

Current Electricity

What do we mean by Current?

- When electrical charges move, we call it current
- The amount of current is the number of charges passing through an area per second

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

I - current (amps, A)
Q – charge (coulombs, C)
t – time (seconds, s)

- We know that the charges moving through an electrical circuit are electrons
- Each electron has a charge of 1.6×10^{-19} C

Example

- An electrical appliance says that it uses a current of 3.0 A. How many electrons pass through the circuit in one second?

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

$$3.0\text{A} = \frac{Q}{1\text{s}}$$

$$Q = 3.0\text{ C}$$

- But we wanted to know how many electrons

$$\text{number of electrons} = \frac{Q}{\text{charge of 1 electron}}$$

- One electron has a charge of $1.6 \times 10^{-19}\text{ C}$
- So...

$$\text{number of electrons} = \frac{3.0\text{ C}}{1.6 \times 10^{-19}\text{ C}}$$

$$\text{number of electrons} = 1.9 \times 10^{19}$$

Electric Potential Difference

- The energy per unit charge between two points along a conductor
- Also referred to as voltage (V)

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

V – potential difference, voltage (Volts, V)

E – energy of the charges (Joules, J)

Q – charge (Coulombs, C)

Example

- How much energy does each electron in a circuit have if the potential difference is 120 V?

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

$$120 \text{ V} = \frac{E}{1.6 \times 10^{-19} \text{ C}}$$

$$E = 1.9 \times 10^{-17} \text{ J}$$

Sources of Electrical Energy

- Chemical
 - Batteries
- Photo
 - Solar cell
- Electromagnetic
 - Generators
- Thermoelectric
 - Thermocouple

- Piezoelectric
 - microphones

Resistance

- In a conductor, some electrons are free to move but the rest of the atom is fixed
- As the electrons move through the circuit they bump into the fixed atoms
- Whenever an electron bumps into a fixed atom it loses energy as heat (and possibly light)
- This is known as resistance

- The amount of resistance depends on the type of material
 - Tungsten has a high resistance
 - Gold has a very low resistance
- The amount of resistance also depends on temperature, the length and how big the conductor is
- Resistance is measured in units called Ohms (Ω)