**Investigating Electrical Characteristics**

**Introduction**

This investigation is intended to meet the requirement that students should be capable of determining the current-voltage characteristic of an electrical component.

This is a typical approach, but should be adapted to fit the equipment within the school.

The task may be used to introduce ohmic and non-ohmic devices or to consolidate teaching on these.

**Aims and skills covered**

* To construct a circuit from a diagram
* To plot a current-voltage characteristic

**Links to Specifications**

**Physics A**

* 4.2.1(a)(b) circuit diagrams using circuit symbols
* 4.2.2(a) potential difference and the unit *volt*
* 4.2.3(a) resistance; ; the unit ohm
* 4.2.3(b) Ohm’s law
* 4.2.3(c)(i) *I*–*V* characteristics of resistor, filament lamp, thermistor, diode and light-emitting diode (LED)
* 4.2.3(c)(ii) techniques and procedures used to investigate the electrical characteristics for a range of ohmic and non-ohmic components
* 4.3.3(a) potential divider circuit with components – note students are expected to know about the potentiometer as a potential divider

**Physics B**

* 3.1.2a(vi) the relationship between potential difference and current in ohmic resistors (Ohm’s law)
* 3.1.2a(vii) action of a potential divider
* 3.1.2b(ii) recognise standard circuit symbols
* 3.1.2(b)(iii) graphs of current against potential difference and graphs of resistance or conductance against temperature for ohmic and non-ohmic devices or components
* 3.1.2c(i) use formulae **
* 3.1.2(d)(i) investigating electrical characteristics for a range of ohmic and non-ohmic components using voltmeters and ammeters

**Practical Skills**

* 1.2.1(a) apply investigative approaches and methods to practical work
* 1.2.1(b) safely and correctly use a range of practical equipment and materials
* 1.2.1(c) follow written instructions
* 1.2.1(d) make and record observations/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(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 of appropriate digital instruments to include voltage and current
* 1.2.2(g) designing, constructing and checking circuits using DC power supplies, cells, and a range of circuit components

**CPAC**

* (1) Follows written procedures
* (2) Applies investigative approaches and methods when using instruments and equipment
* (3) Safely uses a range of practical equipment and materials
* (4) Makes and records observations

**Mathematical skills**

* M0.1 Recognise and make use of appropriate units in calculations
* M1.1 Use an appropriate number of significant figures
* M2.3 Substitute numerical values into algebraic equations using appropriate units for physical quantities
* M2.4 Solve algebraic equations
* M3.1 Translate information between graphical, numerical and algebraic forms
* M3.2 Plot two variables from experimental or other data
* M3.3 Understand that *y* = *mx* + *c* represents a linear relationship
* M3.6 Draw and use the slope of a tangent to a curve as a measure of rate of change

**Equipment (per learner or group)**

* power supply (maximum 12V output)
* rheostat/potentiometer
* ammeter
* voltmeter
* leads
* test component ( resistor, filament lamp, diode, LED)

**Health and safety**

* Safe use of electrical circuits
* Note that an ntc thermistor may ignite or explode if the voltage applied is too great due to the runaway effect
* LEDs should have a suitable resistor (330Ω) in series to limit current and brightness

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.
* CLEAPSS document R151 “*Ammeters,Voltmeters etc,for Class Use*” and the Laboratory Handbook sections 12.3.1 “*DMMs compared to analogue meters*”, 12.3.2 “*Provision of digital multimeters*” and 12.3.3 “*Which DMMs to buy*”, contain useful information on selection and use of digital multimeters.
* Based on the components available the teacher should assess the maximum permissible current and define this to the students.

**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 in a clear and logical format.

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

* Learners should have completed the tables for potential difference and current
* Learners should have plotted the component characteristic
* If time permits learners could complete the task for an ohmic and non-ohmic device to allow comparison.