

IGCSE/GCE O-LEVEL

# **Electrical safety**

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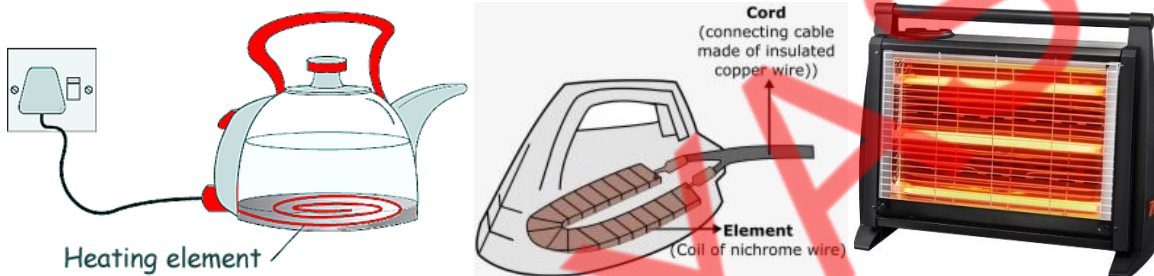
## Uses of Electricity

Electricity is mostly used for

- Heating
- Lighting
- Electric motors

## Electric Heating

- When current passes through the resistance wire then wire produces heat.
- Heat produced by the wire can be used in Electric Kettle, Electric Iron and in Electric heater.



- Electric elements are used in Kettle, Iron and heater.
- These elements are made up of Nichrome wire which is wound on insulating fire proof material such as silica or fire clay.
- Nichrome is selected as resistance wire due to its high resistivity and ability to withstand high temperature without being easily oxidized.
- In case of Kettle, heating element is enclosed in metal tube. Heat is produced by the element. This heat is then absorbed by the water present in the kettle and temperature of the water is increased.
- In case of electric Iron, heat, produced by the heating element which is absorbed by the metal base which is then used to Iron the clothes.
- In case of electric heater, heat produced by the heating element which is used to increase the room temperature.

## **Electric Lighting**

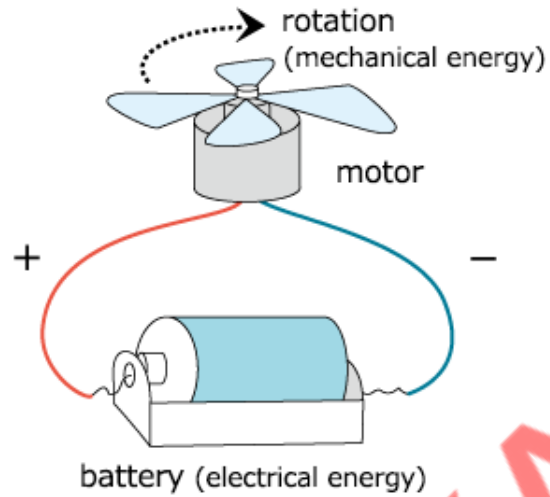
- When current passes through certain metals they produce light.
- This property of metal wire can be used in filament lamp.



- The filament lamp consists of tungsten wire.
- Tungsten has a high resistivity and high melting point ( $3400^{\circ}\text{C}$ ).
- Since light produced by the tungsten wire depends upon its resistance therefore length of tungsten wire is kept very long and cross-sectional area is kept very small.
- When current passes through tungsten filament its temperature increases up to  $2500^{\circ}\text{C}$  and it becomes white hot and light is produced by the lamp.

## **Electric Motor**

- When current passes through electric motor then it starts rotating.



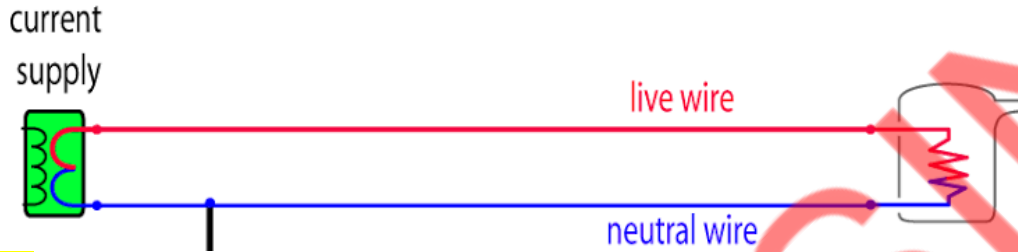
- We can use this property to run fan, washing machine, hair dryer and drill machine.



### **Connection of Electricity**

All the electrical devices are connected to main supply using two wired

- Live wire
- Neutral wire



### **Live Wire**

A wire which is used to carry current from main supply to the electrical device is called live wire.

