



videos

2.6.3 The kilowatt-hour

The relationship between the electrical energy supplied and the electrical power is given by the formula:

$$E = P \times t$$

where t = time

If we use substitute in power in watts and time in seconds, we will calculate the energy supplied in joules.

Example

Question: An electric kettle has a power rating on 1700 W. It is switched on for 100 s. What is the energy transferred, in joules?

$$\begin{aligned} E &= P \times t \\ &= 1700 \text{ W} \times 100 \text{ s} \\ &= \underline{170000 \text{ J}} \end{aligned}$$

We can see that switching on a kettle for a very short time transfers a large number of joules of energy. You can image that the total energy in joules 'consumed' for a household over the course of 3 months (quarterly) will be an extremely large number.

An alternative (more convenient) unit for measuring the energy consumption of a household is the kilowatt-hour.

$$E = P \times t$$

If we measure power in kilowatts (kW) and time in hours (h), we can see that our energy will be measured in kilowatt-hours (kWh).

$$\text{energy (kWh)} = \text{power (kW)} \times \text{time (h)}$$

Example

Question: An electric kettle has a power rating on 1700 W (= 1.7 kW). It is switched on for 100 s (= 1.67 h). What is the energy transferred, in joules?

$$\begin{aligned} E &= P \times t \\ &= 1.7 \text{ kW} \times 1.67 \text{ h} \\ &= \underline{2.84 \text{ kWh}} \end{aligned}$$

1) ✍ Calculate the energy transferred by a cooker with a power rating of 2500 W switched on for 45 mins, in joules. (Hint: Don't forget to convert to seconds.)

2) ✎ Calculate the energy transferred by a cooker with a power rating of 2500 W switched on for 45 mins, in kilowatt-hours. (Hint: Convert to kilowatts and to hours.)

Electricity bills

A quarterly (once every 3 months) bill consists of two charges.

1. A charge for the amount of electrical energy consumed. There is a cost per kilowatt-hour of energy (e.g. 1 kWh = 25p) consumed.
2. A charge for being connected to the electricity supplier. This is a set charge called the 'standing charge' (e.g. £41 per quarter).

Example Bill

Quarter: January - March

Energy consumption = 760 kWh

Cost per kWh = 25p

Charge for electricity consumed = $760 \times 25\text{p} = \underline{\underline{£190}}$

Standing charge = £41

Total bill = $£190 + £41 = \underline{\underline{£231}}$

3) ✎ Work out the missing values for the quarterly bill, below:

Quarter: July-September

Energy consumption = 457 kWh

Cost per kWh = 31p

Charge for electricity consumed =

Standing charge = £73.50

Total bill =