Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Current, voltage and resistance

Time allowed: 1 hour 30 minutes

Subject code **0625**

Physics

Questions from Paper 3, Paper 4 and Paper 6

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 81

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 81 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 This question is about electric circuits.

(a) (i) State the name of the instrument used to measure potential difference (p.d.) in an electric circuit.

..... [1]

(ii) State the unit for the electromotive force (e.m.f.) of a battery.

..... [1]

(b) (i) A student connects a circuit to determine the resistance of a wire. The current in the wire is 0.20 A when the potential difference across the wire is 6.4 V.

Calculate the resistance of the wire.

resistance = ... Ω [3]

(ii) The student has some wires of the same material as those in **(b)(i)** but of various lengths and thicknesses. He wants a wire with higher resistance than the wire in **(b)(i)**.

State **two** ways of identifying a wire with a higher resistance by comparing its length and thickness with the wire in **(b)(i)**.

1 .....

2 .....
[2]

[Total: 7]

Resistance Click for more variations

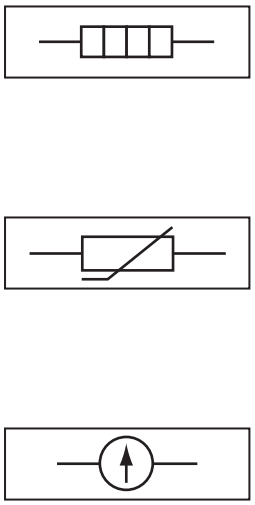
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1(a)(i)	voltmeter	**B1**
1(a)(ii)	volts	**B1**
1(b)(i)	(*R*=) $V \div I$ or $V = I \times R$ or in any form	**C1**
	6.4 ÷ 0.2	**C1**
	32 (Ω)	**A1**
1(b)(ii)	increase the length (of the wire using the same thickness)	**B1**
	smaller diameter (of wire using the same length)	**B1**

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2 **(a)** Fig. 10.1 shows the circuit symbols for three electrical components.

Draw a line from each circuit symbol to the correct electrical component.



fuse

heater

variable resistor

galvanometer

thermistor

Fig. 10.1

[3]

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(b) Fig. 10.2 shows a circuit consisting of a battery, a fixed resistor and an ammeter.

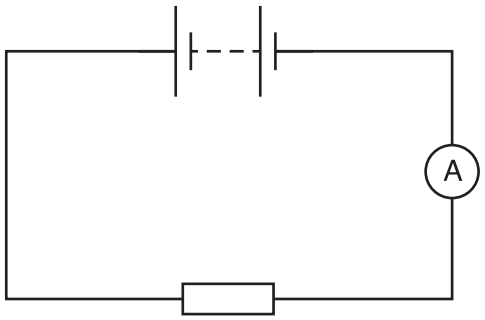


Fig. 10.2

(i) A voltmeter is connected in the circuit to measure the potential difference (p.d.) across the fixed resistor.

By drawing on Fig. 10.2, show how the voltmeter is connected. Use the correct circuit symbol for the voltmeter. [2]

(ii) The potential difference (p.d.) across the fixed resistor is 11.5 V. The reading on the ammeter is 0.25 A.

Calculate the resistance of the fixed resistor.

Include the unit in your answer.

resistance = ... unit ..... [4]

[Total: 9]

Resistance Click for more variations

Reduced to 78% to fit the page (wider than A4).

2(a)	top to heater	**B1**
	middle to thermistor	**B1**
	bottom to galvanometer	**B1**
2(b)(i)	voltmeter symbol	**B1**
	in parallel with resistor / supply	**B1**

2(b)(ii)	V = I × R in any form	**C1**
	11.5 ÷ 0.25	**C1**
	46	**A1**
	ohms / Ω	**B1**

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3 A student investigates how the resistance of a thermistor changes with temperature.
Fig. 9.1 shows part of the circuit the student uses.

