It is recommended that you spend about 60 minutes on this question.

In this experiment you will investigate how the resistance R of a pencil lead varies with the length l of the lead, and use your results to calculate a value for the resistivity of pencil lead.

(a) (i) At some convenient point during the experiment, measure the diameter of the pencil lead using a micrometer screw gauge. Your supervisor may tell you when to do this.

(ii) Determine a value for the cross-sectional area A of the pencil lead.

(b) (i) Construct the circuit shown in Fig. 2.1. Connections to the pencil lead may be made using crocodile clips. Care must be taken not to damage the surface of the pencil lead when using these clips.

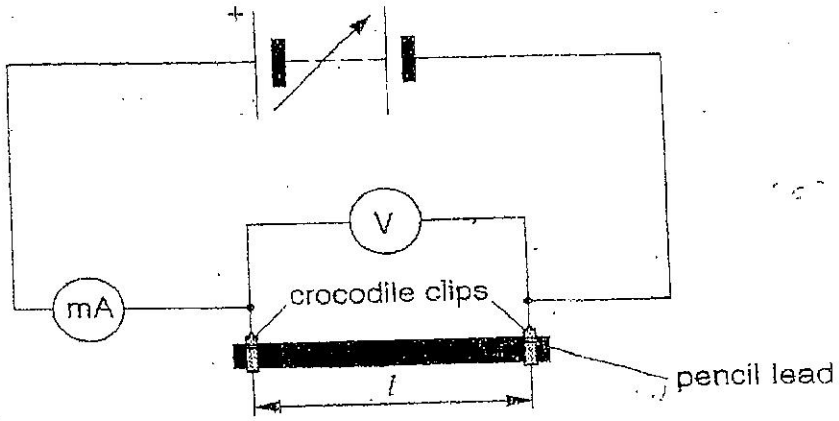

Fig. 2.1

(ii) Adjust the current in the circuit to a convenient value and record the current I, potential difference V and length l.

(iii) Change the value of l and repeat (ii) until you have six sets of values for I, V and l. Include in your table of results all the values of R, where $R = V/I$.

(iv) Justify the number of significant figures which you have given for R.

(c) The formula which relates R and l is

$$R = \frac{\rho l}{A} + R_o$$

where ρ is the resistivity of pencil lead and R_o is a constant.

(i) Plot a graph of R (y-axis) against l (x-axis) and draw the best straight line through th points.

(ii) Determine the gradient and the y-intercept of the graph.

(iii) Use your answers from (ii) and the value of A to determine values for ρ and R_o. Inclu appropriate units in each case.