Domestic Uses and Safety

Mains:

- Mains electricity is an AC supply. In the United Kingdom the domestic electricity supply has a frequency of 50 Hz and is about 230 V.

- AC is alternating current, which comes from the mains
    - Current continuously varies, from positive to negative (charge changes direction)
- DC, direct current, is the movement of charge in one direction only
    - Cells and batteries supply direct current

Cabling:

- In a plug there are 3 wires
- Live wire
    - Brown, at 230V
    - Carries the alternating potential difference from the supply.
    - This may be dangerous even if mains circuit is off, as current may still be flowing through it
- Neutral Wire
    - Blue, at 0V
    - Completes the circuit
- Earth wire
    - Green and Yellow stripes, at 0V. It only carries a current if there is a fault.
    - Safety wire to stop the appliance becoming live
    - It is connected to the earth and to the casing
    - If the live wire touches the metal casing of the appliance, it will become live (you'll get a serious electric shock if you touch it, as current flows through you to the ground)

Power

- Power is the energy transferred per second. It is directly proportional to current and voltage.
- Power loss is proportional to resistance, and to the square of the current.
- Energy is transferred from chemical potential in batteries to electrical energy in wires to any form of useful energy in the devices they power.

$$E = Pt \qquad \text{Energy transferred} = \text{Power} \times \text{time}$$

$$E = QV \qquad \text{Energy transferred} = \text{Charge} \times \text{potential difference}$$

The power, P, in watts W, the potential difference, V, in volts V and the current, I, in amperes A and the resistance, R, in ohms Ω.

Energy Transfers in everyday appliances

Electrical energy may be transferred by the appliance in different ways:

- Kinetic energy for a motor, thermal energy in a kettle
- Work done is when charge flows through a circuit, and is also equal to energy transferred, as all the electrical energy (ideally) gets transferred to the appliance
- Power rating of an appliance shows the power it uses in Watts, so greater power rating means it uses more energy

National Grid

- The National Grid is a system of cables and transformers linking power stations to consumers across the UK.
- Electrical power is transferred from power stations to consumers using the National Grid
- **Transformers:**
    - **These change the potential difference**
    - **Step-up Transformers**
        - **Increase the pd from the power station to the National Grid**
        - **So as the power is constant ($P = IV$) current decreases so less energy is lost.**
    - **Step-down Transformers**
        - **Decrease the pd**
        - **From the National Grid to consumers**
        - **For consumer safety**

Charge

- A property of all matter
- Positive and negative charges exist
    - If a body has the same amount of positive and negative charge, they cancel out, forming a neutral body (i.e. protons and electrons in a neutral atom)
- Like charges repel
- Opposite charges attract

Insulators do not conduct electricity

- Their electrons cannot flow throughout the material, they are fixed

Conductors can conduct electricity

- Their electrons can flow, and are not fixed (they are delocalised)

Static Electricity (Physics only)

- When two insulators are rubbed together
    - Electrons are transferred from one object to the other
    - Forming a positive charge on one object and a negative charge on the other
- If conductors were rubbed, electrons will flow in/out of them cancelling out any effect, so they stay neutral
    - Insulators become charged because the electrons cannot flow
    - A positive static charge forms on object which loses electrons
    - A negative static charge forms on object which gains electrons
- Which object loses/gains electrons depends on the materials involved

Sparking occurs when enough charge builds up, and the objects are close but not touching

- The “spark” is when the charge jumps through the air from the highly negative object to the highly positive object, to balance out the charges

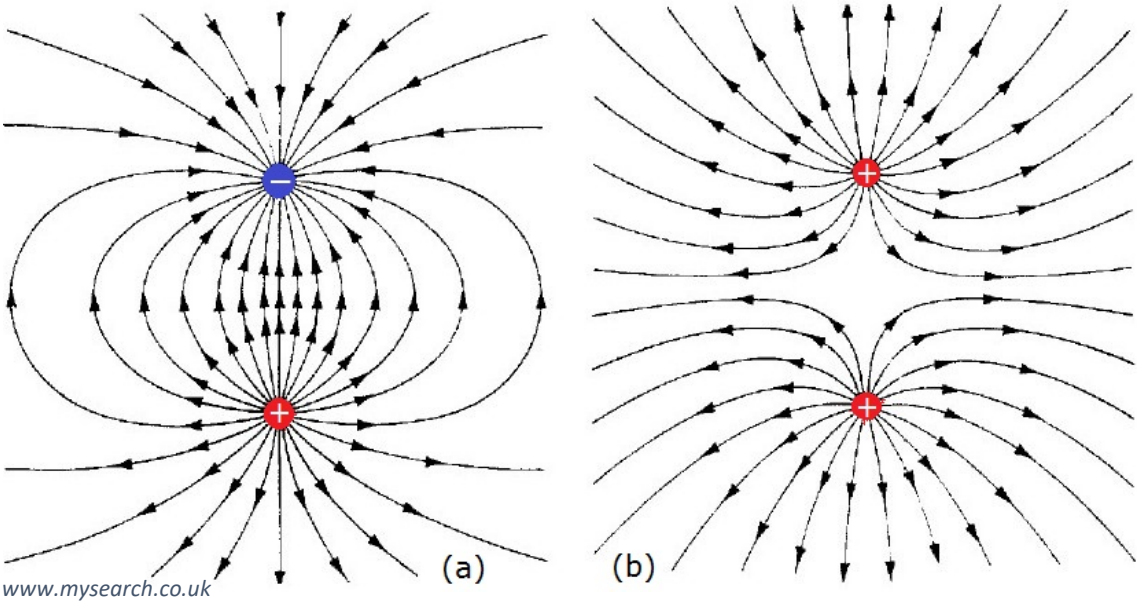
Forces exerted

- The charged objects experience a force – electrostatic force (of attraction/repulsion)
- Greater charge = greater force (e.g. a more positive object, a more negative object)
- Closer together = greater force (force is proportional to the inverse square of the distance)
    - It is a noncontact force, as force can be felt even when the objects are not touching

Electric Fields

- Like magnetic fields for magnets, electric fields are for charges
    - They point in the direction a positive charge would go i.e. away from positive charges, and towards negative charges.
    - They point to charges at right angles to the surface
- Stronger the charge, the more field lines present and the stronger the force felt
- Closer to the charge, the stronger the force felt

Diagrams



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