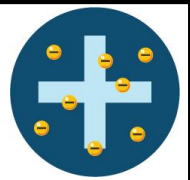
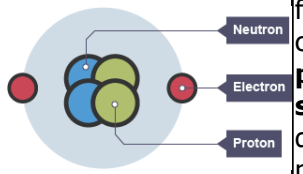
Physics 4: Atomic Structure

Section 1: Key Terms

1 Atom	The **smallest part of an element** that can exist. All substances are made of atoms. **No** overall **electrical charge**. **Very small**, radius of 0.1nm.
2 Element	An element **contains only one type of atom**. Found on the Periodic Table. There are about 100 elements.
3 Isotope	An atom of the **same element** with **different numbers of neutrons**.
4 Radioactive decay	When an **unstable nucleus changes** to **become more stable** and **gives out radiation**. **Random**.
5 Activity	The **rate at which decay occurs**. Measured in **becquerels (Bq).**
6 Count rate	**Number of decays** recorded **each second** by a Geiger-Muller tube.
7 Half life	The **time it takes** for the **number of nuclei of the isotope in a sample to halve** Or, The **time it takes for the count rate** (or activity) from a sample containing the isotope **to fall to half its initial level**.
8 Contamination	The **unwanted presence of materials containing radioactive atoms** e.g. within liquids, with the body/ on the skin.
9 Irradiation	When an object is **exposed to radiation**. The object does not become radioactive itself.
10 Ionisation	Radiation can ionize by **removing electrons from atoms to form ions**. If this happens in **DNA** it could lead to a **mutation that causes cancer**.
11 Peer review	The **checking of scientific results** by other **scientific experts**.

Section 2: Development of Atomic Model

12 Plum Pudding 	The plum pudding model shows that the atom is a **ball of positive charge** with **negative electrons embedded** in it. Was **incorrect**.
13 Nuclear Model 	Rutherford's scattering experiment found a central area of positive charge. The nuclear model has a **positive nucleus** and **electrons in shells**. Later, neutrons were discovered and included in the nucleus.

Section 3: Properties of Sub-Atomic Particles

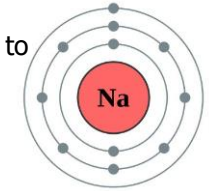
Sub-atomic particle	Mass	Charge	Position in Atom
14 Proton	1	+1	Nucleus
15 Neutron	1	0	Nucleus
16 Electron	Very small	-1	Orbiting in shells

17 **Mass number** – the total number of **protons** and **neutrons**

$^{23}_{11}Na$

18 **Atomic number** – the **number of protons** (the number of electrons is the same in an atom)

19 **Energy levels:**
Absorption of radiation may lead to electrons moving further from the nucleus (higher energy level).
Emission of radiation may lead to electrons moving closer to the nucleus (lower energy level).



Section 4: Nuclear Radiation

Radiation	Range in air	Absorbed by	Ionizing Power	Product emitted when nuclei decays
20 Alpha	Short – **up to 5cm**	**Paper** and **skin**	**Very High**	**2 protons** and **2 neutrons**
21 Beta	Medium – **about 1m**	About 5mm of **aluminium**.	**Medium**	**Electron**
22 Gamma	**Unlimited –** spreads out in air from the source	**Several centimetres** of **lead**.	**Low**	**Electromagnetic wave**

Section 5: Nuclear Decay Equations

23 Alpha decay	$^{219}_{86}Rn \rightarrow {}^{215}_{84}Po + {}^{4}_{2}He$ In alpha decay a helium nucleus (2 protons and 2 neutrons) is emitted. The new element formed has: - A mass number that has decreased by 4. - An atomic number that has decreased by 2.
24 Beta decay	$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$ In beta decay a neutron turns into a proton. An electron is emitted. The new element formed has: - A mass number that stays the same. - An atomic number increases by 1.
25 Gamma ray	There are no changes to the nucleus when gamma rays are emitted.

Section 6: Finding Half Life

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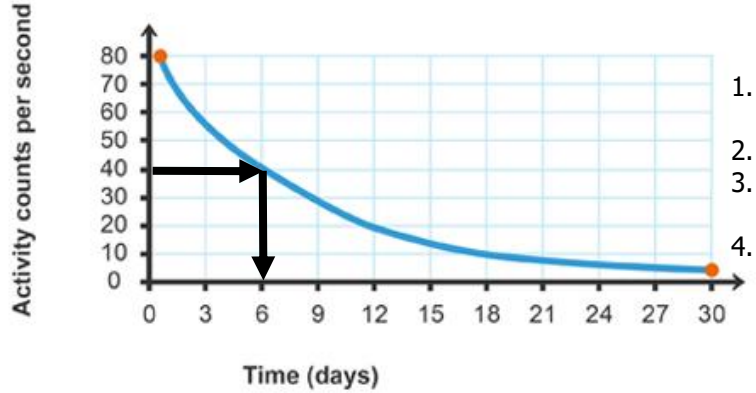

1. Find the initial count rate.
2. Half that value.
3. Draw a line across and then down.
4. This is the half life of the isotope.