**Chemistry Concepts** Name:

**Chapter 3:** Atoms: The Building Blocks of Matter

3-1: The Atom: From Philosophical Idea to Scientific Theory

**Foundations of Atomic Theory**

* **Chemical reaction** *-* transformation of a substance or substances .
* **Law of conservation of mass:** mass is neither during ordinary chemical reactions or physical changes
* **Law of definite proportions:** compounds contain the by mass regardless of the size of the sample of the compound
* **Law of multiple proportions:** if two or more different compounds are composed of the same two elements, then the ratio of the masses of the second element combined with a certain mass of the first element is

**Dalton’s Atomic Theory**

1. All matter is composed of extremely small particles called .
2. Atoms of a given element are identical in ; atoms of different elements differ in size, mass, and other properties.
3. Atoms cannot be .
4. Atoms of different elements combine in simple to form chemical compounds.
5. In chemical reactions, atoms are .

**Modern Atomic Theory**

* Not all aspects of Dalton’s atomic theory have proven to be correct. We now know that:
  + Atoms are .
  + A given element can have atoms with .
* Some important concepts remain unchanged.
  + All matter is composed of .
  + Atoms of any one element differ in properties from atoms of .

3-2: The Structure of the Atom

**Structure of the Atom**

* **Atom** - smallest particle of an element that of that element.
  + *-* very small region located at the center of an atom.
    - *–* positive charge
    - *-* neutral particles
  + – negatively charged particles surrounding the nucleus

**Discovery of the Atomic Nucleus**

* - led to the discovery of a very densely packed bundle of matter with a positive electric charge
* called this positive bundle of matter the *nucleus.*
* - short-range proton-neutron, proton-proton, and neutron-neutron forces that hold the nuclear particles together

3-3: Counting Atoms

**Atomic Number**

* Atoms of the same element all have the same .
* **atomic number** (Z) - number of of each atom of that element

**Isotopes** - atoms of the same element that have

* The isotopes of a particular element all have the same number of but different numbers of .
* Most of the elements consist of .

**Mass number** - total number of protons and neutrons that make up the nucleus of an isotope

**Designating Isotopes**

* : The mass number is written with a hyphen after the name of the element. uranium-235
* : The superscript indicates the mass number and the subscript indicates the atomic number.



* The number of neutrons is found by subtracting the atomic number from the .
  + **mass number − atomic number = number of neutrons**
  + **235 (protons + neutrons) − 92 protons = 143 neutrons**
* is a general term for a specific isotope of an element.

**Sample Problem A**

* How many protons, electrons, and neutrons are there in an atom of chlorine-37?

**Relative Atomic Masses**

* **,** or 1 **amu** - exactly 1/12 the mass of a carbon-12 atom
* The atomic mass of any atom is determined by comparing it with the mass of the carbon-12 atom.

**Average atomic mass** - weighted average of the atomic masses of the naturally occurring isotopes of an element

**Calculating Average Atomic Mass**

* The of an element depends on both the mass and the relative abundance of each of the element’s isotopes.
* Copper consists of 69.15% copper-63, which has an atomic mass of 62.929 601 amu*,* and 30.85% copper-65, which has an atomic mass of 64.927 794 amu*.*

**Relating Mass to Numbers of Atoms**

**The Mole**

* The mole is the SI unit for .
* (abbreviated mol) is the amount of a substance that contains as many particles as there are atoms in exactly 12 g of carbon-12.

—6.022 1415 × 1023—is the number of particles in exactly one mole of a pure substance.

**Molar Mass**

* molar mass - mass of of a pure substance
* Molar mass is usually written in units of .
* The molar mass of an element is numerically equal to the atomic mass of the element in .

**Sample Problem B**

* What is the mass in grams of 3.50 mol of the element copper, Cu?

**Sample Problem C**

* A chemist produced 11.9 g of aluminum, Al. How many moles of aluminum were produced?

**Sample Problem D**

* How many moles of silver, Ag, are in 3.01 × 1023 atoms of silver?

**Sample Problem E**

* What is the mass in grams of 1.20 × 108 atoms of copper, Cu?