

## Atomic Structure: Protons, Neutrons, and Electrons

An **element** is a pure substance that cannot be broken down into simpler substances using chemical means.

An **atom** is the smallest representative particle of an element.

An atom consists of an **electron cloud** which surrounds the **nucleus**.

The **nucleus** is the very small positively charged portion of the atom that contains the **protons** and the **neutrons**.

The **proton** is a positively charged particle in the nucleus.

The number of protons in a nucleus of an element is given by the elements **atomic number, Z**.

The **neutron** is the particle in the nucleus that has no charge. The proton and the neutron have approximately the same mass.

The **mass number, A**, is the number of protons and neutrons in a nucleus.

A **neutral** atom contains an **equal number** of protons and electrons.

A **positive ion** is an atom that has **lost electrons** so there are less electrons than protons.

A **negative ion** is an atom that has **gained electrons** so there are more electrons than protons.

A **nuclear symbol** is used to represent the number of protons, neutrons, and electrons in a given atom.



The example has 8 protons,  $16 - 8 = 8$  neutrons, and  $8 + 2 = 10$  electrons ( (-) charge means you have gained electrons).

An atom can also be represented by its name followed by its mass number.

*Uranium – 235*

The nucleus has 92 protons (atomic number) and  $235$  (mass number) –  $92$  (atomic number) =  $143$  neutrons.

**Problems:**

1. The number of protons in the atom whose atomic mass is 89 and atomic number is 39, is?
2. The number of neutrons in an atom of the radioactive carbon isotope  $^{14}_6\text{C}$ , is?
3. The mass number of an atom of iodine is 127, and the atomic number is 53. The number of protons in the nucleus of this iodine atom is?
4. The number of protons in the nucleus of an atom of  $^9_4\text{Be}$  is?
5. The nucleus of an isotope of tin,  $^{116}_{50}\text{Sn}^{2+}$  contains \_\_\_\_\_ electrons?
6. A particle containing 5 protons, 4 electrons, and 6 neutrons has a mass number of?
7. The number of protons in an atom of carbon-14 is?
8. Write the nuclear symbol for the atom or ion that consists of 13 protons, 14 neutrons, and 10 electrons?
9. An ion has 13 electrons, 12 protons, and 14 neutrons. What is the mass of the ion?
10. How many electrons are in a chromium (III) ion,  $^{52}_{24}\text{Cr}^{3+}$ ?
11. Which chemical species contains the greatest number of electrons? Explain.  
(A)  $^{58}_{26}\text{Fe}^{3+}$  (B)  $^{56}_{26}\text{Fe}^0$  (C)  $^{58}_{26}\text{Fe}^{2+}$  (D)  $^{56}_{26}\text{Fe}^{3+}$
12. An atom of  $^{32}_{16}\text{S}^{2-}$  contains \_\_\_\_\_ electrons.