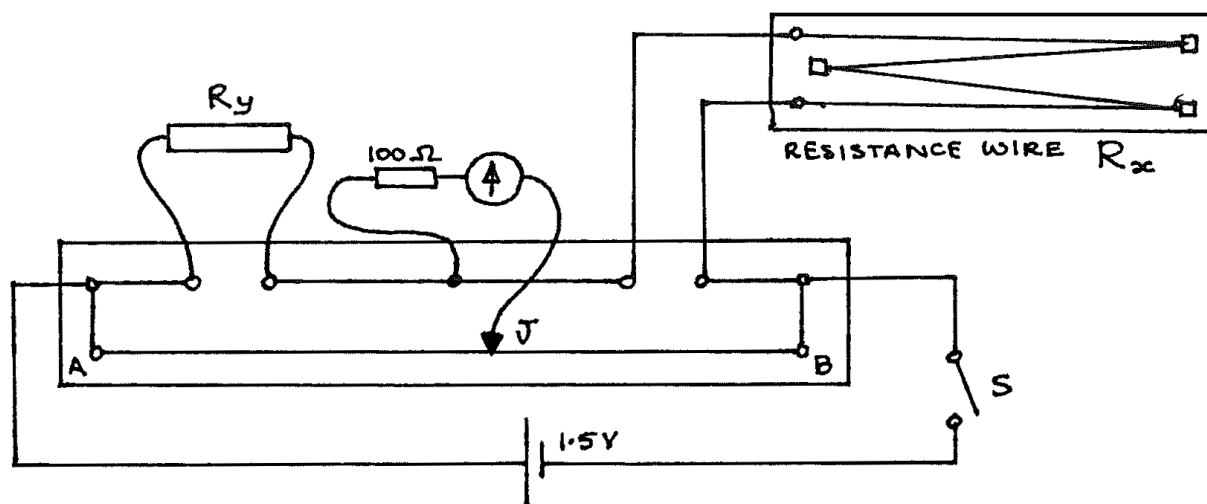


### F2-4: Determination of the Resistivity of the Material of a Wire

#### Apparatus

Metre bridge board; resistance wire board ( $R_x$  – may include wires of several materials); galvanometer with  $100\Omega$  protection resistor; resistor  $R_y$  of  $10\Omega$ ; 1.5V cell; switch; micrometer screw gauge; jockey (J); connecting leads (3 long, 5 short).



#### Procedure

1. Set up the apparatus as above.
2. Close S, and place J at the 50cm mark. Move J until the galvanometer reads zero. Record the length  $\overline{AJ}$ . Open S.
3. Measure the length of  $R_x$ . Very gently lift the wire  $R_x$  and measure its diameter in 5 different positions.
4. If there are wires of other materials, repeat procedure steps 2 and 3 for these

wires.

## Observations

**For each wire**

Wire description: \_\_\_\_\_

$\overline{AJ}$  = \_\_\_\_\_ cm;

$\overline{JB}$  = \_\_\_\_\_ cm;

$R_y$  = \_\_\_\_\_  $\Omega$ ;

Length  $L$  of wire R = \_\_\_\_\_ m

Diameter of wire R:

$d_1$  = \_\_\_\_\_ mm;

$d_2$  = \_\_\_\_\_ mm;

$d_3$  = \_\_\_\_\_ mm;

$d_4$  = \_\_\_\_\_ mm;

$d_5$  = \_\_\_\_\_ mm;

Average value of  $d$  = \_\_\_\_\_ mm.

## Theory

This circuit is a Wheatstone Bridge. Thus:  $\frac{\overline{AJ}}{\overline{JB}} = \frac{R_y}{R_x}$ , or:  $R_x = R_y \frac{\overline{AJ}}{\overline{JB}}$ .

Now  $\rho$  is the resistivity of the material of the wire, and  $\rho = \frac{RA}{L}$ . Where here  $R = R_x$ ,  $A$  = cross-sectional area of wire R, and  $L$  = length of  $R_x$ .

## Analysis

1. Use the theory to find  $\rho$  of the material of each type of wire tested.
2. Find a table that shows the resistivity of many types of wire and try to deduce the type of material of each wire. Calculate the % error in each of your results.
3. Choose a suitable material or materials, giving reasons, for the construction of the following:
  - a. a fixed resistor of  $10000\Omega$

- b. a variable resistor of  $5\Omega$
- c. a lamp filament
- d. a thermistor
- e. a junction diode
- f. a connecting wire
- g. a long-distance power cable in a National Grid
- h. a lightning conductor.

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