- It has potential difference equal to 240 V across it.

### **Neutral Wire**

- A wire which is used to transfer current through electrical device to main supply is called neutral wire.
- It has potential difference equal to 0 V across it.

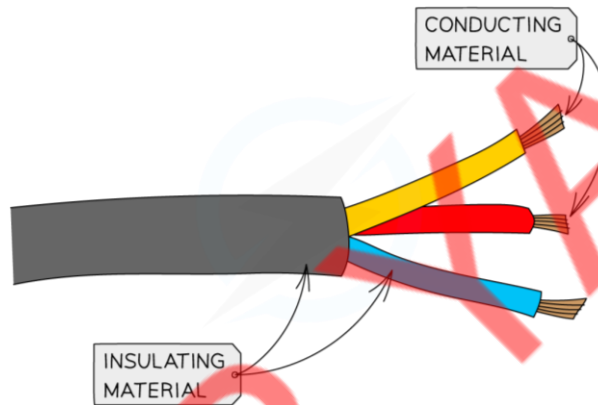
## **Dangers of Electricity**

Electricity can be dangerous in three ways:-

- Due to damaged insulation.
- Due to over heating
- Due to damped environment

## **Damaged Insulation**

Both live wire and neutral wire are covered with insulating material such as rubber and then number of wires are packed together in a circular cable made up of insulating material.



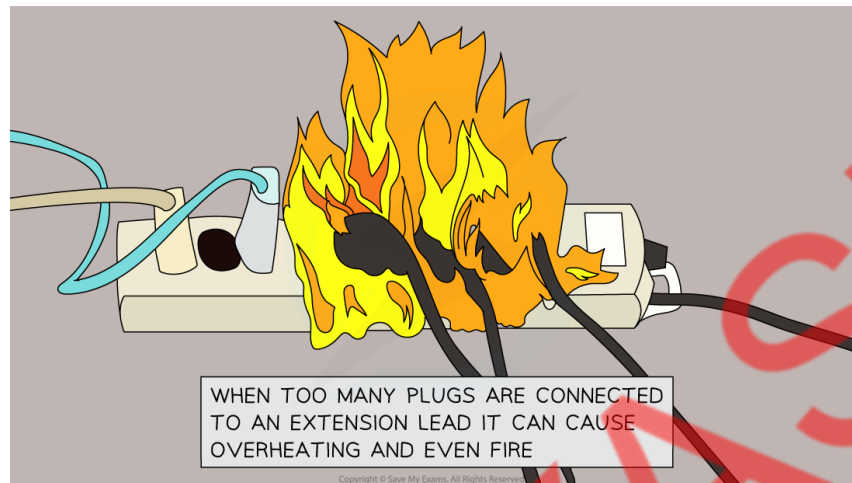
- Live wire is a dangerous wire because its P.D is 240 V.
- If we accidentally touch live wire then current flow to ground through our body and we will experience an electric shock.



- Insulating material deteriorate with time and use.
- For example, the electrical wires connected to hair dryer or electric Iron are always bent and twisted because of the way these appliances are used. This will cause insulation of wires to crack and break, thus exposing conducting wire inside it.
- So if live wire is exposed and touched accidentally then we can experience an electric shock.

## Overheating of Cables

If larger current passes through the connecting wires then large heat is produced in the wires which can melt the insulation around them and can cause the fire.



- Large current can be produced due to short circuit and overloading.
- If live wire makes contact with the neutral wire due to damaged insulation then short circuit is produced.
- Similarly if use large number of devices simultaneously then large current flows through the connecting wires due to over loading.

## **Damped Environment**

Water reduces the insulation of our skin therefore if we touch live wire with wet hand we will experience an electric shock.



- Water in contact with an un-insulated electric wire provides a conducting path for current.
- As human body can only withstand current of about 50 mA, a large current will cause burns and uncoordinated contraction of heat muscles and even death. Therefore electrical appliances should be kept in dry places or handled with dry hand.

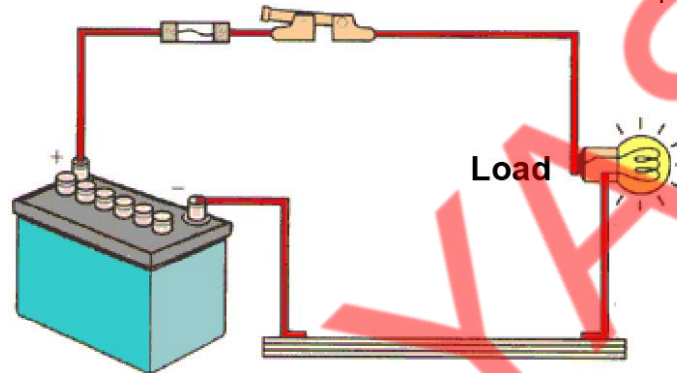
## Safety Features in Home Circuits

### Fuse

A fuse consists of thin metal wire.



