describe the use of the heating effect of electricity in appliances such as electric kettles, ovens and heaters

Heating effect

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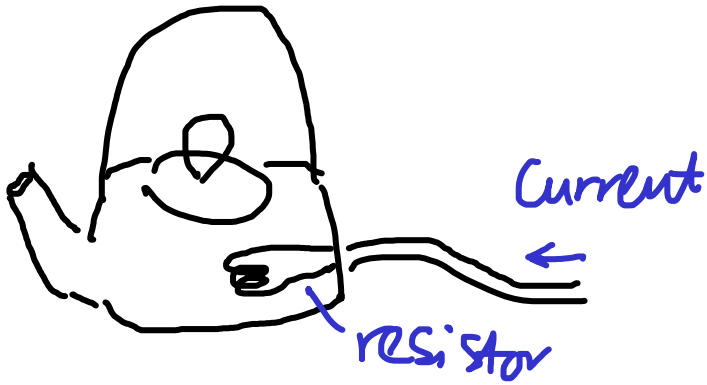
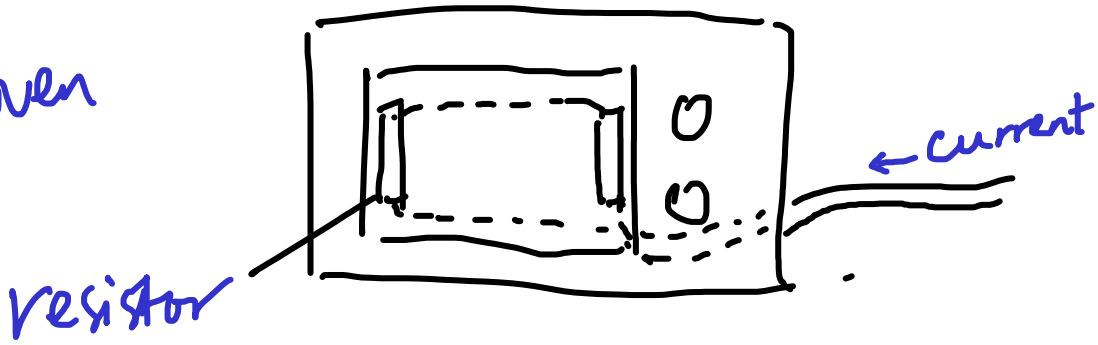
All these appliances containing resistors that heat up when electric current goes through them.

