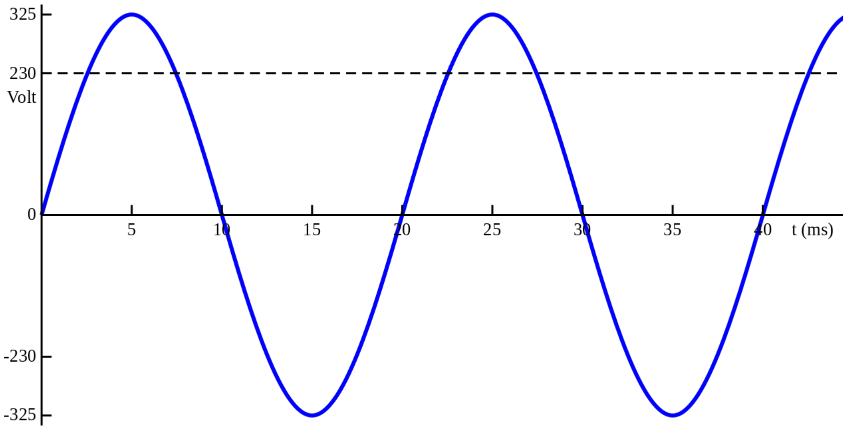
2.6.1 Mains electricity

videos

Mains electricity is the electricity supplied to our houses. It comes through a central 'fuse box' and is distributed to lights and sockets around the home.

Mains electricity is alternating current (a.c.) as opposed to the direct current (d.c.) you would get from a battery.

Consider the following:



This shows how the mains voltage varies with time. You can see that the voltage varies between +325V and -325V. The effect of this varying voltage is that charge is pushed one way around the circuit and then the opposite way. This is repeated 50 times every second (50Hz). This means that current direction alternates – hence 'alternating current'.

(1)✐Explain what direct current (d.c.) is and how we get this from a battery. (Hint: Think of how the voltage changes (or not) and the effect this has on current.)

Even though mains electricity has a peak voltage of 325V, we use 230V in our calculations. The reason for this is that the voltage varies with time. In fact, there are points in the cycle when the voltage is zero. So 230V is an 'equivalent voltage' which would produce the same effect as a 230V direct voltage supply.

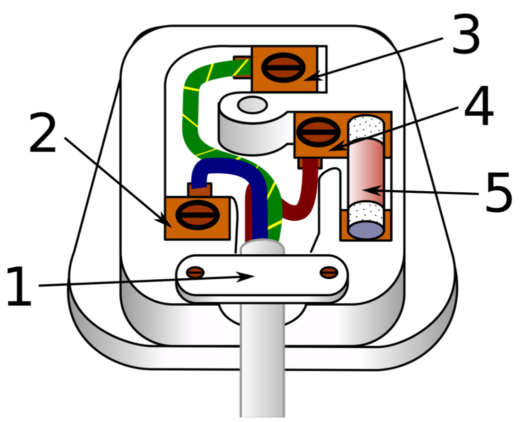
Electricity is distributed around our houses through electric cables. There are generally 3 copper wires contained in these cables. They are coated in coloured plastic to identify them:

BROWN – live
BLUE – neutral
GREEN/YELLOW – earth

(2)✐Why are the copper wires coated in plastic?

For convenience, we have sockets into which we can plug in electrical devices using electrical plugs. These have 3 brass pins that slot into the socket.

(3)✐What 2 properties of brass make it a suitable material for pins of a plug?



If we take the back off a plug, we can see that the brass pins are connected to three wires.

The pin at the top is connected to the yellow and green, earth wire. The bottom left pin is connected to the blue, neutral wire. And the bottom right pin is connected through a fuse to the brown, live wire.

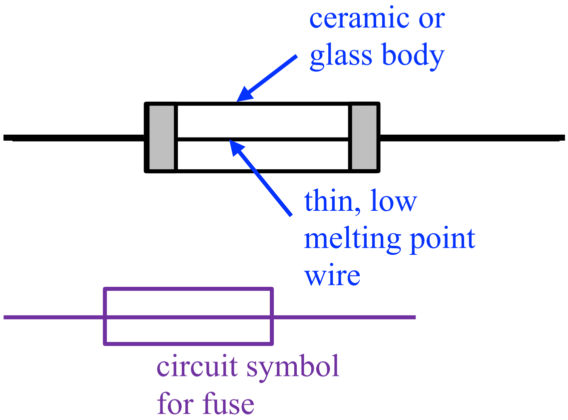
(4)✐Identify the numbered parts of the plug shown in the diagram.

(5)✐The part numbered '1' is called the 'cable grip'. What safety function does it play.

(6)✐The plug is made out of rigid plastic. Why?

In the UK, plug sockets often contain a fuse. The primary function of a fuse is to prevent an appliance from being damaged or catching fire, if the current becomes too large.

Anatomy of a fuse



(7)✐Why does the fuse have a glass or ceramic body?

(8)✐Why does the fuse have a thin, low melting point wire down the middle?

Fuses place a maximum limit on the current that can flow. If the current exceeds this limit, the thin, low melting point wire melts and breaks the circuit. We say that the fuse 'blows'.

Different appliance will need different amounts of current. For example, a tumble dryer will need a lot larger current than a TV. The amount of current that an appliance needs is related to its power. The power rating of an appliance is usually displayed somewhere on the appliance. From this we can work out the current:

$$I = \frac{P}{V}$$

Where P=power of the appliance, V=mains voltage=230V.

Worked example:

A toaster has a power rating of 800W. What current will it draw?

$$I = \frac{P}{V}$$
$$= \frac{800}{230}$$
$$= 3.48A$$

Because this appliance needs 3.48A of current in normal operation, we try to choose a fuse that is slightly larger than this.

Typically, fuses come in 3A, 5A, 13A current values. So for our toaster, we would choose a 5A fuse.

(9)✏Why wouldn't we choose a 3A fuse?

(10)✏Why wouldn't we choose a 13A fuse?

(11)✏An electric kettle is rated at 1.3kW. What current will it draw and what fuse should be fitted in the plug? (Hint: Use the formula to calculate current and remember to convert from kilowatts to watts.)