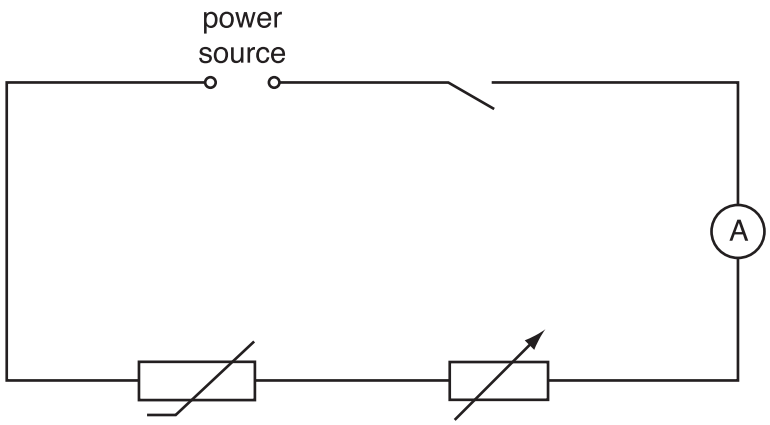


Fig. 9.1

(a) (i) On Fig. 9.1, label the thermistor. [1]

(ii) The student measures the potential difference (p.d.) across the thermistor.
On Fig. 9.1, draw a voltmeter symbol, correctly connected, to measure this potential difference. [2]

(b) The student varies the temperature of the thermistor and measures the current in it.
Some of the results are shown in the table.

temperature of thermistor / °C	20	40	60	80
current in thermistor / A	0.005	0.010	0.040	

(i) The potential difference across the thermistor is 6.0 V.

Calculate the resistance of the thermistor when its temperature is 40 °C.

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resistance = ... Ω [3]

(ii) Describe and explain what happens to the current in the thermistor as the temperature of the thermistor rises.

.....

.....

..... [2]

(iii) Suggest a value for the current in the thermistor at 80 °C.

.....A [1]

(c) At a different temperature, the resistance of the thermistor is 300 Ω and the resistance of the variable resistor is 400 Ω.

Calculate the value of their combined resistance.

combined resistance = ... Ω [1]

[Total: 10]

Resistance Click for more variations

Reduced to 75% to fit the page (wider than A4).

3(a)(i)	Thermistor correctly identified	**B1**
3(a)(ii)	correct symbol for voltmeter	**B1**
	Voltmeter in parallel with thermistor	**B1**
3(b)(i)	V= IR	**C1**
	(R) = 6.0 ÷ 0.010	**C1**
	600 (ohms or Ω)	**A1**
3(b)(ii)	Resistance is decreasing	**B1**
	So current will increase	**B1**
3(b)(iii)	Current greater than 0.04 (A)	**B1**
3(c)	700 (ohms or Ω)	**B1**

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4 An electric heater is connected to a 230 V mains supply. The heater circuit includes two resistors R_1 and R_2, and two switches S_1 and S_2. Fig. 8.1 is the circuit diagram.

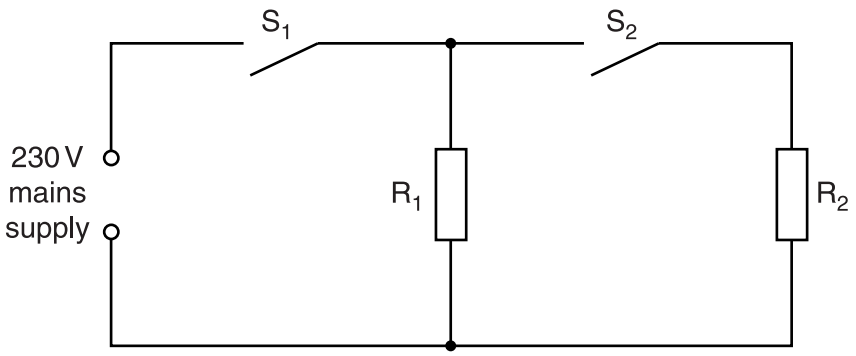


Fig. 8.1

The resistance of R_1 is 46 Ω and the resistance of R_2 is also 46 Ω.

Switch S_1 is closed and switch S_2 remains open.

(a) Calculate

(i) the current from the mains supply,

current = ... [2]

(ii) the power dissipated in the heater.

power = ... [2]

(b) Switch S_2 is now closed.

State the current in R_2.

current = ... [1]

[Total: 5]

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Resistance Click for more variations

4 **(a)** **(i)** (I =) V/R **or** 230/46 C1
5.0 A *Unit penalty applies A1

(ii) (P =) IV **or** V^2/R **or** I^2R **or** 230 × 5 **or** $230^2/46$ **or** $5^2 \times 46$
ecf from **8(a)(i)** C1
1100/1150/1200 W *Unit penalty applies ecf from **8(a)(i)** A1

(b) same as **8(a)(i)** (**c.a.o.**) *Unit penalty applies B1 **[5]**

*Apply unit penalty once only

5 A charger for a cellphone (mobile phone) is marked:

input: a.c. 240 V, 50 Hz, 80 mA.
output: d.c. 5.3 V, 500 mA.

(a) State

(i) the component in the charger that converts a.c. to d.c.,

.....

(ii) the quantity that has the value 50 Hz.

.....
[2]

(b) Calculate

(i) the output power of the charger,

output power = ...[2]

(ii) the energy transferred in the output circuit when the cellphone is charged for 1.5 hours.

energy = ...[2]

(c) In the following list, underline the quantity that is stored in the battery of the cellphone.

voltage current power energy [1]

[Total: 7]

Electrical energy and power Click for more variations

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5 **(a)** **(i)** rectifier / diode B1

(ii) frequency (of A.C. supply) B1

(b) **(i)** (P =) IV **OR** 0.5×5.3 **OR** 500×5.3 C1
2.6 W **OR** 2600 mW A1

(ii) (E =) Pt **OR** IVt **OR** $2.65 \times 1.5 \times 3600$ **OR** $0.5 \times 5.3 \times 1.5 \times 3600$ C1
14000 J A1

(c) energy only underlined B1

[Total: 7]

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6 **(a)** Define *electromotive force* (*e.m.f.*).

.....

.....

..... [2]

(b) Fig. 7.1 shows a circuit.

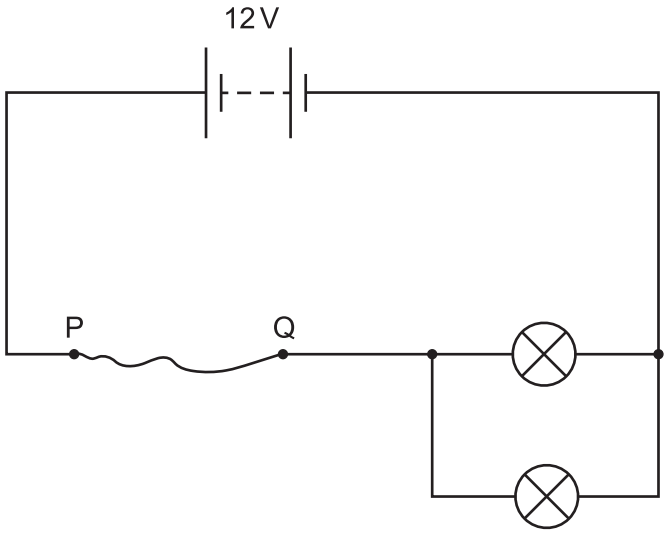


Fig. 7.1

The two lamps shown are identical. Each lamp has a potential difference (p.d.) of 3.0 V across it and a current of 2.0 A in it. PQ is a length of uniform metal wire. The resistance of PQ is *R*.

(i) Calculate the value of *R*.

R = ... [3]

(ii) Another piece of wire is made of the same metal as PQ. The length of the new piece of wire is twice the length of PQ. The diameter of the new piece of wire is twice the diameter of PQ.

Calculate the resistance of the new piece of wire.

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resistance = ... [3]

[Total: 8]

Resistance Click for more variations

6(a)	energy supplied	**M1**
	to drive a unit charge / 1 C round a complete circuit	**A1**
6(b)(i)	(R =) 2.3 Ω OR 2.2 Ω	**A3**
	$R = V/I$ in any form	**C1**
	current in R = 4 (A) OR p.d. across R = 9 (V)	**C1**
6(b)(ii)	1.1 Ω	**A3**
	resistance proportional to length (so twice length twice resistance)	**C1**
	resistance inversely proportional to area (so twice diameter decreases resistance by factor of 4)	**C1**

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7 An electric heater uses a resistance wire of resistance 26 Ω. The power dissipated in the resistance wire is 2500 W.

(a) Calculate the current in the resistance wire.

current = ... [3]

(b) The resistance wire of the heater has a length of 1.2 m and a cross-sectional area of $7.9 \times 10^{-7}\,m^2$.

A new heater is designed using wire of the same material with length 1.8 m and cross-sectional area $5.8 \times 10^{-7}\,m^2$.

Calculate the resistance of this wire.

resistance = ... [3]

(c) The 2500 W heater is used in a country where electricity costs 0.30 dollars per kilowatt-hour.

Calculate the cost of using the heater continuously for two days.

