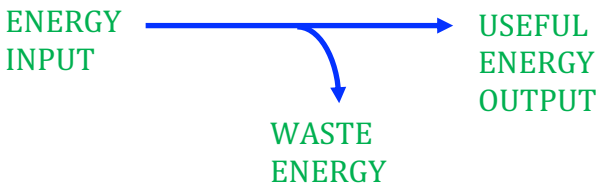
1.5.2 Efficiency

videos

The efficiency of a device is a measure of how much of the input energy ends up being transferred to useful energy. More efficient devices waste less energy.

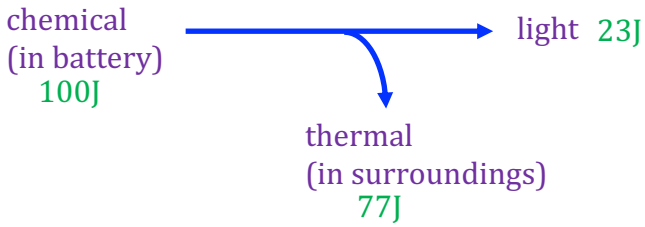


The efficiency of a device is given by the equation:

$$efficiency = \frac{useful\ energy\ out}{input\ energy}$$

It can be expressed as a fraction (e.g. 0.6) or as a percentage (e.g. 60%).

Consider the following energy transfer diagram for a torch:



We can see that only 23J of every 100J ends up as useful energy. Therefore, its efficiency is 0.23 or 23%. The calculation is:

$$efficiency = \frac{useful\ energy\ out}{input\ energy}$$

$$= \frac{23}{100}$$

$$= 0.23$$

(1) What is the efficiency of a low energy lightbulb, when the input energy is 120J and the waste energy is 40J? (Hint: The useful energy is what is left over.)

(2) Rearrange the equation to make useful energy output the subject. (e.g. useful energy output = ...)

(3) What is the useful energy output from a radio when the input energy is 300J and the efficiency is 0.65? (Hint: Use your rearranged formula.)

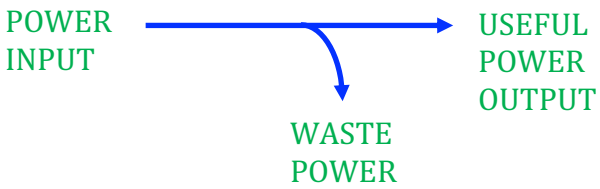
(4) Rearrange the equation to make input energy the subject. (e.g. $input\ energy = ...$)

(5) What is the input energy to a car when the output energy is 360000J and the efficiency is 0.35? (Hint: Use your rearranged formula.)

Power is a measure of the energy transferred every second.

$$power(W) = \frac{energy(J)}{time(s)}$$

This means that we can also calculate efficiency from values of power.



The efficiency is given by the formula:

$$efficiency = \frac{useful\ power\ out}{input\ power}$$

(6) A motor, with a power rating of 3.0W, lifts a 0.10kg weight through a vertical distance of 1.0m in 30 seconds. What is the efficiency of the system? (Hint: Work out the gravitational potential energy gained by the mass ($g.p.e = m \times g \times \Delta h$). Find the output power by dividing this by the time taken.)