

# SUBATOMIC PARTICLES

## VOCAB REVIEW

- Atomic mass unit (amu): 1 proton has a mass of 1 amu; determined by taking the mass of a Carbon-12 atom and dividing by the total number of particles.
- Atomic number: the number of protons in an atom.
- Mass number: the sum of the protons and neutrons in an atom.
- Isotopes: atoms of the same element with different masses. They have the same number of protons and electrons but greater or lesser numbers of neutrons.
- Ions: charged particles caused by an atom or groups of atoms losing or gaining electrons
- Cations: positively charged ions due to the loss of electrons.
- Anions: negatively charged ions due to the gain of electrons; they become negative when they gain electrons because electrons are negatively charged particles and they outnumber the positively charged protons.

## CALCULATING NUMBER OF PROTONS, NEUTRONS, AND ELECTRONS

- The proton number is the atomic number of the atom.
- The mass number is the sum of the number of protons and neutrons.
- The neutron number is the mass number minus the number of protons.
- The electron number equals the proton number in an atom but for an ion, the sum of the proton charge and electron charge equals the charge of the ion. Sn positive ions have more protons than electrons whereas anions have more electrons than protons.

In the case of Neon – 20, the total mass is 20. Neon is atomic number 10 and therefore has 10 protons. Since the mass is the sum of the protons and neutrons, a total mass of 20 minus the mass of 10 protons indicates the mass of 10 neutrons. Since neon is not charged, the number of protons and electrons must be equal. Note that it is easier to use mass values in amu or Daltons (symbol Da) than grams because the mass is so small. A carbon-12 atom is defined to have a mass of 12.0000 Da or 12.0000 amu.

Summary table of subatomic particles:

Particle	Charge (Relative)	Mass 2.7 (g)	Mass (amu or Da)
Proton	+1	$1.672 \times 10^{-24}$	1.00727
Neutron	0	$1.674 \times 10^{-24}$	1.00866
Electron	-1	$9.10 \times 10^{-20}$	0.00055

## CALCULATING AVERAGE ATOMIC MASS

- Atomic mass is the average mass of an atom of an element. Because elements can have isotopes, the mass on the periodic table is a weighted average of the isotopic masses. If you know the main isotopes of carbon have masses of 12, 13, and 14, and the mass on the table is 12.01 amu, we know there must be a much higher percentage of carbon with a mass of 12 than carbon with a mass of 13 or 14.
- To calculate atomic mass use this equation:
  - Atomic mass = (fraction of isotope 1 x mass of isotope 1) + (fraction of isotope 2 x mass of isotope 2), adding as many isotopes as needed.