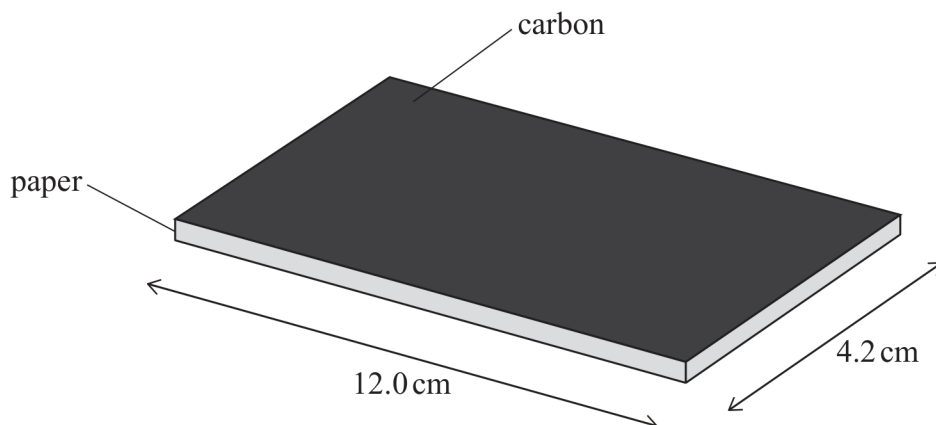13 'Resistivity paper' is paper covered with a thin layer of carbon.

The distance between the ends of a piece of resistivity paper is 12.0 cm. The resistivity paper is 4.2 cm wide as shown.

carbon

paper

12.0 cm
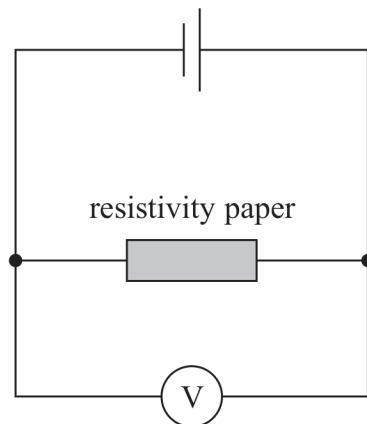
4.2 cm

The resistance between the ends of the resistivity paper is 8.8 Ω.

(a) Calculate the thickness of the layer of carbon.

resistivity of carbon = $3.7 \times 10^{-5}\,\Omega\,\text{m}$

(3)

....

....

....

....

....

Thickness of layer of carbon = ...

(b) A student connected the ends of the resistivity paper to a cell of e.m.f. 1.5 V and a voltmeter, as shown.

(i) The reading on the voltmeter was 1.4 V.

Calculate the internal resistance of the cell.

(3)

....

....

....

....

....

Internal resistance = ...

(ii) The connection to the right-hand terminal of the voltmeter was moved to a distance of 3.0 cm from the left-hand side of the resistivity paper.

Determine the reading on the voltmeter.

(1)

....

....

Reading on voltmeter = ...

(Total for Question 13 = 7 marks)