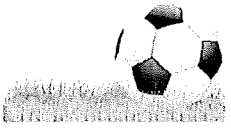
13.7 Resistance

Learning Goals/Success Criteria: *At the end of this lesson, I will be able to:*

- ☐ Calculate resistance using the formula V=IxR

Have you ever noticed that when you recharge your cellphone, the adaptor gets warm? The warmth is caused by the **electrical resistance** experienced by the electric current flowing through the adapter. Electrical resistance is the **opposition** to the movement of electrons as they flow through a circuit. The symbol for resistance is **R** and the unit for resistance is **ohm (Ω)**.

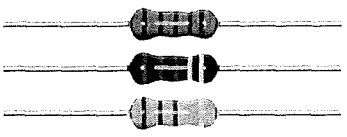
Analogy for the Concept of Resistance	
Imagine you are kicking a soccer ball, if the ball is on a rough surface like grass; you have to kick the ball much harder to make it roll. 	However, if you are kicking a soccer ball on a smooth and hard surface like pavement, the ball will roll easily. 

When electrons flow through a material that is rough or "bumpy", there will be **more** resistance than if the material is "smooth". For example, insulators slow down the flow of electrons, so the internal resistance of an insulator is quite **high**. On the other hand, electrons can flow easily in conductors, so a conductor like copper wire has very **low** internal resistance.

All materials have some internal resistance. The greater the resistance, the **lower** the current, and the **warmer** the materials becomes when current flows through it. The **internal resistance** of a material depends on many factors, some of the factors that affect resistance are: type of material, cross-sectional area, length, and temperature.

Factor	**How does this factor affect the resistance of a wire?**
Material	- depends on how freely electrons can move within the material - the **greater** the conductivity, the **lower** the resistance
Cross-Sectional Area	- **thicker** wires have **less** internal resistance than thinner ones - electrons flowing through a thicker wire have more room to move freely
Length	- as the length of the wire **increases**, its internal resistance **increases** - as electrons have to travel through more material, the resistance becomes higher
Temperature	- resistance **increases** when electrons bump into atoms as they move through a material - the wire gets warmer when the number of atom collisions increase hence resistance **increases** with temperature

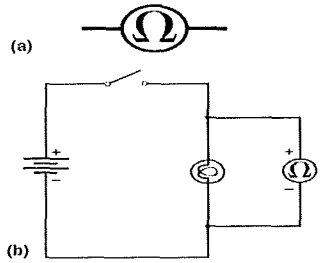
What is a resistor?



A resistor is an **electrical device** that reduces the flow of electric current in a circuit. The circuit diagram symbol for a resistor is  . In reality, resistors look like the diagram on the right. There are different **coloured bands** on the resistor that indicate how much resistance the resistor provides.

Measuring Resistance

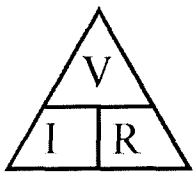
An **ohmmeter** is the device designed to measure resistance. The circuit diagram symbol for an ohmmeter is shown in the diagram below. An ohmmeter must be connected in **parallel** with a **load**. The circuit does not need to be closed because the ohmmeter contains a **power source** that will provide a current. We will be calculating resistance using Ohm's Law.



13.9 Ohm's Law

The amount of current that flows through a circuit given a certain electric potential difference depends on the total **electric resistance** of the circuit. Electric resistance is a measure of how much an electrical component **opposes or resists** the flow of electric charge.

Some resistors have a known resistance that remains **constant**. When resistance is constant, the relationship among voltage, current and resistance can be written mathematically as an equation (see below). This relationship is known as **Ohm's law**



ΔV = potential difference (volts - V)
I = current (amperes – A)
R = resistance (ohms - Ω)

Electric components that obeys Ohm's Law are known as **ohmic resistors**. Alternatively, an electric component that does not obey Ohm's Law is known as a **non-ohmic resistor**. In these electric components, resistance is not constant. A light bulb is a non-ohmic resistor because it does not have a constant resistance.

Graphing Resistance

A student is investigating a resistor. She has collected the data shown below. Plot the data on a graph. Then find the resistance by calculating the slope of the line of best fit.

Current (A)	Potential Difference (ΔV)
0.05	40
0.10	60
0.15	80
0.20	100
0.25	120

$$m = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{120 - 40}{0.25 - 0.05} = \frac{80}{0.2} = 400\ \Omega$$