Resistance & Resistivity

Question paper 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Current of Electricity
Sub Topic	Resistance & Resistivity
Paper Type	Theory
Booklet	Question paper 1

Time Allowed: **82 minutes**

Score: **/68**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** On Fig. 5.1, sketch the temperature characteristic of a thermistor.

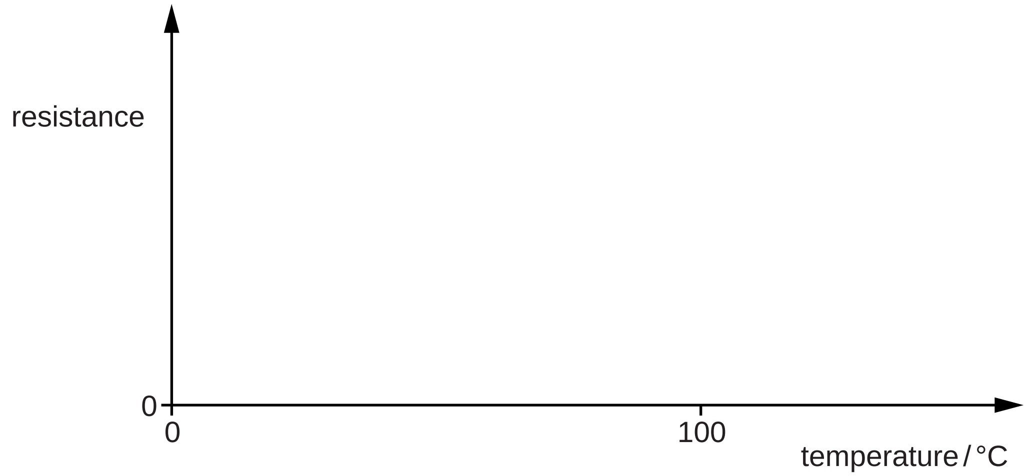


Fig. 5.1

[2]

(b) A potential divider circuit is shown in Fig. 5.2.

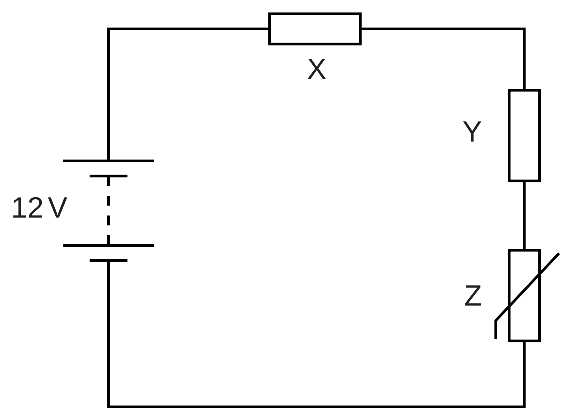


Fig. 5.2

The battery of electromotive force (e.m.f.) 12 V and negligible internal resistance is connected in series with resistors X and Y and thermistor Z. The resistance of Y is 15 kΩ and the resistance of Z at a particular temperature is 3.0 kΩ. The potential difference (p.d.) across Y is 8.0 V.

(i) Explain why the power transformed in the battery equals the total power transformed in X, Y and Z.

.... [1]

(ii) Calculate the current in the circuit.

current = ... A [2]

(iii) Calculate the resistance of X.

resistance = ... Ω [3]

(iv) The temperature of Z is increased.

State and explain the effect on the potential difference across Z.

....

....

....

.... [2]

2 A uniform resistance wire AB has length 50 cm and diameter 0.36 mm. The resistivity of the metal of the wire is $5.1 \times 10^{-7}\,\Omega\,m$.

(a) Show that the resistance of the wire AB is 2.5 Ω.

[2]

(b) The wire AB is connected in series with a power supply E and a resistor R as shown in Fig. 5.1.

