4 DANGERS OF ELECTRICITY

Electricity is an effective method for transferring energy in many domestic situations. Often, electric circuits are used to transfer energy to movement (using an electric motor) or to heating. Electrical heating can be used in cooking and in heating a building (for example, through fan heaters or radiators).

Electricity can cause hazards in domestic situations. For example:

Hazard	Danger
Frayed cables	wiring can become exposed
Long cables	cause a trip or a fall
Damaged plugs	wiring can become exposed
Water around sockets	water conducts, so can connect a person into the mains supply
Pushing metal objects into sockets	connects the holder to the mains supply

If there is a fault in an electrical appliance, it could take too much electrical current. This might make the appliance itself dangerous, or it could cause the flex between the appliance and the wall to become too hot and start a fire.

Electrical appliances can be damaged if the current flowing through them is too high. The electric current usually has to pass through a **fuse** or circuit breaker before it reaches the appliance. If there is a sudden surge in the current, the wire in the fuse will heat up and melt – it 'blows'. This breaks the circuit and stops any further current flowing. If a circuit breaker is used, then the circuit breaker springs open (trips) a switch if there is an increase in current in the circuit. This can be reset easily after the fault in the circuit has been corrected.

In many houses there will be a distribution box that takes all of the electricity for the house and sends it to the different rooms. In old houses this box may still use fuses, but in modern installations, the box will use miniature circuit breakers, often known as MCBs.

Where a fuse is fitted to the plug, it must have a value above the normal current that the appliance needs but should be as small as possible. The most common fuses for plugs are rated at 3 A, 5 A and 13 A.

WORKED EXAMPLES

1 What fuse should be fitted in the plug of a 2.2 kW electric kettle used with a supply voltage of 230 V?

Calculate the normal current: $I = \frac{P}{V}$

$$= \frac{2200\,\text{W}}{230\,\text{V}}$$

$$= 9.6\,\text{A}$$

Choose the fuse with the smallest rating bigger than the normal current: the fuse must be 13 A.

2 What fuse should be fitted to the plug of a reading lamp which has a 60 W lamp and a supply of 230 V?

Calculate the normal current: $I = \frac{P}{V}$

$$= \frac{60\,\text{W}}{230\,\text{V}}$$

$$= 0.26\,\text{A}$$

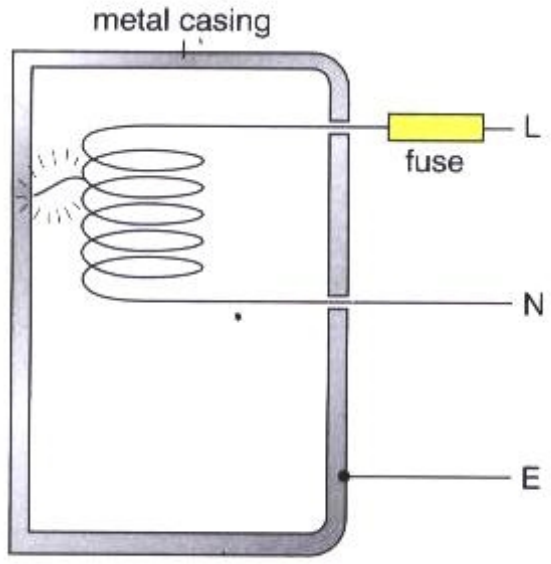
Choose the fuse with the smallest rating bigger than the normal current: the fuse must be 3 A.

OTHER SAFETY MEASURES

Metal-cased appliances must have an **earth wire** as well as a fuse. If the live wire worked loose and came into contact with the metal casing, the casing would become live and the user could be electrocuted. The earth wire provides a very low resistance route to the 0 V earth – usually water pipes buried deep underground. This low resistance means that a large current passes from the live wire to earth, causing the fuse to melt and break the circuit.

Appliances that are made with plastic casing do not need an earth wire. The plastic is an insulator and so can never become live. Appliances like this are said to be **double insulated**.

In situations that may expose people to electricity unexpectedly, for example using an electric drill, especially drilling into a wall with hidden power cables, or using power tools out of doors, perhaps in wet conditions, a residual current circuit breaker (RCCB) must be used in the power socket on the wall. If any of the charges starts to leak out, the RCCB will turn off the power in 30 ms or less. This may or may not be quick enough to save the user's life.



The earth wire and fuse work together to make sure that the metal outer casing of this appliance can never become live and electrocute someone.

REVIEW QUESTIONS

Q1 **a** A hairdryer works on mains electricity of 230 V and takes a current of 4 A. Calculate the power of the hairdryer.
b In some countries it is illegal to have power sockets in a bathroom, to stop you using hairdryers. Why would it be foolish to use a hairdryer near to a washbasin?

Q2 In her living-room, Felicity has the following items:
- three 100 W lamps
- a TV that takes 2 A
- a hi-fi audio system that takes 1 A
- a 2 kW electric heater
- a 3 kW air conditioning unit.

The whole room is supplied from a 220 V a.c. power supply through one miniature circuit breaker (MCB). What rating of MCB should you fit, if values of 10 A, 20 A, 30 A, 40 A, 50 A and 60 A are available? How would your answer change if the supply were 120 V a.c.?

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