DETERMINATION OF THE RESISTIVITY OF A METAL

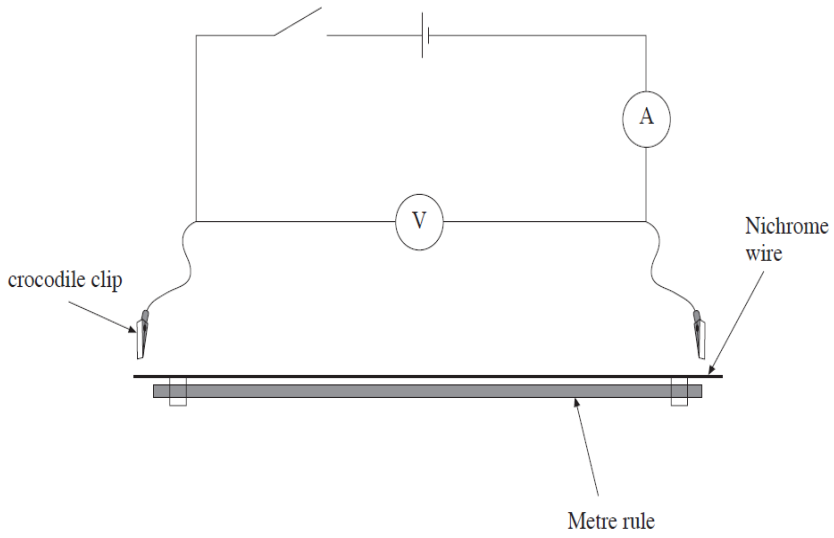
Specification reference: **AS Component** **2.2 – Resistance**

A level Component **2.2 – Resistance**

Theory:

Resistivity, ρ can be found using the equation $R = \rho\frac{l}{A}$ where l is the length of the wire, A the cross-sectional area and R the resistance. This can be compared with the equation for a straight-line $y = mx + c$. A graph plotted of R (y-axis) against l (x-axis) will be a straight line through the origin of gradient $\frac{\rho}{A}$. The cross sectional area can be found using $A=\pi r^2$ and the resistivity calculated by ρ = gradient $\times A$.

Apparatus:



7 × 4 mm leads
1 × ammeter
1 × voltmeter
1 × 1.5 V 'D' type battery
1 × metre rule
1 × 110 cm length of nichrome wire
1 × micrometer/vernier callipers (resolution ±0.01 mm)
1 × 30 cm ruler (resolution ±0.001 m)

Further guidance for technicians:

Wires of SWG 24 to 28 will give accurate results whilst still being robust enough that will not snap when adding or removing the crocodile clips. If nichrome is not available then constantan is a suitable alternative. The ammeter should have a resolution of ± 0.01 A and the voltmeter a resolution of ± 0.01 V

Experimental Method:

Leaving one crocodile clip fixed at one end of the wire, the other clip should be moved along at suitable intervals e.g. every 10 cm / 20 cm to cover the whole range of the wire. Readings on the voltmeter and ammeter should be noted for each length and the resistance determined using $R = \frac{V}{I}$. The diameter of the wire can be found using a micrometer or Vernier callipers and the cross-sectional area determined. Plot a graph of R (y-axis) against l (x-axis) and calculate the resistivity using: $\rho =$ gradient $\times A$.

Extension:

By comparing the resistivity value obtained to known constants it is possible to determine the type of metal making up different wires.

Practical Techniques:

- Use appropriate analogue apparatus to record a range of measurements (to include length/distance, temperature, pressure, force, angles, volume) and to interpolate between scale markings.
- Use appropriate digital instruments, including electrical multimeters, to obtain a range of measurements (to include time, current, voltage, resistance, mass).
- Use calipers and micrometers for small distances, using digital or vernier scales.
- Correctly construct circuits from circuit diagrams using D.C. power supplies, cells, and a range of circuit components, including those where polarity is important.
- Use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data.

Relevant previous practical past papers:

- PH3 2009 Task A3
- PH3 2014 Task B4