**Investigation to Determine the Resistivity of a Metal**

Introduction

This experiment should be attempted after candidates have studied basic circuits, resistance, resistivity, measurement of p.d. and current in series and parallel circuits. Learners also need to be able to set up a d.c.circuit, make measurements of p.d. and current.

**Aims and skills covered**

* To determine the resistivity of a metal
* Use of calipers and micrometers for small distances using digital and Vernier scales
* Use of appropriate digital instruments to measure current and voltage
* Correctly constructing circuits from circuit diagrams

Links to Specification

**Physics A**

* 4.2.3(a)(b)(c) Ohm’s Law and I-V characteristics
* 4.2.4(a) Resistivity and the equation R *=  L* / A

**Physics B**

* 3.1.2b(i)(ii) Make appropriate use of terms including resistivity
* 3.1.2c(iii) Make calculations and estimates involving R *= L* / A
* 3.1.2d(ii) Experiment to determine the resistivity of a metal

Practical Skills

* 1.2.1(b) safely and correctly use a range of practical equipment
* 1.2.1(c) follow written instructions
* 1.2.1(d) make and record measurements
* 1.2.1(e) keep appropriate records of experimental activities
* 1.2.1(f) present information and data in a scientific way
* 1.2.1(h) use research skills
* 1.2.1(i) cite sources
* 1.2.1(j) use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification
* 1.2.2(b) use appropriate digital instruments, including electrical multimeters
* 1.2.2(e) use micrometer for measuring small distances
* 1.2.2(f) correctly construct circuits using DC power supplies and a range of circuit components

**CPAC**

* (1) Follows written procedures
* (3) Safely uses a range of practical equipment and materials
* (4) Makes and records observations
* (5) Researches, references and reports

Mathematical skills

* M0.1 Recognise and make use of appropriate units in calculations
* M0.2 Recognise and use expressions in standard form
* M0.3 Calculate percentage uncertainties
* M1.1 Use an appropriate number of significant figures
* M1.2 Find arithmetic means
* M1.5 Identify and combine uncertainties
* M2.2 Change the subject of an equation
* M2.3 Substitute numerical values into algebraic equations using appropriate units
* M3.1 Translate information between graphical, numerical and algebraic forms
* M3.2 Plot two variables from experimental data
* M3.4 Determine the slope of a linear graph

Equipment (per group)

Teachers will need to ensure learners are familiar with the apparatus below in order to demonstrate these Practical Skills.

* 1 m swg 28 constantan wire
* micrometer or Vernier caliper
* switch
* 2crocodile clips
* 7 connecting leads
* 1 d.c.power supply capped at 6 V max. or battery pack ( four 1.5 V cells)
* rheostat ( not necessary if using variable power supply)
* voltmeter
* ammeter

**Health & Safety**

The power supplies should be capped at about 6 V d.c.

Learners are asked to assess risk and propose a procedure to minimise risk. This should be checked before commencing taking measurements.

1. Strategy to minimise “on-time” when wire heats
2. Use heatproof mat and/or have wire on ruler to avoid damage to furniture
3. Be aware of heating and avoid touching hot wire or crocodile clips

Before carrying out any experiment or demonstration based on this guidance, it is the responsibility of teachers to ensure that they have undertaken a risk assessment in accordance with their employer’s requirements, making use of up-to-date information and taking account of their own particular circumstances. Any local rules or restrictions issued by the employer must always be followed.

**Notes**

* These practical activities are not controlled assessments, should not be carried out in exam conditions and can be adapted by the centre. Students can collaborate during the activities which should take place as part of the normal teaching sequence. They are intended to be formative with students acquiring and practising skills throughout the course.
* To achieve a pass in the Practical Endorsement each student is required to demonstrate competence in all the skills, apparatus and techniques listed in section 1.2 of the specification and assessed against the Ofqual Common Practical Assessment Criteria (CPAC) at the end of the course.
* The skills, apparatus and techniques can be demonstrated during any practical work undertaken during the A Level course whether an OCR practical activity or not.
* The power supplies, and any associated potential divider circuits, should allow a variable adjustment in the range 0 V to about 6 V d.c.
* Constantan wire SWG28 has a resistance of about 4.4 Ω/m, however, any suitable wire that gives a measurable variation in p.d. with change in length may be used.
* Learners are expected to take a number of readings for diameter, both along the length of the wire and perpendicular to each other to account for possible variations along the length and for it not being circular.
* The student sheet intentionally does not specify axes for plotting *V* against *L* allowing teaching of *V* on the y-axis and *L* on the x-axis.

**Recording**

* Learners should not need to re-draft their work but rather keep all their notes as a continuing record of Practical Activity.
* As evidence for the Practical Endorsement learners should have evidence of the data collected from their individual readings in a clear and logical format.

In addition, to support the assessment of practical work in the written examinations:

* Learners should have plotted an appropriate graph
* Learners should have used the gradient of the graph to calculate a value for resistivity
* Learners should have researched an accepted value for comparison and referenced the source
* Learners could comment on uncertainty and accuracy.