Physics topic 1: Energy

1. Energy stores

Key Term	Definition
Kinetic energy store	Describes the energy an object has because it is moving.
Gravitational potential energy store	Describes the energy stored in an object because of its position, such as an object above the ground.
Elastic potential energy store	Describes the energy stored in a springy object when you stretch or squash it.
Thermal energy store	Describes the energy a substance has because of its temperature.
Chemical energy store	This store describes energy stored within foods, fuels or the chemicals found in batteries. The energy is transferred during chemical reactions.
Nuclear energy store	Describes the energy an atom holds within its nucleus.
Magnetic energy store	Describes the energy stored in an object because of its position within a magnetic field.
Electrostatic energy store	Describes the energy stored in an object because of its position within an electric field.

2. Energy pathways

Key Term	Definition
Mechanical pathway	Describes how energy is transferred when forces act on a system.
Electrical pathway	Describes how energy is transferred when a current flows within a system.
Heating pathway	Describes how energy is transferred there is a temperature difference within a system.
Radiation pathway	Describes how energy is transferred by waves.

3. Key terms

Key Term	Definition
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.

4. Calculating efficiency

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

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

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. Equations to recall and apply

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

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

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

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

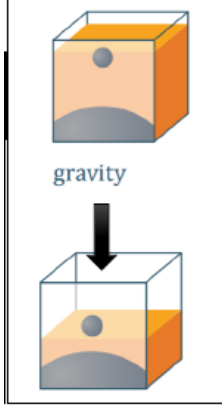
6. Power

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

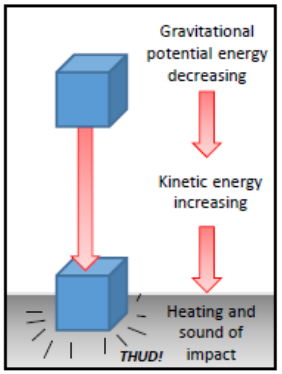
2. **Power, P** (watts, W) = $\dfrac{\text{Energy transferred to appliance, E (joules, J)}}{\text{Time taken for energy to be transferred, t (seconds, s)}}$

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

7. 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



A roller coaster is at the top of the slope and begins accelerating down the hill.

Decrease in gravitational potential energy store → **Mechanical** → Increase in kinetic energy store

A candle is lit and begins to burn.

Decrease in chemical energy store → **Heating** → Increase in thermal energy store of the surroundings

Decrease in chemical energy store → **Radiation** → Light waves

8. 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.