

Lecture 20

Atom - the smallest unit of an element

- An atom consists of protons, neutrons and electrons

REMEMBER: Protons have a positive charge, electrons have a negative charge, and neutrons have a neutral charge (e.g. no charge).

Ex: A helium atom has two protons and two neutrons in the nucleus (2 protons + 2 neutrons = 4.00 atomic mass units (amu)). Two electrons are on the outside of the nucleus, circling the center of the atom.

NOTE: The electrons in an atom are arranged in shells that surround the nucleus, with each successive shell being farther from the nucleus; in other words, the electrons in an atom are arranged in shells that orbit the nucleus.

Subshell - a subdivision of electron shells separated by electron orbitals

Ex: 1s, 2s, $2p_x$, $2p_y$, $2p_z$

Orbit - the fixed path on which electron moves or revolves around the atom's nucleus

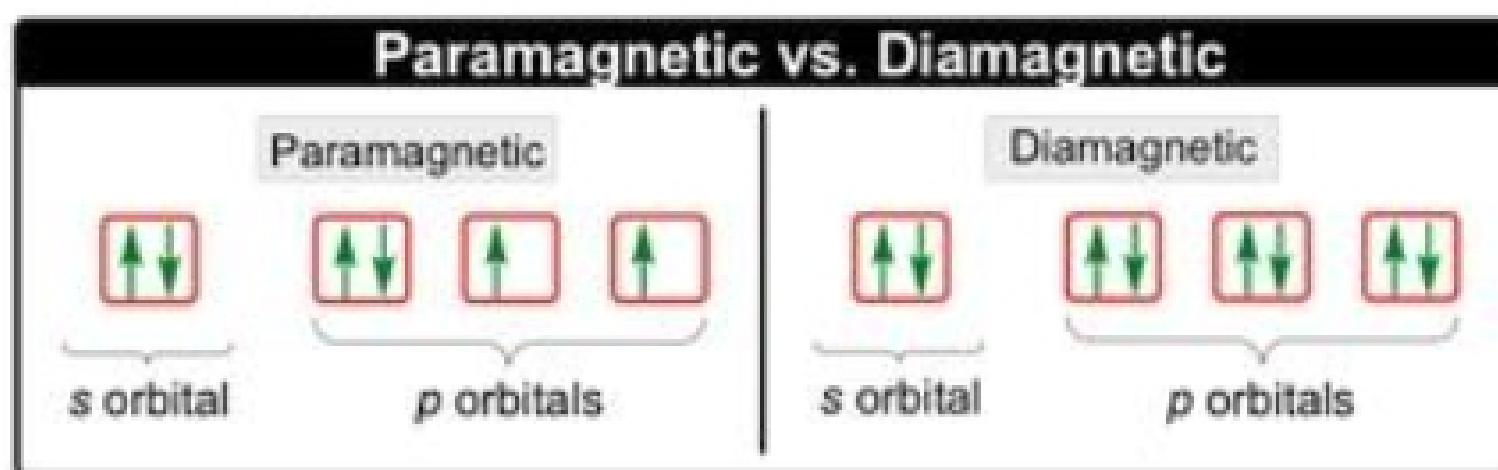
Orbital - a three-dimensional region within which there is a 95 percent probability of finding the electron.

- If you add energy to an electron, it can undergo an increase in energy level or transition to a higher orbit within an atom. This means that you now have a 95% chance of locating that electron in either the first shell (the one closest to the nucleus) or the second shell.

Transition of Energy Throughout the Nucleus of An Atom Pathway

- 1) The first energy level or first shell in the lowest energy level (s-orbital) is called 1s.
- 2) If you add more energy to the electron in 1s shell, that electron will transition into the second energy level or second shell in the S-orbital; this shell is called 2s.
- 3) If you add more energy to the electron in the 2s shell, that electron will transition into the higher second energy shells; this shell is called $2p_x$
- 4) If you add more energy to the electron in the $2p_x$ shell, that electron will transition into the higher second energy shells; this shell is called $2p_y$
- 5) If you add more energy to the electron in the $2p_y$ shell, that electron will transition into the higher second energy shells; this shell is called $2p_z$.
- 6) If you add more energy to the $2p_z$ shell, that electron will transition into the d-shell and if you add more to that d-shell, it will transition into the f-shell.

PARAMAGNETISM VS. DIAMAGNETISM



	Paramagnetic substances	Diamagnetic substances
Electrons	Unpaired	Paired
External magnetic field	Weakly attracted	Weakly repelled
Magnetic field	Magnetic field created in the direction of the external magnetic field.	Magnetic field created opposite to the direction of external magnetic field
Magnetic dipole momentum	Presence of permanent magnetic momentum.	No dipole momentum when there is no external magnetic field.
Examples	Aluminum, Platinum, Lithium	Copper, Water, Alcohol, Hydrogen

NOTE: For paramagnetic substances, the magnetic field generated by the dipoles or moments of the atom are aligned in the same direction as the external (outside) magnetic field. For diamagnetic substances, the magnetic field generated by the dipoles or moments of the atom are aligned in the opposite direction as the external (outside) magnetic field.

Bond Order - represents the number of chemical bonds between two atoms

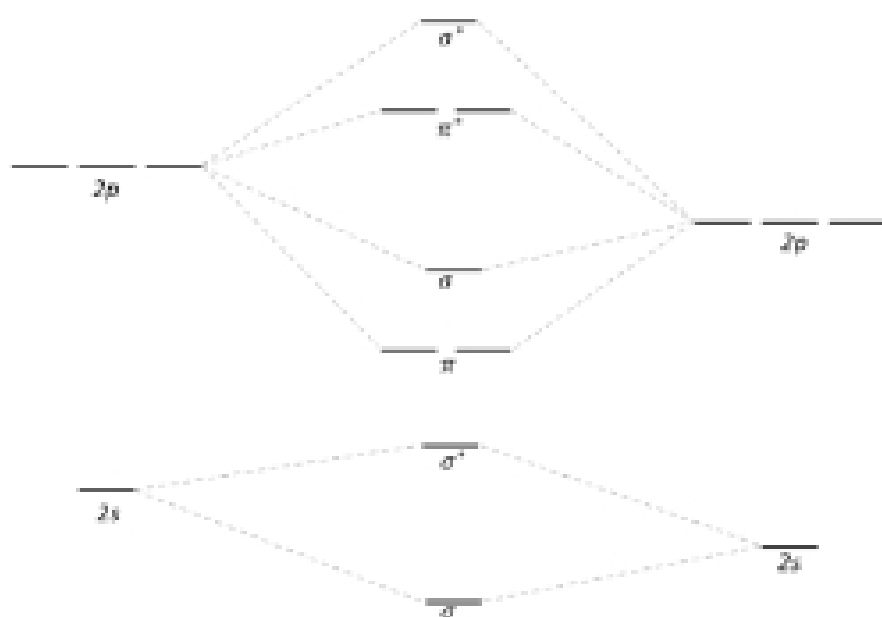
- **B.O. Formula:**

$$B.O. = \frac{1}{2} (\# \text{ of bonding orbiting electrons} - \# \text{ of antibonding orbiting electrons})$$

NOTE: Bond Order does NOT need to be a whole number

Z_{avg} : average atomic number

If your $Z_{avg} < 8$:



If your $Z_{avg} \geq 8$:

