Al-Mustaqbal University College

Department of Radiology Techniques

Subject :- General Chemistry (2020-2021)

lecture :- 1

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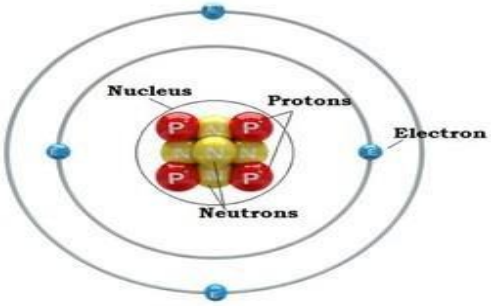
ATOMS AND ELEMENTS

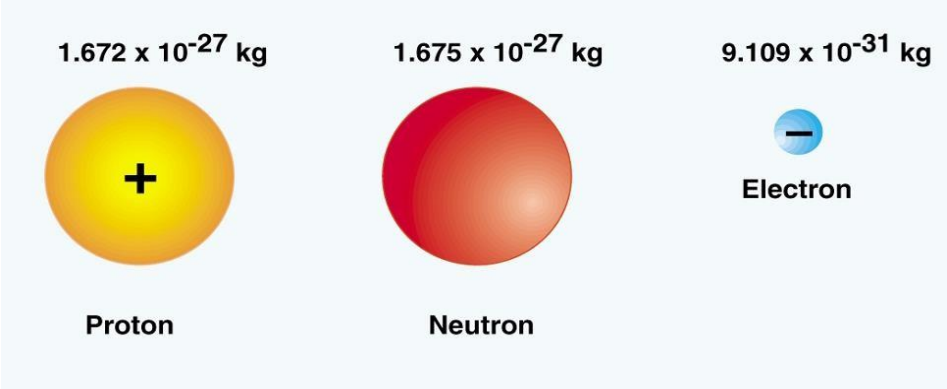
An atom is the basic structure from which all matter is composed.

Atoms are made of small particles called protons, neutrons, and electrons. Each of these particles is described in terms of measurable properties, including mass and charge. An **atom** is composed of two regions: the nucleus, which is in the center of the atom and contains protons and neutrons, and the outer region of the atom, which holds its electrons in orbit around the nucleus.

- A **proton** is a positively charged particle in an atom
- An **electron** is a negatively charged particle in an atom
- A **neutron** is a neutral (neither negative nor positive) particle in an atom
- The **Atomic Number** is the number of protons in an atom
- The **Atomic Mass Number** is the number of protons and the number of neutrons in an atom



Mass is the amount of matter that an object contains. The proton and neutron have roughly the same mass and have approximately one thousand times the mass of the electron. The proton and electron have equal, but opposite, electrical charges. A neutron does not have an electrical charge.



Model of Proton, Neutron and Electron

If the proton and neutron were enlarged, and each had the approximate mass of a panda, the electron, enlarged to the same scale, would have less mass than an owl.

In an atom, the protons and neutrons clump together in the center and are called the nucleus. Because the protons are positively charged, the nucleus has a positive electric charge.

The electrons of the atom move rapidly around the nucleus. If we attempt to detect an electron in an atom, we might find evidence of it located almost anywhere around the nucleus. However, if we repeat this experiment many times, it will be found that the electron is much more likely to be located in certain regions of space surrounding the nucleus than in other regions of space. We might think that the electron is rapidly moving around the nucleus and our experiment "catches" the electron as an instantaneous "snapshot" of it in motion. The probability of finding the electron in any region of space can then be described by a cloud that rapidly thins out as one goes farther from the nucleus. The density of the cloud at any point is the probability of finding the electron at that point.

The attractive electric force between the positively-charged protons in the nucleus and the negatively-charged electrons around the nucleus holds the atom together. Atoms containing the same number of protons and electrons have no net charge. Atoms that have extra electrons or are missing electrons have a net electrical charge and are called ions. Ions can interact with other ions due to the electrical attraction between opposite charges.