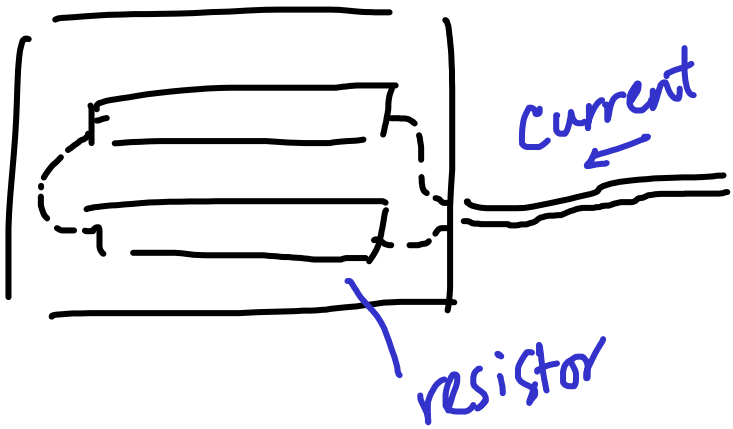
Electric kettle



Electric oven



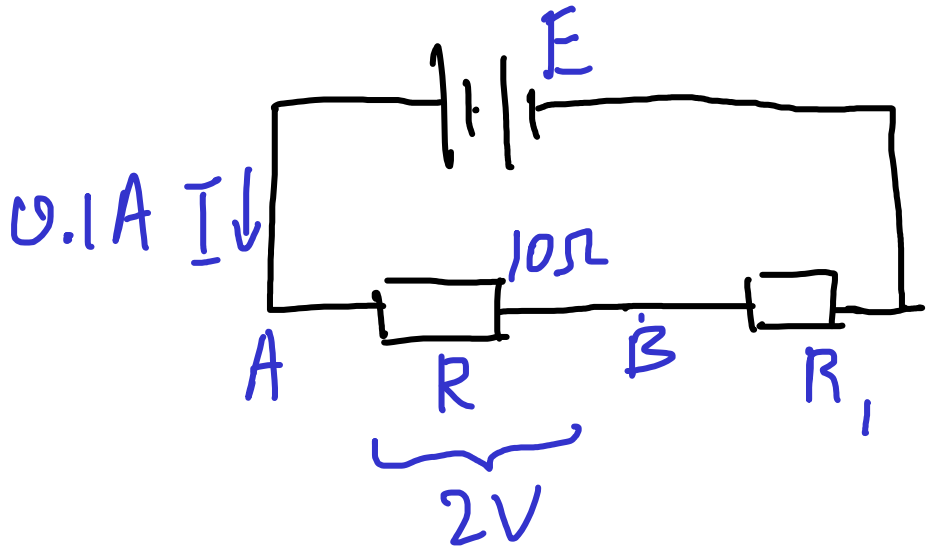
Electric heater



recall and apply the relationships P = VI and E = VIt to new situations or to solve related problems

Electric power

Dr K M Hock



e.g. V = p.d. across AB = 2V

When 1C of charge moves from A to B, 2J of work is done by the battery.

This work becomes heat of 2J in R.

Since current I = 0.1A, it takes 10s to move 1C of charge from A to B. (Q = It)

So power $P = \frac{W}{t} = \frac{2J}{10s} = 0.2W$.

$$\boxed{P = \frac{W}{t} = \frac{VQ}{t} = VI}$$

Using V = IR, get $\boxed{P = I^2R = \frac{V^2}{R}}$ also.

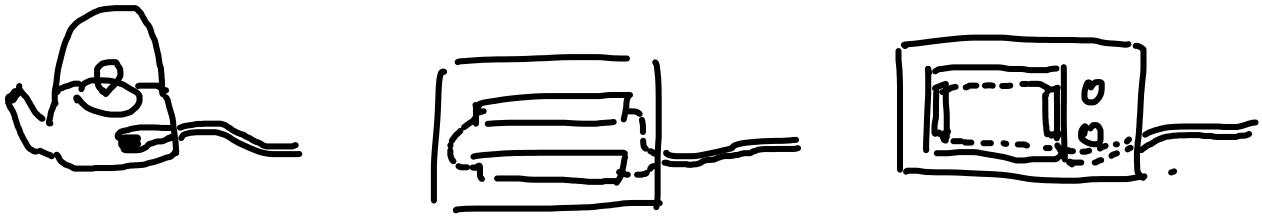
calculate the cost of using electrical appliances where the energy unit is the kW h

Kilowatt Hour

Dr K M Hock

We pay for using electricity at home..

e.g. in 2014, we pay $0.2568 for 1 kWh in Singapore.

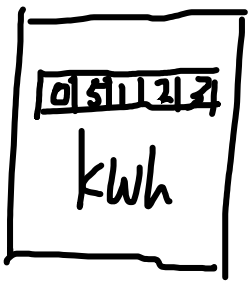


kWh? Kilowatt hour.

This is a unit of energy, like J.

1 kWh = 1 kW x 1 hour

= 1000 W x 60 x 60 s = 3 600 000 J.



Meter at our house shows number of kWh.

Recorded each month by electricity supply company.

On 1 September, it was 1099.9.

On 1 October, it was 1255.2.