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cost = ... dollars [2]

[Total: 8]

Electrical energy and power Click for more variations

7(a)	(I =) 9.8 A	**A3**
	$P = I^2R$ **OR** $I^2 = \frac{P}{R}$ **OR** $I^2 = \frac{2500}{26}$	**C1**
	I^2 = 2500 / 26 **OR** (I =) $\sqrt{(P / R)}$ **OR** $\sqrt{\frac{2500}{26}}$	**C1**
7(b)	(R =) 53 Ω	**A3**
	$R \propto l$ **OR** 1.8 / 1.2 **OR** 1.5 seen as multiplier	**C1**
	R ∝ 1 / A **OR** 7.9 ($\times 10^{-7}$) / 5.8 ($\times 10^{-7}$) **OR** 1.36(2) seen as multiplier	**C1**
7(c)	(cost =) $36	**A2**
	$E = Pt$ **AND** (cost =) $E \times 0.3(0)$ **OR** (cost =) $25 \times 10^N \times 2 \times 24 \times 0.3(0)$ **OR** 3.6×10^N dollars	**C1**

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8 A cylinder is made of modelling clay. The modelling clay is an electrical conductor.

Fig. 8.1 shows the cylinder.

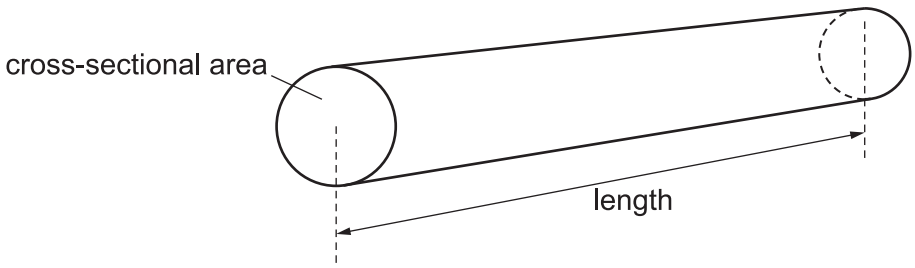


Fig. 8.1

The cylinder is connected into a circuit.

Fig. 8.2 shows that the circuit also includes a battery of electromotive force (e.m.f.) 9.0 V and a resistor P.

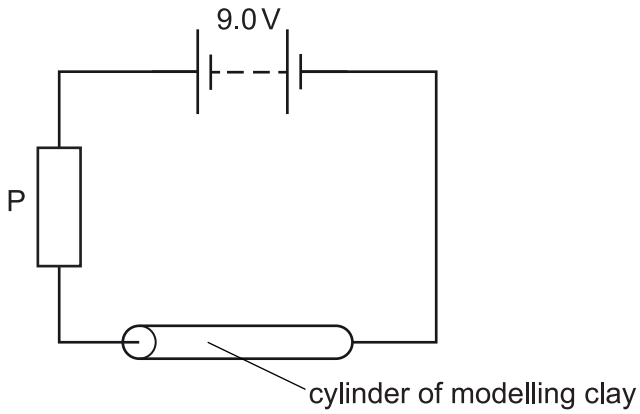


Fig. 8.2

The resistance of P is 4.0 Ω. The current in P is 1.5 A.

(a) Calculate:

(i) the magnitude *X* of the charge that flows through P in 600 s

X = ... [2]

(ii) the resistance of the cylinder of modelling clay.

resistance = ... [3]

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(b) The cylinder is removed from the circuit and replaced with a new cylinder made of the same modelling clay.

The new cylinder is twice the length and has half the cross-sectional area of the first cylinder.

Calculate the time that it now takes for a charge of magnitude X to flow through resistor P.

time = ... [4]

[Total: 9]

Resistance Click for more variations

Reduced to 78% to fit the page (wider than A4).

8(a)(i)	900 C	**A2**
	$I = Q / t$ **OR** ($Q =$) It **OR** 1.5×600	C1
8(a)(ii)	2.0 Ω	**A3**
	$R = V / I$ **OR** ($R_{tot} =$) V / I **OR** 9.(0) / 1.5 **or** 6.(0)	C1
	($R_{cyl} =$) total resistance – P **OR** ($R_{cyl} =$) 6.0 – 4.0	C1
8(b)	1200 s	**A4**
	R is directly proportional to l **OR** (new cylinder) twice as long means twice R	C1
	R is inversely proportional to A **OR** (new cylinder) half cross-sectional area means twice R	C1
	(resistance of cylinder =) 4 × **(a)(ii)** (Ω)	C1

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9 A student investigates the resistance of a wire.

