**How to get the atomic mass unit**

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= 1.66053904e-27 kilograms.

The average atomic mass of an element is the sum of the masses of its isotopes, each multiplied by its natural abundance. Calculate the average atomic mass of an element given its isotopes and their natural abundance Key Takeaways Key Points An element can have different numbers of neutrons in its core, but it always has the same number of protons. Versions of an element with different neutrons have different masses and are called isotopes. The average atomic mass by an element is calculated by suming the masses of the isotopes of the element, multiplied by its natural abundance on Earth. When mass calculations are carried out involving elements or compounds, always use the average atomic mass, which can be found on the periodic table. Key terms mass number: The total number of protons and neutrons in an atomic nucleus. Natural abundance: The abundance of a particular isotope naturally found on the planet. average atomic mass: The calculated mass by adding the masses of isotopes of an element, each multiplied by its natural abundance on Earth. The atomic number of an element defines the identity of the element and means the number of protons in the nucleus of an atom. For example, the hydrogen element (the lightest element) will always have a proton in its core. The helium element will always have two protons in its core. The atoms of the same element can, however, have different numbers of neutrons in their nucleus. For example, there are stable helium atoms that contain one or two neutrons, but both atoms have two protons. These different types of helium atoms have different masses (3 or 4 atomic mass units), and are called isotopes. For any isotope data, the sum of the numbers of protons and neutrons in the nucleus is called the mass number. This is because each proton and every neutron weighs an atomic mass unit (amu). Adding together the number of protons and neutrons and multiplying by 1 amu, you can calculate the mass of the atom. All elements exist as a collection of isotopes. The word 'isotope' comes from the Greek 'isos' (which means 'stex') and 'topes' (which means 'place') because the elements can occupy the same place on the periodic table while they are different in subatomic construction. Lithium atom: sterilized lithium-7 atom: 3 protons (red), 4 neutrons (black), and 3 electrons (blue). (Lithium also has another more rare isotope with only 2 neutrons.) Calculation of the average atomic mass The average atomic mass of an element is the sum of the masses of its isotopes, each multiplied by its natural abundance (the decimal associated with the percent of the atoms of that element which are of a given isotope). Average atomic mass = f1M1 + f2M2 +... + fn Mn where f is the fraction that represents the natural abundance of the isotope and M is the mass number (weight) of the isotope. The average atomic mass of an element can beon the periodic table, typically under the elementary symbol. When the data is availableThe natural abundance of various isotopes of an element, and it is easy to calculate the average atomic mass. For helium, there is about one isotope of helium-3 for every million isotopes of helium-4; therefore, the average atomic mass is very close to 4 amu (4,002,602 amu). Chlorine consists of two main isotopes, one with 18 neutrons (75.77% of natural chlorine atoms) and one with 20 neutrons (24.23% of natural chlorine atoms). The atomic number of chlorine is 17 (it has 17 protons in its nucleus). To calculate the average mass, first convert the percentages into fractions (divide them by 100). Then, calculate the mass numbers. The 18-neutron chlorine isotope has an abundance of 0.7577 and a mass number of 35 amu. To calculate the average atomic mass, multiply the fraction by the mass number of each isotope, then add them together. Average atomic mass of chlorine = (0,7577 [latex]\cdot[/latex] 35 amu) + (0.2423 [latex]\cdot[/latex] 37 amu) = 35,48 amu Another example is to calculate the atomic mass of boron (B), which has two isotopes: B-10 with 19.9% natural abundance, and B-11 with 80 1% abundance. Therefore, average atomic mass of boron = (0.199 [latex]\cdot[/latex] 10 amu) + (0,801 [latex]\cdot[/latex]Ä 11 amu) = 10,80 amu Whenever we do mass calculations involving elements or compounds (combinations of elements), we always use average atomic masses. Mass spectrometry is a powerful characterization method that identifies elements, isotopes and compounds based on the mass-charge ratio. Defining the Primary Application of a Mass Spectrometer Key Points Key Points Mass spectrometers work on samples in the gaseous state. Gas samples are ionized by an ion source, which adds or removes charged particles (electrons or ions). Examples of ion sources include the impact of electrons and inductively coupled plasma. Mass analysers separate ionised samples according to their mass-to-charge ratio. Flight time and quadruple are examples of mass analyzers. The mass of a particle can be calculated very accurately based on parameters such as the time it takes to travel a certain distance or its angle