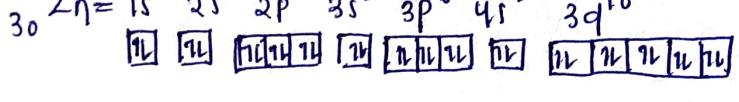
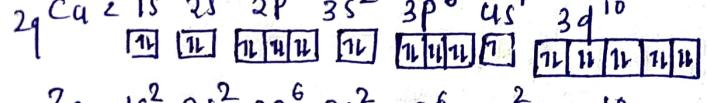
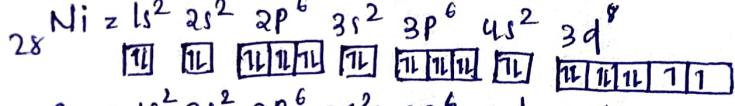
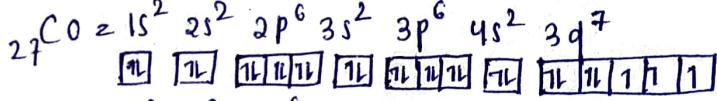
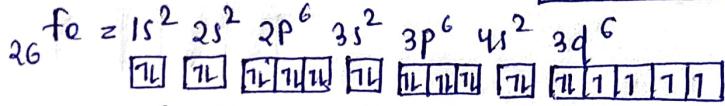
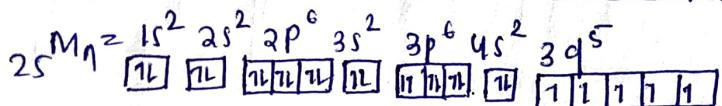
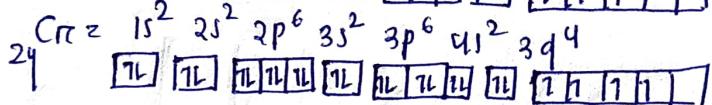
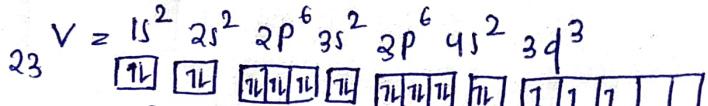
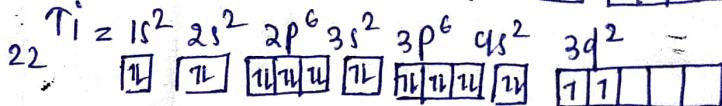
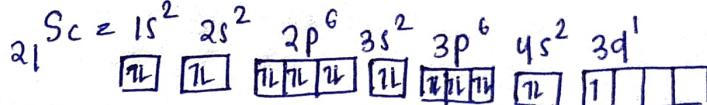
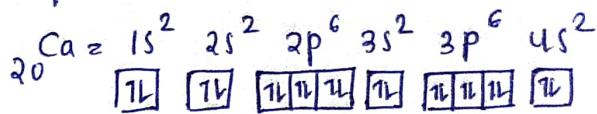
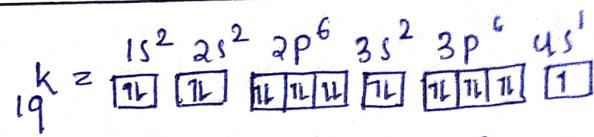
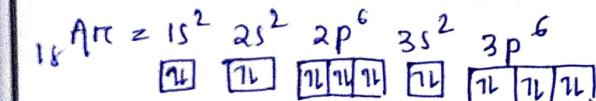
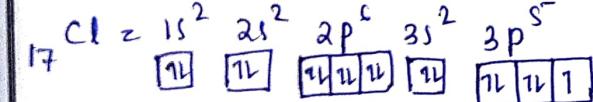
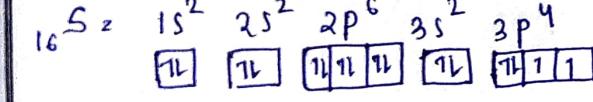
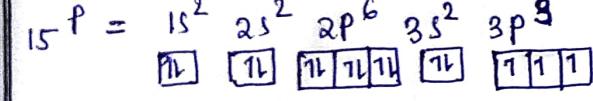
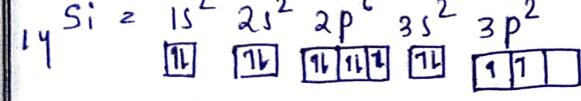
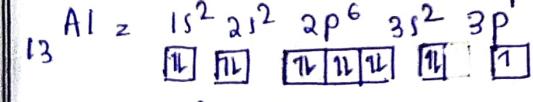
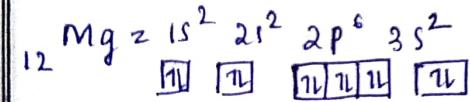
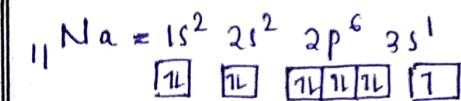
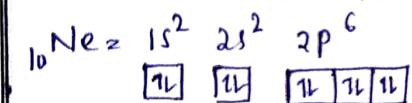
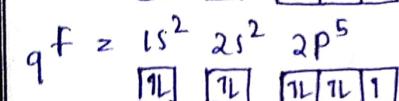
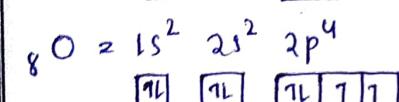
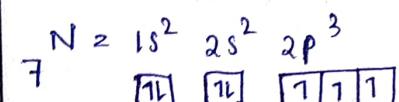
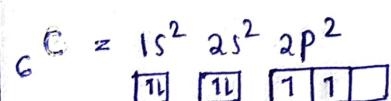
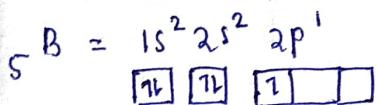
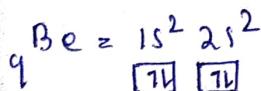
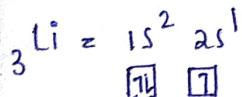
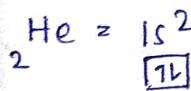
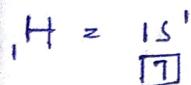
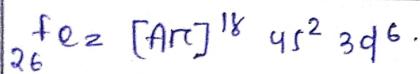
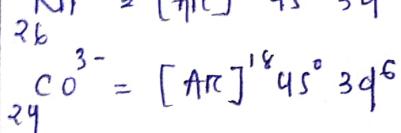
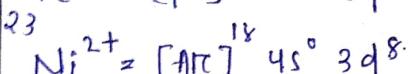
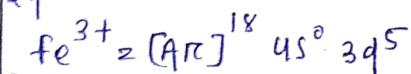
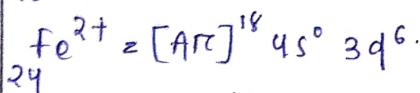


