Episode 100: Preparation for electric current topic

This topic looks at basic electrical ideas, particularly current, potential difference and energy. Students are likely to have spent a significant amount of time studying electric circuits (although their ideas of current and pd may be rather muddled). This topic starts with a closer look at electric current.

Episode 101: Introduction to circuits

Episode 102: Current as a flow of charge

Episode 103: Currents and charge carriers

Episode 104: Drift velocity

Episode 105: Sources of electrical energy

Episode 106: Electrical power

Advance warning

The equipment used in this topic is relatively basic. Look out for **display meters**, excellent for demonstrations, and which are usually provided with shunts to allow you to change the range of the meter. Find out what **ammeters** and **voltmeters** are available for class use; see the note on **multimeters** in Episode 101.

Lamps (light bulbs) are often useful in place of resistors, since they light up to show when a current is flowing. However, two lamps may look identical but their resistances may not be equal – check them out before you start a demonstration. Also, the resistance of a lamp increases as it gets hotter, so double the voltage may not give double the current.

To show an electron beam, you will need to use a **vacuum tube** (Teltron tube). These are very useful in later work on electron beams, so it is worth learning how to set one up, and to use it without damaging it.

Prepare yourself to be careful in the **language** you use. Current flows *through* a component, and *around* a circuit. A potential difference is *between* two points, or *across* a component. Link this to the way you connect meters in a circuit. The circuit must be broken to insert an ammeter; a voltmeter is connected between two points.

Main aims

Students will:

1. Describe current as a rate of flow of electric charge: $I = \Delta Q/\Delta t$

2. Give examples of charge carriers in different conductors.

3. Use flow analogies for current: e.g. water circuit, traffic etc.

4. Relate current to microscopic charge flow: $I = nAqv$

5. Use ammeters correctly.

6. Describe sources of electrical energy (cells, batteries etc.) as electrical 'pumps'.

7. Use energy analogies - e.g. relating potential difference to changes in height and gravitational potential energy.

8. Give examples of energy transfers (heating effect - filament lamp and kettle).

9. Define the volt using $V = \Delta W/\Delta Q$, 1 V = 1 J C^{-1}

10. Use voltmeters correctly.

11. Calculate work, energy and power in electric circuits **P = IV**.

Prior knowledge

Most students will be familiar with concepts of charge, current and voltage from their previous work at pre-16 level. However, these ideas are often muddled and this can be a real obstacle to progress so it is well worth reinforcing simple ideas and providing basic training in the use of ammeters, voltmeters (and/or multimeters) fairly early on. It is particularly important to separate the idea of an **electric current** as a flow of real 'stuff' (i.e. charge carriers) from the more abstract idea of **potential difference** which does not 'flow' and which is related to energy changes around the circuit.

Where this leads

Note that the idea of resistance is not included here, but will be dealt with in the next topic. The ideas of charge and energy conservation are implicit in this topic; they will be formalised in Kirchhoff's laws.