Isotopes

Definition of 'Isotope'

Isotope: Atoms of the same element with identical atomic numbers but different atomic masses due to varying numbers of neutrons.

Examples and Uses of Isotopes

Hydrogen Isotopes:

Hydrogen-1 (Protium): Used in ammonia production with nitrogen. It's also utilized in the hydrogenation process to convert unsaturated or liquid fats into solid fats used in food and soap production.

Hydrogen-2 (Deuterium): Primarily employed in the production of hydrogen bombs.

Hydrogen-3 (Tritium): Utilized in nuclear fusion reactions and has potential applications as an artificial radioactive tracer.

Calculation of Relative Atomic Mass Using Percentage Abundance of Isotopes

Relative Atomic Mass: Represents the weighted average of the atomic masses of an element's naturally occurring isotopes, taking into account their relative abundances.

Formula:

Relative Atomic Mass = (% of isotope 1 x mass of isotope 1) + (% of isotope 2 x mass of isotope 2) ÷ 100

Example:

Copper: Two naturally occurring isotopes with mass numbers 63 and 65.

Abundance: 69.2% for mass 62.93 amu

Abundance: 30.8% for mass 64.93 amu

Using the formula:

Relative Atomic Mass of Copper = (69.2% x 62.93 amu) + (30.8% x 64.93 amu) ÷ 100

= (43.5716 + 20.0024) ÷ 100

= 63.546 amu

Correct Isotope Notation

Radioactivity

Stable and Unstable Nuclei

Stable	Unstable
Have a balanced number of protons and neutrons.	Have an unbalanced number of protons and neutrons; too much of either. They decay and emit particles to achieve a balanced state.
Located in the lighter section of the periodic table.	Generally heavy due to an excess number of protons and neutrons.
Nuclei with proton numbers under 83 are naturally stable.	Nuclei with proton numbers over 83 are unstable and radioactive.

Define the terms:

Decay Series: A sequence of decay where a radioactive element breaks down into different elements until reaching stability.

Parent Isotope: The initial radioactive isotope before decay occurs.

Daughter Isotope: The resulting isotope from the decay of the parent isotope.

Half-Life: The duration required for an isotope's radioactivity to decrease to half of its original level.

Transuranium Element: Elements with radioactive isotopes that decay to stable atoms, characterized by an atomic number exceeding 92, the atomic number of Uranium.

Compare alpha, beta, and gamma decay:

Alpha, beta, and gamma decay are different types of radioactive decay processes:

Alpha Decay: Involves the emission of an alpha particle, which consists of two protons and two neutrons. This type of decay reduces the atomic number of the parent nucleus by 2 and the atomic mass by 4.

Beta Decay: Involves the emission of a beta particle, which can be an electron (beta-minus decay) or a positron (beta-plus decay). Beta-minus decay increases the atomic number by 1, while beta-plus decay decreases it by 1.

Gamma Decay: Involves the emission of gamma radiation, which is high-energy electromagnetic radiation. Gamma decay does not change the atomic number or mass of the nucleus but lowers its energy state after other types of decay.

Outline the use of a Geiger counter

Geiger counters are instruments employed to identify radioactive emissions, especially in industries utilizing radioactive materials. While capable of detecting various radiation types, they primarily identify beta and gamma radiation.

The operation of Geiger counters relies on inert gases. These gases are contained within the counter's tube. When radiation interacts with the gas inside the tube, it ionizes the gas atoms, creating a conductive path. This ionization event produces an electrical pulse that is then amplified and counted by the Geiger-Müller tube, allowing for the detection and measurement of radiation levels.