Physics topic 1: Energy

1. Key Term

Key Term	Definition
Kinetic energy (KE)	The energy an object has due to its movement
Gravitational potential energy (GPE)	The energy an object has due to its height
Elastic potential energy	The energy stored in an elastic object when you stretch or squash it
Thermal energy	The energy a substance has because of its temperature
Chemical energy	The energy stored in fuels, food, and batteries
Conservation of energy	Energy cannot be created or destroyed only transferred.
Work done	The energy transferred by a force
Dissipation	The process of energy being transferred or lost to the surroundings
Friction	A force that opposes movement
System	An object or group of objects
Closed system	An isolated system where no energy transfers take place into or out of the energy stores in the system.
Useful energy	Energy in the place it is wanted in the form that it is needed in
Wasted energy	Energy that is not usefully transferred, usually as thermal to the surroundings

2. Calculating efficiency

1. Efficiency = $\frac{\text{Useful output energy transferred by the device}}{\text{Total input energy supplied to the device}}$

2. Efficiency = $\frac{\text{Useful power out}}{\text{Total power in}}$

3. No device can be more than 100% efficient.

4. Machines waste energy because of friction between their moving parts, air resistance, electrical resistance, and noise.

5. Energy is transferred by:

1. Heating
2. Waves
3. Electric current
4. Force when it moves an object.

3. Equations to recall and apply

Work done, W (joules, J) = **force applied, F** (newtons, N) x **distanced moved, s** (metres, m)

Change in objects gravitational potential energy store, ΔE_p (joules, J) = **mass, m** (kilograms, kg) x **Gravitational field strength, g** (newtons per kilogram, N/kg) x **Change of height, Δh** (metres, m)

Elastic potential energy, E_e (joules, J) = ½ x **spring constant, k** (newtons per metre, N/m) x **extension^2 , e ^{2}** (metres, m)

Kinetic energy, E_k (joules, J) = ½ x **mass, m** (kilograms, kg) x **speed^2 , v ^{2}** (metres per second, m/s)

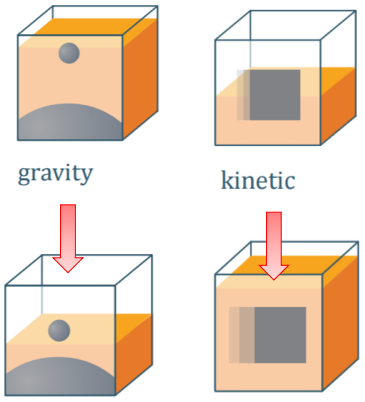
4. Power

1. The more powerful an appliance, the faster the rate at which it transfers energy

2. **Power, P** (watts, W) = $\frac{\textbf{Energy transferred to appliance, E} \text{ (joules, J)}}{\textbf{Time taken for energy to be transferred, t} \text{ (seconds, s)}}$

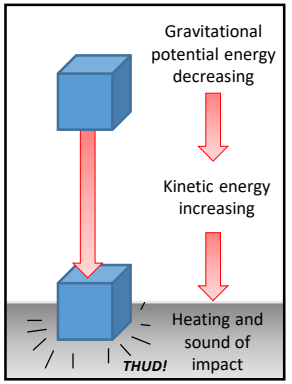
3. The power wasted by an appliance = total power input - useful power output

6. Conservation of energy in action



A falling object:

1. Decreases its GPE store
2. Increases its KE store as it falls
3. Waste energy transferred as thermal and sound



4. Energy Resources			
Energy Resource	Renewable	Advantages	Disadvantages
Fossil Fuels	No	• Low cost. • Easily transportable. • Reliable.	• Produces large amounts of Carbon Dioxide. • Produces some Sulfur Dioxide.
Nuclear	No	• Generates a lot of electricity. • Reliable.	• Expensive to construct and run. • Produces dangerous radioactive waste which will last for thousands of years.
Solar	Yes	• No fuel costs. • No pollution.	• Expensive to set up. • Doesn't work at night.
Wave	Yes	• No fuel costs. • Reliable.	• Can damage marine ecosystems. • Not everywhere is near water.
Tidal	Yes	• No fuel costs. • No pollution. • Reliable.	• Can damage marine ecosystems. • Not everywhere is near water.
Wind	Yes	• No fuel costs. • No pollution.	• Not always reliable. • Noisy. • Some think they are ugly (eyesore).
Geothermal	Yes	• No fuel costs. • No pollution.	• Very few areas where it is accessible.
Biomass	Yes	• Low cost. • Readily available. • Carbon neutral.	• Large scale land use requiring lots of water. • Destruction of habitat to grow crops.
Hydro-electric	Yes	• No fuel costs. • Reliable. • Easily controlled.	• Requires flooding land to build

Carbon neutral: a process by which no extra carbon is released to the atmosphere.