Electron Configuration :-





$\uparrow \rightarrow \text{loss of } e^-$
 $\downarrow \rightarrow \text{gain of } e^-$



- electrons are discovered by JJ Thomson and mass of $e^- = 9.1 \times 10^{-31}$ kg
→ Proton discovered by Rutherford. mass of proton $= 1.67 \times 10^{-27}$ kg.
→ Mass of proton $= 1836 \times$ mass of e^-
→ Neutrons discovered by James Chadwick.
mass of neutron $= 1.67 \times 10^{-27}$ kg. It has no charge.

Planck's Quantum Theory :-

Energy is directly proportional to frequency & inversely proportional to wavelength

$$E \propto \nu$$

$E = h\nu$, where 'h' is Planck's constant.

$$h = 6.627 \times 10^{-34} \text{ J sec.} / 6.627 \times 10^{-27} \text{ erg. sec.}$$

$$\therefore \nu = \frac{c}{\lambda}$$

λ = wavelength.

$$E = h \frac{c}{\lambda}$$

$$c = 3 \times 10^8$$
$$1 \text{ A}^\circ = 10^{-8}$$

Energy emission and absorption takes place in packet i.e. called as quanta or photon. Always present in whole no. never takes place in fraction.

$$N = 1, 2, 3, 4, \dots$$

$$E = Nh\nu$$

Numericals:-

Find out the energy associated with an e^- having λ (wave length) of 600 A° .

$$E = \frac{hc}{\lambda}$$

$$E = \frac{6.627 \times 10^{-34} \times 3 \times 10^8}{600 \times 10^{-10}}$$

$$E = 3.313 \times 10^{-20}$$

Q. How many photons of light having $\lambda = 4000\text{ Å}^\circ$ are necessary to provide 1 joule of energy.

$$E = 1 \text{ joule.}$$

$$\lambda = 4000\text{ Å}^\circ = 4000 \times 10^{-10}$$

$$E = N h \nu$$

$$E = N h \frac{c}{\lambda}$$

$$1 = N \frac{6.627 \times 10^{-34} \times 3 \times 10^8}{4000 \times 10^{-10}}$$

$$\Rightarrow 4000 \times 10^{-10} = N 6.627 \times 10^{-34} \times 3 \times 10^8$$

$$\Rightarrow N = \frac{6.627 \times 10^{-34} \times 3 \times 10^8}{4000 \times 10^{-10}}$$

$$\Rightarrow N = 4.97 \times 10^{19} \quad 2.01 \times 10^{18} \text{ photons}$$