How much must I pay?

state the hazards of using electricity in the following situations: (i) damaged insulation (ii) overheating of cables (iii) damp conditions

Hazards

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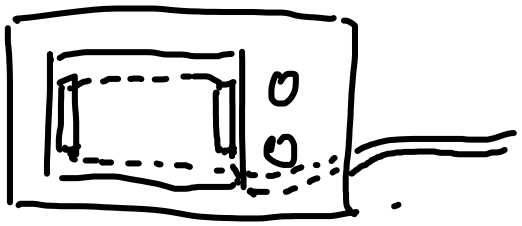
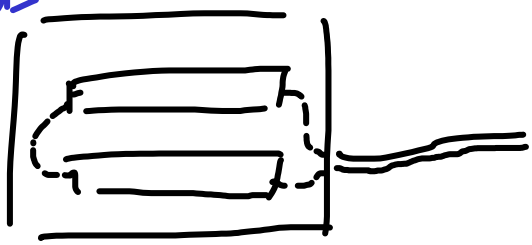
A 10mA current through our arm makes the muscle contract strongly

This can happen if the wire <u>insulation is damaged</u> and we touch it



If the cable overheats, the insulation can melt. Or nearby objects can catch fire.



Water can conduct electricity

e.g. if the plug in a kettle gets wet, large current flows through the plug.

→ heating, fire.

Fuse

Dr K M Hock

If insulation is damaged or if plug/socket is wet, large current can flow.

→ electric shock, fire.

element plug

To prevent this, a fuse is used in the circuit - at wall plug, in appliance, etc.

fuse (Wiki)

Circuit breaker (Wiki)

Usually a small tube with low melting metal wire inside

When large current flows, wire inside gets hot → melts → breaks → cuts off current → safe.

Or use a circuit breaker.

Earthing

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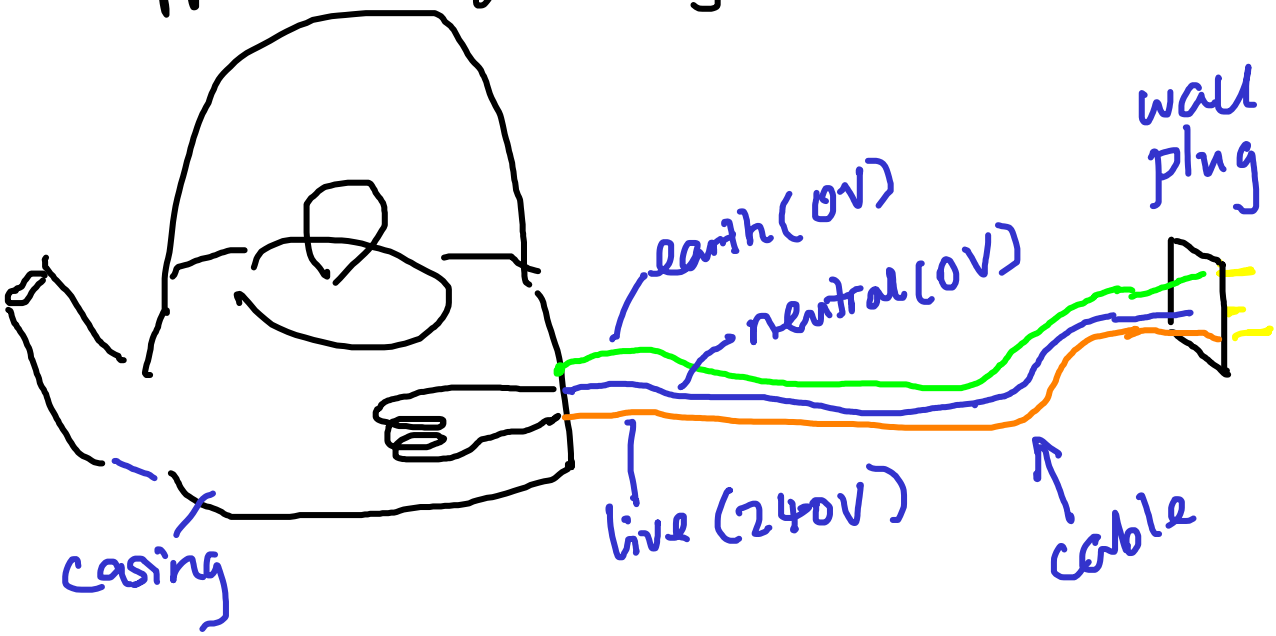
In Singapore, the UK and some countries, the cable contain 3 wires.

