

## P13 Electromagnetic Waves Knowledge Organiser (F) PT84.2

Electromagnetic wave	<ul style="list-style-type: none"> <li>•An electrical and magnetic disturbance that transfers energy from a source to an absorber</li> <li>•All EM waves travel at <math>3 \times 10^8</math> m/s (the speed of light)</li> </ul>	Ionising radiation	<ul style="list-style-type: none"> <li>•Radiation that has enough energy to knock electrons out of atoms in substances.</li> <li>•This can kill cells or damage DNA, causing mutations and possibly cancer</li> </ul>
Electromagnetic spectrum	<ul style="list-style-type: none"> <li>• EM waves arranged in order of decreasing wavelength and increasing frequency.</li> <li>•Radio → Microwaves → Infrared → Visible → Ultraviolet → X-rays → Gamma</li> </ul>	Optical fibres	<ul style="list-style-type: none"> <li>•Thin glass fibres used to transmit signals.</li> <li>•The signal is carried by beams of IR or visible light, which are reflected back into the fibre at the surface and so travel along it.</li> <li>•Carry lots more information than micro or radio waves as light has a shorter wavelength. This means it can carry more pulses of waves</li> <li>•More secure than radio or microwaves as the signal can't escape the fibre</li> </ul>
Radio waves	<ul style="list-style-type: none"> <li>•Used for TV and radio signals. Shorter wavelengths of radio waves can be used for mobile phone signals.</li> <li>•Frequencies range from 300 000 Hz to 300 000 0000 Hz</li> <li>•Are able to heat internal parts of people's bodies, so could be hazardous</li> <li>•Different frequencies are used for different jobs as the frequency (and therefore wavelength) affects the distance travelled, how much the wave spreads and how much information it carries.</li> </ul>	X-rays	<ul style="list-style-type: none"> <li>•Ionising radiation emitted when electrons moving at high speeds are stopped</li> <li>•Used in hospitals to produce images of the body for diagnosis or to destroy tumours close to or on the surface of the body.</li> <li>•Bones and teeth are more dense so absorb more X-rays than soft tissue.</li> <li>•Used in industry to detect cracks in metal objects</li> </ul>
Microwaves	<ul style="list-style-type: none"> <li>•Shorter wavelength than radio waves</li> <li>•Able to pass through the atmosphere so used for satellite communications like TV</li> <li>•Also used for mobile phone signals</li> <li>•Used to cook food faster than an ordinary oven. The microwaves penetrate food and are absorbed by water molecules in the food. This heats it up as the water molecules gain KE.</li> <li>•Can cause internal heating of the body so could be hazardous</li> </ul>	Gamma rays	<ul style="list-style-type: none"> <li>•Ionising radiation emitted when radioactive atoms decay</li> <li>•Used to treat food to reduce spoilage by killing microorganisms (irradiation) and to sterilise surgical equipment.</li> <li>•Gamma rays from Cobalt-60 are used to kill cancer cells.</li> </ul>
Infrared	<ul style="list-style-type: none"> <li>•Emitted by all objects. Hotter objects emit more IR per second.</li> <li>•Used for transmitting information in optical fibres, for TV remotes and for IR cameras.</li> </ul>		
Visible light	<ul style="list-style-type: none"> <li>•The part of the EM spectrum we can detect with our eyes.</li> <li>•Visible light has wavelengths from 650 nm (red light) to 350 nm (violet light)</li> <li>•All the colours of the visible spectrum together make up white light.</li> </ul>		

Key Equations To Learn	
Wave Speed, $v$	Wave speed = frequency x wavelength $v = f \times \lambda$