**Electricity & Energy**

**Resistance**

**Summary**

**Resistance** is the opposition to the movement of charge through a material.

Increasing the resistance in an electrical circuit decreases the current.

Resistance is measured in **ohms** (Ω).

resistor

**Resistance, Voltage & Current**

**(Ohm’s Law)**

$$resistance=\frac{voltage}{current}$$

$$R=\frac{V}{I}$$

$$V=IR$$

$$I=\frac{V}{R}$$

V

Ω

A

*R*

*V*

*I*

For a given resistor the ratio V/I remains approximately constant, provided there is no change in temperature.

This ratio is defined as the **resistance** of the resistor.

The relationship between resistance, current and voltage is known as **Ohm’s Law**.

(NOTE: For some components, such as lamps, the ratio of voltage to current is not fixed, as their resistance varies with temperature.)

An accurate value for the resistance of a resistor can be established by connecting the resistor to a variable voltage power supply and taking a range of measurements of voltage across and current in the resistor

A

V

+

-

The graph of voltage against current for this resistor is a “best-fit”, straight line and its gradient is equal to the resistance of the resistor.

Ω

0

Resistance can also be measured directly with an **ohmmeter**.

**Variable Resistors**

**Variable resistors** can be use to alter the current in a circuit. For example, variable resistors are used in the volume controls of radios and in dimmer switches.

variable resistor

Certain types of variable resistor respond to changes in temperature (**thermistors**) and light level (**light dependent resistors (LDRs)**).

light dependent resistor (LDR)

thermistor

t

For most thermistors, as temperature increases resistance decreases.

**T**emperature

**U**p

**R**esistance

**D**own

For LDRs, as light level increases resistance decreases.

**L**ight

**U**p

**R**esistance

**D**own

0

*light level*

*resistance*

0

*temperature*

*resistance*

**Resistance in Series**

The total resistance of resistors connected in series is equal to the sum of the individual resistances.

$$R\_{T}=R\_{1}+R\_{2}+R\_{3}…$$

R1

R2

R3

**Resistance in Parallel**

The total resistance of resistors connected in parallel is less than the smallest value of the individual resistors.

R1

R2

R3

$$\frac{1}{R\_{T}}=\frac{1}{R\_{1}}+\frac{1}{R\_{2}}+\frac{1}{R\_{3}}…$$