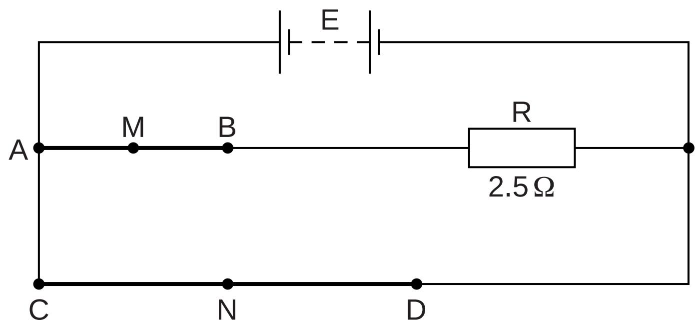


Fig. 5.1

The electromotive force (e.m.f.) of E is 6.0 V and its internal resistance is negligible. The resistance of R is 2.5 Ω. A second uniform wire CD is connected across the terminals of E. The wire CD has length 100 cm, diameter 0.18 mm and is made of the same metal as wire AB.

Calculate

(i) the current supplied by E,

current = ... A [4]

(ii) the power transformed in wire AB,

power = ... W [2]

(iii) the potential difference (p.d.) between the midpoint M of wire AB and the midpoint N of wire CD.

p.d. = ... V [2]

3 The resistance R of a uniform metal wire is measured for different lengths l of the wire. The variation with l of R is shown in Fig. 3.1.

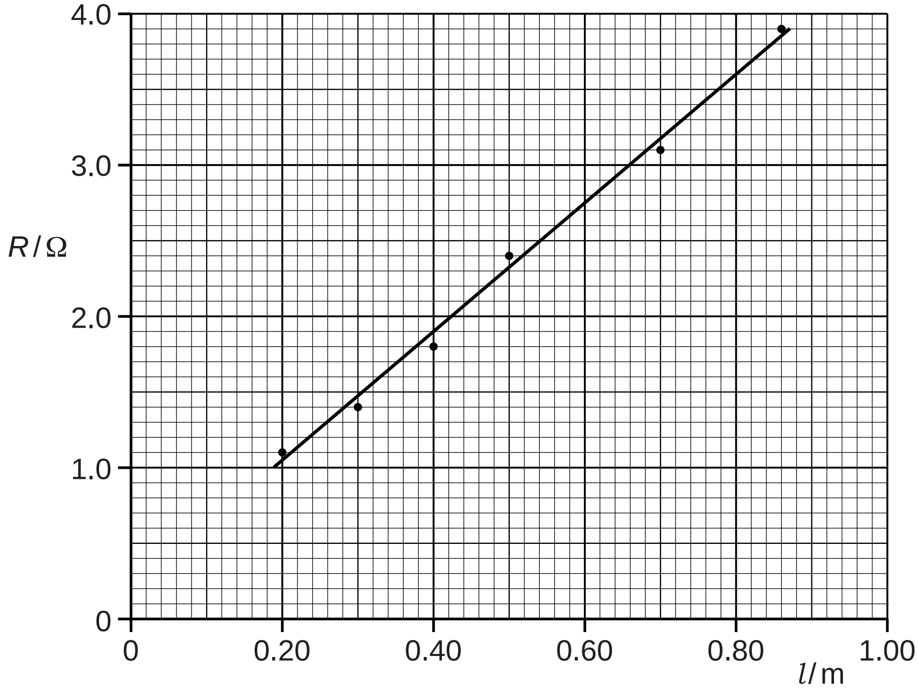


Fig. 3.1

(a) The points shown in Fig. 3.1 do not lie on the best-fit line. Suggest a reason for this.

....

.... [1]

(b) Determine the gradient of the line shown in Fig. 3.1.

gradient = ... [2]

(c) The cross-sectional area of the wire is 0.12 mm^2.

Use your answer in **(b)** to determine the resistivity of the metal of the wire.

resistivity = ... Ω m [3]

(d) The resistance *R* of different wires is measured. The wires are of the same metal and same length but have different cross-sectional areas *A*.

On Fig. 3.2, sketch a graph to show the variation with *A* of *R*.

Fig. 3.2

[2]

4 **(a)** A wire has length 100 cm and diameter 0.38 mm. The metal of the wire has resistivity $4.5 \times 10^{-7}\,\Omega\,m$.

Show that the resistance of the wire is 4.0 Ω.

[3]

(b) The ends B and D of the wire in **(a)** are connected to a cell X, as shown in Fig. 6.1.

