KNOWLEDGE

Physics Topic P13 Waves, electromagnetism & space – Electromagnetic waves

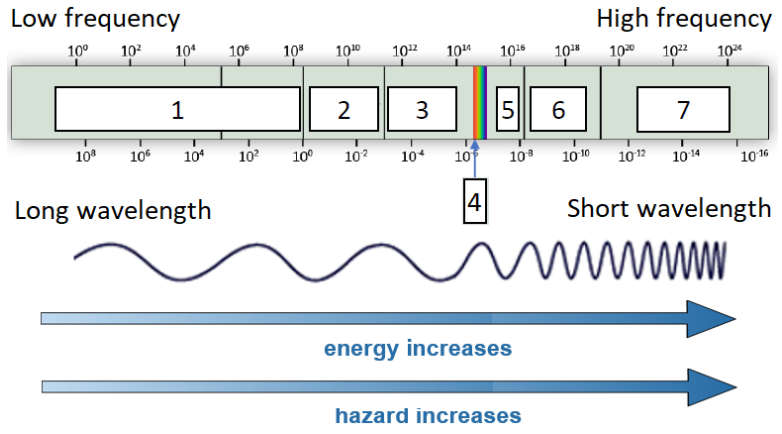
ORGANISER

Section 1: Key terms

Electromagnetic Spectrum	The collective name for **all types of EM radiation**. They are all **transverse waves** that travel at **300,000,000 m/s** (speed of light).
Wavelength	The distance from one wave crest to the next.
Frequency	The **number of wave crests** passing a fixed point every second.
Carrier wave (HT)	Waves used to carry information. They do this by varying their amplitude.
Ionising radiation	**High energy radiation** which can **remove electrons** leaving **ions**. If this happens **in DNA** it can cause a **mutation** that could lead to **cancer**.
Radiation dose	A **measure of** the **risk of harm** resulting **from exposure** of the body **to ionising radiation**. Measured in **Sieverts**.

Section 2: The electromagnetic spectrum

The waves in the electromagnetic spectrum are grouped together according to their wavelength and frequency. They are **transverse** waves **that transfer energy** (not matter) from a source to an absorber. The **human eye** can only **detect visible light**.



1.	Radio	5.	Ultraviolet
2.	Microwaves	6.	X-rays
3.	Infrared	7.	Gamma
4.	Visible		

Section 3: Uses and Risks of EM Radiation

EM Wave	Use	Why it's suitable (HT)	Risks
Radio	**Television** and **radio**	**Reflected** by **ionosphere** so can broadcast over **long distances**. Is a **carrier** wave.	
Microwaves	**Satellite communications, cooking food**	Able to **pass through the atmosphere** to **satellites**. Has a **heating** effect. Is a **carrier** wave.	Internal heating of the body (cooked from the inside.)
Infrared	**Electrical heaters, cooking food, infrared cameras**	Has a **heating** effect. **Emitted by objects** so can be **detected**.	Skin burns
Visible Light	**Fibre optic communications**	Able to **pass along a cable** by **total internal reflection**.	Blindness from bright light.
Ultraviolet	**Energy efficient lamps, sun tanning, checking bank notes.**	**Increases** amount of **melanin** (brown pigment) in **skin**.	**Premature skin ageing**, increase **risk of skin cancer**
X-Rays	**Medical imaging and treatments**	**Absorbed by bone** but **transmitted through soft tissue.**	**Ionizing** – can cause **mutation of genes** and **cancer**
Gamma	**Medical imaging and treatments**	Able to **pass out of body** and be **detected by gamma cameras**. Can **kill cancerous cells**.	**Ionizing** – can cause **mutation of genes** and **cancer**

Section 4: Production of electromagnetic waves

Radio (HT)	**Radio waves** are produced by **oscillations** in **electrical circuits.** When radio waves are absorbed they may create an alternating current with the same frequency as the radio wave itself, so radio waves can themselves make electrons vibrate in an electrical circuit.
Gamma	**Gamma rays** are produced from the **decay** of an **unstable nucleus**.

Section 5: Equations to learn

Calculation	Equation	Symbol equation	Units
Wave speed	Wave speed = frequency x wavelength	$v = f \lambda$	Wave speed - metres per second (m/s) Frequency - hertz (Hz) Wavelength - metres (m)