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WORK, ENERGY, POWER

Work

- Work done = Energy transferred
- Work done is the energy transferred when a force moves an object.

Work done = force $\times$ distance

$$\Delta W = \bar{F} \times d$$

Energy

- An object may have energy due to its motion (kinetic energy) or its position (potential energy), and energy may be transferred or stored.

Potential energy

- The energy of an object due to its position.

Potential energy = mass $\times$ gravitational pull $\times$ vertical distance

$$PE = mgh$$

Kinetic energy

- The energy of an object due to its motion.

Kinetic energy = $\frac{1}{2} \times \text{mass} \times \text{speed}^2$

$$KE = \frac{1}{2}mv^2$$

Other forms of energy

- Chemical : energy stored in a substance and released when chemical reactions take place.

eg. car battery

- Elastic strain : energy stored in an elastic object when stretched.
eg. stretched spring

- Nuclear: energy released when nucleus of an atom splits.
eg. uranium fuel rod in a nuclear reactor
- Thermal: energy transfer from a hot object to a cold object
eg. heat radiation from burning coal
- Light: energy transfer by light.
eg. light from a torch
- Sound: energy transfer by sound waves.
eg. sound from a drum
- Electrical: energy transferred by an electric current.
eg. electric heater switched on

Conservation of energy

- Energy cannot be created or destroyed. It can only be transferred from one place to another or transformed from one form to another.

Efficiency

- A measure of how much energy supplied to a device is useful.
- Measured in joules

$$\frac{\text{useful energy output}}{\text{energy supplied}} \times 100\% = \text{efficiency}$$

or

$$\frac{\text{useful power output}}{\text{power input}} \times 100\% = \text{efficiency}$$

Power

- Rate of transfer of energy.
- Measured in watts (W).
- $\text{Power} = \frac{\text{energy transferred (joules)}}{\text{time taken (seconds)}}$

$$P = \frac{E}{t}$$

- One watt is a rate of transfer of energy of one joule per second.

Energy resources

- A petrol engine is used to turn on a petrol generator.
- chemical $\rightarrow$ heat (+light) $\rightarrow$ kinetic (+sound+heat) $\rightarrow$ electrical
is the energy flow diagram for fuel for electricity.
- Electricity generators are driven by turbines.
- Gas-fired power stations' turbines can be switched on very quickly. Energy output, although is not the same, as energy, in the form of heat, is given to surroundings.
- A wind turbine is an electricity generator on top of a tall tower.
- A wave generator is a floating generator turned by waves.
- Hydroelectricity generators are turned by water running downhill.
- Tidal power stations trap each high tide and use it to turn generators.
- Geothermal energy is released by radioactive substances deep inside Earth.
- The Sun is the source of all energy except geothermal, nuclear,

and tidal. Moon controls movement of water due to its gravity.

- Solar energy can be converted into electricity using solar cells or used to heat water in solar heating panels.
- Panel has a black cover, which absorbs heat.
- Back of the panel is insulated so heat is not lost.
- Panel is filled with oil so it heats up faster.
- Water passes through copper pipes and heat is transferred from the oil to the water.
- Hot water is collected in an insulated tank.

Nuclear fission

- Nuclear fission occurs when a uranium nucleus splits due to being struck by a neutron. Energy is released.
- When uranium atoms undergo fission, two or three neutrons may be released, causing a chain reaction in the core of the reactor.
- Thermal energy in the core is taken away as a fluid, coolant which flows through pipes and makes water steam. Steam turns turbines.

Nuclear fusion

- Nuclear fusion occurs when two nuclei are forced close enough together so they form a single large nucleus.
- Energy is released by nuclear fusion in the Sun.
- A collection of unbound nuclei is known as plasma.
- Plasma, in a fusion reactor, is heated by passing large current.
- The plasma does not touch the walls because it has a magnetic field. If it did not, it would become cold and fusion would stop.