Two wires carry the current to/from the appliance - e.g. heating element.



One wire - Earth wire - connects to the casing.

If wet or damaged, live wire can touch casing
→ dangerous.

Earth wire - ensures casing stay 0V.
- Carries away large current and cause fuse to break.

Double Insulation - If no earth (some countries), then need two layers of e.g. plastic casing for safety.

Live, Neutral, Earth

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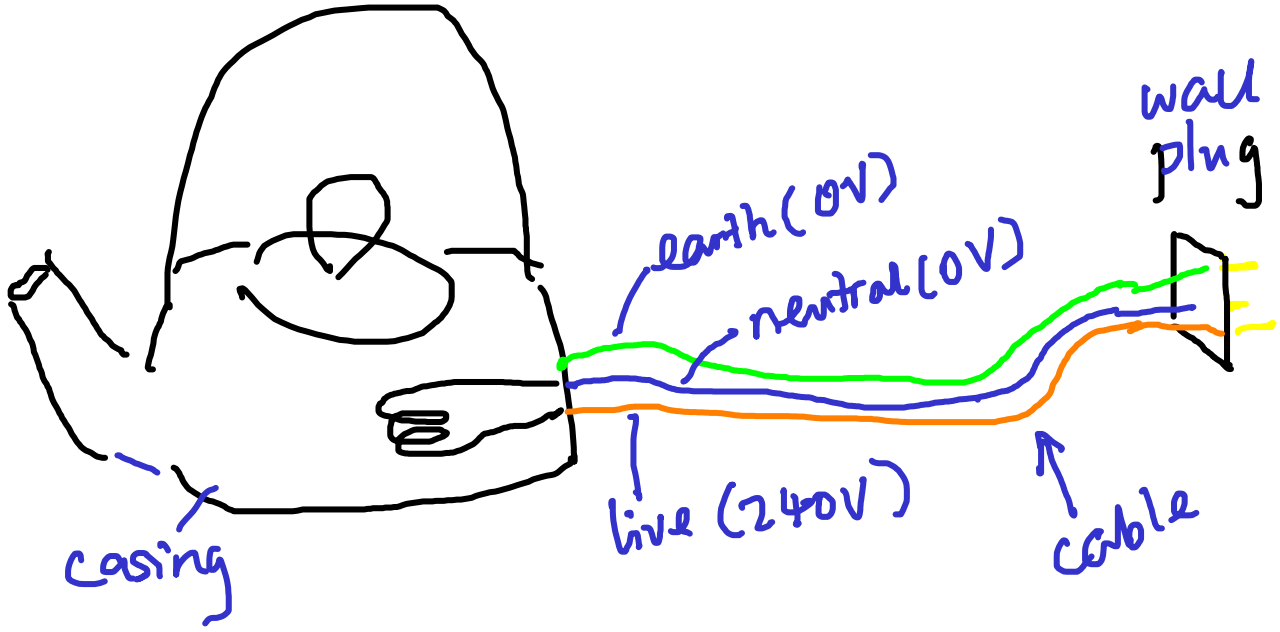
The 2 wires that carry current are called:

