

2S.1 (Chemistry) Atomic Structure



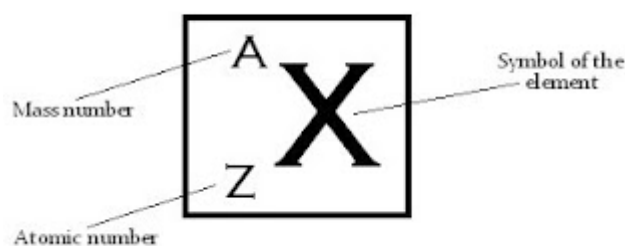
Introduction to STAMP year 2 science notes and notations

Hi all, here are some pointers to help you make best use of STAMP notes.

1. Science notes are labeled 2S (for science) .X for the Xth set of notes
2. Bullet points are formatted to be large circles for your checklist purposes
3. Only essential ideas are listed: they are no means complete and you are to refer to school notes to understand the full concepts
4. To emphasise again, these notes cannot substitute class lessons
5. Take note of bolded words: they are key words/phrases to be used in ALL your answers
6. Underline = key answers (memorise!)

Atomic Structure

- An atom is the **smallest particle of an element** that has the same **chemical properties** of that element
- An atom is made up of subatomic particles:
- **Protons** – Charge: +1, Relative mass: 1
- **Electrons** – Charge: -1, Relative mass: 1/1836 or 0*
- **Neutrons** – Charge: 0, relative mass: 1 (Note: **The neutron has no charge**/The neutron is neutral. Cannot write “neutral charge”)
- The nucleus of an atom is the center of it, made up of densely packed neutrons and protons (collectively known as nucleons)
- Overall, the nucleus has a positive charge
- The electrons spin around the nucleus at nearly the speed of light, and it rotates on an axle (something like how the Earth spins while rotating around the Sun)
- Most of the atom is empty space. An analogy is using a football stadium as the whole atom. The nucleus is a pea in the center of the stadium and the electrons form a cloud surrounding the nucleus. It takes up the rest of the space in the stadium
- In atoms, the overall charge of an atom is neutral (or “has no charge”)
- The atomic structure can be written as a symbol called the Nuclide Notation:
- A = **Mass number** (nucleon number):
Number of protons + Number of neutrons
- Z = **Atomic number** (proton number):
Number of protons
- X = Symbol of the element
- $A - Z =$ Number of neutrons
- Atomic number = Number of electrons
- Isotopes:



- Isotopes are **atoms of the same element with the same number of protons but different number of neutrons**
- They have the same proton number but different mass number
- For example, most hydrogen atoms have 1 neutron and 1 proton, but it has 2 isotopes, containing 2 neutrons and 3 neutrons respectively
- Isotopes have different masses (refer to mass number of the isotope) as they have a different number of neutrons
- They have the **same chemical properties but different physical properties** (e.g. masses and boiling points)
- Naturally occurring or produced by nuclear reactions
- Niels Bohr discovered the electron shell model in 1913, which enables us to answer more questions about atoms
- Based on his model, electrons are arranged into orbits around the nucleus. These orbits are called shells:
- Shells are numbered 1, 2, 3, 4 and so on and so forth
- The first shell can contain at most 2, the second 8, the third 8
- For elements 1 to 20, the fourth shell contains a maximum of 2
- The 1st shell must be filled before the second can be filled, and so on and so forth
- This is called **electronic configuration**
- For elements beyond calcium (20), the third shell can hold up to 18 (e.g. krypton/Kr has an electronic configuration of 2.8.18.8)
- The electronic configuration of magnesium can be represented as 2,8,2 or 2.8.2
- The **valence electrons** of an atom are the electrons in the outermost shell. This is called the valence shell
- The chemical properties of an element depend on the number of valence electrons. **Elements with the same number of valence electrons tend to have similar chemical properties because the valence electrons are responsible for forming the chemical bonds with other atoms in a chemical reaction**
- When filling the electron shells:
- fill the top first, then the bottom, then the left then the right, and then repeat it
- Opposites must be filled first
- The four sides must be filled before there can be a pair of 2 electrons
- Electrons must be paired when there are more than 4
- This applies for only the second and third shell
- Use only cross or dot for drawing the electronic structure (crosses are faster)