- Fuse is connected with the live wire in series with an electrical appliance.



- When current above certain value passes through metal wire of the fuse then it heats up and melts.
- When fuse blows current stops flowing through the electrical device.
- All fuses have rated value. This value indicates the maximum current that can flow through the fuse before it blows.
- Fuses with thicker wire can conduct larger current before blowing typical household fuses are rated as 1A, 2A, 3A, 5A, 10A, 13A

### Circuit Breaker

Circuit breaker can switch off the current passing through it when current above certain value passes through it.



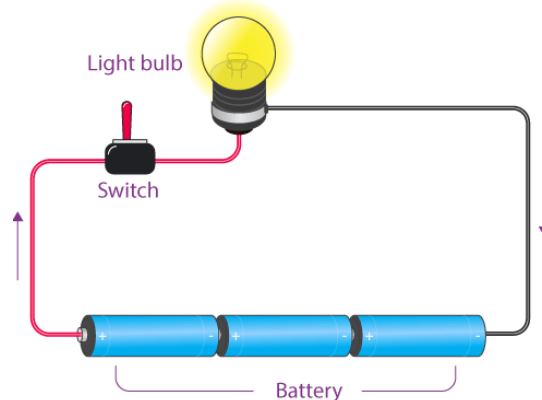
- Circuit breaker is connected with live wire in series with an electrical device.
- All circuit breakers have rated value.
- Circuit breaker can be reset by switching them on again.
- This should be done only after the fault in the circuit is removed.
- However fuse must be replaced after it blows.

### Switch

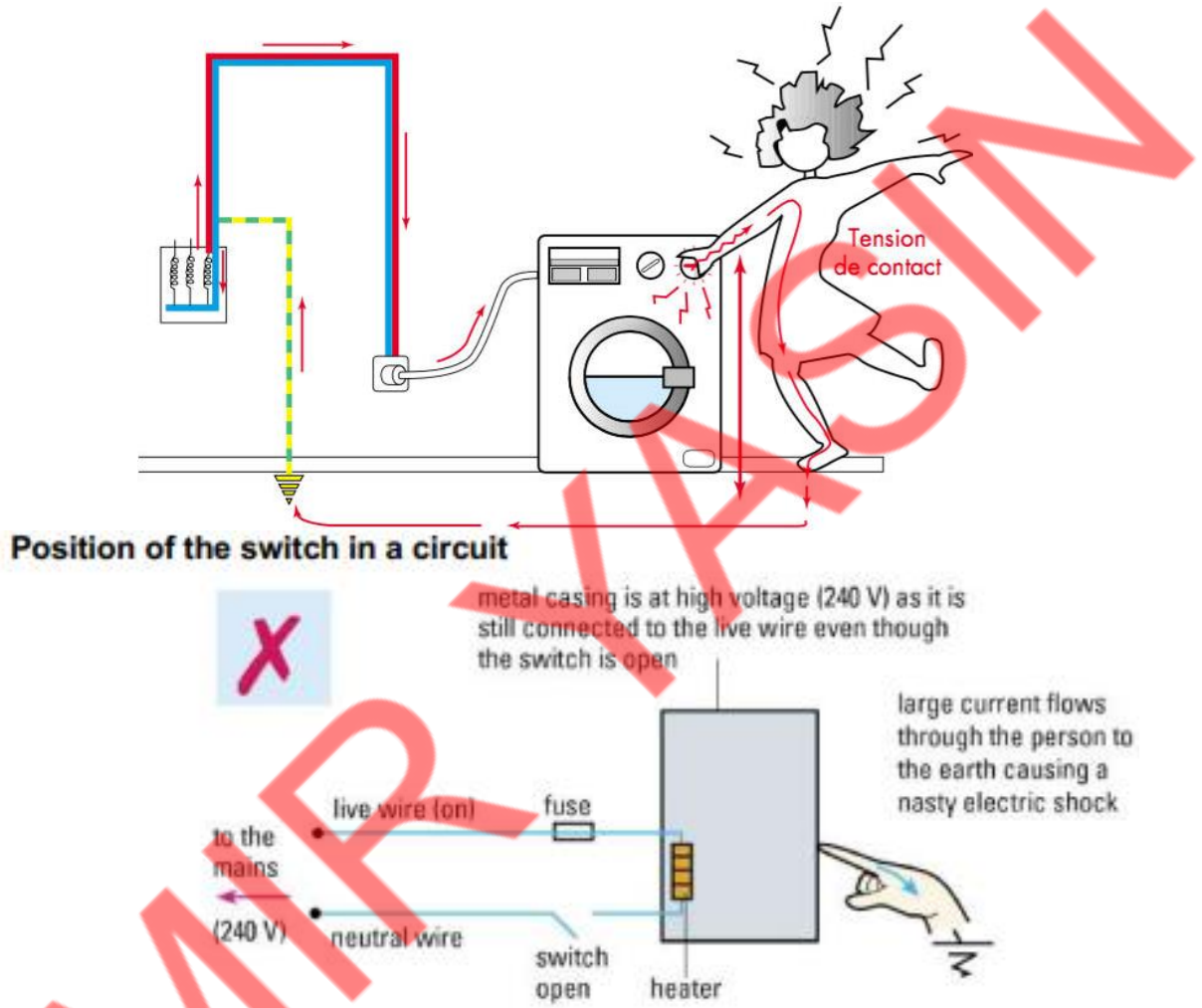
Switch is used to break (open) or complete (close) an electric circuit.



