ATOMS

INTRODUCTION OF ATOM

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The term "atom" originates from the Greek word "atomos," which translates to "indivisible." The ancient Greeks, notably philosophers like Democritus and John Dalton, postulated the idea that matter could be disassembled into exceedingly small and imperceptible particles known as atoms. This concept of the atom formed the basis of early philosophical and scientific thought regarding the fundamental building blocks of matter.

Democritus delved into the essence of matter, asserting that it constitutes the entirety of substances. According to his proposition, atoms, which are imperceptible and exceedingly small entities, form the fundamental building blocks of all matter. He elaborated that atoms exhibit continuous motion and exist in various shapes, sizes, and temperatures. Additionally, Democritus posited the idea that atoms are indestructible, emphasizing their enduring nature.

In 1808, John Dalton introduced the atomic theory, which offered an explanation for the laws governing chemical combinations. As the 18th century transitioned into the early 20th century, several scientists, including J.J. Thomson, Goldstein, Rutherford, and Bohr, contributed to the evolving understanding of the atom by proposing various conceptual frameworks.

The atom, considered the smallest unit of matter, comprises a positively charged central core known as the "nucleus," with negatively charged electrons orbiting this central nucleus. Despite its minuscule size, an atom retains all the chemical properties characteristic of its corresponding element. For instance, a silver spoon is composed of silver atoms and other constituent elements, where the distinctive properties of the silver atom are defined by its tiny subatomic particles.

Atoms are not isolated entities but are rather organized into larger structures called molecules. Even within the human body, atoms and molecules adhere to the fundamental principles of chemistry and physics. To gain a deeper understanding of how atoms react, behave, and interact, let's delve into the structure of the atom.

STRUCTURE OF ATOM

The atom's structure comprises two main components:

The atomic nucleus The extra nuclear region.

The minuscule atomic nucleus serves as the central core of an atom, housing positively charged particles known as protons and neutral particles called neutrons. In contrast, the extra nuclear region is significantly more expansive. It encompasses a cloud of negatively charged particles referred to as electrons, which orbit around the nucleus. The interplay of attractive forces between protons and electrons is what sustains the structural integrity of the atom.

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PHYSICS



In the majority of cases, atoms are composed of three fundamental subatomic particles: protons, neutrons, and electrons. It is noteworthy that hydrogen stands as an exception among all atoms. Hydrogen deviates from the norm by containing only one proton and one electron, omitting neutrons entirely. The number of protons within an atom serves as a distinctive marker, identifying the specific element to which the atom belongs. Conversely, the quantity of electrons plays a crucial role in determining the nature of reactions that an atom can undergo.

Within the structure of an atom, the atomic nucleus is characterized by a constant and specific count of protons. This count is crucial, as it determines the elemental identity of the atom. Importantly, the positive charge carried by the protons is balanced by an equivalent number of negatively charged electrons orbiting the nucleus. This equilibrium maintains the overall electric neutrality of the atom. The dynamic relationship between protons and electrons forms the foundation of the atom's stability. Notably, alterations in this balance, such as the addition or removal of electrons, lead to the creation of ions, imparting the atom with a net electrical charge.

Discovery of an Electron

In 1897, the British physicist J.J. Thomson put forth the proposition that an atom comprises at least one particle carrying a negative charge. Initially referred to as "corpuscles," these entities were later recognized and termed as "electrons." This groundbreaking idea significantly contributed to the evolving understanding of atomic structure. The identification and characterization of electrons laid the groundwork for subsequent advancements in atomic theory and had profound implications for the field of physics.

'e' symbolizes an electron and contributes to the negative charge within an atom. The electron carries an absolute charge of -1.6×10^{-19} coulombs. In terms of relative mass, an electron is approximately 1/1836 times the mass of a proton. Additionally, the mass of an electron is 0.

Discovery of Proton

The proton was first identified by Ernest Rutherford through his renowned gold foil experiment. In 1886, during experiments with a discharge tube and perforated cathode, Eugen Goldstein observed the existence of positively charged rays. These rays came to be known as anode rays or canal rays. A sequence of experiments eventually led to the identification of protons as the subatomic particles responsible for the positive charge within an atom.

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The symbol "p" is used to denote a proton. Protons carry a positive charge with an absolute value of 1.6×10^{-19} coulombs. In terms of mass, a proton weighs approximately 1.6×10^{-24} grams, equivalent to the mass of a hydrogen atom, which is conventionally considered as 1 atomic mass unit (amu).

Discovery of Neutron

The identification of the neutron was a breakthrough that occurred in 1932, credited to James Chadwick. Using a method involving scattered particles, Chadwick calculated the mass of this neutral subatomic particle. Represented by the symbol n, neutrons are found within the nucleus of an atom. Unlike protons and electrons, neutrons carry no net electric charge, making them neutral. The mass of a neutron is approximately 1.6×10^{-24} grams.

Using grams as a unit for the measurement of such minuscule subatomic particles is not suitable. Instead, the more appropriate unit is the Dalton or atomic mass unit (amu). It's important to note that the mass of protons and neutrons is close to 1 amu.

Example.

What is the overall charge of an atom?

Solution.

An atom does not have a net charge. This is because electrons carry a negative charge, while protons carry a positive charge. The equal positive charge of the protons and the negative charge of the electrons effectively cancel each other out. In a neutral atom, the number of electrons orbiting the nucleus is equal to the number of protons within the nucleus. This balance of positive and negative charges results in an atom with no net charge.