Physics: Waves and Radiation

Waves

1 Transverse wave	Oscillates (moves between two points) perpendicular (at right angles) to direction of movement eg ripples on a water surface
2 Longitudinal waves	Oscillates parallel to the direction of wave movement. Areas of compression (squashing) and rarefaction (spreading) eg sound waves travelling through air
3 Amplitude	Maximum displacement of a point on a wave away from its undisturbed position. Bigger amplitude means more energy
4 Wave Length (λ)	Distance from a point on one wave to the equivalent point on the adjacent wave. Measured in metres (m)
5 Frequency (*f*)	Number of waves passing a point each second. Measured in hertz (Hz)
6 Period (*T*)	Time taken for each wave to pass a fixed. Calculated using equation $\text{period, } T \text{ (seconds, s)} = \frac{1}{\text{frequency, } f \text{ (hertz, Hz)}}$
7 Wave speed (m/s)	Speed at which the energy is transferred (or wave moves) through a medium. Calculated using equation wave speed, v (metres per second, m/s) = frequency, f (hertz, Hz) × wavelength, λ (metres, m)

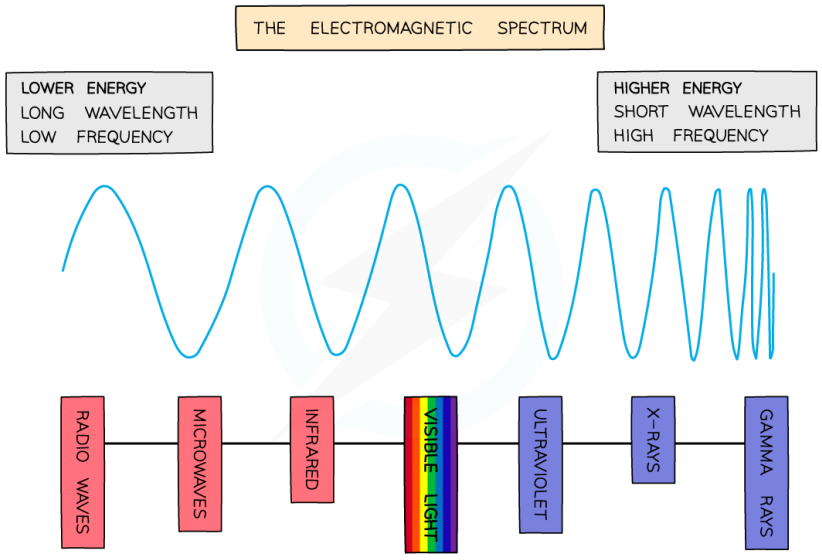
Atomic Structure (Chemistry Link)

Key Term	Description
Size of the atom	1×10^{-10} m
Nucleus	A positively charged basic structure of the atom composed of both protons and neutrons. The radius of the nucleus is 1/10000 the radius size of an atom. Where most the mass of an atom is.
Electrons	A negatively charged particle which orbits around the nucleus of an atom.
Mass number	The number of protons and neutrons in a nucleus
Atomic number	The number of protons in an atom. Sometimes called the proton number
Isotopes	Atoms with the same number of protons and different numbers of neutrons
Ion	A charged atom or molecule
Ionisation	A process in which atoms become charged.
Atom	A particle with the same number of protons and electrons to give it no overall charge.

Electron arrangements may change with the absorption of electromagnetic radiation or by the emission of electromagnetic radiation.
Losing electrons makes an ion positive.
Gaining electrons makes an ion negative.

