

Electromagnetic Spectrum

Radio waves	Micro waves	Infra Red	Visible Light	Ultra Violet	X-Rays	Gamma Rays
1–10 ⁴ m	10 ⁻² m	10 ⁻⁵ m	10 ⁻⁷ m	10 ⁻⁸ m	10 ⁻¹⁰ m	10 ⁻¹⁵ m

Wavelength

Long wavelength Low Frequency → Short wavelength High Frequency

All EM waves travel at the same speed through a vacuum.

Radio Waves

Made using an **AC** supply – this creates oscillating electric and magnetic fields (EM waves). The frequency of the wave depends on the frequency of the alternating current. Once transmitted the radio wave is absorbed by a receiver. The energy in the wave is transferred to the **electrons** in the receiver, causing them to oscillate. These in turn cause electrons in a circuit to oscillate at the **same frequency** as the wave.

Radio waves are used for **communication**:

- **Long wave** radio (1 to 10K wavelength) can be transmitted around the world because they diffract around the earth's surface and hills.
- **Short wave** radio (10m – 100m wavelength) are reflected off the ionosphere in the atmosphere so can also be transmitted long distances.

Dangers of EM Waves

UV can damage surface cells, causing sunburn and increasing the risk of cancer.

X-rays and gamma rays are ionising, meaning they can knock electrons off atoms. This can lead to mutations in DNA, destroy cells and cause cancer.

Radiation dose is measured in Sieverts (Sv), a measure of the risk of harm. This risk depends on the total amount of radiation absorbed and how harmful it is. This can be different for different body parts.

Microwaves

Used to communicate with satellites (eg. TV, mobile phones). The signal is sent from a transmitter into space, received by a satellite orbiting the Earth which transmits the signal back to Earth to a satellite dish. Due to long distances there is a time delay.

Microwave ovens use microwaves that are absorbed by water in food. Their energy is transferred to the water molecules in the food, heating it up. This is transferred to the rest of the food by heating.

Infra Red Radiation

Given out by **all** objects. **Hotter** objects give out **more**.

IR cameras can detect IR radiation to monitor temperature. An image can be displayed where the brighter the object the hotter it is.

Food is cooked by **absorbing** IR, eg. from a toaster

REQUIRED PRACTICAL
SEE PRACTICAL SHEET FOR DETAIL

Black objects are **good absorbers** of IR so heat up easily.

Silver objects are poor absorbers but **good reflectors** of IR.

Ultraviolet Radiation

Fluorescent lights produce UV which is absorbed by phosphorus on the bulb and re-emitted as visible light.

Security pens can be used to mark property. The ink is only visible when viewed under UV.

Visible Light

Optical fibres can transmit visible light over long distances. The light bounces along the cable and is used to transmit data. Very little light is absorbed or scattered.

X-Rays and Gamma Rays

X-Rays pass through flesh but are absorbed by the more dense bone.

Gamma rays can be used as a **tracer**. A gamma source is injected and its path through the body can be detected. Both are used to **treat cancer** as they kill cells.