

Chapter 7 Periodic Table**Elements, Atomic Numbers, and Isotopes**

7. b. *Students know* each element has a specific number of protons in the nucleus (the atomic number) and each isotope of the element has a different but specific number of neutrons in the nucleus.

Atomic Number

The definition of an element is based on its atomic number. The **atomic number** of an element is the number of protons in an atom of that element. All atoms of a given element have the same number of protons in the nucleus. Atoms with different atomic numbers are atoms of different elements. For example, carbon has an atomic number of 6, which tells you that the nucleus of every carbon atom has 6 protons. Oxygen has an atomic number of 8. Silver has an atomic number of 47.

In the periodic table, elements are arranged by increasing atomic number. As atomic number increases, the mass of atoms in succeeding elements generally increases. Moving left to right across a period, you will notice that the atomic masses tend to increase. Within a group, the elements listed in the lower rows are more massive than those in the upper rows.

Isotopes

The number of protons is fixed for a given element. But the same is not true for the number of neutrons in the nucleus. Atoms of the same element that have different numbers of neutrons are called **isotopes**. Figure 7–2 illustrates three isotopes of carbon. Each carbon atom has 6 protons and 6 electrons. But the number of neutrons can vary from 6 to 8.

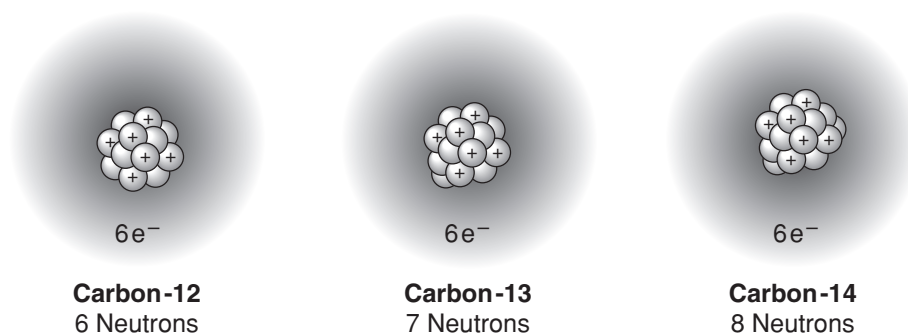


Figure 7–2 Isotopes of carbon All isotopes of carbon have 6 protons and 6 electrons, but they differ in their number of neutrons.

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An isotope is identified by its mass number. The **mass number** of an atom is the sum of the protons and neutrons in the nucleus. The most common isotope of carbon has 6 protons and 6 neutrons, giving it a mass number of 12. This isotope is written as “carbon-12.” The other two isotopes of carbon are carbon-13 (which has 7 neutrons) and carbon-14 (which has 8 neutrons). All three isotopes of carbon react the same way chemically.

Some elements have radioactive isotopes. The nuclei of radioactive isotopes are unstable. During **radioactive decay**, unstable nuclei spontaneously release fast-moving particles and energy. As a result of this process, an unstable nucleus can become the nucleus of a different element with a different atomic number. Radon (element 86) and uranium (element 92) are examples of elements in which no stable isotopes exist.

Standard 7. b. Check

5 The atomic number of sodium is 11. The nucleus of every sodium atom contains

- A 11 isotopes.
- B 11 protons.
- C 11 neutrons.
- D 11 electrons.

6 The atomic number of hydrogen is 1. The nucleus of the isotope hydrogen-2 contains

- A 1 proton and 1 neutron.
- B 1 proton and 0 neutrons.
- C 2 protons and 0 neutrons.
- D 1 proton and 2 neutrons.

7 Isotopes of the same element differ from each other by their

- A atomic number.
- B reactivity.
- C number of neutrons.
- D number of protons.

8 Two atoms with different atomic numbers are

- A the same isotope of the same element.
- B different isotopes of the same element.
- C atoms of different elements.
- D atoms that react the same way chemically.