# Fuses and Earthing

Fuses and circuit breakers are super important. And questions on them cover a whole barrel of fun — electrical current, resistance, potential difference... Read this page and make sure you've got it sussed.

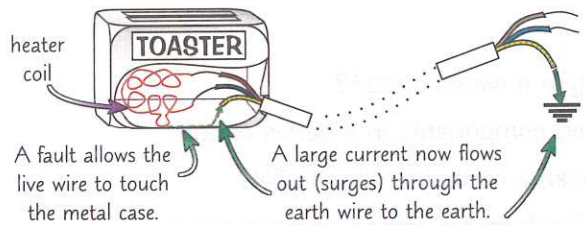
## Earthing and Fuses Prevent Electrical Overloads

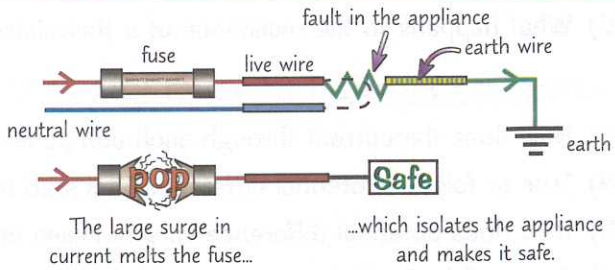
Surges (sudden increases) in current can occur because of changes in a circuit (e.g. an appliance suddenly switching off) or because of a fault in an electrical appliance. Current surges can lead to the circuits and wiring in your appliances melting or causing a fire, and faulty appliances can cause deadly electric shocks.

The earth wire and a fuse are included in electrical appliances to prevent this from happening. This is how they work:

1) If a fault develops in which the live wire somehow touches the metal case, then because the case is earthed, too great a current flows in through the live wire, through the case and out down the earth wire.
2) This surge in current melts the fuse when the amount of current is greater than the fuse rating. Fuses are connected to the live wire, so that breaking the fuse breaks the circuit and cuts off the live supply.
3) This isolates the whole appliance, making it impossible to get an electric shock from the case. It also prevents the risk of fire caused by the heating effect of a large current.
4) Fuses should be rated as near as possible but just higher than the normal operating current.
5) The larger the current, the thicker the cable you need to carry it (to stop the cable getting too hot and melting). That's why the fuse rating needed for cables usually increases with cable thickness.

**Blowing a fuse in a toaster**




6) As well as the fuses in plugs, there are also household fuses (these are the ones that blow when a light bulb goes). These work in the same way, but protect the wiring in the house, not just in an appliance.

## Circuit Breakers are Even Safer Than Fuses

Circuit breakers can be used in the place of household fuses.

1) Instead of melting a fuse, a large current may instead 'trip' (turn off) a circuit breaker.
2) Circuit breakers turn off quicker than the time taken for a fuse to melt.
3) They can also be reset, which is much easier than having to replace a fuse.
4) However, circuit breakers are more expensive than fuses.

## Insulating Materials Make Appliances "Double Insulated"

1) All appliances with metal cases are usually "earthed" to reduce the danger of electric shock.
2) "Earthing" just means the case must be attached to an earth wire. An earthed conductor can never become live.
3) If the appliance has a plastic casing and no metal parts showing then it's said to be double insulated.
4) Anything with double insulation like that doesn't need an earth wire — just a live and neutral. Cables that only carry the live and neutral wires are known as two-core cables.

### Nothing shocks my mum — she's very down to earth...

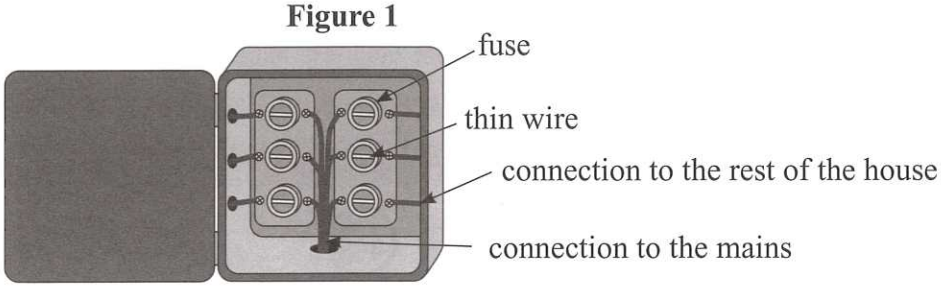
Earthing is dead important, so make sure you understand it and the life-saving protection it provides.

Q1 Which wire are fuses connected in? [1 mark]

# Fuses and Earthing

1 **Figure 1** shows an old-fashioned household fuse box. Grade 6-7

**Figure 1**




a) Explain why houses have fuse boxes.

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*[1]*

b) In old-fashioned fuse boxes like this, home-owners sometimes replaced old fuses with pennies. Explain why replacing fuses with pennies like this was dangerous.

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*[1]*

c) Most modern houses uses circuit breakers, rather than fuse boxes.
Give **one** advantage and **one** disadvantage of using circuit breakers instead of fuses.

Advantage: .....

Disadvantage: .....

*[2]*

*[Total 4 marks]*

2 Many electrical devices include an Earth wire. Grade 6-7

a) Explain how the earth wire and fuse work when a fault develops with a metal appliance.

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*[3]*

b) The fuse in an electric heater is rated at 13 A. The fuse in a clock radio is rated at 3 A.
Suggest why these devices need fuses with different ratings.

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*[2]*

*[Total 6 marks]*