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | parallel using the equation $R_p = \frac{V_1}{I_c}$. |
| | | -1 |
| | | |
| | | <i>R</i> _P = |
| | (iii) | Calculate 4R _p . |
| | | $4R_{\rm p} = $ [2] |
| (b) | | student rearranges the circuit so that the two resistors are connected in series and voltmeter is connected to measure the potential difference across both resistors. |
| | The | new potential difference and current readings are V_2 = 1.9V and I_2 = 0.08A. |
| | Cal | culate the total resistance $R_{ m S}$ of the combination of the two resistors arranged in |
| | seri | es using the equation $R_{\rm S} = \frac{V_2}{I_2}$. |
| | | |
| | | R _S =[1] |
| (c) | you | ory suggests that R_S = $4R_P$ if the two resistors have the same value. State whether results indicate that the resistors have the same value. Justify your answer with rence to the results. |
| | stat | ement |
| | justi | fication |
| | | [1] |
| (d) | Usir lam | ng the circuit described in (b) , the student replaces the two series resistors with two ps. |
| | In th | ne space below, draw a circuit diagram of the new circuit using standard symbols. |
| | | |

- (e) A student suggests repeating the experiment described in parts (a) to (c). He connects a variable resistor between the power source and the switch.

 - (ii) Explain why you might want to use a variable resistor in this way.

[Total: 10]

[2]

- 3 The IGCSE class is investigating the potential differences across circuit components.
 - Fig. 3.1 shows the apparatus used.

(i) State the function of the variable resistor.

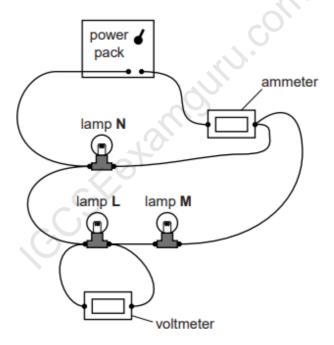


Fig. 3.1

(a) Draw a circuit diagram of the circuit shown in Fig. 3.1, using standard symbols.

(b) A student records the current \mathbf{I}_{A} , the potential difference V_{L} across lamp \mathbf{L} and the potential difference V_{M} across lamp \mathbf{M} .

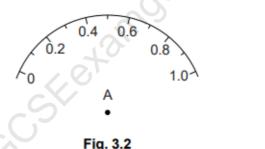
$$I_{A} = 0.65 A$$
 $V_{L} = 0.9 V$
 $V_{M} = 1.0 V$

(i) Calculate the potential difference $V_{\rm A}$ across lamps **L** and **M** using the equation $V_{\rm A}$ = $V_{\rm L}$ + $V_{\rm M}$.

(ii) Calculate R_A , the combined resistance of lamps **L**, **M** and **N**, using the equation $R_A = \frac{V_A}{I_A}$.

[1]

(iii) On Fig. 3.2, draw a pointer showing the current $I_A = 0.65 \, A$.



| (c) | The student rearranges the circuit so that the three lamps are in series with each other. He records the potential difference across each lamp in turn. |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | V _L = 0.6V |
| | V _M = 0.7V |
| | V _N = 0.7V |
| | Calculate the potential difference $V_{\rm B}$ across the three lamps using the equation $V_{\rm B}$ = $V_{\rm L}$ + $V_{\rm M}$ + $V_{\rm N}$. |
| | <i>V</i> _B = |
| (d) | A student suggests that $V_{\rm A}$ should be equal to $V_{\rm B}$. |
| | State whether the results support this suggestion and justify your answer with reference to the results. |
| | statement |

4 The IGCSE class is investigating current and potential difference using identical lamps in a circuit.

The circuit is shown in Fig. 3.1.

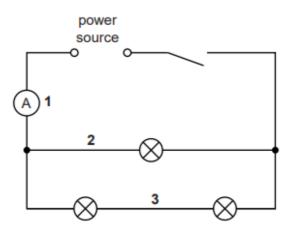
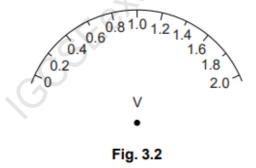


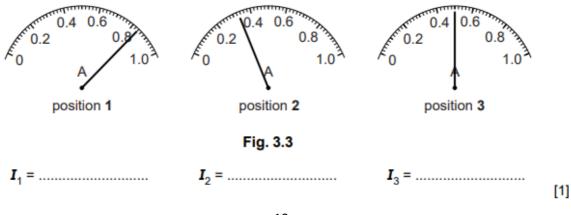
Fig. 3.1

- (a) On Fig. 3.1, draw the symbol for a voltmeter connected to measure the potential difference V across the combination of lamps. [1]
- (b) On Fig. 3.2, draw a pointer showing the voltmeter reading V = 1.9V.



(c) (i) A student measures the current at positions 1, 2 and 3 in the circuit. Record the current at each position as shown on the ammeters in Fig. 3.3.

[1]



| | (ii) | Calculate the total current $\mathbf{I}_{\mathbb{C}}$ in the combination of lamps using the equation $\mathbf{I}_{\mathbb{C}} = \mathbf{I}_2 + \mathbf{I}_3$. |
|-----|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | (iii) | ${\bf I_C} =$ Theory indicates that ${\bf I_1} = {\bf I_C}$. Suggest why a student may find the two values to be different in this experiment. |
| | | |
| (d) | | student decides to investigate the effect of changing the current \mathbf{I}_1 , using a variable stor (rheostat). |
| | | e space below, copy the diagram shown in Fig. 3.1, but with the addition of a variable stor connected at a suitable position for the investigation. |
| | | stor connected at a suitable position for the investigation. |
| | | [2] |
| (e) | | udent sets up the circuit as shown in Fig. 3.1. Neither of the two lamps in series s. He suspects that one of the lamps is faulty. |
| | Sug | gest how the apparatus may be used to find out which lamp is faulty. |
| | | |
| | | [Total: 7] |
| | | [1044111] |

5 The IGCSE class is investigating the resistance of a lamp.

The apparatus has been set out as shown in Fig. 3.1.

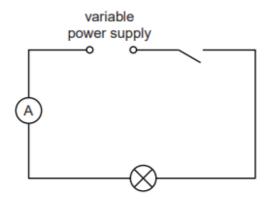


Fig. 3.1

- (a) On Fig. 3.1, draw the symbol for a voltmeter correctly connected to measure the potential difference across the lamp. [2]
- **(b)** Table 3.1 shows the values of potential difference *V* and current *I* obtained during the experiment, and observations regarding the lamp.

