P5 Light and the Electromagnetic spectrum

1. Ray diagrams

Electromagnetic waves	A group of waves that all travel at the same speed (speed of light) in a vacuum, and are all transverse.
Speed of light	300,000,000 m/s (3×10^8 m/s)
Frequency	The number of waves that pass a point every second. One hertz (Hz) is one wave per second.
Wavelength	The distance between a point on one wave and the same point on the next wave.
EM wave similarities	All are transverse, all travel at the speed of light.
EM wave differences	Different frequencies, different wavelengths.
Visible light	The only type of EM radiation that our eyes can detect.
Interface	The boundary between two different materials.
Refraction and wave speed	Light travels at different speeds in different materials causing it to refract when hitting the interface at an angle.
Prisms and the colour spectrum	Different wavelengths slow down by different amounts when they hit glass causing each colour to refract differently.
Infrared discovery	Light split into a spectrum. Thermometer placed on every colour plus next to red. Red was hot, next to red was hottest.

1. Core practical – Investigating refraction

Normal	A line at right angles to the interface.
Angle of incidence	Angle between the incident ray and the normal.
Angle of refraction	Angle between the refracted ray and the normal.
CP5 – Aim	To explore how changing the angle of incidence changes the angle of refraction.
CP5 - Setup	Place a glass block on a sheet of paper, point a beam of light from a ray box at it, trace around the block and draw in the light ray.
CP5 - Measurement	Use a protractor to draw a normal, then measure the angles of incidence and refraction.
CP5 - Variations	Repeat 5 times, from 5 different angles, including head-on.
CP5 - Results	The greater the angle of incidence, the greater the angle of refraction.

2. Colours

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3. Lenses

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Angle of refraction	Angle between the refracted ray and the normal.
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CP5 - Setup	Place a glass block on a sheet of paper, point a beam of light from a ray box at it, trace around the block and draw in the light ray.
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4. Electromagnetic waves

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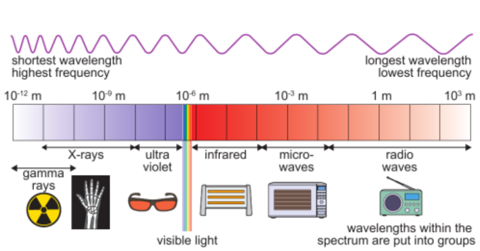
5. The electromagnetic spectrum

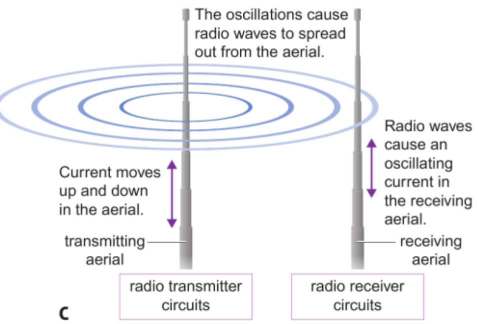
EM spectrum mnemonic	**R**ubbish **M**emories **I**nclude **V**isiting **U**r **X** **G**irlfriend
EM spectrum – lowest to highest frequency or energy	Radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, gamma rays.
EM spectrum – lowest to highest wavelength	Gamma rays, X-rays, ultraviolet, visible light, infrared, microwaves, radio waves.
EM spectrum	The full range of types of EM waves.
EM Radiation and the atmosphere	Some EM radiation (visible light, radio waves) passes through the atmosphere, most is absorbed.
Space telescopes	For radiation absorbed by the atmosphere, a telescope must be placed in space.



Electromagnetic spectrum

6. Using the long wavelengths

Visible light uses	Illumination, photography
Infrared uses	Short-range communications (TV remotes), fibre optics, cooking (grills and toasters), security cameras, thermal images.
Microwave uses	Microwave ovens, mobile phone and satellite communications.
Radio wave uses	Radio and TV signals, communications between controllers and spacecraft, satellite communications.
Producing radio waves	Oscillating electricity in a metal rod produces radio waves.
Receiving radio waves	Radio waves absorbed by a metal rod cause electrical oscillations.



Producing radio waves

7. Radiation and temperature

Fluorescence	Absorbing ultraviolet and re-emitting it as visible light.
Ultraviolet uses	Security marking, fluorescent lamps, detecting forged bank notes and disinfecting water.
X-ray uses	Observing the internal structure of objects, airport security scanners and medical X-rays.
Gamma ray uses	Sterilising food and medical equipment, and the detection of cancer and its treatment.

7. Core practical – Investigating radiation

Fluorescence	Absorbing ultraviolet and re-emitting it as visible light.
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8. Using the short wavelengths

Fluorescence	Absorbing ultraviolet and re-emitting it as visible light.
Ultraviolet uses	Security marking, fluorescent lamps, detecting forged bank notes and disinfecting water.
X-ray uses	Observing the internal structure of objects, airport security scanners and medical X-rays.
Gamma ray uses	Sterilising food and medical equipment, and the detection of cancer and its treatment.

9. EM radiation dangers

Infrared dangers	Surface heating causing skin burns.
Microwave dangers	Absorbed by water causing it to heat up → internal heating of body cells.
Ionisation	High-energy radiation causes ions to form in our cells, damaging DNA and causing cancer.
Ultraviolet dangers	Damage to surface cells and eyes leading to skin cancer and eye conditions.
X-ray dangers	Cancer, mutation or damage to cells in the body.
Gamma ray dangers	Cancer, mutation or damage to cells in the body.

Lesson	Memorised?
1. Electromagnetic waves	
2. Core practical – Investigating refraction	
3. The electromagnetic spectrum	
4. Using the long wavelengths	
5. Using the short wavelengths	
6. EM radiation dangers	