Chemistry S1 Summary

The revision is much more important than the PPT's and this summary in my opinion.

The Quantum Model of the Atom

Quantum Numbers :

- are values that describe the unique quantum state of an electron.
- They indicate the main energy(where the electrons are found), shape, and orientation of an electron.

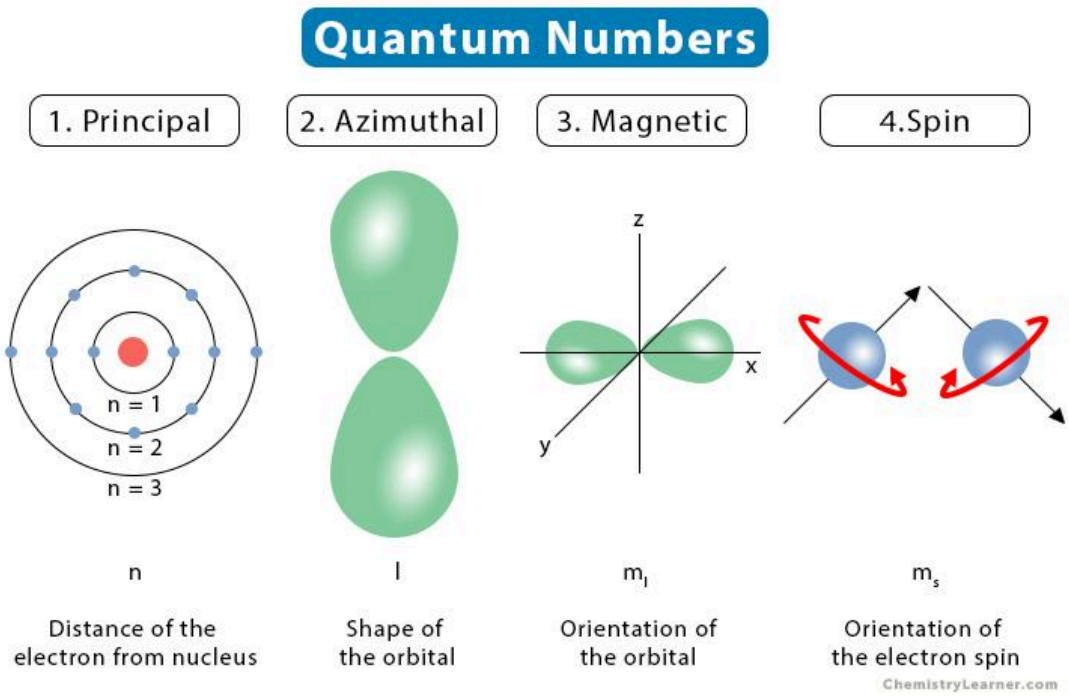
The 4 Quantum Numbers :-

1. **The principal quantum number** : symbolized by n
- It indicates the main energy level occupied by the electron.
- Simply the energy level of an electron.

2. **The angular momentum quantum number** : symbolized by l(as in L)
- it indicates the shape of the orbital.

3. **The magnetic quantum number** : symbolized by m
- It indicates the orientation of an orbital around the nucleus.

4. **The spin quantum number** :
- has only two possible values—(+1/2 , −1/2)
- which indicate the two fundamental spin states of an electron in an orbital.



Chemistry S1 Summary

Electron Configuration

The 3 Configuration Notation :- *Intro/Summary/Recap

1. **Electronic Configuration** : $1s^2$, $2s^2$, $2p^4$

2. **Orbital Notation** : *Add image

3. **Noble-gas Notation** : [He] $2s^2$

- Fact : Helium & Hydrogen can be used in all notations.

Electronic Configuration :

- is the distribution of electrons of an atom | or molecule in atomic or molecular orbital.
- describes the arrangement of electrons in an atom

- The maximum number of electrons contained in an orbital is 2.

Relative Energies of Orbital | Order of Filling :- *to memorize

- $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$, $4p^6$, $5s^2$, $5p^6$

Principles of Electron Configuration :-

1. **Aufbau's Principle** :

- an electron occupies the lowest energy orbital that can receive it.
- The electron always starts from the lowest energy level/orbitals.

2. **Pauli's Exclusion Principle** :

- No two electrons in the same atom can have the same 4 quantum numbers.
- In an orbital, electrons should have different orbital directions ↑↓

3. **Hund's Rule** :

- All orbitals of equal energy are occupied by 1 electron before any single orbital is occupied by a second electron.
- It's like trying to fill all the orbitals with an electron first and then going back and filling in the second electron.

