1.5.1 Conservation of energy

The law of 'conservation of energy' states that:

The energy of an isolated system remains the same over time. This means that energy cannot be created or destroyed, only transferred from one energy store to another.

Consider the following:

We have a candle burning inside a sealed, insulated box. Because the box is insulated, no thermal energy can enter or leave. To start with, energy is contained in a chemical store (in the wax) and in the thermal energy of the gas molecules. The candle will burn for a short time as it uses up oxygen in the box. This will transfer energy from the chemical store (in the wax) to the thermal energy store of the gas molecules.

(1) What measurement could we make to show that the thermal (or internal) energy of the gas molecules had increased?

We could find the amount of fuel (wax) that had been used up, and from this, find the amount of chemical energy supplied. We would find that the chemical energy supplied is equal to the increase in thermal energy of the gas molecules.

An energy transfer diagram would look like the following:

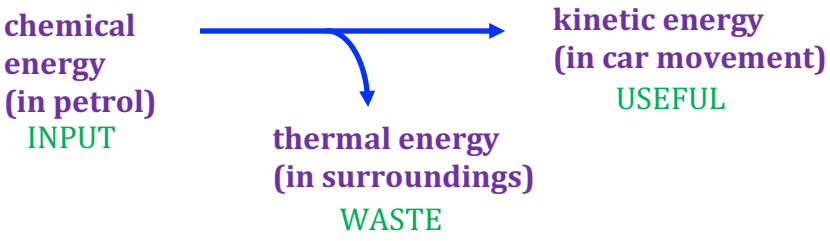
chemical energy (in wax) → **thermal energy (in gas molecules)**

This is only true if the candle+box system is completely isolated (i.e. no energy can enter or leave the box.)

(2) In reality, the increase in thermal energy of the gas molecules in the box is likely to be less than the chemical energy supplied. Why?

A car is a device for transferring energy from a chemical store (in the petrol) to a kinetic store (in its movement). This transfer is not perfect. The car also ends up heating the surroundings, through heat escaping from the engine, and from air resistance and friction. We consider these energy transfers as 'waste' transfers.

An energy transfer diagram for the car might look like the following:



(3) Draw energy transfer diagrams for the following: i) a battery powered torch, ii) a bicycle free-wheeling down a hill, iii) a slingshot firing a pebble.

(4) How could you change the design of a car, so that less energy is wasted heating the surroundings? (Hint: think about air resistance.)

(5) If less energy is wasted, more energy is available to transfer to useful energy. How would this affect the performance of the car?

A house in winter time can be considered as a device for transferring energy from a chemical store (in gas used for heating) to a thermal store (in gas molecules in the house). We design houses to maximise this useful energy transfer and to minimise the waste transfers that ultimately end up heating the surroundings outside the house.

(6) What can we do to minimise waste transfers i) through the walls, ii) through the roof, iii) through the floor?