Heisenberg's uncertainty principle:-

→ It is impossible to measure position & momentum of a microscopic particle with absolute accuracy.

$$\Delta x \Delta p \geq \frac{h}{4\pi}$$

$$p = mv$$

$$\Delta x m \Delta v \geq \frac{h}{4\pi}$$

$$\Delta p = m \Delta v$$

where Δx = uncertainty in position.

Δp = uncertainty in momentum

Δv = uncertainty in velocity

m = mass of microscopic particle.

Dual nature of matter :-

All the forms of matter i.e., molecule, atom, electrons have both particle nature as well as wave nature. This is called dual nature of matter.

Debroglie eqn :-

Based on the dual nature of matter Debroglie has derived an eqn that is known as Debroglie's wave eqn.

According to Einstein $E = mc^2 \rightarrow \text{①}$

According to Planck's $E = h\nu$

$$mc^2 = h\nu$$

$$mc^2 = \frac{hc}{\lambda} \quad (\because \nu = c/\lambda)$$

$$mc^2 \lambda = hc$$

$$\lambda = \frac{h}{mc}$$

$$\boxed{\lambda = \frac{h}{mv}}$$

c = velocity of light

Q. Calculate the wavelength of a material, if the material is moving with velocity of 0.25 m/s & at mass 0.1 gm .

$$v = 0.25 \text{ m/s}$$

$$m = 0.1 \text{ gm} = 0.001 \text{ kg}$$

$$\lambda = \frac{h}{mv} = \frac{6.627 \times 10^{-34}}{1 \times 10^4 \times 25 \times 10^{-2}}$$

$$\lambda = 2.65 \times 10^{-37}$$

Schrodinger Wave Equation:-

To find out the wave equation,

→ Schrodinger wave equation was given by Erwin Schrodinger in 1926 and based on dual nature of electron i.e., particle & wave nature.

→ The probability of finding an electron at any point around the nucleus can be determine by the help of Schrodinger wave equation.

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} + \frac{\partial^2 \psi}{\partial z^2} + \frac{8\pi^2 m}{h^2} (E - V) \psi = 0 \quad \text{--- (1)}$$

Where x, y & z are three space co-ordinates, or distance of e's from nucleus.

ψ = amplitude of wave function.

m = mass of electron

E = total energy.

V = potential energy

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} + \frac{\partial^2 \psi}{\partial z^2} = \Delta^2$$

$$\Rightarrow \Delta^2 \psi + \frac{8\pi^2 m}{h^2} (E - V) \psi = 0$$

$$\Rightarrow \Delta^2 \psi = -\frac{8\pi^2 m}{h^2} (E - V) \psi$$

$$\Rightarrow -\frac{\Delta^2 \psi h^2}{8\pi^2 m} = (E - V) \psi$$

$$\Rightarrow -\frac{\Delta^2 \psi h^2}{8\pi^2 m} = E \psi - V \psi$$

$$\Rightarrow -\frac{\Delta^2 h^2 \psi}{8\pi^2 m} + V \psi = E \psi$$

$$\Rightarrow \left(-\frac{\Delta^2 h^2}{8\pi^2 m} + V \right) \psi = E \psi \rightarrow (1)$$

eqⁿ (1) becomes.

$$\hat{H} \psi = E \psi$$

ψ = Eigen function.

E = Eigen value.

$$\hat{H} = \left(-\frac{\Delta^2 h^2}{8\pi^2 m} + V \right), \hat{H} = \text{Hamilton operator}$$

Eigen function and Eigen value:-

If an operator act on a well behaved function & generates same function multiplying with a constant is called Eigen value and the function is call Eigen function.

$$\hat{A}\Psi = E\Psi$$

Ψ = Eigen function.

E = Eigen value.