Table 3.1

| V/ | C_I/ | R/ | observation |
|-----|------|----|------------------------|
| 1.5 | 0.15 | | lamp is just glowing |
| 3.2 | 0.23 | | lamp is lit but is dim |
| 4.7 | 0.26 | | lamp is brighter |
| 6.5 | 0.31 | | lamp is very bright |

[3]

| (i) | Complete | the column | headings | in Table | 3.1. |
|-----|----------|------------|----------|----------|------|
|-----|----------|------------|----------|----------|------|

(ii) Calculate, and record in the table, the resistance R of the lamp at each potential difference V using the equation $R = \frac{V}{I}$.

| (c) | Α | student | suggests | that | the | resistance | of | а | lamp | stays | the | same | whatever | its |
|-----|-----|----------|----------|------|-----|------------|----|---|------|-------|-----|------|----------|-----|
| | tei | mperatur | e. | | | | | | | | | | | |

State whether the results support this idea. Justify your answer, using the results and the observations obtained during the experiment.

| statement | | |
|-----------|------------|-----|
| | | |
| | | |
| | <i>2</i> 0 | |
| | 13, | |
| | | |
| ••••• | | [3] |

[Total: 8]

6 The IGCSE class is investigating the resistance of a wire.

The circuit used is shown in Fig. 3.1.

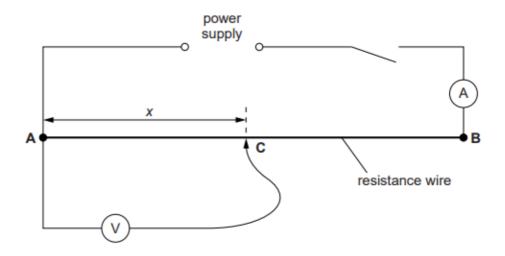


Fig. 3.1

A student moves contact $\bf C$ to give a range of values of the length $\bf x$. For each length $\bf x$, the current $\bf I$ and potential difference $\bf V$ are measured and recorded in Table 3.1.

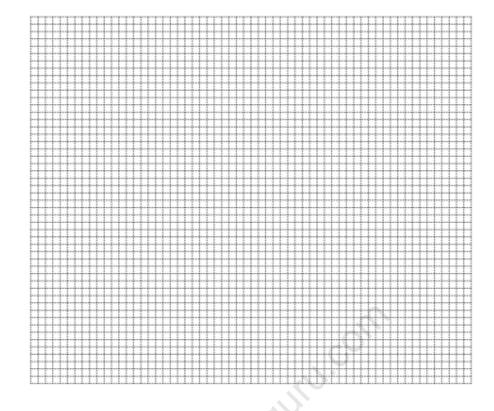
- (a) (i) Calculate the resistance R of 10.0 cm of the resistance wire using the equation $R = \frac{V}{I}$. Record this value of R in the table.
 - (ii) Repeat step (i) for each of the other values of x.
 - (iii) Complete the column headings in the table.

Table 3.1

| x/ | V/ | I/ | R/ |
|------|------|------|----|
| 10.0 | 0.20 | 0.33 | |
| 30.0 | 0.60 | 0.33 | |
| 50.0 | 1.01 | 0.32 | |
| 70.0 | 1.41 | 0.33 | |
| 90.0 | 1.81 | 0.33 | |

[3]

(b) Plot a graph of V/V (y-axis) against R/Ω (x-axis).



[5]

(c) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information. Cosket

[Total: 11]

7 The IGCSE class is investigating resistor combinations in circuits.

The first circuit used is shown in Fig. 3.1.

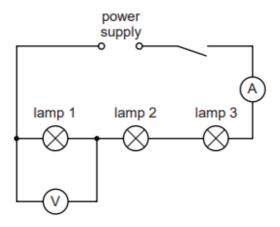
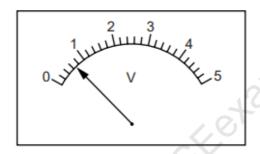


Fig. 3.1

A student measures the potential difference V_1 across lamp 1 and the current I in the circuit.

(a) (i) Using Fig. 3.2, record the student's readings.



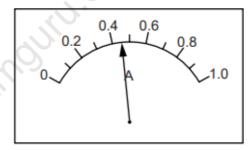


Fig. 3.2

(ii) Calculate the resistance R_1 of lamp 1 using the equation $R_1 = \frac{V_1}{I}$.

- (b) The student uses the voltmeter to measure the potential difference V_2 across lamp 2, and the potential difference V_3 across lamp 3.
 - (i) Using Fig. 3.3, record the student's reading of V_2 .

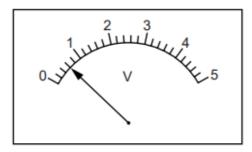


Fig. 3.3

V₂ =

(ii) Using Fig. 3.4, record the student's reading of V_3 .

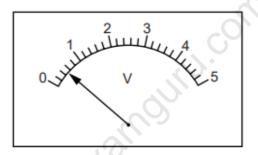


Fig. 3.4

V₃ =[1]

(c) Calculate the total potential difference $V_{\rm T}$ across the three lamps using the equation $V_{\rm T}$ = V_1 + V_2 + V_3 .

V_T =[1]

| (d) | The student rearranges the circuit so that the lamps are in parallel with each other and the ammeter is connected to measure the total current \mathbf{I}_{T} in the circuit. |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | He connects the voltmeter to measure the potential difference $V_{\rm p}$ across the lamps. |
| | In the space below, draw a circuit diagram of this new circuit using standard symbols. |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | [2] |
| (e) | The student measures the potential difference $V_{\rm p}$ and the current $I_{\rm T}$, and calculates the total resistance $R_{\rm p}$ of the lamps arranged in parallel. |
| | $R_{\rm p}$ = |
| | R. |
| | The student suggests that R_p should be equal to $\frac{R_1}{3}$. |
| | State whether the results support this suggestion and justify your answer by reference to the results. |
| | |
| | statement |
| | justification |
| | [1] |
| (f) | Another student suggests that R_p should not be equal to $\frac{R_1}{3}$ because the lamp filaments |
| | are hotter when the lamps are connected in parallel than when the lamps are connected in series. |
| | State one piece of evidence, that you would see during the investigation, that shows that the lamp filaments are hotter in the parallel circuit. |
| | |
| | [1] |
| | [Total: 9] |

8 Students in the IGCSE class are investigating the resistance of electric circuits with parallel branches.

The apparatus has been set up as shown in Fig. 3.1.

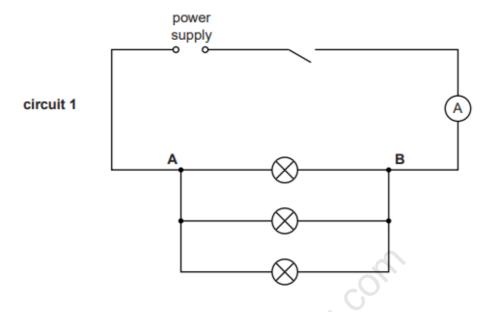


Fig. 3.1

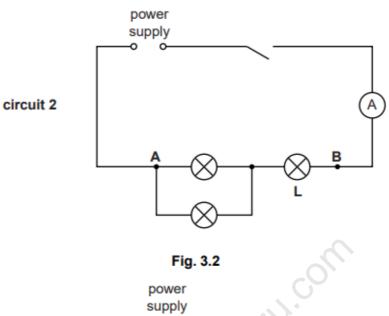
The current in the circuit and the potential difference across the combination of lamps connected between **A** and **B** are to be measured.

(a) On Fig. 3.1, draw the symbol for a voltmeter, connected to measure the potential difference V between A and B.