Plan an experiment which enables him to investigate how the length of a wire affects the resistance of the wire.

Resistance R is calculated from the equation: $R = \frac{V}{I}$

where V is the potential difference (p.d.) across the wire and I is the current in the wire.

The apparatus available includes:

- a selection of wires
- a variable power supply
- an ammeter
- a voltmeter.

In your plan:

- list any additional apparatus needed
- complete Fig. 4.1 to show a voltmeter connected to measure the potential difference across the wire
- explain briefly how to do the experiment, including the measurements to take so that the resistance can be determined
- state the key variables to keep constant
- draw a table, or tables, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

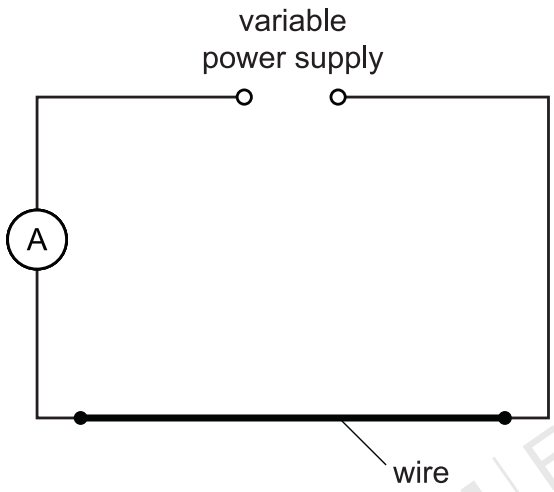


Fig. 4.1

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[7]

Planning an experiment Click for more variations

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9	**MP1**	**circuit diagram:** correct voltmeter circuit symbol shown in parallel with all or part of wire	**1**
	MP2	**apparatus:** metre ruler	**1**
	MP3	**method:** measure / record length; measure p.d. and current; specific reference to repeating with different length	**1**
	MP4	**key / control variable:** constant diameter / radius / gauge of wire material of wire / same wire / same type of wire	**1**
	MP5	**table:** columns, with units, for length, p.d., current, resistance	**1**
	MP6	**analysis:** compare readings in the table to see <u>if</u> change in length produces change in resistance plot resistance-length or length-resistance graph	**1**
	MP7	**additional point** (one from)**:** at least 5 sets of data taken; repeat for each length <u>and</u> take average; 2nd control variable: diameter / material / temperature of wire; use of protective resistor	**1**

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10 A student compares the resistances of two wires.

She uses the circuit, part of which is shown in Fig. 2.1.

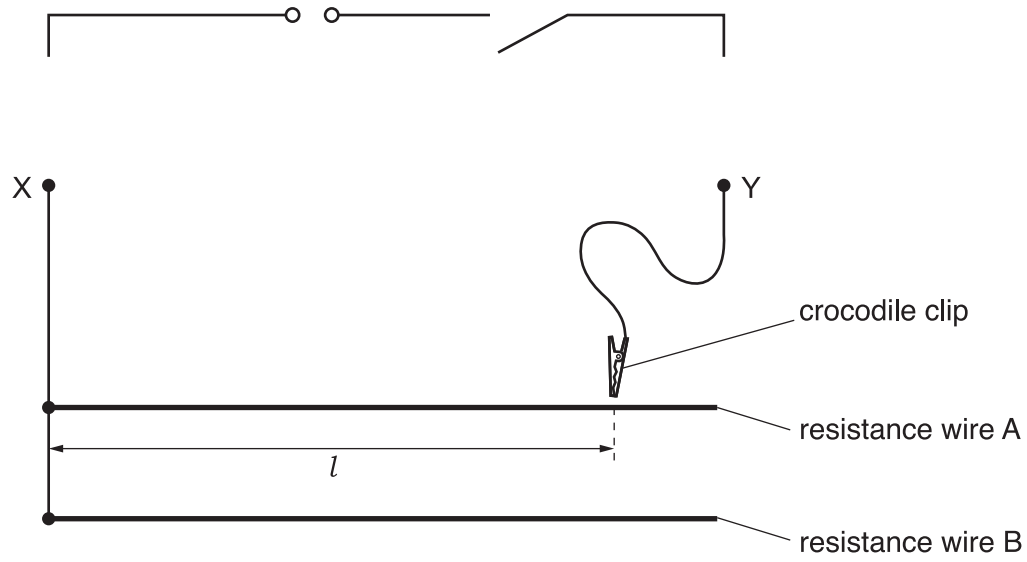


Fig. 2.1

(a) On Fig. 2.1, complete the circuit diagram to show a voltmeter connected to measure the potential difference (p.d.) across terminals X and Y, and an ammeter connected to measure the current in the circuit. [2]

(b) The student connects the crocodile clip to a length l = 90.0 cm of resistance wire A and measures the potential difference V and the current I for the length l of the wire.

