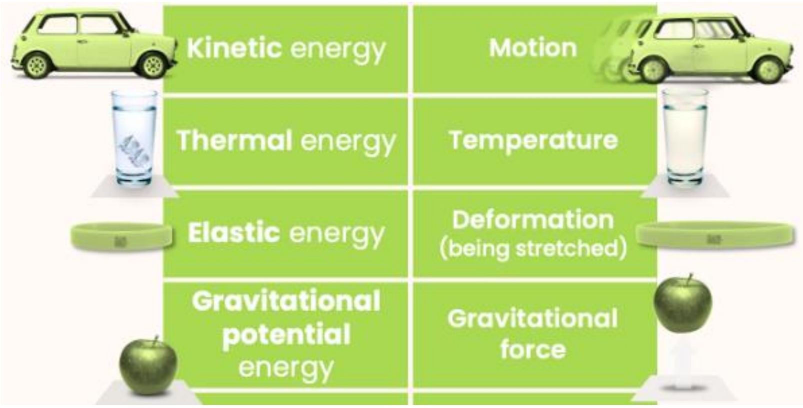
Energy, energy transfers and energy resources

Energy can be stored as kinetic, gravitational potential, thermal and elastic potential. It can be change from one store to another when a system changes. For example:

- an object projected upwards
- a moving object hitting an obstacle
- a vehicle slowing down
- bringing water to a boil in an electric kettle.



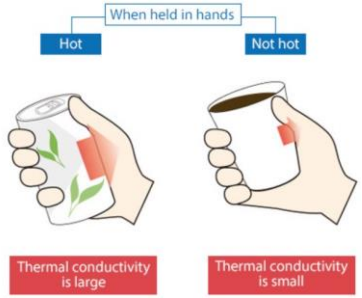
Energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed.

Whenever there are energy transfers in a system only part of the energy is usefully transferred. The rest of the energy is dissipated so that it is stored in less useful ways. This energy is often described as being 'wasted'.

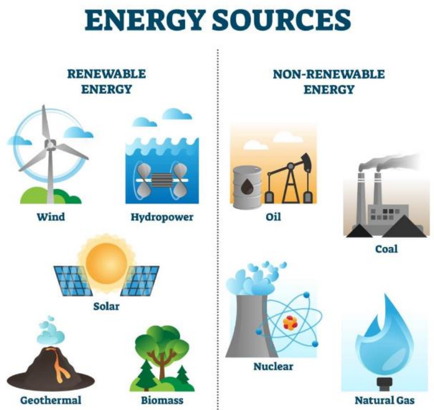
Unwanted energy transfers can be reduced in a number of ways, e.g. through lubrication and the use of thermal insulation.

The rate of cooling of a building is affected by the thickness and thermal conductivity of its walls.

The higher the thermal conductivity of a material the higher the rate of energy transfer by conduction across the material.



The main energy resources available for use on Earth, include fossil fuels (coal, oil and gas), nuclear fuel, bio-fuel, wind, hydro-electricity, geothermal, the tides, the Sun, water waves. Energy resources are either renewable or non-renewable.



Forces and work

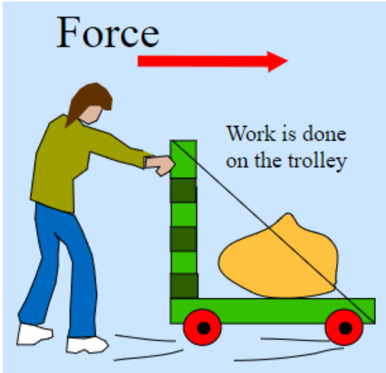
A force is a push or pull that acts on an object due to the interaction with another object. All forces between objects are either:

- contact forces – the objects are physically touching
- non-contact forces – the objects are physically separated.

Examples of contact forces include friction, air resistance, tension and normal contact force.

Examples of non-contact forces are gravitational force, electrostatic force and magnetic force.

When a force causes an object to move through a distance, work is done on the object.



Work done against the frictional forces acting on an object causes a rise in the temperature of the object.

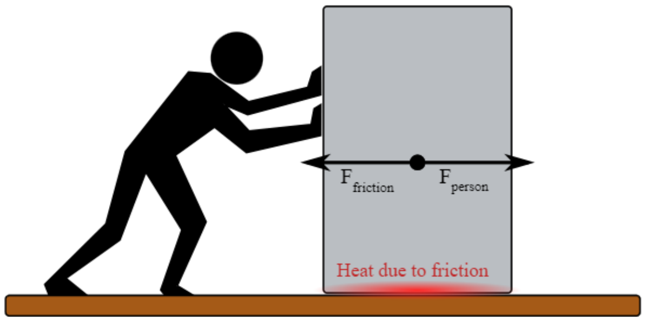


Figure 1: Man pushing a box opposed by friction.

