

Atomic Structure, Number and Mass - NOTES

When scientists were discovering the elements, they didn't have the periodic table. They had information about these elements, but they weren't in any order. They needed some way to organize the elements in a way that made sense. A good classification system groups similar things together and keeps different things apart. Like in your binder – English is in one section, Math in another, Science in another, and so on. Classification must be clear and practical for the people who are using it. If the basis for sorting is carefully chosen, classification may also reveal relationships that would go unnoticed. The best basis for sorting data depends on how they will be used and who will be using them.

Initially, scientists tried classifying elements on the basis of their properties, but this didn't work very well, since most of the known elements were metals, and all metals are malleable, shiny, conduct electricity, and are a similar color. Even where the colors were different, they could not be measured.

So they tried organizing the elements based on something they could measure – atomic mass. Atomic mass is the relative average mass of an atom of the element. There are no mass units for atomic mass. They are simply a ratio. Carbon has an atomic mass of 12, so it is 12 times heavier than hydrogen, which is 1. Oxygen atoms have 16 times more mass than hydrogen. John Dalton published the first table of atomic masses as part of his Atomic Theory. No one had actually measured the mass of a single atom. They simply found a way to compare the atoms of different elements, according to mass. Since then, the actual mass of atoms has been measured using a mass spectroscope. One Atomic Mass Unit (amu) is equal to 1.66×10^{-27} kg. One proton is 1 amu, and one neutron is 1 amu.

Another way to look at atomic mass is to say that it is the sum of the number of protons and neutrons in an atom (since they have the majority of the mass). To find the number of neutrons in an atom = atomic mass – atomic number (# of protons).

If you look on your periodic table, you will see that a number of elements do not have whole numbers for their atomic mass. This is because there are isotopes of different elements, with a different number of neutrons in the nucleus, and so the atomic mass is an average of those masses.

Isotope: A form of a chemical element with the same atomic number (number of protons) as another element but having a different atomic mass (different number of neutron).

The number of fundamental particles (subatomic) in an atom can be determined by knowing the atomic number and atomic mass, and that there is an important difference in these numbers.

- Number of protons is equal to the atomic number.
- Number of electrons is equal to the atomic number
(In a neutral atom, proton # = electron #).
- Number of neutrons is calculated by subtracting the atomic number from the atomic mass.

For example: Sodium Na

23

11

Atomic number = 11

Atomic mass = 22.990

Protons = 11

Electrons = 11

Neutrons $23 - 11 = 12$

Elements can be identified by the number of protons they contain, as this value never changes. If this value is known, the element can be identified because proton number = atomic number

Physical Properties

Physical properties are characteristics that **exist in a material.**

1. **State** – Solid, liquid or gas
2. **Hardness** – Resist scratches and dents
3. **Malleability** – Bendy or brittle
4. **Ductility** – Drawn into a wire
5. **Melting & Boiling Point**
6. **Viscosity** – Thickness of liquid
7. **Solubility** – Ability to dissolve in solvent
8. **Density** – Amount of matter in an amount of space (**g/cm³**)

Chemical Properties

Chemical properties describe the **behaviour** of a substance as it **reacts with another substance** to form new materials.

1. **Combustion** – Burning when combined with other chemicals
2. **Oxidation** – Changes color when exposed to air
3. **Hydration** – Reacts with water
4. **Corrosion** – Reacts with acids
5. **Heating** – Reacts with heat