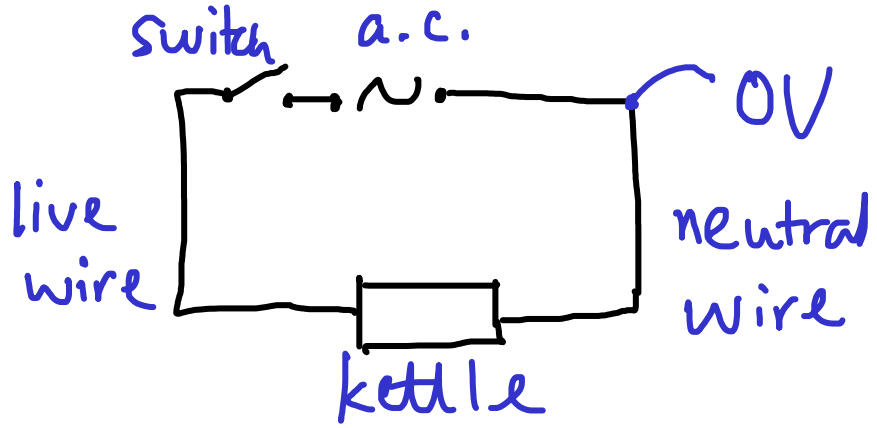
Live - at 240V ← (alternating current)

Neutral - at 0V.



Voltage on live wire changes direction 50-60 times per second.

The switch should be on the live wire.



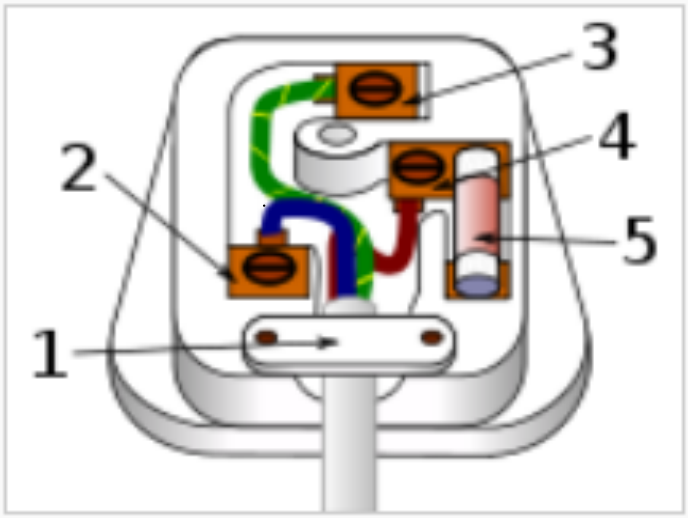
If it is on the neutral wire, kettle will remain "live" (240V) even when switched off.

describe the wiring in a mains plug

Mains Plug

Dr K M Hock

Wikipedia :



Internal wiring.

1. Cable grip
2. Neutral terminal
3. Earth terminal
4. Line terminal
5. Fuse

explain why switches, fuses, and circuit breakers are wired into the live conductor

Switches, fuses

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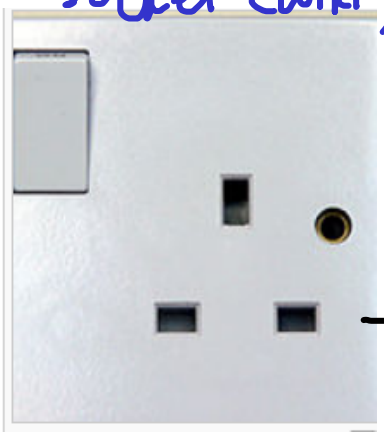
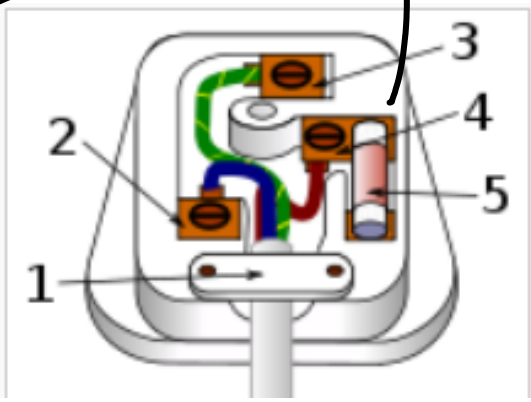
circuit breaker (wiki)

Socket (wiki)



connect to live wire



So when fuse breaks or switch off, appliance is not live (240V).