

Keywords: Conduction, convection, radiation, kinetic, gravitational, chemical, elastic

**Convection**- Liquids and gases expand when they are heated. The particles move faster and the gap between particles widens. The liquid or gas in hot areas is less dense than the liquid or gas in cold areas, so it rises into the cold areas. The denser cold liquid or gas falls into the warm areas. In this way, convection currents are set up

**Conduction**-energy is transferred via particles colliding. It happens quicker in solids due to particles being close together. It is quick in metals as electrons are free to move throughout metal.

**Radiation**

Travel as waves, known as thermal/infra red radiation. The heat from the sun reaches us in this way, the waves can travel through a vacuum.

**Types of Energy**

- Light
- Sound
- Gravitational Potential (objects above the Earth's surface have this)
- Electrical
- Kinetic (moving)
- Chemical
- Elastic (stretched or compressed objects)
- Thermal
- Nuclear

# P1a) Energy & Electricity

**Emitters of radiation**

White/silver surfaces emit less thermal radiation. Polar bears are white so they emit less thermal radiation.

**The Energy Law**

Energy can't be created or destroyed it is just transferred into different forms. It is measured in Joules (J)

Electrical → Heat (useful)  
Light/sound (wasted)

**Energy Efficiency**

Efficiency =  $\frac{\text{useful energy out}}{\text{total energy in}}$

To convert to a percentage  $\times 100!$

Efficiency =  $\frac{15}{20} = 0.75$

**Reducing Heat Loss Examples**

- Flasks have a vacuum layer so conduction and convection don't occur.
- Silver materials used so less thermal radiation emitted.
- Larger objects have a smaller surface area : volume ratio so less heat is lost.
- Loft insulation as hot air rises (convection)
- Double glazing has a layer of air as conduction is slower in gases.

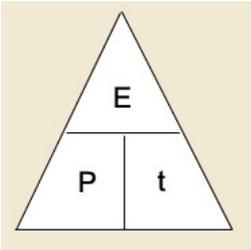
Keywords: Efficiency, power, joule, nuclear, geothermal. Greenhouse effect, thermal, vacuum, renewable, turbine, generator.

## Power

$$\text{Power (W)} = \frac{\text{energy (J)}}{\text{time (s)}}$$

Power is the rate at which energy is transferred.

1 watt means 1 joule of energy is transferred every second.



## Electricity Costs

Measured in kilowatt-hours (kWh) the cost per unit also needs to be known.

$$\text{Energy used (kWh)} = \text{power (kW)} \times \text{time (hours)}$$

Take care with units!



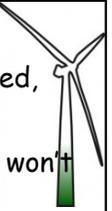
## Fossil Fuels

Coal (highest start up time), oil and gas (shortest start up time). Disadvantages  
-Carbon dioxide produced -global warming  
-Sulphur dioxide produced (acid rain)  
-Non renewable

## Wind

**Advantages** - no Greenhouse gases produced, renewable, no fuel costs

**Disadvantages** - noise and visual pollution, won't always work

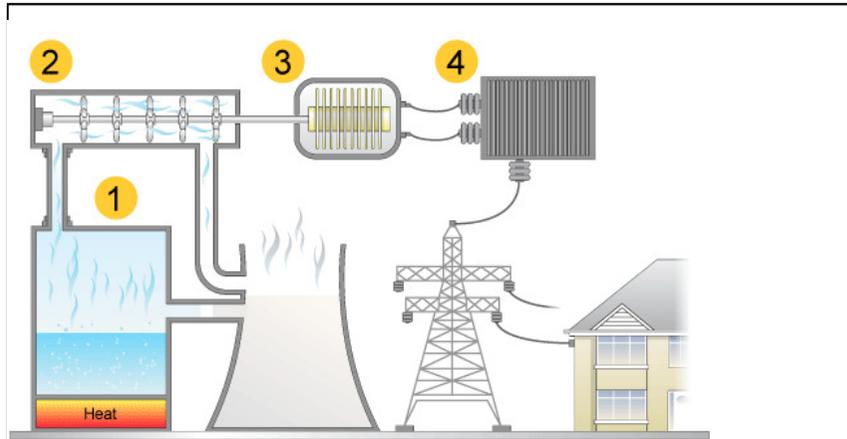


## Nuclear

Chemical reactions involving uranium and plutonium release heat which is used to boil water in power stations.

