

Atomic Structure Notes

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What actually is an atom, and what is an atom made of? Let's start with that first question. **What is an atom?**

An atom: the simplest particle of an element that is neutral.

What is an atom made of? Atoms are made of three different particles.

1. **Protons.**

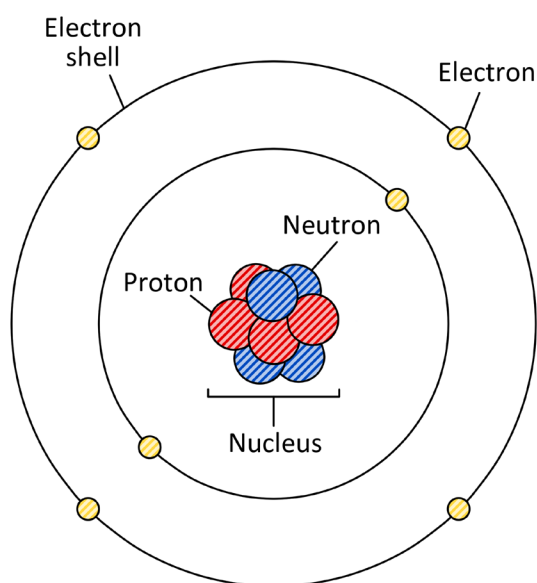
2. **Neutrons.**

3. **Electrons.**

Where do we find each particle?

- Protons and neutrons are located in the nucleus of the atom.
- Electrons are located in the orbits also known as electron shells surrounding the nucleus.

The figure below shows the structure of an atom.



The radius of an atom is approximately 1×10^{-10} metres or 0.1 nm

The radius of a nucleus is about 100,000 times smaller, at approximately 1×10^{-15} metres

Important note: almost all of the mass of an atom is concentrated in the nucleus.

Each particle has its own electrical charge and mass:

Particle	Charge	Mass
Proton	+1	1
Neutron	0	1
Electron	-1	$\frac{1}{2000}$

How can we tell how many of each of these particles are present in each atom?

In the periodic table the numbers of each of these particles is given to us. Take the example of helium below.

He

4

Mass number

Tells us the number of protons and neutrons in an atom.

2

Atomic number

Tells us the number of protons in an atom.

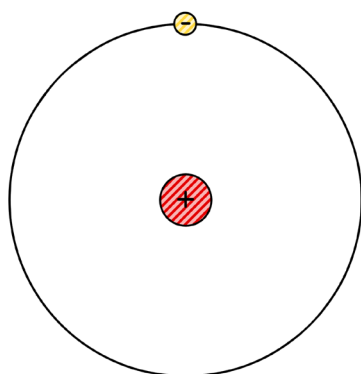
What other things can we work out from this information?

- In a neutral atom the number of electrons is equal to number of protons.
- The number of neutrons can be found by subtracting the atomic number from the mass number.

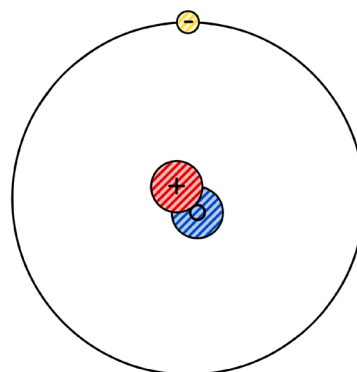
Isotopes

Isotopes: are atoms of elements that have the same number of protons but different numbers of neutrons.

An isotope can still be the same element even though the mass numbers are different. So, again isotopes have the same number of protons but different numbers of neutrons. Take the next figure as an example.



Hydrogen atom



Deuterium atom

We can see here that a deuterium atom is an isotope of hydrogen. Having the same number of protons and a different number of neutrons 😊. We don't have to know about deuterium for the GCSE, it's just a nice example to highlight how having more neutrons makes it an isotope but it's still hydrogen.

Electrons

Now, we don't need to know about the electron shell rules as such, the 2, 8, 8 rule, that's chemistry. For physics, we do still need to know that electrons orbit the nucleus in shells and that these are known as energy levels.

The further out from the nucleus we go the higher the energy of each shell 😊

Electrons can actually move between these energy levels, they can move from shell to shell! They can move up and down. They can move up when they gain energy and move down when they lose energy. **How does this happen?**

Moving on up – if an electron **absorbs** electromagnetic radiation, let's say light, it gains energy and moves to a higher energy level, further from the nucleus.

Moving on down – if an electron **emits** electromagnetic radiation, it loses energy and drops to a lower energy level, closer to the nucleus.

Let's take this opportunity to remind ourselves what an ion is 😊

An ion: an electrically charged particle that is made by the loss or gain of one or more electrons. If the atom loses electrons it becomes a positive ion (a cation) or gains electrons to become a negative ion (an anion)