[1]

(b) The values of potential difference V across AB and current I for circuit 1 are recorded in Table 3.1.

The lamps are then reconnected as shown in Fig. 3.2 and then Fig. 3.3 and the experiment is repeated.



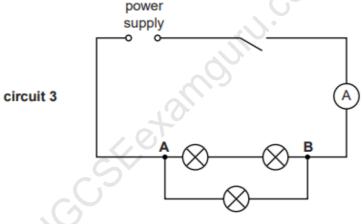


Fig. 3.3

(i) Calculate, and record in the table, the total resistance R of each combination of lamps, using the equation $R = \frac{V}{7}$.

[2]

(ii) Complete the column headings in the table. [1]

Table 3.1

| circuit | V/ | I/ | R/ |
|---------|------|------|----|
| 1 | 1.81 | 0.70 | |
| 2 | 1.76 | 0.22 | |
| 3 | 1.72 | 0.44 | |

| (c) | If each of the lamps had the same resistance, the total resistance of the lamps in circuit 3 would be twice the total resistance of the lamps in circuit 1. |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | State whether the results in the table show this to be the case. Justify your answer by reference to the results. |
| | statement |
| | |
| | justification |
| | |
| | |
| | [2] |
| (d) | An IGCSE student wants to measure the potential difference across the lamp marked L in circuit 2 . |
| | On the diagram for circuit 2 , Fig. 3.2, show how a voltmeter should be connected to measure this potential difference. [1] |
| | [Total: 7] |
| | tains |

9 The IGCSE class is investigating the power of lamps in a circuit.

Fig. 3.1 shows the circuit used.

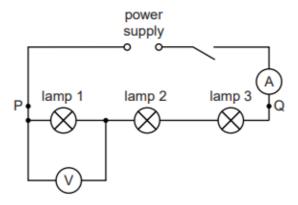
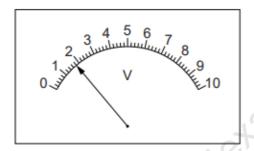


Fig. 3.1

(a) A student measures the potential difference V_1 across lamp 1 and the current I in the circuit. The meters are shown in Fig. 3.2.



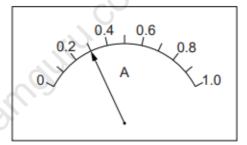


Fig. 3.2

(i) Write down the readings shown on the meters in Fig. 3.2.

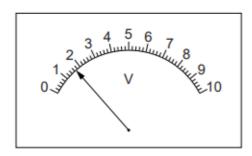
| V ₁ = | |
|------------------|--|
| T - | |

(ii) Calculate the power P_1 of lamp 1 using the equation $P_1 = IV_1$.

P₁ =

(iii) The student reconnects the voltmeter to measure the potential difference V_2 across lamp 2 and then V_3 across lamp 3.

Write down the readings shown on the meters in Figs. 3.3 and 3.4.



2 3 4 5 6 7 2 1 1 V V REE 10

Fig. 3.3

Fig. 3.4

V₂ =

(iv) Calculate the power for each lamp using the equation P = IV.

(v) Calculate the total power P_T for the three lamps using the equation $P_T = P_1 + P_2 + P_3$.

$$P_{\mathsf{T}} = \dots [1]$$

(b) The student connects the voltmeter across the three lamps and records the potential difference. He calculates the power *P*.

Another student suggests that P_T should be equal to P.

State whether the results support this suggestion and justify your answer by reference to the results.

statement

justincation

[2]

- (c) (i) Draw a circuit diagram, similar to that in Fig. 3.1, to show:
 - a variable resistor in series with the power supply,
 - three lamps in parallel with each other between P and Q,
 - a voltmeter connected to measure the potential difference across the lamps.

Use standard symbols.

| | adjiri).com | |
|------|-------------------------------------------------------------|------------|
| | LEXAII. | [2] |
| (ii) | State the purpose of the variable resistor in this circuit. | |
| | O | [1] |
| | | [Total: 9] |

10 The IGCSE class is investigating the resistance of a wire.

The circuit used is shown in Fig. 3.1.

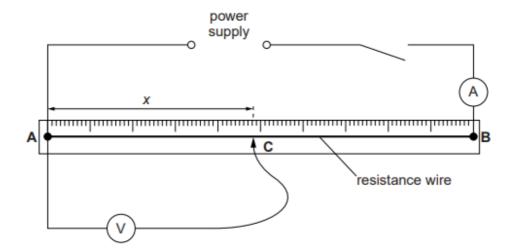


Fig. 3.1

- (a) A student places the sliding contact C on the resistance wire AB at a distance x from A, where x = 0.200 m.
 - (i) He measures the current I in the wire. Fig. 3.2 shows the ammeter.

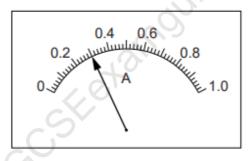


Fig. 3.2

Record the value of I.

(ii) The student measures the potential difference V across the wire between A and C. Fig. 3.3 shows the voltmeter.

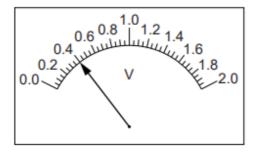


Fig. 3.3

In the first row of Table 3.1 record the value of V.

(iii) Calculate the resistance R of the section **AC** of the wire using the equation $R = \frac{V}{I}$. Record R in the first row of the table.

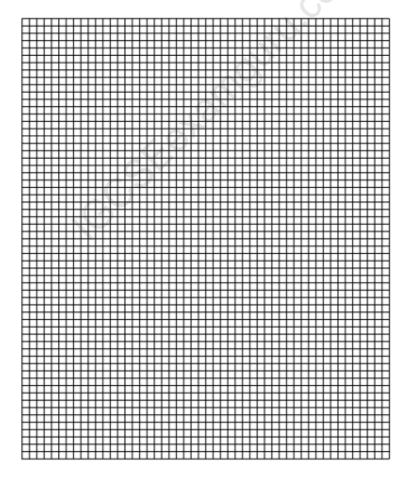
Table 3.1

| x/m | V/V | R/Ω |
|-------|------|------|
| 0.200 | | |
| 0.350 | 0.80 | 2.67 |
| 0.500 | 1.00 | 3.33 |
| 0.650 | 1.25 | 4.17 |
| 0.800 | 1.60 | 5.33 |

[2]

(b) The student records the voltmeter readings using a range of *x* values. The readings are shown in Table 3.1.

Plot a graph of R/Ω (y-axis) against x/m (x-axis).



[5]

| (c) | Using your graph, determine the length $\it l$ of the resistance wire necessary to a resistor of resistance 1.20 $\it \Omega$. Show clearly on your graph how you obtain necessary information. | |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| | 1= | [1] |

(d) Predict the resistance Z of 1.50 m of the resistance wire. Show your working.

| | Z = | [1] |
|------|------|-------------|
| | | [Total: 10] |
| | coll | |
| | (1). | |
| | 9, | |
| Tail | | |
| CKO! | | |
| | | |
| 0 | | |
| | | |

11 IGCSE students are investigating the current and potential difference in an electrical circuit.
The circuit is shown in Fig. 3.1.

