

## FlexiPrep

# Isotopes of Elements, Physical and Chemical Properties of Isotopes (For CBSE, ICSE, IAS, NET, NRA 2022)

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- The word isotope has been derived from two Greek words isos and topo's which further translates to "the same place". Isotope's variants of a single element are found in the same position on the periodic table.
- The term was first used by Margaret Todd, a Scottish doctor, and writer while consulting with radiochemist Frederick Soddy. This term was coined in the year 1913.

## Isotope

- The term "isotope" mainly refers to the variation in the atomic mass or weight of an element.
- It is also defined as variants of a particular element where these variants will have the same number of protons but differ in the number of neutrons in the atom.
- Due to the unequal numbers of neutrons, the isotopes of elements usually have a different mass. Generally, elements which have odd atomic number will have one or two stable isotopes whereas elements with even atomic numbers will mostly have 3 or more stable isotopes. However, there are also exceptions like carbon, helium, and beryllium.
- An isotope is usually denoted or identified by the name of the particular element at the beginning which is followed by a hyphen and the mass number.

## Physical and Chemical Properties of Isotopes

- When we talk about the chemical properties of isotopes of a given element, they are almost the same or identical. Different isotopes exhibit nearly identical chemical behaviors. However, when it comes to physical properties of isotopes like the mass, melting or boiling point, density, and the freezing point they all are different.
- The physical properties of any isotope mostly depend on the mass of each isotope. Knowing the differences allows us to distinguish between one isotope from another.

## Types of Isotopes

- Isotopes are said to be either stable or radioactive. Therefore, isotopes that are radioactive are often called as radioisotopes or radionuclides.
- Isotopes that do not decay radioactively are known as stable isotopes or stable nuclides.

- As per the findings, there are about 339 naturally occurring nuclides or isotopes on the planet earth.
- In this, 286 are said to be primordial nuclides which are believed to have existed since the formation of the Solar System.

### Isotope Examples

- The common examples are the isotopes of hydrogen and carbon. If we talk about the element Hydrogen, it has three stable isotopes namely protium, deuterium, and tritium. These isotopes have the same number of protons but a different number of neutrons wherein protium has zero, deuterium has one and tritium has two.
- When we look at carbon it also has three isotopes namely Carbon-12, Carbon-13, and Carbon-14. The numbers 12,13, and 14 are the isotopes' atomic masses. Here, Carbon-12 is a stable isotope whereas carbon-14 is mostly a radioactive isotope.
- Apart from these some of the other common isotope examples include – Tin has 22 isotopes, Zinc has 21 known isotopes, Neon is a mix of 3 isotopes, natural xenon consists of a mixture of 9 stable isotopes, Nickel has 14 known isotopes.

### Element Isotopes Facts

- Most of the elements that are found in nature are a combination of several different isotopes.
- They are also known as Nuclides.
- About 1000 unstable isotopes are currently present. Some of these occur in nature while some are manufactured synthetically in laboratories
- Close to 20 elements have only 1 stable isotope. Few of them include gold, aluminum, phosphorous, fluorine, and sodium.
- Different isotopes of elements are used in fields like carbon dating, nuclear reactors and in medicinal purposes.

### Questions

#### Who Discovered Isotopes?

Ans: In 1913, while explaining the aspects of radioactivity, Frederick Soddy introduced the concept of isotopes. The first stable isotope in neon was discovered by Thomson.

#### Why Do Isotopes Exist?

Ans: There may be different types of atoms of a chemical element. These are referred to as isotopes. They have the same number (and electrons) of protons, but different neutron numbers. However, isotopes have different mass numbers, because they have different neutron numbers.

### What Are the Natural Isotopes?

Ans: Isotopes are atoms of different masses of the same element. By having different numbers of neutrons in their nuclei they get these different masses. However, they are the same type of atom, because they have the same number of protons in their nuclei.

### How Are Isotopes Useful?

Ans: An element's isotopes all have the same chemical behavior, but the unstable isotopes experience spontaneous decline during which they emit radiation and reach a stable state. The radioisotope activity is useful for food preservation, archeological object identification, and medical diagnosis and treatment.

### What Causes an Isotope?

Ans: Atoms of the same element are called isotopes with different numbers of neutrons. Many elements contain one or more radioactive isotopes. These are called radioisotopes. Their nuclei are unstable, breaking down or declining, and emitting radiation.

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