

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

Long wavelength Low Frequency → Short wavelength High Frequency

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

Wavelength

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**:
 - 7. **Long wave** radio (1 to 10K wavelength) can be transmitted around the world because they diffract around the earth's surface and hills.
 - 8. **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 skin 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.

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.

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.

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.
- Black** objects are **good absorbers** of IR so heat up easily.
- Silver** objects are poor absorbers but **good reflectors** of IR.

REQUIRED PRACTICAL
SEE PRACTICAL SHEET FOR DETAIL

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.

