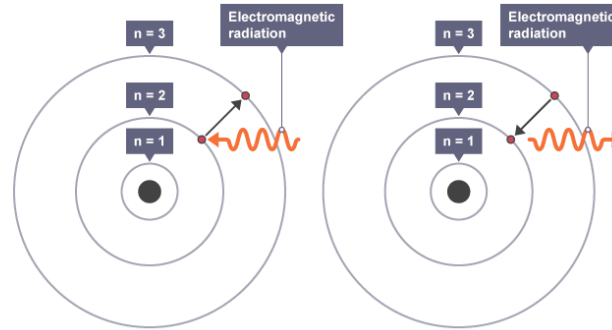


GCSE Knowledge Organiser SCIENCE

Physics Unit 3 – Radiation and Risk

ONE

Atoms absorb energy which moves their electrons to higher energy levels. When they jump back down this energy is released as radiation. The size of the jump determines the frequency of the radiation emitted.



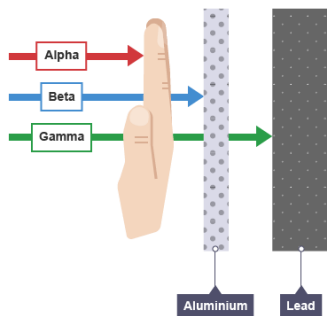
Radiation can be emitted at light and different frequencies of light has different colours

TWO

An unstable nucleus can decay by emitting an **alpha particle** (α), a **beta particle** (β), a **gamma ray** (γ) or in some cases a single **neutron** (n). All types of radioactive decay can be detected by a Geiger-Muller tube, or G-M tube. The radiations ionise the gas inside and the resulting charged particles move across the chamber and get counted as charges per second.

THREE

The Sievert (Sv) is the unit used to measure radiation dose. Radiation is around us all the time. People often worry about the perceived risk that is much higher than the actual measured risk present.



FOUR

	Symbol	Penetrating power	Ionising power	Range in air
Alpha	α	Skin/paper	High	< 5 (cm)
Beta	β	3 mm aluminium foil	Low	$\approx$ 1 (m)
Gamma	γ	Lead/concrete	Very low	> 1 (km)

Nuclear radiation can **ionise** chemicals within a body, which changes the way the cells behave. It can also deposit large amounts of energy into the body, which can damage or destroy cells completely. Ultraviolet, x-rays, alpha, beta and gamma radiations are all examples of ionising radiations.

FIVE

A nucleus changes into a new element by emitting **alpha** or **beta** particles. These changes are described using nuclear equations.

An example of **alpha decay**: $^{219}_{86}\text{Rn} \rightarrow ^{215}_{84}\text{Po} + ^4_2\text{He}$
The mass goes down by 4

and the atomic number goes down by 2.

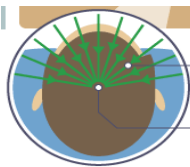
An example of **beta decay**: $^{14}_6\text{C} \rightarrow ^{14}_7\text{N} + ^0_{-1}\text{e}$

The mass stays the same but the atomic number goes up by 1.

Gamma is pure energy so does not change the structure of the nucleus.

SEVEN

Ionising radiations can affect the way the cell divides and new cells may



Healthy cells receive low dose of gamma radiation

Cancer cells receive high dose of gamma radiation

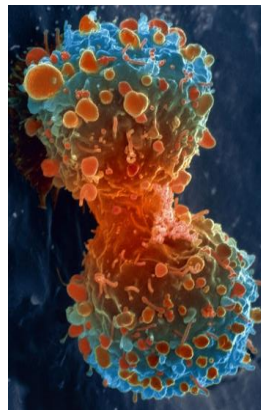
be formed before they are needed.

A large mass of tissue, containing these new unnecessary cells, is called a tumour.

Tumours may be benign. Benign tumours stay where they are and are relatively easy to operate on and remove.

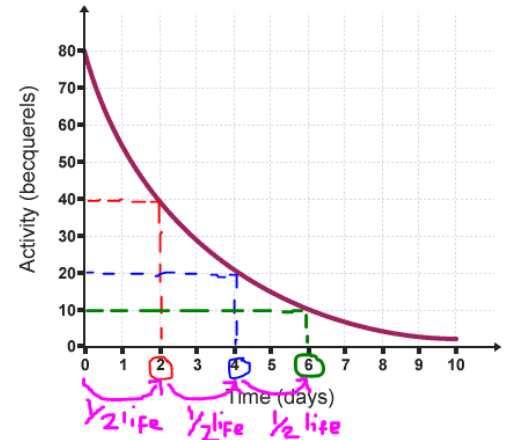
A malignant tumour contains cells that break away and travel through the blood system to other parts of the body. These cells then go on to form new tumours and the cancer spreads.

Beams of **gamma rays**, called a gamma knife, can be used to destroy cancerous tumours deep inside the body.



SIX

Half life is the time it takes for half of the radioactive nuclei to decay. It can be calculated from a graph as shown in the example where the half life is 2 days. Every half life of a particular substance is the same length. Radioactive decay is random.



EIGHT

Irradiation	Contamination
Occurs when an object is exposed to a source of radiation outside the object.	Occurs if the radioactive source is on or in the object.
Doesn't cause the object to become radioactive.	A contaminated object will be radioactive for as long as the source is on or in it.
Can be blocked with suitable shielding or moving away.	Once an object is contaminated, the radiation cannot be blocked from it.
Stops as soon as the source is removed.	It can be very difficult to remove all of the contamination.

E.g. An apple exposed to the **radiation** from cobalt-60 is irradiated but an apple with cobalt-60 injected into it is **contaminated**.