Ohms law and resistance

Aim

To determine the relationship between the length of eureka wire, and resistivity of the wire. Hypothesis: As the length of the wire increases, the resistance of the wire will increase. Background: Some materials have consistent resistance at the same temperature regardless of how much voltage is applied through them, these materials are known as ' Ohmic' resistors. This is because they are said to obey Ohm's law, which states that if a voltmetre is used to measure the voltage (V) of an unknown resistance (R), and an ammetre is used to measure the current (i) through the same unknown resistance, then ' R' would be given by $R = V/i$.

The eureka wire used in this experiment is an ohmic resistor, so theoretically it can be used to measure the relationship between its length and resistance without other variables affecting it.

Equipment

1. Metre length of eureka wire

2. Power supply unit

3. Voltmetre

4. Ammetre

5. Rheostat

6. Connecting wires

Procedure

1. Measure and cut 1 metre of wire

2. Set up the electrical circuit as in the diagram

3. Set the rheostat at its furthest point on one end.

4. Connect the wire into the circuit at 10cm length

5. Turn the power supply on, and record the voltage and amp readings. Turn the power supply off immediately after to prevent temperature build up in the circuit.

6. Repeat step 5 twice, adjusting the rheostat to the middle position, and then the other end position.

7. Repeat steps 3-6 increasing the length of the wire 10cm at a time, up to 1 metre total length

8. Divide the voltage by the amp readings to calculate the resistance

9. Plot the wire length against the resistance

Discussion

The results support the hypothesis, showing that as the length of the wire was increased, the resistance also increased. The voltage and current readings were taken over 3 trials at different settings on the rheostat. The plotted results do not all sit in a linear pattern as they should in theory, showing that the precision of the results is poor. For example, there is a comparatively large inconsistency which can be seen in the results at 80 and 90cm wire lengths, where the resistance remains the same at 2. ohms rather than increasing. Smaller deviations in the data can be seen at the 50, 60 and 70cm wire lengths, where the points are above and below the trendline. These inconsistencies suggest the presence of random errors, which may arise from poor resolution of the voltmetre and ammetre, and build-up of heat in the rheostat and the wire causing excess resistance. Accuracy of the

results may have been affected by systematic error, which may have been caused by incorrect calibration of the voltmetre and ammetre.

Inconsistencies in the eureka wire's structure such as curvature or bends in the wire may affect the actual length of the wire compared to the measured length, and inconsistencies in the compound makeup of the wire may have also affected the results, causing them to be all higher or lower than the true value. In the circuit setup, the ammetre is measuring current through both the wire and voltmetre. This could cause the measured current to be higher than the true value, and therefore the calculated resistance to be too low. To reduce the effect of random errors, digital multimetre's could be used to provide more accurate readings.

Allowing time for the rheostat and wire to cool down after each trial, or using new sections of wire stored at room temperature in each trial would minimise the effect of heat on the wire's resistance. To identify the presence of systematic error, the experiment should be repeated with a single multimetre rather than two separate volt and ammetres. The experiment should then be further repeated with new sections of wire to identify error caused by any inconsistencies in the wire.