

12.1 Atoms and Isotopes

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You have learned that atoms contain three smaller particles called protons, neutrons, and electrons, and that the number of protons determines the type of atom. How can you figure out how many neutrons an atom contains, and whether it is neutral or has a charge? Once you know how many protons and neutrons are in an atom, you can also figure out its mass.

In this skill sheet, you will learn about **isotopes**, which are atoms that have the same number of protons but different numbers of neutrons.

What are isotopes?

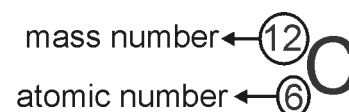
In addition to its atomic number, every atom can also be described by its mass number:

$$\text{mass number} = \text{number of protons} + \text{number of neutrons}$$

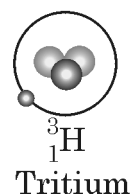
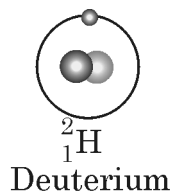
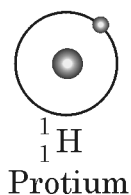
Atoms of the same element always have the same number of protons, but can have different numbers of neutrons. These different forms of the same element are called **isotopes**.

EXAMPLE

Sometimes the mass number for an element is included in its symbol. When the symbol is written in this way, we call it isotope notation. The isotope notation for carbon-12 is shown to the right. How many neutrons does an atom of carbon-12 have? To find out, simply take the mass number and subtract the atomic number: $12 - 6 = 6$ neutrons.

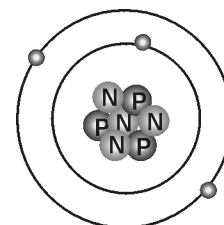


Hydrogen has three isotopes as shown below.



PRACTICE

- How many neutrons does protium have? What about deuterium and tritium?
- Use the diagram of an atom to answer the questions:
 - What is the atomic number of the element?
 - What is the name of the element?
 - What is the mass number of the element?
 - Write the isotope notation for this isotope.



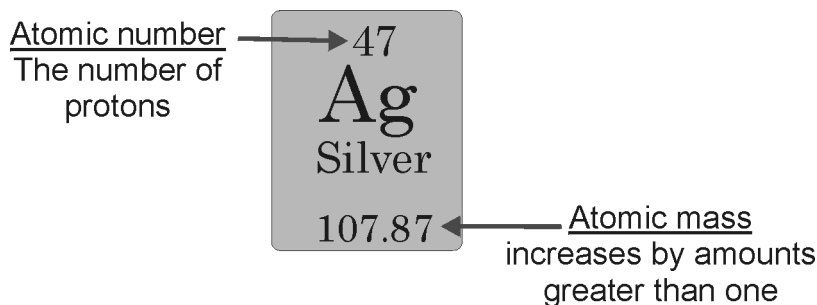


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What is the atomic mass?

If you look at a periodic table, you will notice that the atomic number increases by one whole number at a time. This is because you add one proton at a time for each element. The atomic mass however, increases by amounts greater than one. This difference is due to the neutrons in the nucleus. The value of the atomic mass reflects the abundance of the stable isotopes for an element that exist in the universe.



Since silver has an atomic mass of 107.87, this means that most of the stable isotopes that exist have a mass number of 108. In other words, the most common silver isotope is “silver-108.” To figure out the most common isotope for an element, round the atomic mass to the nearest whole number.

PRACTICE

1. Look up bromine on the periodic table. What is the most common isotope of bromine?
2. Look up potassium. How many neutrons does the most common isotope of potassium have?
3. Look up lithium. What is its most common isotope?
4. How many neutrons does the most common isotope of neon have?