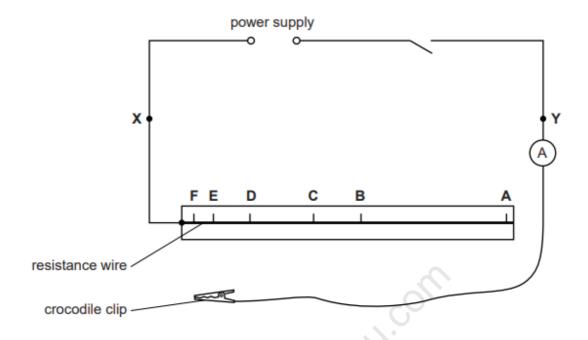


Fig. 3.1

- (a) The potential difference across part of the resistance wire, and the current in the circuit are to be measured.
 - On Fig. 3.1, use an appropriate circuit symbol to draw a voltmeter connected to measure the potential difference between ${\bf X}$ and ${\bf Y}$.

[1]

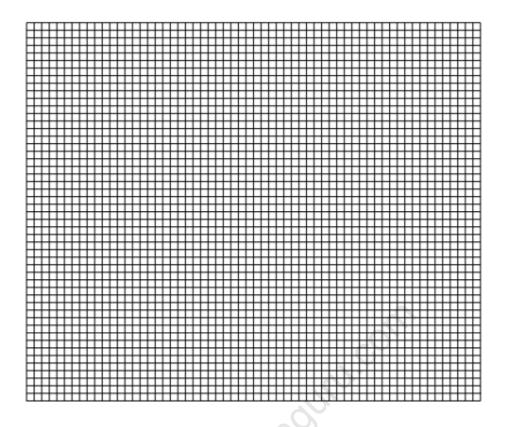
(b) The crocodile clip is connected in turn to the resistance wire at points A, B, C, D, E and F.

The potential difference V and current I are measured for each position and recorded in Table 3.1.

Table 3.1

| position | V/V | I/A |
|----------|-----|------|
| A | 1.3 | 0.20 |
| В | 1.2 | 0.35 |
| С | 1.1 | 0.46 |
| D | 0.9 | 0.74 |
| E | 0.8 | 0.87 |
| F | 0.6 | 1.13 |

(i) Plot a graph of V/V (y-axis) against I/A (x-axis).



[4]

(ii) Determine the gradient *M* of the graph. Show clearly on the graph how you obtained the necessary information.

| | ro: |
|-----|-----|
| M = | 2 |

(iii) The gradient M is numerically equal to the resistance R of the power supply.

Write down the resistance R to a number of significant figures suitable for this experiment.

[Total: 9]

12 The IGCSE class is investigating the resistance of a resistor.

Fig. 3.1 shows the circuit.

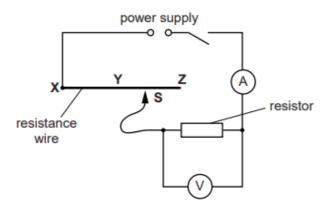
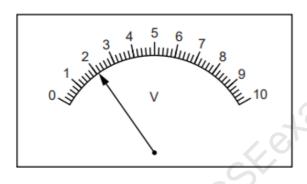


Fig. 3.1

(a) A student connects the sliding contact S to point X in the circuit. She measures the potential difference V across the resistor and the current I in the circuit. The meters are shown in Fig. 3.2.



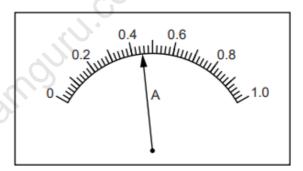


Fig. 3.2

(i) Write down the readings shown on the meters in Fig. 3.2.

| /= | | | |
|------------|------|------|-----|
| I = | | | [2] |

(ii) Calculate the resistance R of the resistor using the equation $R = \frac{V}{I}$.

(b) The student repeats the steps in (a), moving the sliding contact to point Y and then to point Z.
Comment on the effect, if any, on the current I in the circuit of changing the position of the sliding contact in this way.

(c) In this experiment, the resistance wire XYZ acts as a variable resistor (rheostat).

Draw the standard circuit symbol for a variable resistor.

[1]

(d) A student carries out this experiment using a different resistor. He takes readings using various lengths of resistance wire in the circuit. He plots a graph of V/V against I/A.

Fig. 3.3 is a sketch of the graph.

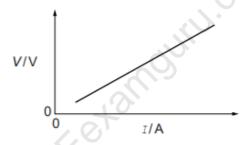


Fig. 3.3

Explain briefly how the student would use the graph to determine the gradient of the line. You may draw on the graph of Fig. 3.3. You are not asked to calculate the value of the gradient.

[Total: 8]

13 Some IGCSE students are investigating resistance using a set of wires.

The circuit they are using is shown in Fig. 3.1.

They measure the potential difference and current for three wires **A**, **B** and **C** inserted in turn between the crocodile clips. All three wires have the same diameter and are made from the same material.

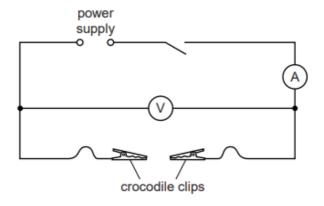
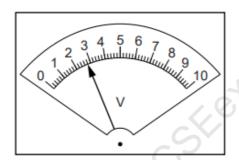


Fig. 3.1

(a) The crocodile clips are connected to the ends of wire A and the circuit is switched on. The readings on the voltmeter and ammeter are shown in Fig. 3.2.



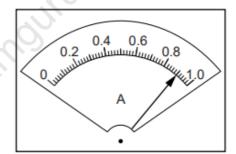


Fig. 3.2

Read, and record in Table 3.1, the potential difference V and the current I.

Table 3.1

| wire | length/cm | V/ | I/ |
|------|-----------|-----|------|
| A | 90.0 | | |
| В | 60.0 | 2.6 | 1.33 |
| С | 30.0 | 2.3 | 2.31 |

[3]

(b) The procedure is repeated for wire B and for wire C and the readings are as shown in the table.

Complete the column headings in the table.

| (c) | (i) | Calculate and record the resistance R of each wire, using the readings from Table 3.1 and the equation $R = \frac{V}{I}$. |
|-----|------|------------------------------------------------------------------------------------------------------------------------------|
| | | resistance of wire A , R _A = |
| | | resistance of wire B , R _B = |
| | | resistance of wire C , R_{C} =[2] |
| | (ii) | One student suggests that $R_{\rm A}$ should be equal to $(R_{\rm B}$ + $R_{\rm C}$). |
| | | State whether the findings support this suggestion. Justify your answer by reference to the results. |
| | | statement |
| | | justification |
| | | |
| | | [1] |
| (d) | | e problem encountered in this type of investigation is that resistance can be affected by a in temperature of the wire. |
| | Sug | gest one way in which this effect could be kept to a minimum. |
| | | |
| | | |
| | | [1] |
| | | [Total: 7] |

14 The IGCSE class is investigating the resistance of a lamp filament.

The circuit is shown in Fig. 4.1.

