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The total number of protons and neutrons in the nucleus of an atom is known as

The Atom and Electromagnetic Radiation Basic Subatomic Particles Symbol Electronic Mass Electron E--1 0.0Â 005Â 486 Amu Protone P + +1 1.007Â 276 Amu Neutron No 0 1.008Â 665 AMU The number of protons, neutrons and electrons in a Atom can be determined by a series of simple rules. The number of protons in the nucleus of the atom is the same as the atomic number (Z). The number of electrons in a neutral atom is the same as the number of protons. The mass number of the atom (m) is equal to the sum of the number of protons and neutrons in the nucleus. The number of neutrons is equal to the difference between the mass number of the atom (M) and the atomic number (Z). Examples: We determine the number of protons, neutrons and electrons in the following isotopes. The different isotopes of an element are identified by writing the mass number of the atom in the upper left corner of the element symbol. 12c, 13c and 14c are carbon isotopes (z = 6) and therefore contain six protons. If atoms are neutral, they must also contain six electrons. 12C: 6 electrons, 6 protons and 6 neutrons 13c: 6 electrons, 6 protons and 6 neutrons 14c: 6 electrons, 6 protons and 7 neutrons interaction between matter and different forms of electromagnetic radiation. Electromagnetic radiation has some of the properties of both a particle and a wave. Particles have a defined mass and occupy space. The waves do not have mass and yet they carry energy as they travel in space. In addition to their capacity to transport energy, the waves have four more features: speed, frequency, wave length and width. The frequency (V) is the number of waves (or cycles) per unit of time. The frequency of a wave is expressed in cycle units per second (S-1) or Hertz (Hz). The idealized design of a wave in the figure below illustrates the width and wave length definitions. The wave length (L) is the minimum distance between repeated points on the wave. The wave width is the distance between the highest point (or lower) of the wave and the gravity of the wave. If we measure the frequency (V) of a wave in cycles per second and the wave length (L) in meters, the product of these two numbers has the meters per second. The frequency product (V) multiplied by the wave length (L) of a wave is therefore the speed or speeds with which the wave travels into space. VL = s light and other forms of electromagnetic radiation Light is a wave with both electric and magnetic components. It is therefore a form of electromagnetic radiation. The visible light contains the narrow band of frequencies and wave lengths in part of the electromagnetic spectrum that our eyes can detect. It includes radiation with wave lengths between about 400 nm (violet) and 700 nm (red). Because it is a wave, the light bends when it enters a glass prism. When white light is focused on a prism, the rays of different wave lengths are folded in different quantities and the light is transformed into a color spectrum. Starting from the spectrum side where the light is folded from the smallest corner, the colors are red, orange, yellow, green, blue and purple. As we can see from the following diagram, the energy transported by light increases as we spend from red to blue through the visible spectrum. Because the wave length of electromagnetic radiation can reach 40 m or 10-5 nm, the visible spectrum is only a small part of the total range of electromagnetic radiation. The electromagnetic spectrum includes radio and television waves, microwaves, infrared, visible light, ultraviolet, X-rays, g rays and cosmic rays, as shown in the previous figure. These different forms of radiation all travel to the speed of light (C). They differ, however, for frequencies and wavelengths. The product of the frequency times the wavelength of electromagnetic radiation is always equal to the speed of light. Vl = c As a result, electromagnetic radiation that has a long wavelength has a low frequency, and radiation with a high frequency has a short wavelength. Atomic Structure A. Atomic Number Parities Electrons or Protons Each element has an atomic number. The atomic numbers are listed together with the names and symbols of the elements on the inside cover of the text. The atomic number is equal to the charge on the nucleus. It is also equivalent to the number of protons in the nucleus and is also numerically equal to the number of electrons in the neutral atom. The atomic number has the symbol Z. Different elements have different atomic numbers; therefore, the atoms of different elements contain different numbers of protons (and electrons). Oxygen has the atomic number 8; its atoms contain 8 protons and 8 electrons. Uranium has the atomic number 92; its atoms contain 92 protons and 92 electrons. The ratio between atomic number and number of protons or electrons can be indicated as follows: Atomic number = number of protons per atom = number of electrons per neutral atom B. Mass number Parity Protons and Neutrons Each atom also has a mass number, indicated by the symbol A. The mass number of an atom is equal to the number of electrons. protons plus the number of neutrons it contains. In other words, the number of neutrons in any atom is its mass number minus its atomic number. Number of neutrons = mass number – atomic number or mass number = number of protons + number of neutrons The atomic number and the mass number of an atom of an element can be shown by writing, in front of the element symbol, the mass number as a superscript and the atomic number as a undersigned: the numeric symbol Element mass or AZ X For example, a gold atom (symbol Au) with an atomic number 79 and the mass number of 196 is indicated as: C. Isotopes Although all the atoms of a given element must have the same atomic number, they do not all have the same mass number. For example, some carbon atoms (atomic number 6) have a mass number of 12, others have a mass number of 13, and still others have a mass number of 14. These different types of the same element are called isotopes. Isotopes are atoms that have the same atomic number (and are therefore of the same element) but different mass numbers. The composition of the atoms of the natural carbon isotopes is shown in Table 4.2 TABLE 4.2 Natural Carbon Isotopes Protons Electrons Neutrons 6 6 6