**Advantages** - no Greenhouse gases produced

**Disadvantages** - non renewable, hazardous waste produced which must be dealt with.



## Electricity and The National Grid

- 1- Fuel is burnt to heat water to make steam
- 2- The steam is used to spin a turbine
- 3- The spinning turbine spins a generator which produces electricity.

- 4- The electricity goes to transformers to produce the correct voltage

Step up transformers increase the voltage, step down transformers reduce voltage. The National Grid carries energy at a low current as this means less energy is lost as heat, but it requires a high voltage.

## Water (tidal, wave & hydroelectric)

The movement of water is used to drive turbines.

**Advantages** - no Greenhouse gases produced, renewable, hydroelectric and tidal are reliable

**Disadvantages** - can only be used in certain locations, loss of habitats and farmland.



## Solar

Solar cells convert light into electricity. Solar panels are used to heat water

**Advantages** - renewable, no fuel costs, no harmful gases produced

**Disadvantages** - expensive and inefficient, need a sunny climate, won't work at night.



## Geothermal

Cold water is heated using rocks within the Earth, the resulting steam is used to drive turbines.

**Advantages** - renewable, no fuel costs, no harmful gases

**Disadvantages** - very few suitable sites.

## Colours

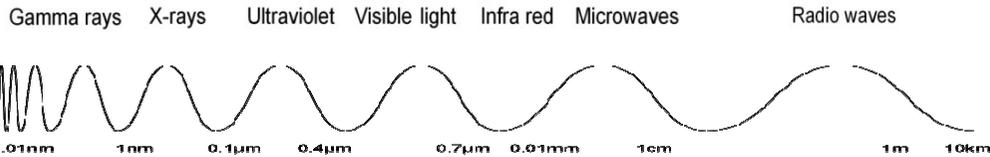
Dark colours absorb more heat.

Light colours reflect more heat



## Extra Notes

Keywords: Electromagnetic radiation, reflected, absorbed, transmitted, wavelength,



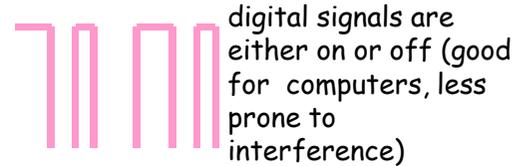
**Electromagnetic Radiation**

Waves move energy they can be reflected, transmitted or absorbed.

When absorbed it: makes the substance hotter

may create an alternating current with the same frequency as the radiation

**Analogue and digital signals**



**Gamma, x-rays, ultraviolet**

Gamma and x-rays mainly pass through soft tissue. Large doses can kill cells, small doses can cause cancer



**Infra red and visible light**

Can send signals down optical fibres and so travel in curved paths



**Microwaves**



can pass through Earth's atmosphere and are used to send signals too and from satellites

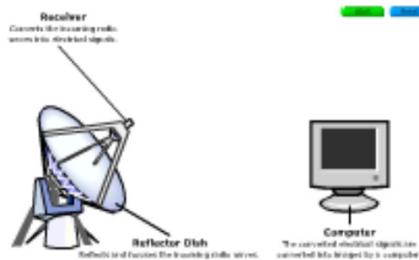
**Wave speed**

$$\text{Wave speed (v) in m/s} = \text{frequency (f) in Hz} \times \text{wavelength (\lambda) in m}$$

All electromagnetic waves travel at 300,000,000 m/s in a vacuum

**Telescopes**

Observations are made using telescopes on earth that detect light, radio and x-rays. Easy to fix but not all e.m waves reach earth.



in space all e.m.waves can be detected using satellites. The atmosphere does not get in the way but this is very expensive

**Red shift and doppler effect**



If something is moving away it's wavelength becomes longer, and frequency lower. For light it shifts to the red end of the spectrum

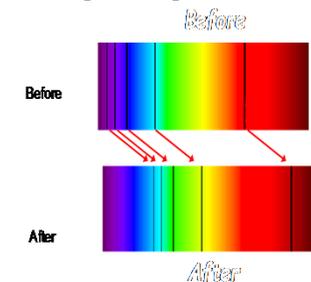


The Doppler Effect for a moving sound source

**Big Bang Theory**

The further away a galaxy is the bigger the redshift, therefore the faster the galaxy is moving away. This shows the universe is expanding

The absorption lines have all been "shifted" towards the longer wavelength end (red end)...



This supports the big bang theory that the universe started from a single point 15 billion years ago