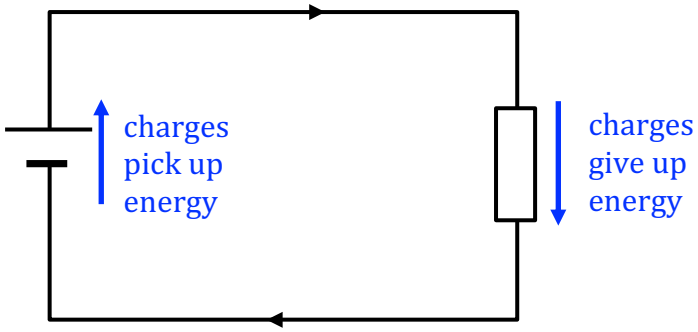
2.5.1 Electrical power

videos

In an electric circuit, energy is picked up by charges as they pass through a power supply (e.g. a battery). This energy is then distributed to components in the circuit.



Power is the amount of energy transferred every second.

$$P = \frac{\Delta E}{\Delta t}$$

Where ΔE=the amount of energy supplied in a given time=Δt.

The unit for power is the watt (W).

(1) Looking at the equation (above), what is an alternative unit for power? (Hint: energy is in joules (J), and time is in seconds (s).)

(2) Rearrange the formula (above) to make energy the subject (i.e. $\Delta E = \cdots$).

(3) A lightbulb has a power rating of 36W. How much energy is transferred to the bulb, when it is switched on for 60 seconds? (Hint: Use your rearranged equation from (2).)

You will recall, from section 2.4, that voltage is the amount of energy that one coulomb of charge carries:

$$V = \frac{\Delta E}{\Delta Q} \qquad (i)$$

Where ΔE=amount of energy carried by an amount of charge=ΔQ.

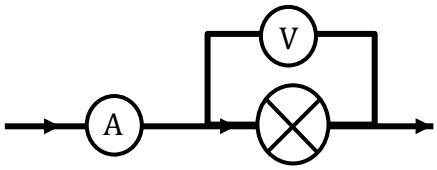
The unit for voltage is the volt (V).

(4) Looking at the equation, what is an alternative unit for voltage? (Hint: energy is measured in joules (J), and charge is measured in coulombs (C).)

You will also recall that the current is the amount of charge that flows in one second:

$$I = \frac{\Delta Q}{\Delta t} \qquad (ii)$$

Consider charges flowing through a bulb. We can use an ammeter to measure the current, and a voltmeter to measure the voltage drop (potential difference) across the bulb.



We can work out the energy transferred to the bulb every second (i.e. the power) by multiplying the current by the voltage:

$$P = I \times V$$

(5) By substituting the equation (i) and (ii) for I and V in the equation (above), and simplifying, show that you get the first equation $P = \frac{\Delta E}{\Delta t}$.

(6) A current of 3A flows through a bulb. A voltage drop of 4V is measured across the bulb. What is the power transfer to the bulb?

(7) Rearrange the equation $P = I \times V$ *to make current the subject (i.e.* $I = \cdots$*).*

(8) An electric toaster has a power rating of 1500W. The voltage dropped across the toaster in the mains voltage = 230V. What current flows through the toaster? (Hint: Use you rearranged equation from (7).)

The first equation shows us that power is how much energy is transferred every second (or the 'rate' of energy transfer). Therefore, we can write:

$$\Delta E = P \times \Delta t$$
$$= (I \times V) \times \Delta t$$

(9) An ammeter and voltmeter are used to measure the current through and the potential difference across a bulb, respectively. The ammeter reads 0.52A and the voltmeter reads 12.4V. How much energy is transferred to the bulb when it is switched on for 4 minutes. (Hint: take care to use time in seconds.)

(10) It is found that the energy given out as light is less than you have calculated in (9). Why is this?