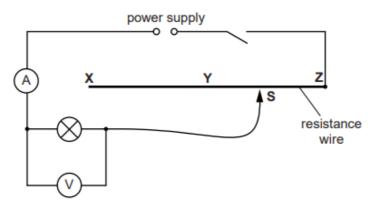
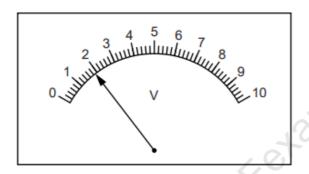


Fig. 4.1

(a) A student connects the sliding contact S to point X in the circuit. She measures the potential difference V across the lamp and the current I in the circuit. The meters are shown in Fig. 4.2.



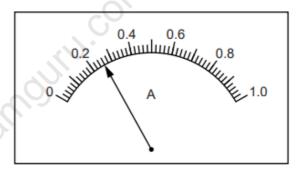


Fig. 4.2

(i) Write down the readings shown on the meters in Fig. 4.2.

| V | = | | | | | |
|---|---|------|------|------|------|------|------|------|-----|------|------|------|
| I | = | | ••• | | | |

(ii) Calculate the resistance R of the lamp filament using the equation $R = \frac{V}{I}$.

| (b) | The student repeats the steps in (a) with the sliding contact S at point Y and then at point Z. | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| | Comment on the effect, if any, on the brightness of the lamp that you would expect to see when the sliding contact is moved from X to Y to Z . | | | |
| | [1 | | | |
| (c) | The student moves the sliding contact S back to point X . | | | |
| | Suggest one practical reason why the new meter readings might be slightly different from those shown in Fig. 4.2. | | | |
| | | | | |
| | [1 | | | |
| (d) Another student carries out the experiment using a different lamp. He takes readi various lengths of resistance wire in the circuit. He plots a graph of V/V against I/A | | | | |
| | Fig. 4.3 is a sketch of the graph. | | | |
| | V/V 0 1/A Fig. 4.3 | | | |
| | State whether the graph shows that the resistance increases, decreases or remains cons as the current increases. Justify your conclusion by reference to the graph. | | | |
| | The resistance | | | |
| | justification | | | |
| | | | | |

[Total: 8]

[2]

15 The IGCSE class is investigating the resistance of a wire.

The circuit used is shown in Fig. 3.1.

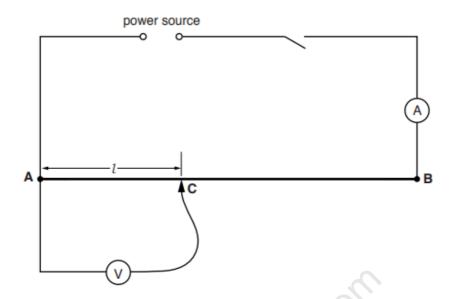


Fig. 3.1

(a) A student measures the potential difference V across different lengths l of the wire AB and the current I in the wire. The wire AB is 1.00 m long. The readings are shown in Table 3.1.

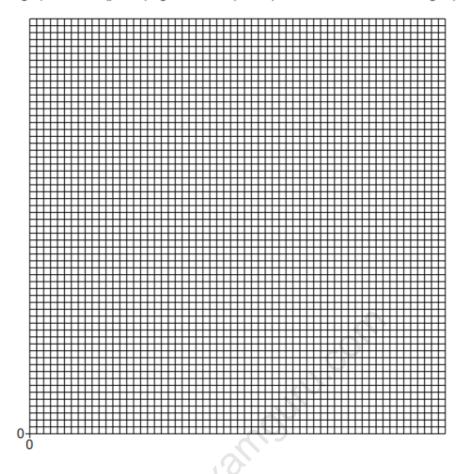
Calculate the resistance R of each length l of the wire **AB**, using the equation $R = \frac{V}{I}$. Record the values of R in the table.

Table 3.1

| l/cm | V/V | I/A | R/Ω | |
|------|------|------|-----|--|
| 10.0 | 0.36 | 0.73 | | |
| 20.0 | 0.70 | 0.71 | | |
| 30.0 | 1.10 | 0.73 | | |
| 40.0 | 1.45 | 0.73 | | |
| 50.0 | 1.80 | 0.72 | | |

[2]

(b) Plot a graph of R/Ω (y-axis) against l/cm (x-axis). Start both axes at the origin (0,0).



enath 1. Justify

[5]

(c) State whether your graph shows that the resistance R is proportional to the length I. Justify your answer by reference to the graph.

.....

[Total: 10]

16 The IGCSE class is investigating the resistance of a wire.

Fig. 3.1 shows the circuit used.

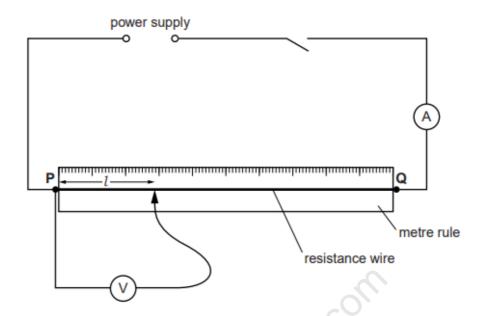


Fig. 3.1

(a) A student measures the current I in the circuit and the p.d. V across a length l = 0.250 m of the wire PQ.

He repeats the readings using a range of different lengths of the wire. The readings are shown in Table 3.1.

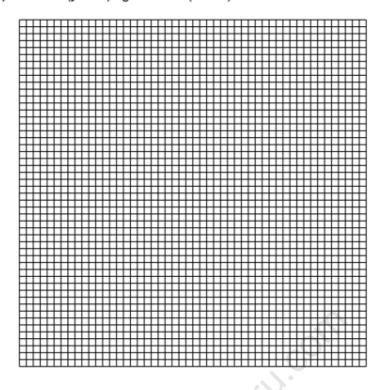
Table 3.1

| 1/ | VI | I / | R/ |
|-------|------|------------|----|
| 0.250 | 0.50 | 0.33 | |
| 0.350 | 0.69 | 0.36 | |
| 0.450 | 0.90 | 0.32 | |
| 0.550 | 1.11 | 0.34 | |
| 0.650 | 1.32 | 0.35 | |
| 0.750 | 1.50 | 0.33 | |

- (i) Calculate the resistance R of each length l of wire using the equation $R = \frac{V}{I}$. Record the values of R in the table.
- (ii) Complete the heading for each column of the table.

[1]

(b) Plot a graph of R/Ω (y-axis) against l/m (x-axis).



[4]

(c) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

Costetai (d) Predict the value of the resistance R_1 of 1.00 m of the resistance wire connected between P and Q. Give your answer to a number of significant figures that is suitable for this experiment.