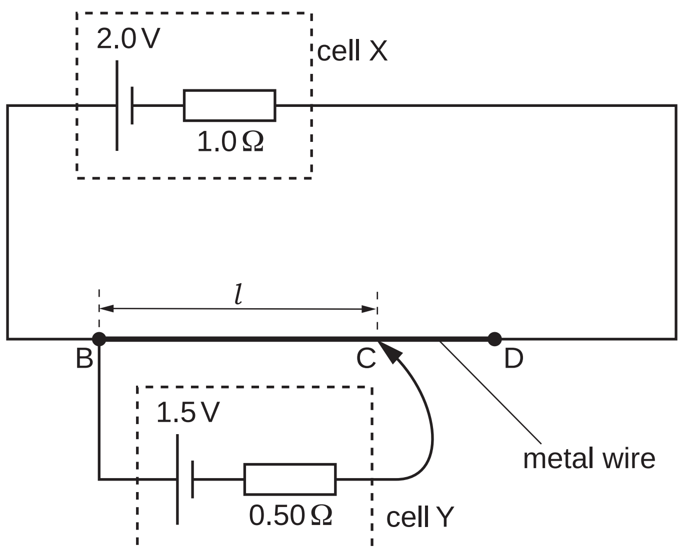


Fig. 6.1

The cell X has electromotive force (e.m.f.) 2.0 V and internal resistance 1.0 Ω.

A cell Y of e.m.f. 1.5 V and internal resistance 0.50 Ω is connected to the wire at points B and C, as shown in Fig. 6.1.

The point C is distance l from point B. The current in cell Y is zero.

Calculate

(i) the current in cell X,

current = ... A [2]

(ii) the potential difference (p.d.) across the wire BD,

p.d. = ... V [1]

(iii) the distance l.

l = ... cm [2]

(c) The connection at C is moved so that l is increased. Explain why the e.m.f. of cell Y is less than its terminal p.d.

....

....

....[2]

5 **(a)** Define the *ohm*.

.... [1]

(b) Determine the SI base units of **resistivity**.

base units of resistivity = ... [3]

(c) A cell of e.m.f. 2.0V and negligible internal resistance is connected to a variable resistor R and a metal wire, as shown in Fig. 5.1.

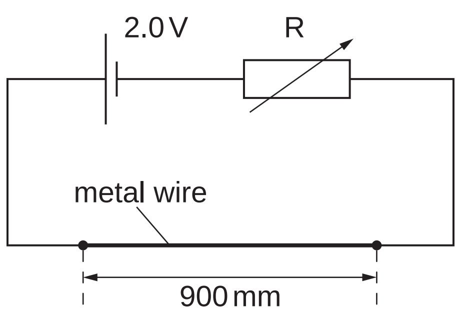


Fig. 5.1

The wire is 900mm long and has an area of cross-section of $1.3 \times 10^{-7}\,\text{m}^2$. The resistance of the wire is $3.4\,\Omega$.

(i) Calculate the resistivity of the metal wire.

resistivity = ... [2]

(ii) The resistance of R may be varied between 0 and 1500 Ω.
Calculate the maximum potential difference (p.d.) and minimum p.d. possible across the wire.

maximum p.d. = ... V

minimum p.d. = ...V
[2]

(iii) Calculate the power transformed in the wire when the potential difference across the wire is 2.0 V.

power = ... W [2]

(d) Resistance R in **(c)** is now replaced with a different variable resistor Q. State the power transformed in Q, for Q having

(i) zero resistance,

power = ... W [1]

(ii) infinite resistance.

power = ... W [1]

6 **(a)** **(i)** On Fig. 5.1, sketch the I – V characteristic for a filament lamp.

Fig. 5.1

[2]

(ii) Explain how the resistance of the lamp may be calculated for any voltage from its I – V characteristic.

....

.... [1]

(b) Two identical filament lamps are connected first in series, and then in parallel, to a 12V power supply that has negligible internal resistance. The circuits are shown in Fig. 5.2 and Fig. 5.3 respectively.

