

**GHSGT Study Guide**  
**Domain3: Structure and Properties of Matter**

**A. Structure of the Atom**

1. 2 Regions of the atom:

- **Nucleus:** the center of the atom, contains 99.9% of the mass of the atom, holds protons and neutrons
  - **Proton ( $p^+$ )**
    - a. positively charged
    - b. mass of 1 amu
    - c. determines the identity of the element (atomic number)
  - **Neutron ( $n^0$ )**
    - a. neutral (no charge)
    - b. mass of 1 amu
    - c. mass of an isotope is determined by number of neutrons
    - d. number of neutrons in an atom is determined by: Mass number – Atomic Number
- **Electron Cloud:** the area surrounding the nucleus, contains most of the volume of the atom, is mostly empty space, holds electrons
  - **Electron ( $e^-$ )**
    - a. negatively charged
    - b. practically no mass (  $1/1840$  amu)
    - c. determines the charge of an ion
    - d. in a neutral atom, protons = electrons
  - **Structure of electron cloud**
    - a. electrons are arranged in energy levels in the cloud
    - b. The 1<sup>st</sup> energy level can hold  $2e^-$
    - c. The 2<sup>nd</sup> energy level can hold  $8e^-$
    - d. The 3<sup>rd</sup> energy level can hold  $18e^-$
    - e. The 4<sup>th</sup> energy level can hold  $32e^-$
    - f. The electrons in the outermost energy level of an electron are called **valence electrons**.
    - g. Valence electrons are electrons involved in chemical bonds

**B. Atomic number (Z)**

- is the number of protons in an element
- determines the identity of element
- Ex: Sodium (Na) has an atomic number of 11 and has 11 protons
- If the number of protons changes, the element changes

**C. Mass Number (A)**

- is the number protons and neutrons in the nucleus
- is different for each isotope of an element

**D. Atomic mass:**

- is the average of all masses of the isotopes of an element

**E. Element**

- atoms with different numbers of protons

**F. Isotope:**

- atoms with different numbers of neutrons
- Ex: Neon – 20 has a mass number of 20 and has 10 protons and 10 neutrons  
Neon – 22 has a mass number of 22 and has 10 protons and 12 neutrons

**G. Radioactivity:**

- occurs when an atom has too many or too few neutrons compared to the number of protons, and the isotope is **unstable**
- the unstable isotope will emit a particle or energy to become more stable
- Types of nuclear radiation that can be emitted:
  - **alpha particle**
    - a. positively charged particle with 2 protons and 2 neutrons = helium nucleus
  - **beta particle**
    - a. an electron
  - **gamma ray**
    - a. high energy X-ray

## H. Properties of matter

- **Physical properties**
  - characteristics that can be observed without changing the sample's composition
  - Examples: color, odor, hardness, boiling point, melting point, density, conductivity and state of matter
  - States of matter: solid, liquid, and gas
- **Chemical properties**
  - is the ability to combine with or change into one or more substances
  - Examples: rusting, burning, tarnishing, decomposing, igniting

## I. Changes in Matter

- **Physical change**
  - changes which alter a substance **without** changing its composition
  - Examples: bending, braking, melting, boiling, condensing, subliming
- **Chemical Change**
  - process in which one or more substances changes into new substances
  - Examples: fermentation, oxidation, rusting, corrosion, burning

## J. Solutions

- is a mixture of two or more substances where all parts are identical
- parts of a solution will not settle out and cannot be filtered
- Examples: tea, coffee, air, sterling silver
- Parts of a solution:
  - **solute**
    - a. is the part being dissolved
    - b. is the part in the lesser amount
  - **solvent**
    - a. is the part doing the dissolving
    - b. is the part found in the greater amount
    - c. **Water** is the universal solvent

## K. Organization of the Periodic Table

- It is arranged according to increasing atomic number
- A vertical column is called a **group or family**.
  - All of the elements in the same family have the same number of valence electrons
- A horizontal row is called a **period**.
  - The period number indicates the energy level of an element's valence electrons (its outermost energy level)

- **The Representative Families**

Family 1 (1A)	Alkali Metals	Form 1+ ion	1 valence electron
Family 2 (2A)	Alkaline Earth Metals	Form 2+ ion	2 valence electrons
Family 13 (3A)	Boron family	Form 3+ ion	3 valence electrons
Family 14 (4A)	Carbon family	Form 4+ or 4- ion	4 valence electrons
Family 15 (5A)	Nitrogen family	Form 3- ion	5 valence electrons
Family 16 (6A)	Oxygen family	Form 2- ion	6 valence electrons
Family 17 (7A)	Halogen family	Form 1- ion	7 valence electrons
Family 18 (8A)	Noble gas family	Forms no ions	8 valence electrons

- The alkali metals are the most reactive family of metals and form compounds easily
- The halogens are the most reactive family of nonmetals and form compounds easily
- The noble gases are very unreactive. They are stable because the outermost energy level is full.