 $R_1 = \dots [2]$

[Total: 9]

| Ead | ch st | udent has a selection of wires and a range of apparatus that could be used, listed below. |
|-----|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | 30 cm ruler ammeter electrical leads electromagnet electronic balance lamp metre rule 12V fixed-voltage power supply switch tape measure variable resistor (rheostat) voltmeter |
| (a) | cop | m the list, choose the most suitable device to measure the length of approximately 20 m of oper wire. |
| | | [1] |
| (b) | (i) | Draw a circuit diagram to show the circuit that you would set up to measure the current in a sample of copper wire. The current is to be measured for a range of potential differences that must also be measured. Draw the symbol for a resistor to represent the sample of copper wire. |
| | | [3] |
| | (ii) | A student replaces the copper wire with a lamp. She switches on the circuit but the lamp does not glow. |
| | | Suggest how she can check that the lamp filament is not broken by using the circuit, and without removing the lamp. |
| | | |
| | | [1] |

17 The IGCSE class is investigating the current in copper wires.

| (iii) | State whether a 0 – 300V voltmeter is suitable for measuring a potential difference in the |
|-------|--------------------------------------------------------------------------------------------|
| | circuit you have drawn in part (b)(i). Give a reason for your answer. |

| statement | |
|-----------|----|
| | |
| reason | |
| | |
| | |
| | |
| | [1 |

[Total: 6]

- 18 Some IGCSE students are finding the resistance of a lamp in two different electrical circuits.
 - (a) Circuit 1 is shown in Fig. 5.1.

circuit 1

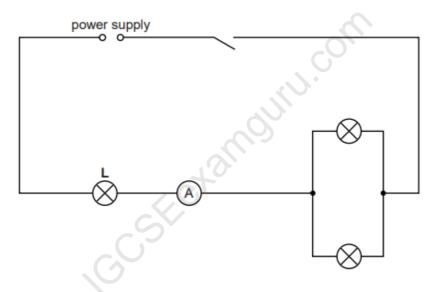
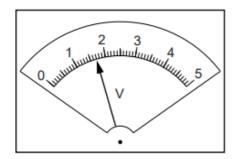


Fig. 5.1

On Fig. 5.1, draw a voltmeter connected to measure the potential difference across lamp L. [1]

(b) The switch is closed.

Fig. 5.2 shows the readings on the voltmeter and ammeter measuring the potential difference and the current for lamp ${\bf L}$.



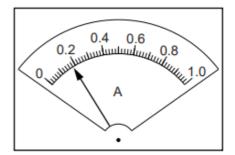


Fig. 5.2

Read, and record in Table 5.1, the potential difference V and the current I.

Table 5.1

| circuit | V/ | I/ | RI | appearance of lamp L |
|---------|------|------|----|-----------------------------|
| 1 | | | | bright |
| 2 | 0.91 | 0.12 | 5 | dim |

(c) The circuit is reconnected as shown in Fig. 5.3.

circuit 2

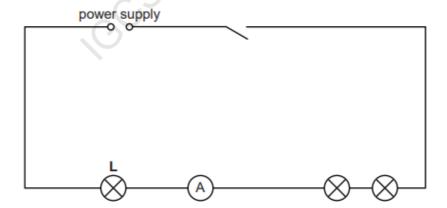


Fig. 5.3

The potential difference V and the current I for lamp L in this circuit are shown in the table.

- (i) Using the equation $R = \frac{V}{I}$, calculate and record in the table the resistance R of lamp Lwhen connected in each circuit.
- (ii) Complete the column headings in the table.

| | [4] |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------|
| (d) | A student suggests that, as the same lamp ${\bf L}$ is used throughout the experiment, its resistance in each circuit should be the same. |
| | State whether the findings agree with this idea. Justify your answer by reference to the results. |
| | statement |
| | |
| | justification |
| | |
| | |
| (e) | [1] Theory suggests that the resistance of a lamp increases when its temperature rises. |
| | Explain whether the observations in Table 5.1 support this. |
| | 20 |
| | |
| | [1] |
| (f) | It is possible to change the current in this type of experiment by using a variable resistor rather than rearranging the circuit. |
| | In the space below, draw a circuit with a power supply, a lamp, an ammeter and a variable resistor used for this purpose. |
| | |

[2]

[Total: 9]

19 The class is investigating the resistance of lamp filaments in series and parallel circuits.

Fig. 3.1 shows the first circuit used.

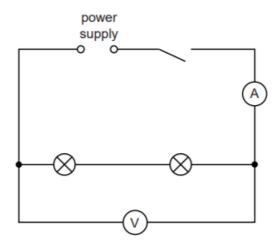


Fig. 3.1

(a) (i) Write down the readings shown on the meters in Figs. 3.2 and 3.3.

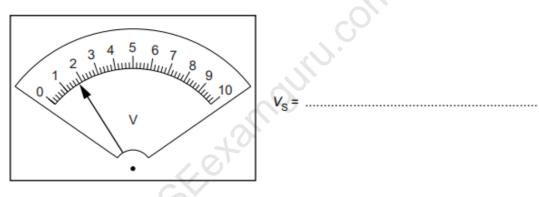


Fig. 3.2

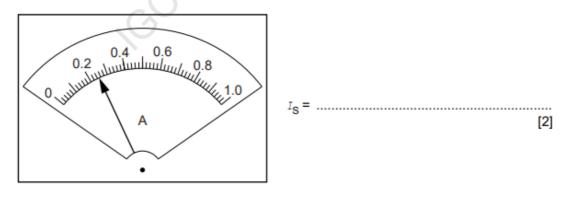


Fig. 3.3

(ii) Calculate the resistance R_S of the lamp filaments using the equation $R_S = \frac{V_S}{I_S}$.

- (b) The student rearranges the circuit so that
 - · the lamps are in parallel
 - · the ammeter will measure the total current in the circuit
 - · the voltmeter will measure the potential difference across the lamps.
 - (i) Draw a diagram of this circuit using standard circuit symbols.

[2]

(ii) The student measures the potential difference V_P across the lamps and the current I_P in the circuit.

Calculate the resistance R_p of the lamp filaments using the equation $R_p = \frac{V_p}{I_p}$.

R_p =

(iii) Calculate the ratio $\frac{R_{\rm S}}{R_{\rm p}}$.

$$\frac{R_{\rm S}}{R_{\rm p}}$$
 =[1]

(c) A student wishes to investigate whether the ratio $\frac{R_{\rm S}}{R_{\rm P}}$ for the two lamps is the same under all conditions.

(i) Suggest a variable that you could change in order to obtain further sets of readings.

(ii) Explain briefly how you would change this variable.

[Total: 8]

[2]

- 20 The class is investigating the resistance of lamps.
 - Fig. 3.1 shows the first circuit used.

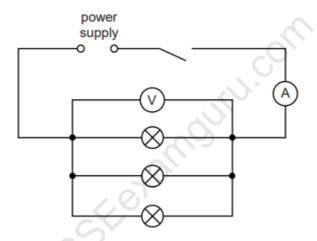
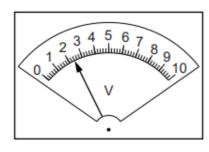


Fig. 3.1

(a) A student measures the potential difference V_P across the lamps and the current I_P in the circuit. The readings are shown in Figs. 3.2 and 3.3.



0.2 0.4 0.6 0.8 0.8 0.4 0.6 A

Fig. 3.2

Fig. 3.3

(i) Write down the readings shown on the meters.