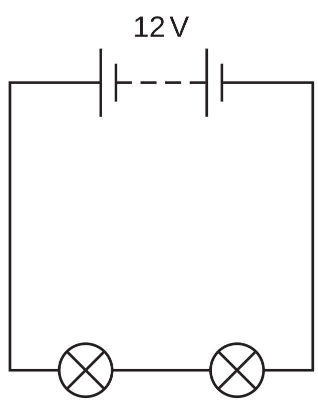


Fig. 5.2

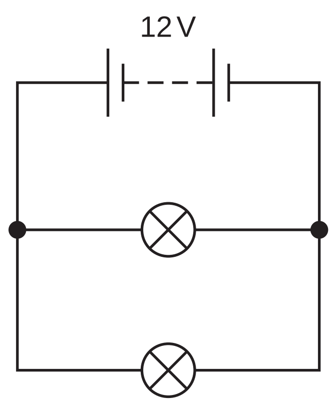


Fig. 5.3

(i) State and explain why the resistance of each lamp when they are connected in series is different from the resistance of each lamp when they are connected in parallel.

....

....

....

....

....[3]

(ii) Each lamp is marked with a rating '12 V, 50 W'. Calculate the total resistance of the circuit for the two lamps connected such that each lamp uses this power.

total resistance = ... Ω [3]

7 **(a)** A lamp is rated as 12V, 36W.

(i) Calculate the resistance of the lamp at its working temperature.

resistance = ... Ω [2]

(ii) On the axes of Fig. 6.1, sketch a graph to show the current-voltage (I–V) characteristic of the lamp. Mark an appropriate scale for current on the y-axis.

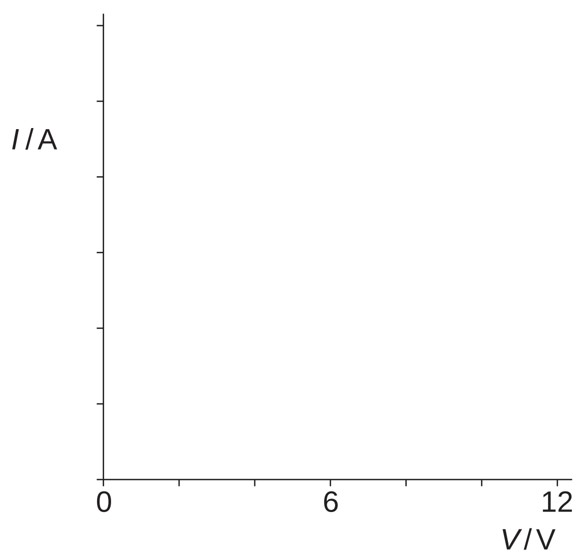


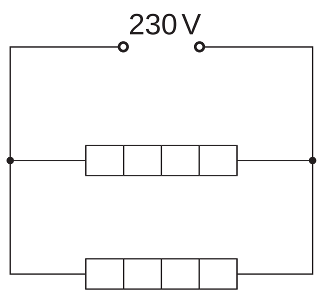
Fig. 6.1

[3]

(b) Some heaters are each labelled 230 V, 1.0 kW. The heaters have constant resistance.

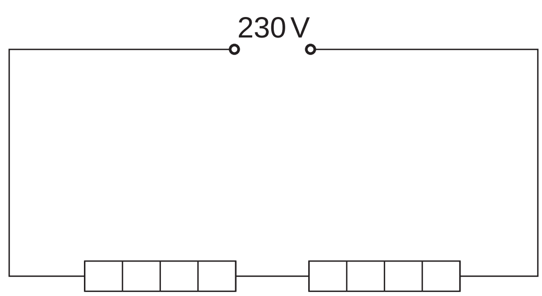
Determine the total power dissipation for the heaters connected as shown in each of the diagrams shown below.

(i)



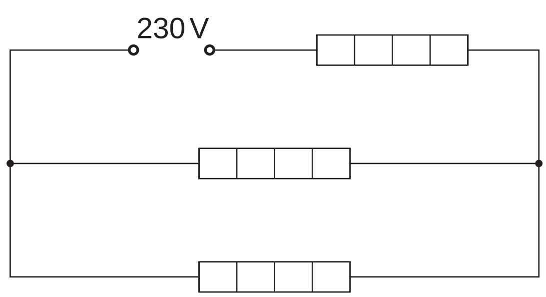
power = ... kW [1]

(ii)



power = ... kW [1]

(iii)



power = ... kW [2]