Your notes

GCSE Physics: revision notes

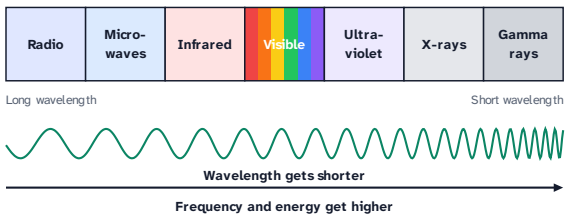
The electromagnetic spectrum

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The electromagnetic spectrum

- Electromagnetic waves are transverse waves that transfer energy from the source to an absorber.
- They form a continuous spectrum, and all types travel at the same speed through a vacuum or air: 3×10^8 m/s.
- In order of increasing frequency (decreasing wavelength): **radio waves**, **microwaves**, **infrared**, visible light (red to violet), ultraviolet, X-rays, gamma rays.
- Our eyes only detect visible light, a very limited range of the spectrum.



How EM waves are made and absorbed

- Different wavelengths are reflected, refracted, absorbed or transmitted differently by different substances and surfaces.
- (Higher) **Radio waves** can be produced by oscillations in electrical circuits. When **radio waves** are absorbed, they can create an alternating current with the same frequency, which is how aerials work.
- Changes in atoms and in their nuclei can generate or absorb EM waves. **Gamma rays** come from changes in the nucleus.

Uses

- **Radio waves**: television and radio broadcasting. **Microwaves**: satellite communications and cooking food.
- **Infrared**: electrical heaters, cooking food and **infrared** cameras. Visible light: fibre optic communications.
- **Ultraviolet**: energy-efficient lamps and sun tanning. **X-rays** and **gamma rays**: medical imaging and treatments.
- (Higher) Each use suits the wave's properties: for example, **X-rays** pass through soft tissue but are absorbed by bone.

Dangers

- **Ultraviolet**, **X-rays** and **gamma rays** can have hazardous effects on human body tissue. The effects depend on the type of radiation and the size of the dose (measured in sieverts).
- **Ultraviolet** can make skin age prematurely and increase the risk of skin cancer.
- **X-rays** and **gamma rays** are **ionising radiation** that can cause mutation of genes and cancer.

Required practical: infrared radiation

- Use a **Leslie cube**: a hollow cube with four different surfaces (matt black, shiny black, matt white, shiny silver). Fill it with hot water.
- Measure the **infrared** radiated from each surface with an **infrared** detector at the same distance.
- Matt black surfaces are the best emitters (and absorbers) of **infrared**; shiny silver surfaces are the worst, and the best reflectors.

Key terms

Electromagnetic spectrum	The continuous range of EM waves from radio waves to gamma rays.
Radio waves	EM waves with the longest wavelength, used for broadcasting.
Microwaves	EM waves used for satellite communication and cooking.
Infrared	EM radiation emitted by warm objects, used in heaters and thermal cameras.
Ultraviolet	EM radiation that can damage skin and cause skin cancer.
X-rays	Ionising EM waves used in medical imaging.
Gamma rays	The highest-frequency, ionising EM waves, from the nucleus.
Ionising radiation	Radiation that can remove electrons from atoms, damaging cells.

Your notes

Leslie cube	A cube with differently finished faces used to compare infrared emission.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. Which EM wave has the longest wavelength?
2. Which EM wave has the highest frequency?
3. What do all EM waves have in common?
4. Which EM wave is used for satellite communications?
5. Which EM wave is used in fibre optic communications?
6. Which EM wave can cause skin cancer?
7. Why are X-rays used to image bones?
8. Which colour of visible light has the longest wavelength?

Answers

1. Radio waves
2. Gamma rays
3. They travel at the same speed in a vacuum
4. Microwaves
5. Visible light
6. Ultraviolet
7. They pass through soft tissue but are absorbed by bone
8. Red

What to do next

Practise 11 questions on this topic

Try 7 exam questions, with mark schemes

Read the lesson, one step at a time

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