V_p =

I_P =[2]

(ii) Calculate the resistance R_p of the lamp filaments using the equation $R_p = \frac{V_p}{I_p}$.

- (b) The student rearranges the circuit so that
 - · the lamps are in series
 - · the ammeter will measure the total current in the circuit
 - · the voltmeter will measure the potential difference across all three lamps.

In the space below, draw a diagram of this circuit using standard circuit symbols.

[2]

(c) The student measures the potential difference V_S across the lamps and the current I_S in the circuit in (b).

Calculate the resistance R_S of the lamp filaments using the equation $R_S = \frac{V_S}{I_S}$.

(d) (i) A student wishes to vary the current in the first circuit, shown in Fig. 3.1, using a variable resistor.

In the space below, draw the standard circuit symbol for a variable resistor.

[1]

(ii) On Fig. 3.1, label with X a suitable position in the first circuit for a variable resistor used to vary the current in all the lamps.[1]

[Total: 8]

21 Some students are determining the resistance per unit length of a wire.

They are using the circuit shown in Fig. 3.1.

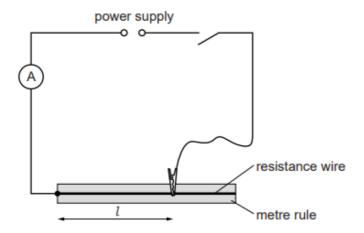


Fig. 3.1

The crocodile clip is connected to a length *l* of the wire and the current and potential difference are measured.

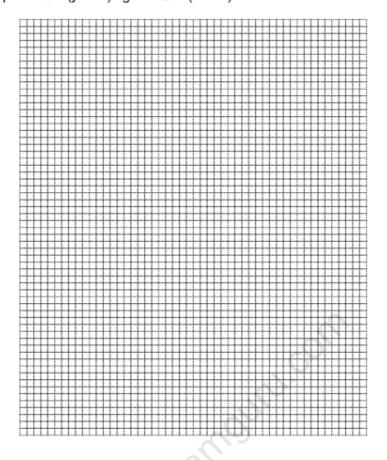
- (a) On Fig. 3.1, draw the symbol for a voltmeter correctly connected to measure the potential difference across the selected length *l* of the resistance wire. [1]
- (b) The potential difference V and current I for various lengths l of the wire are shown in Table 3.1.

Table 3.1

| <i>1</i> /m | V/V | I/A | R/Ω |
|-------------|------|------|-----|
| 0.900 | 2.98 | 0.42 | |
| 0.800 | 2.86 | 0.46 | |
| 0.700 | 2.89 | 0.53 | |
| 0.600 | 2.82 | 0.60 | |
| 0.500 | 2.83 | 0.72 | |

For each value of l, calculate and record in the table the resistance R of the wire, using the equation $R = \frac{V}{\tau}$. [1]

(c) Plot a graph of R/Ω (y-axis) against l/m (x-axis).



[4]

(d) (i) Determine the gradient G of the graph.

Show clearly on the graph how you obtained the necessary information.

| G= | | [1 |] | |
|----|--|----|---|--|
|----|--|----|---|--|

(ii) For this experiment and wire, the resistance per unit length *r* of the wire is numerically equal to *G*.

Give a value for r, to a suitable number of significant figures for this experiment. Include the unit.

$$r = \dots [2]$$

[Total: 9]

22 The class is determining the resistance of a resistor.

Fig. 2.1 shows the circuit.

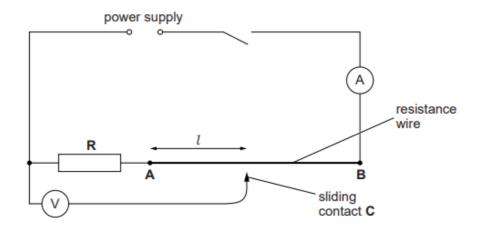


Fig. 2.1

- (a) A student places the sliding contact **C** at a distance *l* from end **A** of the resistance wire. She records the reading on the voltmeter.
 - (i) Read the meter shown in Fig. 2.2. Record, in Table 2.1, this value of V for length $l = 100 \, \text{cm}$.

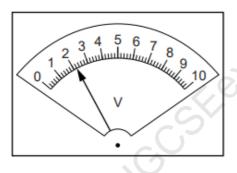


Fig. 2.2

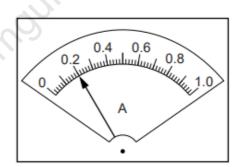


Fig. 2.3

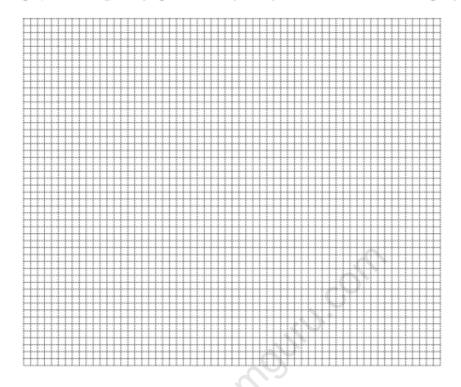
Table 2.1

| l/cm | V/V |
|-------|-----|
| 20.0 | 1.1 |
| 40.0 | 1.4 |
| 60.0 | 1.6 |
| 80.0 | 1.9 |
| 100.0 | |

[1]

| | | | | | | | | | | | _ |
|---|-----|------|-----|-------|-------|----|------|------|--------|------|------------|
| (| ii) | Read | the | meter | shown | in | Fig. | 2.3. | Record | this | current I. |

(b) Plot a graph of V/V (y-axis) against 1/cm (x-axis). Start both axes at the origin (0, 0).



[4]

(c) (i) Determine the value of the intercept Y on the y-axis.

(ii) Calculate the ratio $\frac{Y}{I}$. The value of I is your answer to part (a) (ii).

$$\frac{\mathsf{Y}}{I}$$
 =

(iii) $\frac{Y}{I}$ is numerically equal to the resistance R of the resistor R.

Write down a value for R to a suitable number of significant figures for this experiment. Include the unit.

[Total: 9]

23 The class is investigating the combined resistance of resistors in series and parallel arrangements.

The circuit is shown in Fig. 3.1.

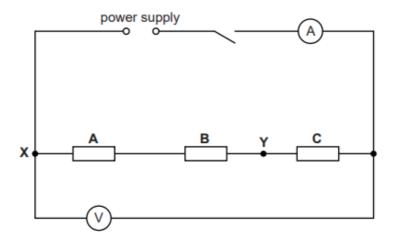


Fig. 3.1

(a) (i) Record the potential difference V_1 across the resistors and the current I_1 in the circuit, as shown in Figs. 3.2 and 3.3.

