WJEC (Eduqas) Physics GCSE

6.2: Electromagnetic Interactions and Applications

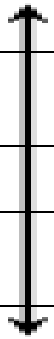
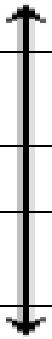
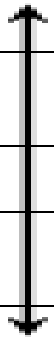
Detailed Notes

(Content in **bold** is for higher tier **only**)

Electromagnetic Interactions

Frequency-Wavelength Relationships

Speed is **constant** for all EM waves. Therefore as wavelength **decreases**, frequency must **increase** and as frequency **increases**, the energy of the wave **increases**. This means each EM wave has a different behaviour that makes them useful for different things.

Type of Radiation	Wavelength	Frequency	Energy	Uses
Gamma	very short	very high	very high	- cancer radiotherapy
X-Rays				- medical imaging
Ultraviolet (UV)				- sterilisation - fluorescent light
Visible Light				- illumination
Infrared (IR)				- heating - remote control
Micro-waves				- cooking food
Radio-waves	very long	very low	very low	- broadcasting - communications

Radiation can also refer to energy given out by **radioactive materials**. Gamma, X-rays and UV all have very short wavelengths and **very high energy** meaning they can **damage cells** through interaction with atoms. This means they are a form of **ionising radiation**.

Electromagnetic Applications

Radio Waves

Radio waves are used in **communication** of TV or radio signals. They are very **low energy** and can travel over very **long distances**. Radio waves can also be **reflected** to help distribute them over a large area.

Radio waves are produced from oscillating currents in an electrical circuit. They can also induce these currents in an electrical circuit, which explains how they transmit communications. Circuits pick up these waves and turn them into electrical signals.

Microwaves

Microwaves are used for satellite communication and for heating food.

The frequency range of microwaves is easily absorbed by the molecules in food making them vibrate more so that their internal energy increases.

UV, X-Rays and Gamma Rays

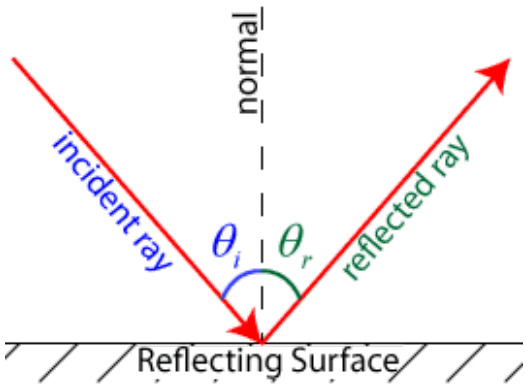
UV, X-ray and Gamma are dangerous as they have a **small wavelength**, **high frequency**, and therefore **high energy**. This high energy means they can cause cells to **mutate**, potentially causing **cancer**. UV causes skin cells to **age prematurely**, increasing the chances of developing skin cancer.

This means **radiotherapists**, who constantly operate with X-ray and gamma sources, try to **minimise exposure** by leaving the room or by wearing **lead aprons**. Pilots flying at **high altitudes** where there is more UV, are more likely to suffer from cancer.

Plane Surface Reflection

For reflection off a plane surface, the **angle of incidence (i) = angle of reflection (r)**. These angles are always measured from **normal**.

This law of reflection can be shown on a **ray diagram** with the normal shown as a **dashed line** and the **plane surface** indicated by **angled, dashed lines**.

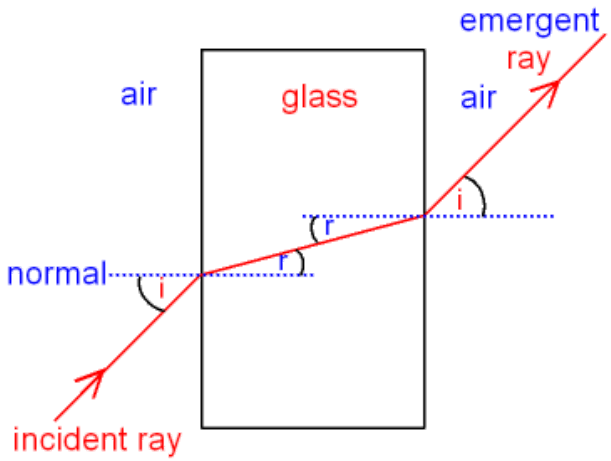


Reflection off a plane surface (aplusscience.com)

Plane Surface Refraction

For refraction at a plane surface, if the wave enters a **denser material,** it bends in **towards the normal.** If the wave enters a **less dense** material, it bends **away from normal**.

Again, this can be shown on a **ray diagram** with the normal shown as a **dashed line**.



Refraction through a glass block (gcsescience.com)