Chemistry S1 Summary

Noble-gas Notation : *using noble-gasses and electronic configuration together

- you go in terms of what configuration is near the element, and you do that by seeing the closest/matching number in relation to the normal electronic configuration.
- [Noble gas] + <The rest in *electronic configuration*>
- it can be considered as a short form of [electronic configuration]

- In exam tip : if noble gas was asked in ***orbital notation***, fill all orbitals when writing the answer.

History of The Periodic Table

How was the periodic table discovered and made :

- Tip : to better understand, try to understand and look at the deatails of the periodic table itself.

Mendeleev noticed that when the elements were arranged in order of increasing atomic mass, there were certain similarities in their chemical properties that appeared at regular intervals.

Current periodic table was created by : **Henry Moseley**

- Moseley stated that properties of elements are periodic functions of their atomic number.
- → This is called **periodic law** : elements' properties repeat periodically when arranged by increasing atomic number. ⇒ Like : all similar metals were close to each other.

Exceptions :

- Helium is a noble gas -> because its full in it's orbital($1s^2$)
- Hydrogen is in the 1^{st} or in the s-block because of its electronic configuration, and this explains why it's on the metals side.

Chemistry S1 Summary

Electronic Configuration and Periodic Table

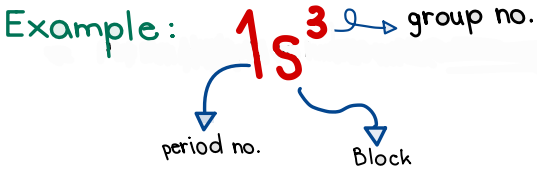
- All s- blacks are metals, all p-blocks are non-metals, and all d-blocks are metals.

Group Properties (on the periodic table) :

- group 1 : Alkali metals → soft, and can be cut with a knife
- group 2 : Alkaline-earth metals → less reactive as you go by the periods
- group 3 - 12 : Transition metals → They can show transition in color.
- group 17 : Halogens → reactive non-metals
- group 18: Noble gasses

- group 3 :- Perind 6 & 7: Lanthanides and Actinides

Identifying an element (using the last electronic configuration) :-



Periodic Trends

Atomic / Inoii Radii :- *It's like the radius (in-terms of the location of its point)

- one-half the distance between the nuclei of identical atoms 1 that are bonded together.

Ionization Energy (IE) :

- the energy required to remove one electron from a neutral atom
- The closer the *electron* is to its nucleus, the higher is the IE and the harder to remove(the electron).

- Among the main-group elements, IE will decrease.
- the smaller the atom, the higher Electronegativity

Electro-negativity : a measurement of how much an (electron) can attract to its nucleus.

- is a measure of the ability of an atom in a chemical compound to attract electrons from another atom in the compound.

- Electron-negativities tend to increase across periods, and decrease or remains the same down a group.

- Electro-negativity increases across a period & decreases down the group.

Chemistry S1 Summary

Polar and Nonpolar Covalent Bonds

- A **covalent bond** is a chemical bond that involves the sharing of electrons between two atoms, forming electron pairs known as shared pairs or bonding pairs.

Polar-covalent bonds : 0.3 >= IE <= 1.7
- is a coralent bond in which the bonded atoms have an uneque 1 attraction lor then shared electrons.

Nonpolar-covalent bonds : IE <= 0.3
- a covalent bond in which the bonding electrons are shared equally by the bonded atoms, resulting in a balanced distribution of electrical charge.

- The IE is ⇒ Ionization Energy
- If the IE < 1.7, it'll an ***Ionic Bond***

Covalent Bonding and Molecular Bonding

- **Molecule** : 2 atoms joining together in an element
- is a neutral group of atoms that are held together by covalent bonds.

Molecular Compound : *mainly formed/composed of molecules
- A chemical compound whose simplest units are molecules.

Molecular Formula : *it's a representation of how molecules are together
- shows the types and numbers of atoms combined in a single molecule of a molecular compound.

>In order for molecules to use the information of covalent bond, its need minimum: bond length and bond/potential energy.

Bond Length :
- The distance between 2 bonded atoms at their minimum potential energy.

Bond energy :
- is the energy required to break a chemical bond and form neutral isolated atoms.

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Interactions during the Formation of a Covalent Bond :

- These 2 forces cancel out, and this is where the energies are at a minimum.

^^^^^^^^^
Forces will be (zero.)

