Physics Knowledge Organiser
P1/2 - Energy transfer by heating

Energy Stores and Systems

A **system** is simply a small part of the universe that we choose to study. It consists of an object or objects, and we use systems to describe how energy changes in terms of how it is stored. Energy has to be conserved in a system, so it cannot be created or destroyed. However, it can change from one store to another, in an **energy transfer**.

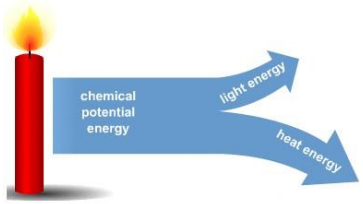
For example:
- Firing an object upwards transfers kinetic energy to gravitational potential energy
- When boiling water in kettle, electrical potential energy is transferred to thermal energy
- When using your phone, chemical potential energy is transferred to electrical energy, which is transferred to the surroundings, where it is stored as thermal energy.

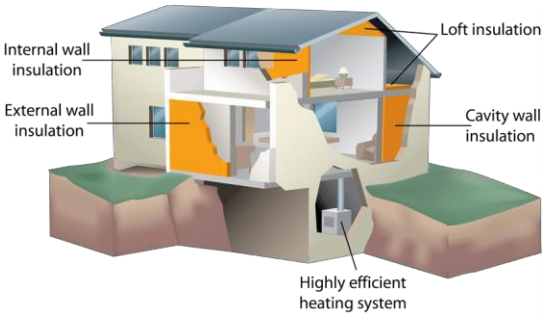
The amount of energy that a moving object has, the amount of energy stored by a stretched spring, and the amount of energy gained by lifting up an object can all be calculated. The equations for E_k, E_e, and E_p are on preceding pages.

Energy Transfers

In a system, the energy in the stores to start with can change form – we can say the overall energy in the system is **redistributed** – meaning it is transferred into other forms. In the end, the energy in the store is transferred to the surroundings. Often, the transfer to the surroundings is in the form of heat (thermal energy). With the candle example here, the chemical potential energy (energy store) is transferred to thermal energy, which is transferred to the surroundings in the end.

It is, in practice, very hard to go back the other way – for example, to transfer the heat energy from the candle back into chemical potential energy. This is what is really meant when people talk about 'saving energy' – overall, energy can't be destroyed so it can't be saved – but, we should try to save the energy stores we rely upon, such as fossil fuels (a huge store of chemical potential energy).





Key Terms	Definitions
Energy store	A system or object can act as an energy store. Energy allows work to be done (since work done = energy transferred). Good examples of energy stores are objects up high (they have gravitational potential energy), fuels (they have chemical potential energy), and stretched springs (they have elastic potential energy).
Energy transfer	The change of energy from one store to another. *Aka* work.
Dissipate	Simply, this means 'spread out'. When applied to energy being dissipated, this means that during energy transfers, some energy is stored in less useful ways. This can be called 'wasted' energy, since it is not transferred to form that is wanted.

Equation	Meanings of terms in equation and units
$\Delta E = m\, c\, \Delta\theta$	*ΔE = change in thermal energy (joules, J)* *m = mass (kg)* *c = specific heat capacity (joules per kilogram per degree Celsius, J/kg ^oC)* *$\Delta\theta$ = temperature change (^oC)*

Unwanted Energy Transfers

During any energy transfer, energy can be transferred usefully, meaning that the stored energy is transferred in a way that does useful work. However, some **dissipation** of the stored energy, in ways that are not useful, is unavoidable. We call the energy transferred in this way 'wasted energy' – meaning unwanted energy transfers have taken place.

Unwanted energy transfers can be reduced by, for instance, oiling/lubricating moving parts (reducing friction, therefore transfer to thermal energy) or insulating systems.

Thermal insulation is insulation that reduces transfer of thermal energy to the surroundings. Thermal conductivity measures how rapidly thermal energy is conducted by a material (so, metals have high thermal conductivity). For effective thermal insulation, you want materials with very low thermal conductivity. The thickness of the material also affects the effectiveness of thermal insulation. Not surprisingly, the thicker the material, usually the better the insulation. Always a consideration in house building – see diagram for examples.