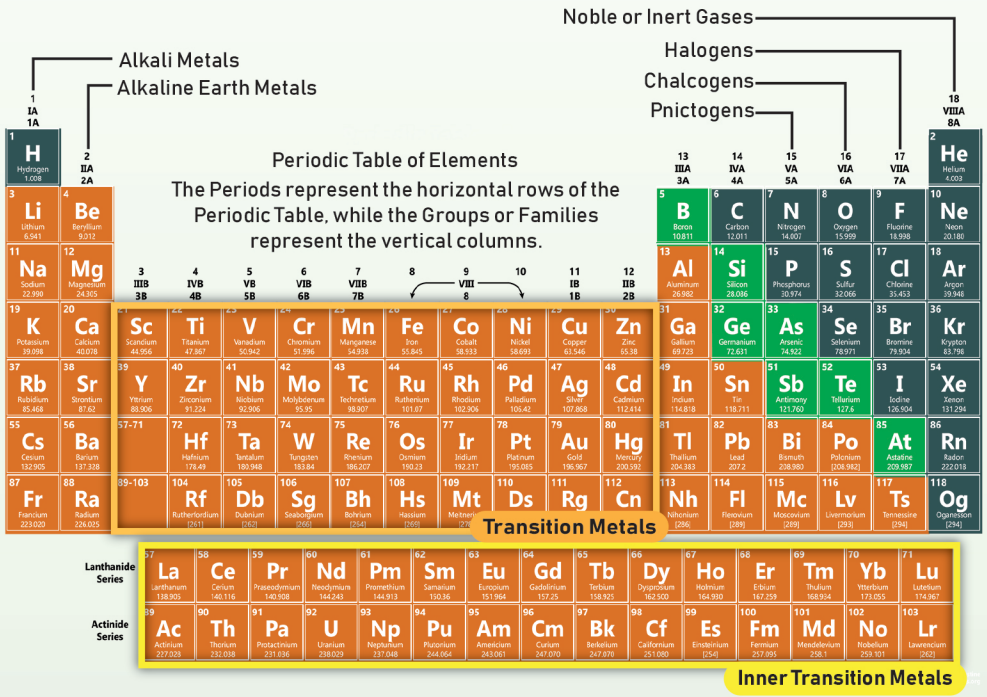
ATOMS AND ELEMENTS

PERIODIC TABLE CLASSIFICATIONS



The 3 major classifications in the periodic table include metals, non-metals & metalloids.

Metals
They have luster (shininess), are good thermal and electrical conductors, malleable, opaque, while having ductility and being solids at room temperature (~25°C).

Non-Metals
They have little to no luster, are poor thermal and electrical conductors, are brittle and transparent, while having no ductility and representing all phases at room temperature (~25°C).

Metalloids
They have characterisitics of both metals and non-metals, which explains why they are sometimes called "semi-metals" or "semi-conductors".

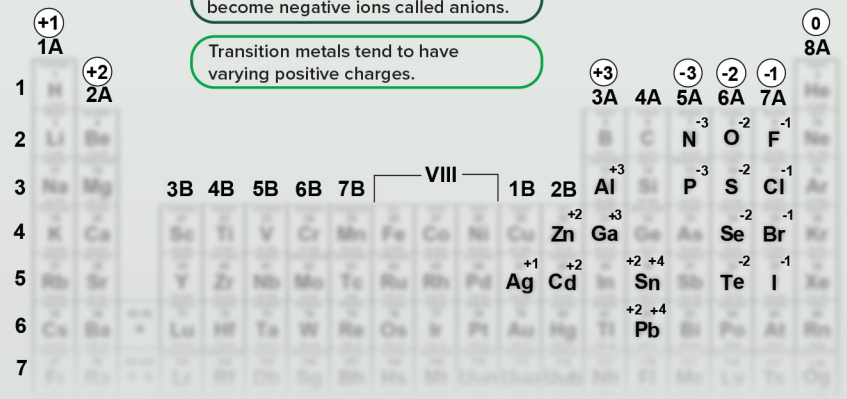
PERIODIC TABLE CHARGES

Elements gain or lose electrons in order to be more like the noble gases, which have the optimal number of outer shell electrons.

Metals tend to lose electrons to become positive ions called cations.

Non-metals tend to gain electrons to become negative ions called anions.

Transition metals tend to have varying positive charges.



Most main group elements possess a single charge, with notable exceptions of lead (Pb) and tin (Sn), which have charges of **+2** and **+4**.

MOLAR MASS

Molar mass or **molecular weight** is a physical property that represents the mass of a substance divided by the amount of that substance.

- When calculating the molar mass of a compound make sure to count the number of each element and find their atomic masses from the periodic table.

