

STRUCTURES AND PROPERTIES OF MATTER

Science Review

When studying for this portion of the test, be sure to review the following:

1. Be able to describe atoms, understanding the structure of an atom in terms of:
 - a. atomic mass and number
 - b. elements (atoms with different numbers of protons)
 - c. isotopes (atoms with different numbers of neutrons)
 - d. proton, neutron, and electron charge and locations
2. Apply the properties of solutions, analyzing solutions in terms of solutes and solvents.

Assessment will focus on the following:

1. Understanding that atoms are composed of a nucleus encompassed by a cloud of electrons
2. Recognizing that electrons are arranged in the electron cloud in energy levels.
3. Understanding that the atomic mass of an atom is concentrated in the nucleus of the atom
4. Identifying the symbol, atomic number, and atomic mass of the first 20 elements on the periodic table.
5. Recognizing the difference between atomic number and atomic mass.
6. Identifying the effect of differing numbers of neutrons in atoms of the same element, primarily in the context of radioactive isotopes.
7. Differentiating among elements.
8. Understanding solutions, including describing the components of solutions as solvents and solutes.

Become Familiar with the following terms:

Element	Electron shells
Atom	Period
Nucleus	Group
Proton	Solution
Electron	Solute
Atomic number	Solvent
Atomic mass	Saturated
Mass number	Electrolyte

THE ATOM

SUBATOMIC PARTICLES

Nucleus is the center of the atom, contains 99.9% of the mass of the atom, holds neutrons and protons.

- **Proton, p⁺**: has a positive charge; all are identical no matter which element; mass is one amu; the number of protons determines which element you have – also called the atomic number.
- **Neutron, n⁰**: is neutral (no charge); all are identical regardless of the element; mass is one amu; the number of neutrons of an element can be determined by: Mass Number – Atomic Number = neutron number.

Electron Cloud is the area surrounding the nucleus, is mostly empty space, and holds electrons.

- **Electron, e⁻**: has a negative charge, the mass is 1/1840 amu, in a neutral atom, the number of electrons equals the number of protons.

ATOMIC NUMBER, Z: Equals the number of protons; determines the identity of the element; if you change the number of protons, you change the element.

MASS NUMBER, A: The number of protons and neutrons combined; is different for each isotope of an element.

ATOMIC MASS: All masses of the isotopes of the element averaged together. It is rarely a whole number.

SUMMARY:

Particle	Location	Charge	Mass (amu)	the number in a neutral atom
PROTON	nucleus	positive	1	same as the atomic number
NEUTRON	nucleus	neutral	1	mass number – atomic number
ELECTRON	electron cloud	negative	1/1840	same as protons in a <u>neutral</u> atom

PERIODIC TABLE ORGANIZATION

The periodic table is organized by increasing atomic number and is read from left to right.

Each vertical column is called a group or family. All elements in the same family have the same number of valence electrons (the electrons in the outermost energy level).

Each horizontal row is called a period. All elements in the same period are in the same final energy level.

The Element Families

Family 1 (1A)	Alkali Metal family	+1 ion	1 valence electron
Family 2 (2A)	Alkaline Earth Metals	+2 ion	2 valence electrons
Elements in the first two columns are reactive metals and form compounds easily.			
Family 13 (3A)	Boron family	+3 ion	3 valence electrons
Family 14 (4A)	Carbon family	+4 or -4 ion	4 valence electrons
Family 15 (5A)	Nitrogen family	-3 ion	5 valence electrons
Family 16 (6A)	Oxygen family	-2 ion	6 valence electrons
Family 17 (7A)	Halogen family	-1 ion	7 valence electrons

The halogen nonmetals are very reactive and form compounds easily.

Family 18 (8A)	Nobel Gas family	no ion	8 valence electrons
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The Noble Gases are very UNREACTIVE and stable because their outermost energy level is full.

ISOTOPES

An isotope is when you have atoms of the same element that differ in atomic mass. These atoms have the same number of protons but a different number of neutrons. Mass numbers are the way you distinguish one isotope from another. Any sample of an element in nature will contain a mixture of isotopes for that element.

Example:	CARBON	carbon-12	6 protons	6 neutrons
		carbon-13	6 protons	7 neutrons
		carbon-14	6 protons	8 neutrons

Carbon-12 means this carbon has a mass number of 12.

Carbon-14 and Carbon-13 atoms' are not as stable as carbon-12 and easily break down.

If an isotope has too many or too few neutrons compared to the number of protons, it is unstable and will undergo radioactive decay. These radioactive isotopes become different elements in an effort to become more stable.

SOLUTIONS

A solution is different from an element, a compound, or a mixture. A solution is a mixture of two or more substances where all parts are identical. The parts will not settle out upon standing and cannot be filtered. Yet, they are not chemically combined like in a chemical compound. They were just mixed together in any amount. Examples include tea, coffee, and sterling silver

There are two parts to a solution, the solute (substance being dissolved) and the solvent (substance doing the dissolving). The solute is in the lesser amount and the solvent is in the greater amount. Water is called the universal solvent because it dissolves a lot of things.

A solution is saturated when it is holding all the solute that it can at that temperature. So a glass of tea that has sugar sitting at the bottom of the glass is saturated because it cannot hold any more sugar in solution. The excess sugar is sitting at the bottom of the glass.