of travel. Mass spectrometers are so accurate that they can determine the types of elements in a compound or measure the differences between the mass of different isotopes in the same atom. Key terms ionization: Any process leading to the dissociation of a neutral atom or molecule into charged particles (ions). plasma: a state of matter consisting of partially ionized gases, usually at high temperatures. mass-charge ratio: the best way to separate ions in a mass spectrometer. This number is calculated by dividing the weight of the ions by its charge. Mass spectrometry (MS) is a powerful technique capable of identifying a wide variety of chemical compounds. It is used for the mass of a particle, the elemental composition of a sample, and the chemical structures of larger molecules. Mass spectrometers separate compounds based on a known as mass-a-load ratio: the mass of the atom divided by its charge. First, the sample is ionized. Ionization is the process of conversion of an atom or molecule into an ion by adding or removing charged particles such as electrons or ions. Once the sample is ionized, it passed through some form of electric or magnetic field. The mass of a particle can be calculated based on parameters such as the time needed to travel a certain distance or its travel angle. Mass spectrometer diagram: A sample is loaded on the mass spectrometer, where vaporization and ionization are undergoing. Sample components are ionized by a variety of methods, such as ionizing filament. The ions are separated into a magnetic field analysis. They are separated according to their mass-a-load reports. The ions are detected, usually by a quantitative method like a Faraday collector. The ionic signal is processed in a mass spectrum. Mass Spectrometry (MS) MS Tools make-up consists of two main components: An ion source, which can convert sample molecules to ions A mass analyzer, which orders mass ions by applying electromagnetic fields There are a wide range of techniques for ionizing and detecting compounds. Ionizing compounds Inductive plasma fiamma (ICP): Image of a ICP flame seen through the glass of the green welder. The ion source is the part of the mass spectrometer that ionizes the compound. Depending on the information required by mass spectrometry analysis, different ionization techniques can be used. For example, the most common ion source for element analysis is odontoiatically coupled plasma (ICP). In the PIC, a 10,000-degree "flame" C of plasma gas is used to atomize sample molecules and undress the external electrons from those atoms. Plasma is usually generated by argon gas. Plasma gas is electrically neutral overall, but a substantial number of its atoms are ionized by high temperature. The impact of electron (EI) is another method of generating ions. In EI, the sample is heated until it becomes gas. It then passed through an electron beam. This high-energy beam strips electrons from sample molecules, leaving behind a positively charged radical species. Mass analyzers Mass analyzers separate ions based on their mass-a-load ratios. There are many types of mass analyzers. Each has its strengths and weaknesses, including: how accurately they can measure similar mass-to-charge ratios the range of masses and sample concentrations that can measure. For example, a flight time analyzer (TOF) uses an electric field to speed ions through the same potential and thereforethe time necessary to reach the detector. Because all particles have the same charge, their speeds depend only on their masses, and lighter ions will reach the detector first. Time-of-Flight Mass Analyzer: Scheme of a time-of-flight mass analyzer (TOF). Another type ofIt's a quadruple. Here, ions have passed through four parallel rods, which apply a variable electrical voltage. While the field changes, ions respond by following complex paths. Depending on the applied voltage, only ions of a certain mass-a-load ratio will pass through the analyzer. All other ions will be lost from collision with the rods. Using a mass spectrometer to measure Mass Here is how a mass spectrometer could analyze a sample of sodium chloride (table room). In the ion source, the sample is vaporized (transformed into gas) and ionized in sodium ions (Na+) and chloride (Cl–). Sodium atoms and ions have only one isotope and a mass of about 23 amu. Atoms and chloride ions come in two isotopes, with masses of about 35 amu (to natural abundance of about 75 percent) and about 37 amu (to natural abundance of about 25 percent). The mass analysis part of the spectrometer contains electrical and magnetic fields, which exert forces on ions traveling through these fields. The angle in which the ion moves through the fields depends on its mass-a-load ratio: lighter ions change direction more than heavier ions. The ordered ion flows pass from the analyzer to the detector, which records the relative abundance of all types of ion. This information is used to determine the chemical composition of the original sample (i.e. the sodium and chlorine are present in the sample) as well as its isotopic composition (the ratio between chlo-35 and chlo-37).

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