$C_6H_{12}O_6$

6 C, 12 H, 6 O

1 H Hydrogen 1.008	6 C Carbon 12 01	8 O Oxygen 16 00

- Add up all the atomic mass totals to determine the molar mass of the compound.

$C_6H_{12}O_6$

6 C x 12.01 g/mol = 72.06 g/mol
12 H x 1.008 g/mol = 12.096 g/mol
6 O x 16.00 g/mol = 96.00 g/mol

Sum = 180.156 g/mol

CLUTCH

clutchprep.com

ATOMS AND AND ELEMENTS

MOLE CONCEPT

The mole is the chemical unit for the amount of a substance that connects grams, molecules, atoms, formula units and ions.

Atom	a single element with no charge. (Ex: Na)
Ion	a single element with a charge. (Ex: Na+)
Molecule	a compound with 2 or more non-metals together. ($C_6H_{12}O_6$)
Formula Unit	a compound composed of a metal and nonmetal. (Ex: NaCl)

Atom, Molecule, Ions, Formula Unit ⟷ **mole** ⟷ **grams**

Example

➤ Convert 1.85×10^{21} molecules of $C_6H_{12}O_6$ to grams.

$$1.85 \times 10^{21} \text{ molecules } C_6H_{12}O_6 \times \frac{1.0 \text{ mole } C_6H_{12}O_6}{6.022 \times 10^{23} \text{ molecules } C_6H_{12}O_6} \times \frac{180.156 \text{ g } C_6H_{12}O_6}{1.0 \text{ mole } C_6H_{12}O_6} = 0.553 \text{ g } C_6H_{12}O_6$$

* 6.022×10^{23} is known as Avogadro's number.

ATOMIC THEORY

Modern Atomic Theory states that matter is composed of small, indivisible particles called atoms.

Law of Conservation of Mass

states that in a reaction matter is neither created nor destroyed.

Law of Definite Proportions

states that all samples of a compound, no matter on their origin or preparation has the same ratio in terms of their elements.

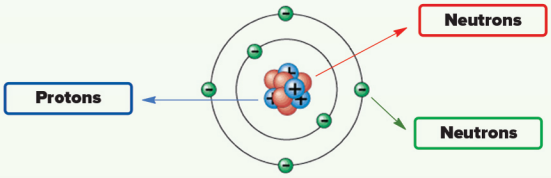
Law of Multiple Proportions

states that when two elements (A & B) form different compounds, the masses of element B that combine with 1 g of A are a ratio of whole numbers.

SUBATOMIC PARTICLES

The atom is the basic functional unit in chemistry.

- The atom is comprised of three subatomic particles: neutron, proton and electron.



Subatomic Particle	Mass(KG)	Mass(amu)	Relative Charge	Charge (Coulombs)
Neutron	1.67493×10^{-27}	1.00866	0	0
Proton	1.67262×10^{-27}	1.00727	+1	$+1.60218 \times 10^{-19}$
Electron	0.00091×10^{-27}	0.00055	-1	-1.60218×10^{-19}

EXPERIMENTS (Atomic Theory)

- **Thomson Cathode Ray Tube Experiment**

  led to the discovery of the electron and its charge-to-mass ratio as -1.76×10^{8} Coulombs per gram.

- **Rutherford Gold Foil Experiment**

  led to the discovery of the nucleus through the use of radioactive alpha particles.

- **Millikan Oil Drop Experiment**

  led to the discovery of the nucleus through the use of radioactive alpha particles.

- **Chadwick Neutron Experiment**

  led to the discovery of neutron through the use of a proton-rich paraffin substance.

ISOTOPES

Isotopes represent atoms of an element **X** that contain the same **atomic number** (**Z**; same number of protons), but different **mass numbers** (**A**; different number of neutrons).

Aluminum - 27 $^{27}_{13}Al$

Number of neutrons (n^0) = 27 – 13 = 14

Number of protons (p^+) = 13

Number of electrons (e^-) = 13 *

* For a neutral element the number of protons and electrons are equal.

The atomic mass of an element on the periodic table is an average of all its isotopes.

Average Mass = [(Mass Isotope 1) (Fractional Abundance)] + [(Mass Isotope 2) (Fractional Abundance)] ....

- Fractional abundance represents the percent abundance of an isotope divided by 100.

The atomic mass of carbon comes from the average masses of its two isotopes, Carbon – 12 and Carbon – 13.

$$\text{Average Mass} = [(12.00 \text{ amu}) \times (\frac{98.93\%}{100})] + [(13.00335 \text{ amu}) \times (\frac{98.93\%}{100}) = 12.01 \text{ amu}$$