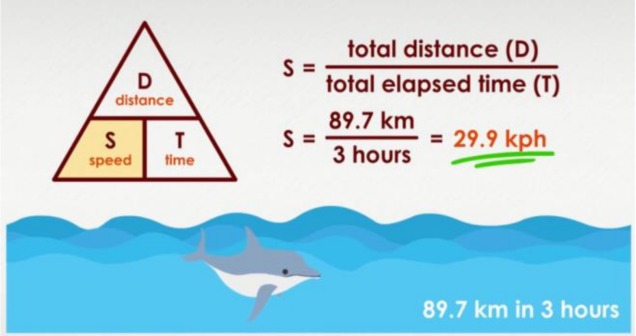
Speed and stopping distances

Speed is measured by the distance travelled in a certain time.

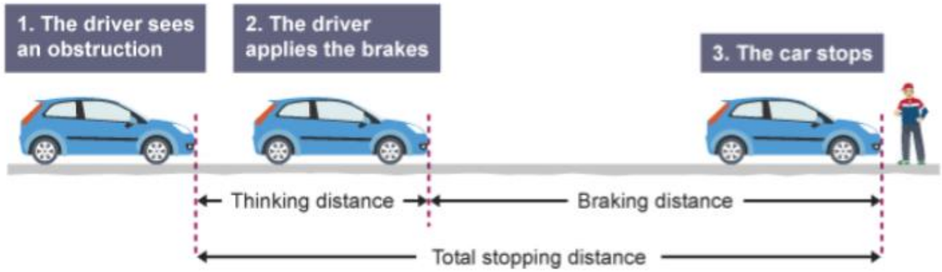
Units of speed include metres per second and kilometres per hour.

Simple calculations of average speed using the equation:

speed = distance ÷ time

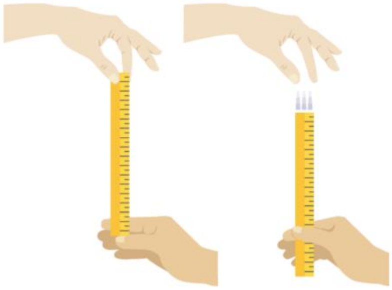


The stopping distance of a vehicle is the sum of the distance the vehicle travels during the driver's reaction time (thinking distance) and the distance it travels under the braking force (braking distance).



It always takes longer to stop if you are going faster because for a given braking force the greater the speed of the vehicle, the greater the stopping distance.

Reaction times vary from person to person. Typical values range from 0.2 s to 0.9 s.



You can measure reaction times by dropping and catching a ruler.

A driver's reaction time can be affected by tiredness, drugs and alcohol. Distractions may also affect a driver's ability to react.

The braking distance of a vehicle can be affected by adverse road and weather conditions, such as wet or icy conditions and poor condition of the vehicle, e.g. the vehicle's brakes or tyres.

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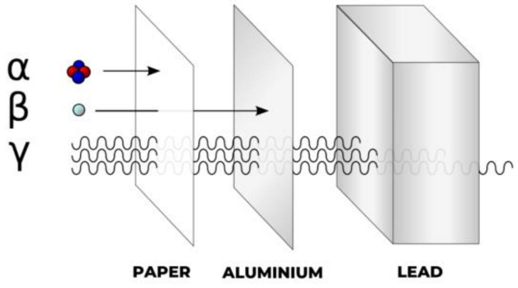
Atoms and nuclear radiation

Some atomic nuclei are unstable. The nucleus gives out ionising radiation. This is a random process called radioactive decay.

The nuclear radiation emitted may be:

- alpha particles
- beta particles
- gamma rays.



Penetrating power of alpha, beta and gamma

	Alpha Particles	Beta Particles	Gamma Rays
Penetration through materials	Not very far	Moderately far	Very far
Range in air	Travel a few centimetres through air	Travel a few metres through air	Travel very long distances through air - almost unlimited
Ionising Power	Strongly ionising	Moderately ionising	Weakly ionising

Dangers of ionising radiation

	Alpha Radiation	Beta and Gamma Radiation
Internal	Very dangerous, radiation easily absorbed by cells.	Less dangerous, radiation less likely to be absorbed.
External	Less dangerous, radiation less likely to reach the cells inside the body.	Most dangerous, radiation can penetrate the skin to reach the cells causing tissue damage.

Nuclear radiation is used in many different applications in everyday life, including medical imaging, cancer treatment, food preservation, and smoke detectors.

In medical imaging, nuclear radiation is used to produce images of the inside of the body, such as x-rays or CT scans.

In cancer treatment, nuclear radiation is used to kill cancer cells.

Nuclear radiation is also used to preserve food by killing bacteria and other microorganisms, and to detect smoke in smoke detectors.