- It is fitted to live wire of the electrical device.



- If switch is connected to neutral wire and even if it is open and live wire comes in contact with metal casing and if someone accidentally touches the metal casing then he can experience electric shock.

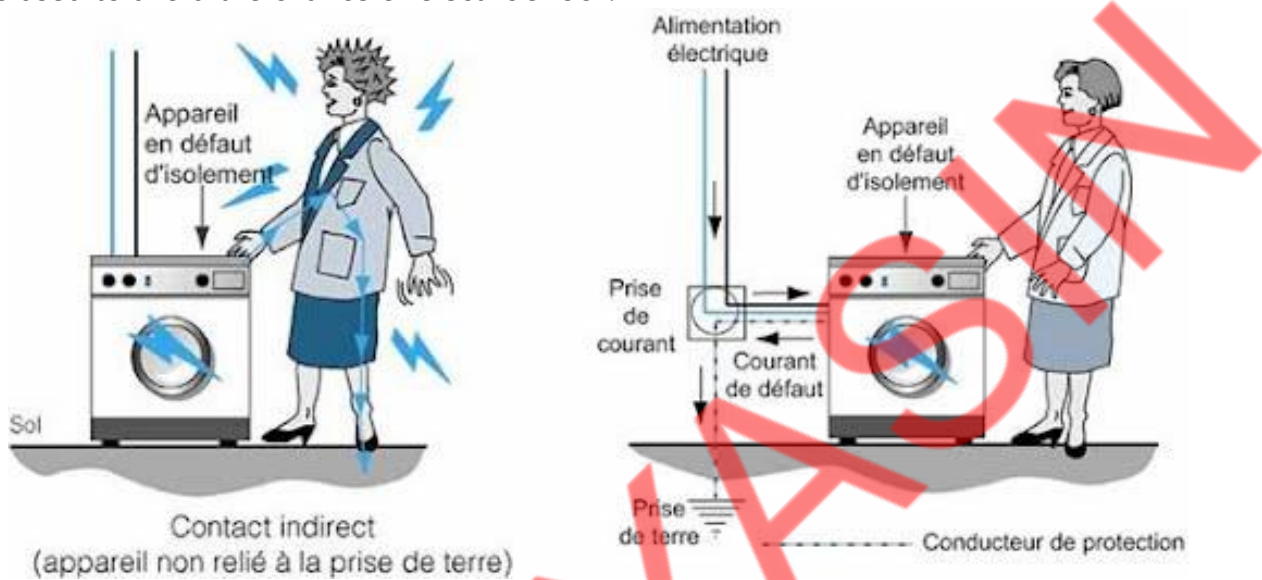


- If switch is connected to live wire then we can disconnect the flow of current to the metal casing if live wire touches the metal casing.

### Earthing

Earth wire is connected between metal casing and ground.

- It is used to avoid the chance of electric shock.



- If metal casing of washing machine is not given an Earth connection then we can experience electric shock.
- But if metal casing is given an Earth connection then current will flow from metal casing to ground avoiding the electric shock.

### Three Pin Plug

A plug connects electrical devices with the main supply.

- In three pin plug there are three terminals.
- First terminal connects Live wire.
- Second terminal connects Neutral wire.
- The third terminal is used for Earth connection.

