PHYSICS: Conservation of Energy

Energy Stores	
Chemical	In Chemicals – e.g. in fuels or batteries
Kinetic	In moving objects
Thermal	In warm objects
Elastic Potential	In stretched or compressed objects
Gravitational Potential	Due to the position of an object in a gravitational field
Nuclear	In the nucleus of atoms
Magnetic	Magnetic objects in a magnetic field
Electrostatic	Charged objects in an electric field
Energy Transfers	
By Forces	When a force moves through a distance
By Heating	Because of a temperature difference e.g. Convection, Conduction
By Electricity	When a charge moves through a potential difference
By Radiation	e.g. Electromagnetic waves or sound

Energy Transfers by Heating

Conduction	Transfers energy by passing vibrations between particles in solids
Convection	Transfers energy in fluids (liquids and gases). Warm fluid is less dense and rises, setting up a convection current
Radiation	Infra-red radiation is absorbed and emitted by objects.

Gravitational Field Strength is given the symbol g and has a value of 10 N/kg on Earth.

Stores and Transfers: Key Facts and equations

Law of Conservation of Energy: Energy cannot be created or destroyed, only transferred from one store to another

$$\text{Kinetic Energy (J)} = \frac{1}{2} \times \text{mass (kg)} \times \text{speed}^2\ (\text{m/s})^2 \qquad KE = \frac{mv^2}{2}$$

$$\text{Change in gravitational potential energy (J)} = \text{mass (kg)} \times \text{gravitational field strength (N/kg)} \times \text{change in height (m)} \qquad \Delta GPE = mg\Delta h$$

Energy Efficiency: Key Facts and Equations

Efficiency tells us how much energy is transferred to a useful store.
It is a number between 0 and 1.

$$\text{Efficiency} = \frac{\text{Useful Energy Transferred (J)}}{\text{Total Energy Input (J)}}$$

Energy that is not usefully transferred is wasted.

Energy is often lost to the surroundings by heating. The energy is spread out (dissipated) and is wasted.

In mechanical (moving) systems this energy loss is minimised by using lubrication to minimise friction.

In systems where thermal energy is useful insulation is used to slow down energy transfer to the surroundings

GCSEPod: Efficiency

Things to do

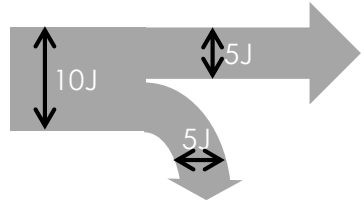
Can you come up with a mnemonic to help you remember the Energy Stores? What about the Energy Transfers?

You need to remember all three equations on this page for your exams. Take some time to memorise them now!

Flow Diagrams show Energy Transfers

Energy stored in a moving car (kinetic energy) → Energy stored in hot brakes (thermal energy)

Sankey diagrams show how much energy is transferred
The width of the arrow corresponds to the amount of energy



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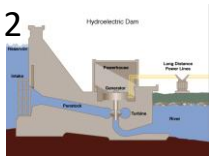
PHYSICS: Conservation of Energy



GCSEPod: Energy Resources

Renewable Energy Resources – Won't run out, usually better for the environment	
1. Solar Power	Converts sunlight into electricity e.g. solar panels. Only useful in daylight
2. Hydroelectricity	Uses falling water to turn turbines. Water can be pumped uphill to store energy for later. Dams flood land that could be used for farming.
3. Wind Turbines	Use wind to generate electricity. Only useful when its windy. Unsightly.
4. Tidal Power	Uses flow of water from tides to turn turbines. Only available at certain, but predictable, times. May affect wildlife.
5. Wave Power	Uses motion of waves to generate electricity.
6. Biofuels	Crops grown and burnt to produce electricity. Takes up land that could be used for food production.
7. Geothermal	Uses hot rocks underground to heat water. Only available in some places.
Non-renewable Energy Resource – Finite resource that will run out one day	
Fossil Fuels Gas Oil Coal	Contribute to Global Warming as they release Carbon Dioxide.
Nuclear Fuels	Don't contribute to Climate Change. Produce nuclear waste which is difficult to dispose of.

Check Your Understanding

Describe the energy transfers for a petrol driven lawnmower, starting with the energy stored in the fuel and finishing with where the energy ends up.

Draw a sankey diagram for a television. For every 100J of energy transferred in to the TV 60J are wasted as thermal energy, 10J are transferred as (useful) sound energy. How is the rest of the energy transferred, and how much?

What is the efficiency of the TV in the question above?

Why does oiling the chain of your bike make it more efficient?

Some central heating systems have hot-water tanks to store hot water. How are these made more efficient?

What is the law of conservation of energy?

If I lift a 3kg mass from the floor to my shoulder (1.8m) how much gravitational potential energy does it gain?

Assuming I'm 100% efficient how much energy did I use to lift the mass?

If I throw a 500g ball at 1.5 m/s how much Kinetic Energy does it have? Remember to convert the mass into kg.

A 90kg person climbs up a 10m diving board. Calculate how much gravitational potential energy they have.

If the person jumps off the diving board state how much kinetic energy they have just before they hit the water. (Remember the law of conservation of energy)

Use this number to work out how fast they are travelling as they hit the water.

Do the same calculations for a 120kg person climbing the same diving board. What do you notice?

6 Mark Question
There are several large-scale energy resources which are suitable alternatives to fossil fuels in some situations.
Two of these alternatives are hydro-electric power and solar power.
Compare hydro-electric power with solar power as energy resources for the large-scale generation of electricity.