Octet Rule :

- when an atom has 8 electrons in its outer-most shell, the atom will be stable.
- Chemical compounds tend to form so that each atom (is formed) by gaining, losing, or sharing of electrons, has an (oc) of electrons in its highest energy level.

Lewis Structure

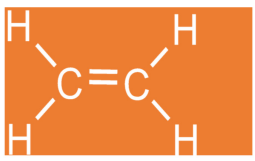
Electron-dot notation : *shows the valence electrons in the outer-most shell

- is an electron-configuration notation in which only the valence electrons of an atom of a particular element are shown, indicated by dots placed around the element's symbol.

Multiple Covalent bond(MC) :

- A triple covalent bond, or simply a triple bond, is a covalent bond in which three pairs of electrons are shared between two atoms.

Example of Lewis Structure & Multiple-Covalent Bond :-



- Carbon will always be placed in the middle, and Hydrogen will never stay in the middle.
- In an MC, the electrons that are not bonded should be placed around the element's symbol.

Chemistry S1 Summary

Molecular Geometry

Molecular Geometry :

- the 3- dimensional arrangement of a molecule's atoms.

Molecular Polarity :

- the uneven distribution of ₐ molecular shape.

VSPER

- Valence-Shell Electron-pair Repulsion

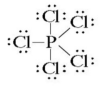
VSEPR theory :

- states that repulsion between the sets of valence-level electrons surrounding an atom causes these sets to be oriented as far apart as possible.
- It just explains how valence electrons should be place in some dimensions after essentially doing/completing the Lewis structure.

Representing the central atom in a molecule by A and the atoms bonded to the central atom by B, then according to VSEPR theory, BeF_2 is an example of an AB_2 molecule, which is **linear**.

In an *AB_3 molecule*, the three A–B bonds stay farthest apart by pointing to the corners of an equilateral triangle, giving **120°** angles between the bonds.

In an AB_4 molecule, the distance between electron pairs is maximized if each A–B bond points to one of four corners of a **tetrahedron**.

	Molecular shape	Atoms bonded to central atom	Lone pairs of electrons	Formula example	Lewis structure
Linear		2	0	BeF_2	
Bent		2	1	$SnCl_2$	
Trigonal-planar		3	0	BF_3	
Tetrahedral		4	0	CH_4	
Trigonal-pyramidal		3	1	NH_3	
Bent		2	2	H_2O	
Trigonal-bipyramidal		5	0	PCl_5	
Octahedral		6	0	SF_6	

Chemistry S1 Summary

Metallic Bonding

Metallic Bonding :

- the chemical bonding that results from the attraction between metal atoms and the surrounding sea of electrons.

Delocalised Electrons :

- they do not belong to any one atom but move freely about the metal's network of empty atomic orbitals.

- These mobile electrons form a sea of electrons around the metal atoms, which are packed together in a crystal lattice(points in space that represent the positions of the particles).

The relationship of delocalised electrons and the metal's physical property :

- Ductility(metal strand/s) and malleability(metal sheets) of metal occurs when electrons are sliding on top of one another.

- Electrical and thermal conductivity occurs when the sea of electrons move freely in/through metal.

- The lustrous/shiny appearance of metal happens when the electrons absorb some kind of photons(light) which then transfer the electrons to a higher energy level and this is where the electrons are in an excited state, then they return to the ground/stable state, and then they emit colors depending on their wavelengths.

Alloy : is a mixture of 2 metals.

- (MAYBE) in the exam the Ms will tell you to give a metal and it's daily use.

Some Examples of Alloys :

- **Brass** is an alloy made of copper and zinc, commonly used in musical instruments like trumpets.
- **White Gold** is an alloy of gold and chromium, often used in jewelry for its strength and bright appearance.
- **Stainless Steel** is an alloy of iron, chromium, nickel, and carbon, frequently used in kitchen utensils.

Chemistry S1 Summary

Metallic, Ionic, and Covalent(Molecular) Bonds :

	Metallic Bonds	Ionic Bonds	Covlent Bonds
Occurs in	Metals only.	Metals and nonmetals.	Nonmetals only.
Nature	Positive metal ions in a "sea of delocalized electrons."	Transfer of electrons from the metal to the nonmetal, forming positive and negative ions.	Sharing of electrons between atoms to form molecules.
Properties	Good electrical and thermal conductors, malleable, and ductile.	High melting/boiling points, conduct electricity when dissolved in water.	Can be gases, liquids, or solids with low melting/boiling points; poor electrical conductors.
Example	Found in copper wires and aluminum foil.	Sodium chloride (table salt).	Water (H_2O).