Electric Circuits Definitions and equations

To be able to define the key terms: current, charge, potential difference (voltage) and resistance
To be able to use the equations that link these.
To know the correct units to be used in each

Definitions

Current, I

Electrical current is the rate of flow of charge in a circuit. Electrons are charged particles that move around the circuit. So we can think of the electrical current is the rate of the flow of electrons, not so much the speed but the number of electrons moving in the circuit. If we imagine that electrons are Year 7 students and a wire of a circuit is a corridor, the current is how many students passing in a set time.

Current is measured in Amperes (or Amps), A

Charge, Q

The amount of electrical charge is a fundamental unit, similar to mass and length and time. From the data sheet we can see that the charge on one electron is actually -1.60×10^{-19} C. This means that it takes 6.25×10^{18} electrons to transfer 1C of charge.

Charge is measured in Coulombs, C

Voltage/Potential Difference, V

Voltage, or potential difference, is the work done per unit charge.
1 unit of charge is 6.25×10^{18} electrons, so we can think of potential difference as the energy given to each of the electrons, or the pushing force on the electrons. It is the p.d. that causes a current to flow and we can think of it like water flowing in a pipe. If we make one end higher than the other end, water will flow down in, if we increase the height (increase the p.d.) we get more flowing. If we think of current as Year 7s walking down a corridor, the harder we push them down the corridor the more we get flowing.

Voltage and p.d. are measured in Volts, V

Resistance, R

The resistance of a material tells us how easy or difficult it is to make a current flow through it. If we think of current as Year 7s walking down a corridor, it would be harder to make the Year 7s flow if we added some Year 11 rugby players into the corridor. Increasing resistance lowers the current.

Resistance is measured in Ohms, Ω

Equations

There are three equations that we need to be able to explain and substitute numbers into.

1

$$\boxed{I = \frac{\Delta Q}{\Delta t}}$$

This says that the current is the rate of change of charge per second and backs up or idea of current as the rate at which electrons (and charge) flow.
This can be rearranged into

$$\Delta Q = I\Delta t$$

which means that the charge is equal to how much is flowing multiplied by how long it flows for.

2

$$\boxed{V = \frac{E}{Q}}$$

This says that the voltage/p.d. is equal to the energy per charge. *The 'push' of the electrons is equal to the energy given to each charge (electron).*

3

$$\boxed{V = IR}$$

This says that increasing the p.d. increases the current. *Increasing the 'push' of the electrons makes more flow.*

It also shows us that for constant V, if R increases I gets smaller. *Pushing the same strength, if there is more blocking force less current will flow.*