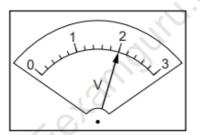


Fig. 3.2

V₁ =

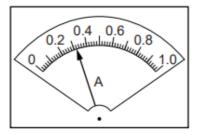
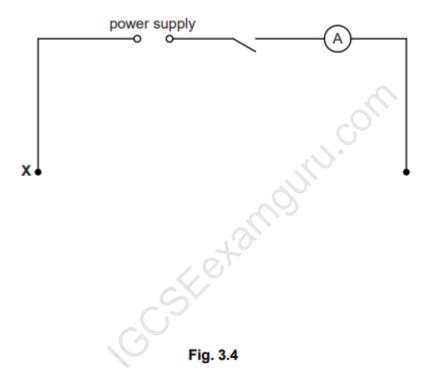


Fig. 3.3

I₁ =[2]

- (b) A student rearranges the circuit shown in Fig. 3.1. He follows these instructions:
 - Disconnect resistors A and B.
 - Connect together the resistors A and B in parallel.
 - Connect one side of this parallel combination to the resistor C at the point labelled Y in Fig. 3.1.
 - Connect the other side of the parallel combination to the point labelled X in Fig. 3.1.
 - Do not make any other changes to the circuit.

On Fig. 3.4, complete the diagram of this new circuit using standard circuit symbols.



[2]

| (c) | Using the new circuit, a student measures resistors and the current I_2 in the circuit. | the potential dif | ference V_2 across the thr | ee |
|-----|-------------------------------------------------------------------------------------------|---------------------------|------------------------------------------|---------|
| | | V ₂ = | 2.1V | |
| | | <i>I</i> ₂ = | 0.69 A | |
| | (i) Calculate the combined resistance R_2 of | the resistors using | g the equation $R_2 = \frac{V_2}{I_2}$. | |
| | | | | |
| | | R ₂ = | | |
| | (ii) Calculate the ratio $\frac{R_1}{R_2}$. | | | |
| | | | | |
| | | $\frac{R_1}{R_2} = \dots$ | | [2] |
| (d) | R_1 should equal 2 × R_2 when all three resistors | s are identical. | | |
| | State whether the results indicate that the reference to the results. | | | |
| | statement | | | |
| | justification | | | |
| | | | | |
| | | | | 2] |
| | | | [Total: | 9] |
| | | | | |
| | | | | |

24 The class is studying the resistance of identical wires connected in parallel.

The circuit is set up as shown in Fig. 4.1, with a crocodile clip connected to the right-hand end of wire **A**.

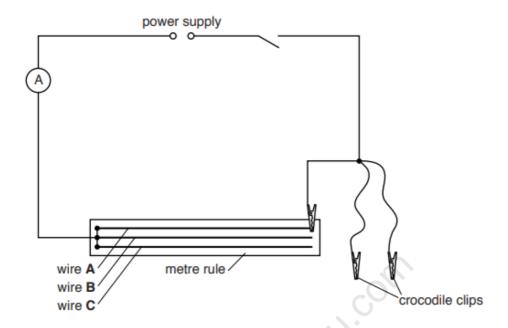
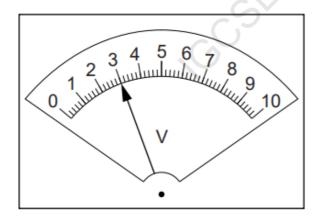


Fig. 4.1

- (a) On Fig. 4.1, use the appropriate symbol to show a voltmeter connected to measure the potential difference across wire **A**. [1]
- (b) In Table 4.1, write down the potential difference V and the current I for wire \mathbf{A} as shown in Figs. 4.2 and 4.3.



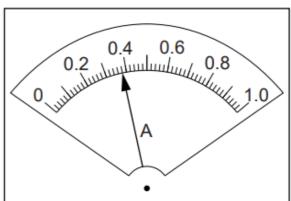


Fig. 4.2

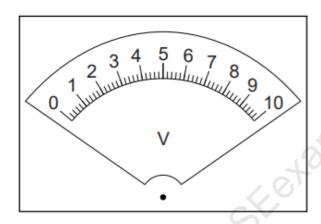
Table 4.1

| wire combination | V/V | I/A |
|---------------------------|-----|------|
| A only | | |
| A and B in parallel | 2.9 | 0.77 |
| A, B and C in parallel | 2.6 | 0.98 |

[1]

(c) The other crocodile clips are used, first to connect wires A and B in parallel, and then wires A, B and C in parallel. The readings for each circuit are shown in Table 4.1.

On Figs. 4.4 and 4.5, draw arrows to show the meter readings for the circuit in which wires A and B are connected in parallel.



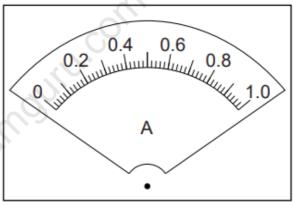


Fig. 4.4

Fig. 4.5

[1]

(d) Calculate, and record below, the resistance R of each wire combination, using the equation $R = \frac{V}{I}$.

resistance of wire **A** R₁ =

resistance of wires ${\bf A}$ and ${\bf B}$ in parallel R_2 =

resistance of wires **A**, **B** and **C** in parallel R_3 =

| (e) | (i) | A student suggests that when 2 identical wires are connected in parallel, their resistance should be equal to 1/2 of the resistance of a single wire. |
|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | State whether your findings agree with this suggestion. |
| | | Justify your answer by reference to your results, giving values to support your justification. |
| | | statement |
| | | |
| | | justification |
| | | [2] |
| | (ii) | Use your results to suggest the relationship that should exist between R_3 and R_1 . |
| | | |
| | | [1] |
| | | [Total: 9] |
| | | |
| | | |
| | | |
| | | [1] [Total: 9] |
| | | |
| | | |
| | | |
| | | |

Chapter 12: Electromagnetism

1 The IGCSE students are investigating the effect of an electromagnet.

Fig. 4.1 shows part of the equipment they are using.

The current I in the coil of the electromagnet is gradually increased and the reading m on the balance is recorded.

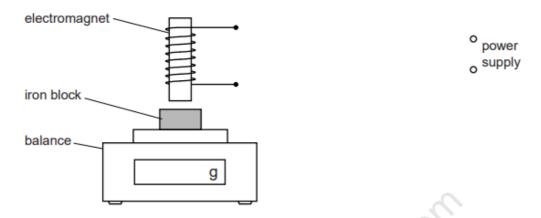


Fig. 4.1

(a) The students are using a variable resistor (rheostat) to change the current in the series circuit that is connected to the electromagnet.

On Fig. 4.1, use standard symbols to draw a circuit containing a variable resistor and an ammeter connected in a way that would be suitable for the experiment. [2]

(b) The readings are shown in Table 4.1.

Table 4.1

| I/A | m/g | M/g |
|------|-------|------|
| 0.00 | 61.37 | 0.00 |
| 1.00 | 57.25 | 4.12 |
| 2.00 | 53.13 | |
| 3.00 | 49.01 | |

(i) At each current, a value M is calculated.

 $M = m_0 - m$, where $m_0 = 61.37$ g, the balance reading when I = 0.00 A.

Complete the table by calculating and recording M for currents of 2.00 A and 3.00 A. [1]

| (ii) | State whether the results suggest that <i>M</i> is proportional to <i>I</i> . |
|------|-------------------------------------------------------------------------------|
| | Justify your statement with reference to the results. |
| | statement |
| | |
| | justification |
| | |
| | [2] |
| | [2] |
| | [Total: 5] |

CCSF.examourus.com