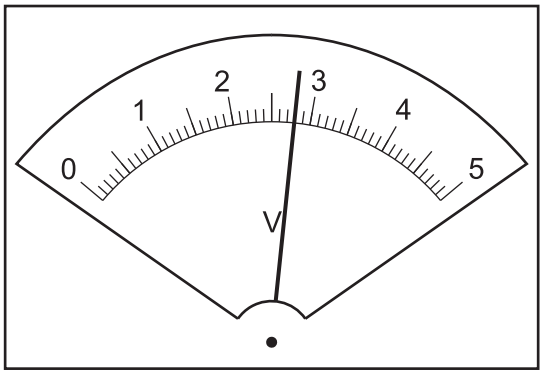


Fig. 2.2

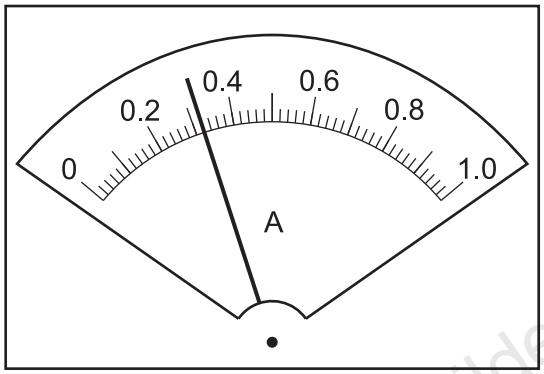


Fig. 2.3

(i) Read, and record in Table 2.1, the values of V and I shown on the meters in Fig. 2.2 and Fig. 2.3. [2]

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Table 2.1

wire	l / cm	V /	I /	R /
A	90.0			
B	90.0	2.6	0.45	
A	50.0	2.7	0.54	
B	50.0	2.3	0.72	

(ii) The student then connects the crocodile clip to lengths l = 90.0 cm of wire B, l = 50.0 cm of wire A and l = 50.0 cm of wire B.

Her readings are shown in Table 2.1.

Calculate, and record in Table 2.1, the resistance R of each length of wire A and wire B.

Use the values of V and I and the equation

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

[2]

(iii) Complete the headings in Table 2.1. [1]

(c) (i) Calculate a value P using your results from Table 2.1 and the equation

$$P = \frac{R \text{ for } 90.0 \text{ cm of wire A}}{R \text{ for } 90.0 \text{ cm of wire B}}.$$

P = ...

Calculate a value Q using your results from Table 2.1 and the equation

$$Q = \frac{R \text{ for } 50.0 \text{ cm of wire A}}{R \text{ for } 50.0 \text{ cm of wire B}}.$$

Q = ...

[1]

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(ii) A student suggests that the values of P and Q should be equal.

State whether your results support this suggestion. Justify your answer by reference to values from your results.

statement .....

justification .....

.....

.....

[2]

(d) Suggest **one** reason why students all doing this experiment carefully with the same apparatus may not obtain the same results.

.....

..... [1]

[Total: 11]

Resistance Click for more variations

Reduced to 78% to fit the page (wider than A4).

10(a)	ammeter in series connection or voltmeter in parallel connection	1
	second meter shown connected correctly and circuit complete	1
10(b)(i)	V = 2.8	1
	I = 0.32	1
10(b)(ii)	R = 8.75 / ecf, 5.78, 5.00, 3.19	1
	R consistent to 2 or 3 significant figures	1
10(b)(iii)	V, A, Ω all correct	1
10(c)(i)	P = 1.51 / ecf and Q = 1.57 / ecf	1
10(c)(ii)	statement matching results and values used	1
	justification matching statement e.g. within limits of experimental accuracy / owtte	1
10(d)	valid inherent source of inaccuracy e.g.: crocodile clip connection not even / difficult to connect at exactly the correct length / resistance wires not uniform	1

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