(Mass number) 23
(Atomic number) 11
Na

The EM spectrum



The EM spectrum

8 Electromagnetic Waves	transverse waves that transfer energy from the source of the waves to an absorber eg microwaves produce waves that are absorbed by food
9 Electromagnetic Spectrum	continuous spectrum in which all electromagnetic waves travel at the same velocity through a vacuum (space) or air. Waves are grouped in terms of their wavelength & frequency

Types	Uses	Properties	Radiation doses
10. Radio waves	television and radio	(HT) Radio waves can be 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 induce oscillations in an electrical circuit	
11. Microwaves	satellite communications, cooking food		
12. Infrared	electrical heaters, cooking food, infrared cameras		
13. Visible light	fibre optic communications	Our eyes only detect visible light and so detect a limited range of electromagnetic waves	
14. Ultraviolet –	energy efficient lamps, sun tanning	Ultraviolet waves can cause skin to age prematurely and increase the risk of skin cancer	The effects depend on the type of radiation and the size of the dose. Radiation dose (in sieverts) is a measure of the risk of harm resulting from an exposure of the body to the radiation. 1000 millisieverts (mSv) = 1 sievert (Sv)
15. X-rays and gamma rays	medical imaging and treatments	Changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed over a wide frequency range. Gamma rays originate from changes in the nucleus of an atom. X-rays and gamma rays can cause the mutation of genes and cancer	

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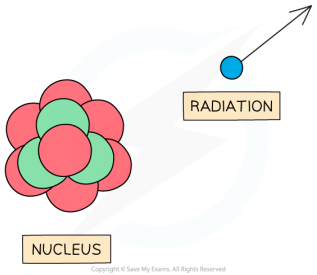
Radioactivity key terms

Key Term	Definition
Unstable	Prone to change, opposite of stable.
Radioactive Decay	A nucleus giving out radiation as it changes to become more stable, the process is random.
Activity	The number of unstable atoms that decay per second in a radioactive source. Measured in Becquerel (Bq).
Count-Rate	The number of decays recorded each second by a detector (e.g. a Geiger-Muller tube).

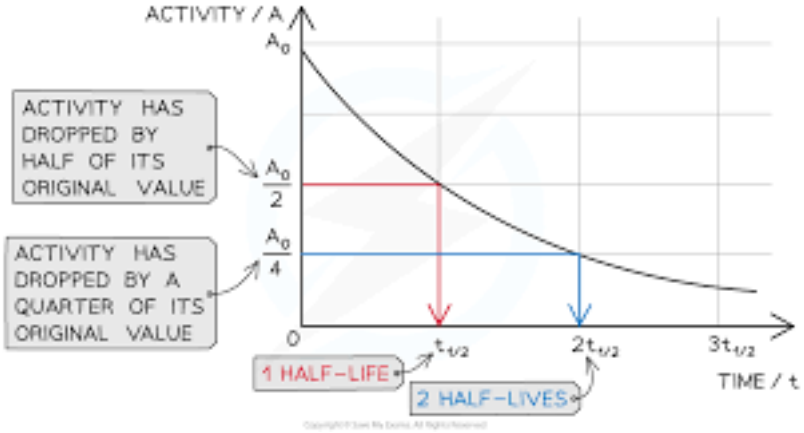
Types of ionising radiation



Particle	What is it	Charge	Range in air	Penetration	Ionisation
Alpha (α)	2 protons + 2 neutrons	+2	Few cm	Stopped by paper	High
Beta (β^-)	Electron	−1	Few 10s of cm	Stopped by few mm Aluminium	Medium
Gamma (γ)	Electromagnetic wave	0	Infinite	Reduced by few mm Lead	Low

Half life

Key Term	Description
Half-life	The time it takes for the number of nuclei of the isotope in a sample to half.
	The time it takes for the count-rate (or activity) from a sample containing the isotope to fall to half it's initial level.



Dangers of Radiation

Radioactive Contamination	The unwanted presence of materials containing radioactive atoms on other materials.
Irradiation	Exposure of an object to ionising radiation.
Radiation Dose	Amount of ionising radiation a person receives.
Hazards	A danger or risk. This is due to the decay of contaminating atoms.

Hazards of radiation:

- Radiation Poisoning
  - Seizures
  - Internal bleeding
  - Inflammation of organs
  - Loss of white blood cells
- Cell mutation
  - Increased risk of cancer
- Burns

Protection against radiation:

- ❑ Keeping as far away from the radiation source as possible.
- ❑ Spending as little time as possible in at-risk areas.
- ❑ Shielding themselves using thick concrete barriers or thick lead plates.
- ❑ Storing radioactive materials in thick, lead-lined boxes.