KNOWLEDGE

Physics Topic P1
Conservation and dissipation of energy

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Section 1: Key terms

Dissipation	Energy becoming **spread out** to the stores of surrounding objects (usually wasted thermal energy.)
Lubrication	A method of reducing unwanted energy transfers by application of a **lubricant** (e.g. **oil**) to **reduce friction**. Occurs in machines.
Insulation	A method of reducing energy transfers by the use of **insulators**. Occurs in buildings e.g. Loft insulation.
Conservation of energy	The law that states that **energy cannot be created or destroyed**.
Closed system	An isolated system in which **no energy transfers** take place **out of or into** the **energy stores** of the system.
Work	Work is done on an object when a force makes the object move.
System	Object or group of objects.
Friction	A **contact force** resisting the relative motion between two surfaces. Friction in machines always **causes energy** to be **wasted**.
Input energy	**Energy supplied** to a device.
Useful energy	Energy transferred to where it is wanted in the way it is needed.
Wasted energy	Energy that is **not usefully** transferred.
Efficiency of a device	The proportion of the total input energy that is transferred in useful ways.

Section 3: Methods of energy transfer (also known as energy carriers)

Mechanical	Energy transferred by forces acting on objects.
Electrical	Energy transferred when an electric current flows through a device.
Radiation	Energy transferred by electromagnetic radiation (light, microwaves, sound etc.)
Heating	Energy transferred by conduction, convection or radiation.

Section 2: Different kinds of energy stores

There are a limited number of **energy stores**.

Chemical energy	(e.g. fuel + oxygen) – Can be changed by bonds being made/broken
Kinetic energy	All **moving** objects have it.
Gravitational Potential energy	Energy stored in objects raised up against the force from **gravity** (possessed by anything that can **fall**.)
Elastic Potential energy	Energy stored in an object that has been **stretched** (stretched springs, rubber bands, elastic band etc.)
Thermal (Heat) energy	Flows from **hot** objects to colder objects.
Nuclear store	Energy stored in the **nuclei** of atoms. Can be released by the fusing or splitting of nuclei.
Magnetic	Two separated magnets that are attracting, or repelling.
Vibrational	Energy from vibrations or moving to and fro (e.g. a pendulum.

Light, electrical (as in a current) or sound are **not energy stores**. These are active processes and cannot be stored in a stable state. Electricity is a **flow of charge** that **transfers energy** from **one energy store to another**.

Section 4: Energy transfers

A Coal fire	Energy is shifted from a store when a fuel like coal burns. The chemical store (fuel) is depleted and the thermal store is filled.
Bow & arrow	Elastic potential energy → kinetic and thermal energy
Placing a book on a shelf	When the book is lifted onto the shelf, energy is shifted from the chemical store of your arm to the gravitational store of the book.
Apple falling from a tree	When an apple falls and gains speed, its store of gravitational potential energy decreases and its kinetic energy store increases. When it hits the ground its kinetic energy is then transferred into thermal and sound energy.

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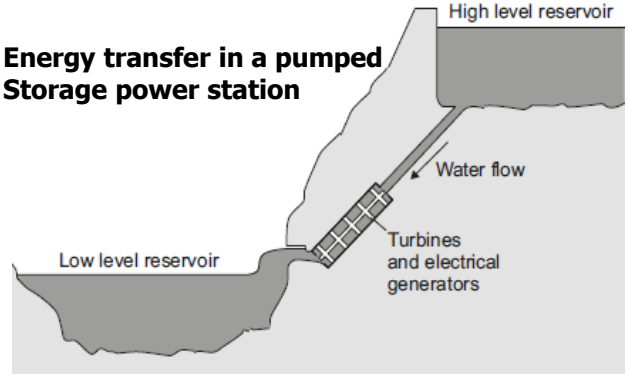
Energy transfer in a pumped Storage power station



When electricity is needed, water from the high level reservoir is allowed to flow into the low level reservoir. The flowing water generates electricity. The water in the high level reservoir stores **gravitational potential energy**. The flowing water has **kinetic energy**. The water turns the turbine which is connected to the generator. The generator produces some **sound**, this is **wasted energy**.

Section 5: Equations to learn

Equation	Units
Kinetic energy = 0.5 x mass x velocity^2 $E_k = 0.5\ m\ v^2$	Energy – Joules (J) Mass – kilograms (kg) Velocity – metres per second (m/s)
Gravitational potential = mass x gravitational field x height energy strength $E_p = m\ g\ h$	Energy – Joules (J) Mass – kilograms (kg) Gravitational field strength – Newtons per kilogram (N/kg) Height – metres (m)
Power =energy transferred ÷ time $P = \frac{E}{t}$	Power – Watts (W) Energy transferred – Joules (J) Time – seconds (s)
Power = work done ÷ time $P = \frac{W}{t}$	Power – Watts (W) Work done – Joules (J) Time – seconds (s)
Work done = force x distance moved	Work done – Joules (J) Force – Newtons (N) Distance – Metres (m)
Efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$	Energy – Joules (J)
Efficiency = $\frac{\text{useful power output}}{\text{total power input}}$	Power – Watts (W)

Section 6: Improving efficiency (HT)

Why devices waste energy	How to reduce the problem
Friction between moving parts **causes heating**	**Lubrication** of moving parts **reduces friction**
The resistance of a wire causes wire to get **hot** when **current passes** through.	Use **wires** with **as little resistance** as possible
Air resistance causes force on a vehicle that **opposes** it's motion.	**Streamline** the **shape** of the vehicle to reduce air resistance.
Working machinery **creates sound**	**Tighten loose parts** to reduce vibration which will reduce the noise.

Section 7: Energy dissipation & Electrical appliances

An electrical appliance is designed for a particular purpose and should dissipate (waste) as little energy as possible.

Appliance	Useful energy	Wasted energy
Light bulb	**Light** emitted from glowing element	Filament heats surroundings
Electric heater	**Heating** the surroundings	Light emitted from the glowing element
Toaster	**Heating** bread	Toaster case heats up and heats air around it.
kettle	**Heating** water	Kettle itself also heats up and the air around it.
TV	Light and sound	Heating of the TV's casing and heat transferred to surroundings.