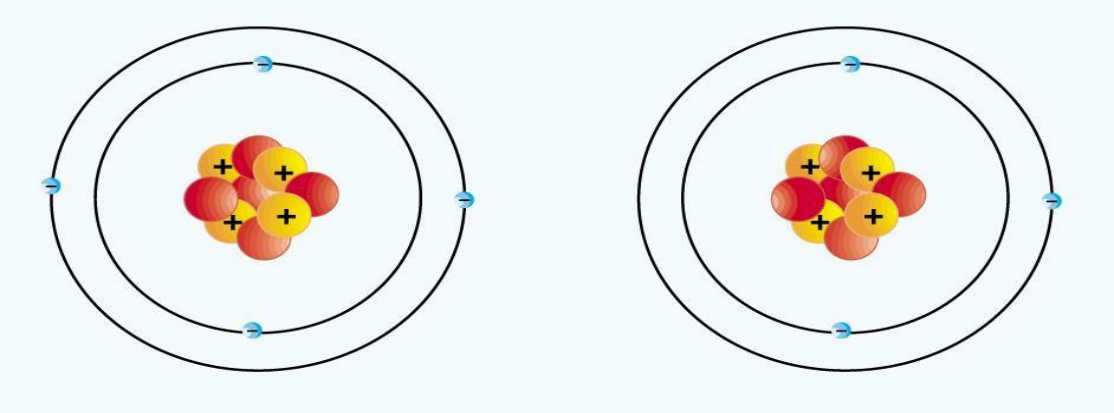
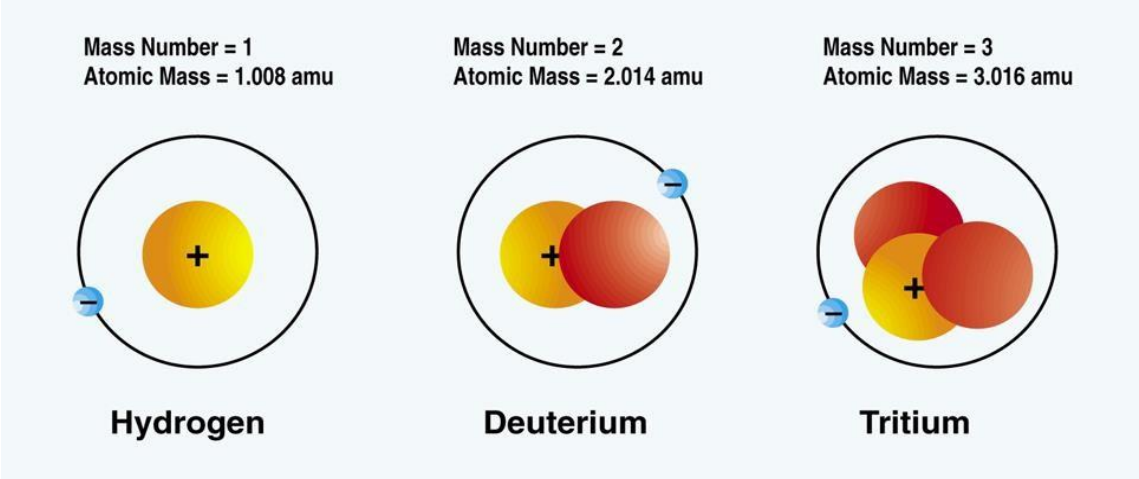


Diagram Comparing a Beryllium Atom and a Positively-Charged Beryllium Ion

Atoms interact with other atoms by sharing or transferring electrons that are farthest from the nucleus. These electrons are sometimes called valence electrons . These outer electrons determine the chemical properties of the element, such as how readily it interacts with other elements and the allowable ratios for its combinations with other substances.

ISOTOPES

When an element has atoms that differ in the number of neutrons in the nuclei, these atoms are called different isotopes of the element. All isotopes of one element have identical chemical properties. This means it is difficult to separate isotopes from each other by chemical processes. However, the physical properties of the isotopes, such as their masses, boiling points, and freezing points, are different. Isotopes can be most easily separated from each other using physical processes.



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Mass Number and Atomic Mass of Hydrogen, Deuterium, and Tritium

The sum of the number of protons and neutrons in the nucleus of an atom is called that element's mass number. This is not the same as the element's mass. Since different isotopes of an element contain different numbers of neutrons in the nuclei of their atoms, isotopes of the same element will have different atomic masses. This was shown above for the three isotopes of hydrogen. The symbol for an isotope is the symbol for the element followed by the mass number. Hydrogen is symbolized as H^1, while deuterium is symbolized as H^2.and tritium is H^3.