4 Fig. 4.1 shows the dimension of a resistive strip.

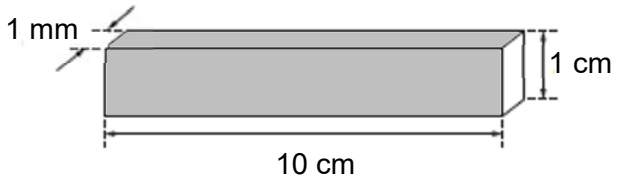

Fig. 4.1 (not to scale)

The body of the resistive strip is coated with insulating paint leaving the two ends as conducting faces.

The resistance R of a resistive strip of cross sectional area A and length L is given by

$$R = k A^p L^q$$

where k, p and q are constants.

Design an experiment to determine the values of p and q.

You are provided with a number of identical resistive strips.

You should draw a diagram to show the arrangement of your apparatus and you should pay particular attention to

(a) the equipment you would use

(b) the procedure to be followed

(c) the connections of the resistive strips

(d) the control of variables

(e) any precautions that should be taken to improve the accuracy and safety of the experiment.

Diagram

……

……

……

……

……

……

……

……

……

……

……

……[12]

[Total: 12]

Experiment (i) *R* vs *A*

Independent variable	Dependent variables	Control variables
What? *A*	*R*	*L*
How? Vernier caliper to measure thickness *t* and width *w* *A = tw* Vary by stacking up the resistive strips	Voltmeter and ammeter to measure *V* and *I* *R = V / I*	Keep the base of stack to one resistive strip

Experiment (ii) *R* vs *L*

Independent variable	Dependent variables	Control variables
What? ***L***	*R*	*A*
How? Metre rule Vary by connecting more resistive stips in series	Voltmeter and ammeter to measure *V* and *I* *R = V / I*	Keep to one single file

Diagram

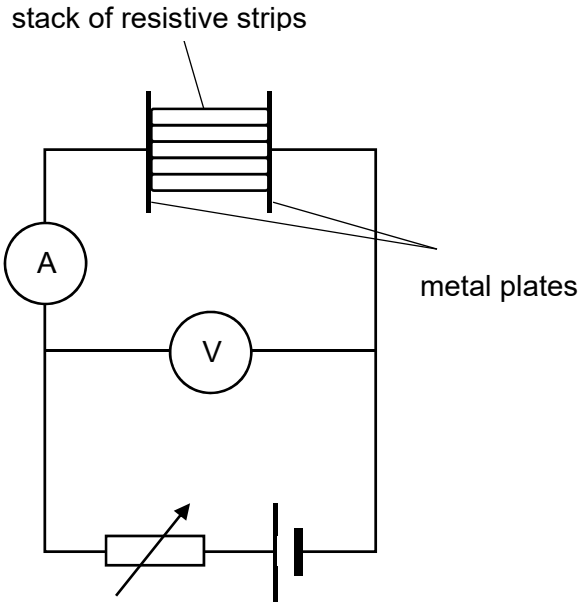

Diagram A

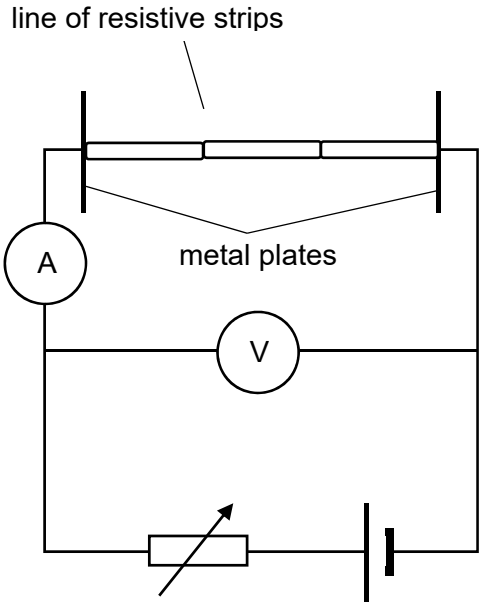

Diagram B

Procedure for Experiment (i) To investigate how *R* varies with *A*, keeping *L* constant

1. Measure and record the thickness *t* and width *w* of a stack of resistive strips with vernier calipers, and calculate the cross sectional area *A* where *A = tw.*
2. Set up the apparatus as shown in diagram A.
3. Close the switch.
4. Measure and record the potential difference V across the resistive strips using the voltmeter.
5. Measure and record the current I through the resistive strips using the ammeter.
6. Calculate and record *R*, where $R = V / I$.
7. Repeat the experiment using different number of resistive strips in the stack, to obtain 6 sets of readings of *R* and *A*.

Analysis for Experiment (i)
From $R = k A^p L^q$, $\lg R = p \lg A + \lg (k L^q)$
Plot a graph of lg *R* against lg *A*.
Calculate the gradient to find *p*.

Procedure for Experiment (ii) To investigate how *R* varies with current *L*, keeping *A* constant

1. Measure and record the length *L* of a number of resistive strips placed end to end with a meter rule.
2. Set up the apparatus as shown in diagram B.
3. Repeat the experiment as in experiment (i), varying *L* by using different number of resistive strips in series obtain 6 sets of readings of *R* and *L*.

Analysis for Experiment (ii)
From $R = k A^p L^q$, $\lg R = \lg (k A^p) + q \lg L$
Plot a graph of lg *R* against lg *L.*
Calculate the gradient to find *q*.

Control of Variables

Expt (i): Keep L constant by keeping the base of stack to one resistive strip.

Expt (ii): Keep A constant by keeping the line of resistive strip to single file.

Safety and Accuracy

1. Take preliminary readings to find suitable setting of rheostat and suitable value of L and A to obtain suitable range of reading for V and I.
2. Use two metal plates to sandwich the resistive strips where the area of each metal plate is greater than the cross section of the resistive strips.
3. Use adhesive tape to bind the resistive strips together to ensure good alignment.
4. Connect a rheostat in series with battery to limit the current in the circuit.