Ex:- Show that $\sin 2x$ is not an Eigen function of operator $\frac{d}{dx}$ but it is an Eigen function of $\frac{d^2}{dx^2}$. calculate Eigen value.

$$\hat{A} = \frac{d}{dx}$$

$$\Psi = \sin 2x.$$

$$\hat{A}\Psi = \frac{d}{dx} \sin 2x = 2 \cos 2x.$$

$$\begin{aligned}\hat{A} = \frac{d^2}{dx^2} \sin 2x &= 2 \cos 2x \\ &= 2 \frac{d}{dx} \cos 2x \\ &= -4 \sin 2x\end{aligned}$$

$$\hat{A}\Psi = E\Psi$$

$$\frac{d^2}{dx^2} \sin 2x = -4 \sin 2x.$$

$$\frac{d^2}{dx^2} = -4 \text{ (Eigen value)}$$

Show that the function $\Psi = 8e^{4x}$ is an eigen function of operator $\frac{d}{dx}$ then what is the Eigenvalue.

$$\hat{A} = \frac{d}{dx}$$

$$\Psi = 8e^{4x}$$

$$\begin{aligned}\hat{A}\Psi = \frac{d}{dx} 8e^{4x} &= 8 \frac{d}{dx} e^{4x} \\ &= 8e^{4x} \cdot 4 \\ &= 4\Psi\end{aligned}$$

Significance of Ψ :

→ It is a solution of Schrodinger wave eqn. It represents the amplitude of the wave eqn. Ψ represents atomic orbital of atom or molecular orbital of molecule.

→ Although the number of value of Ψ are there only few value of Ψ acceptable, who obey the above condition.

→ Those Ψ are known as Eigen function and the value corresponds to Eigen function is called Eigen value.

Significance of ψ^2 :-

- ψ^2 is the probability of finding electron at a particular time in unit volume.
- It gives idea about orbitals.
- It must have real value.

Normalized wave function :-

The normalized wave function must satisfy the following condition:

$$+\infty \int_{-\infty}^{+\infty} \psi \psi d\tau = 1$$

$$= \int_{-\infty}^{+\infty} \psi^2 d\tau = 1$$

Orthogonal wave function :-

→ 2 wave functions (ψ & ψ^*) having energy E_1 & E_2 respectively are said to be orthogonal if they satisfy the following cond'n.

$$+\infty \int_{-\infty}^{+\infty} \psi \psi^* d\tau = 0.$$

Application of Schrodinger wave eqn :-

It helps to calculate the total energy and orientation of electron when it moves around the nucleus.

→ It helps to calculate the energy associated with a particle when it moves in one dimension and three dimension.

Particle in one dimensional box:-

→ Let us consider a particle is moving along x axis of pathlength 'a', within the boundary i.e., $x=0$ to $x=a$, $V=\infty$ and the potential energy within $\psi=0$ the box is zero.

→ The Schrodinger's wave eqn in 1D box

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{8\pi^2 m}{h^2} (E - V) \psi = 0. \rightarrow \textcircled{1}$$

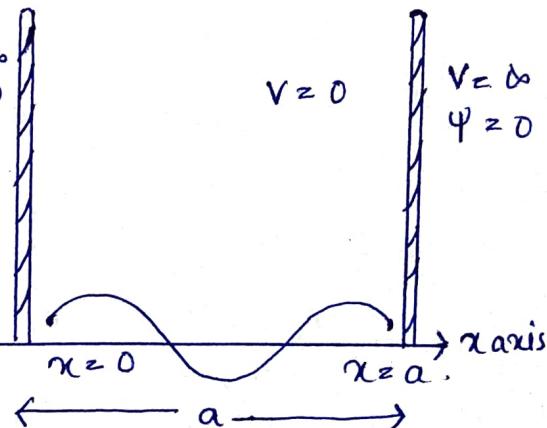
→ But along x -axis the potential energy is zero in eqn $\textcircled{1}$ & become

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{8\pi^2 m}{h^2} (E - 0) \psi = 0$$

$$\Rightarrow \frac{\partial^2 \psi}{\partial x^2} + \frac{8\pi^2 m}{h^2} E \psi = 0. \rightarrow \textcircled{2}, \quad \frac{8\pi^2 m}{h^2} E = k^2 \rightarrow \textcircled{3}$$

Then eqn $\textcircled{2}$ becomes.

$$\frac{\partial^2 \psi}{\partial x^2} + k^2 \psi = 0$$



eqⁿ (IV) is the time independent Schrödinger wave eqⁿ or 2nd order differentiation. Hence the eqⁿ (IV) is.

$$\Psi(x) = A \sin kx + B \cos kx \rightarrow (V)$$

To validate the wave function Ψ must satisfy the boundary condition.

1st boundary condition :- ($x=0, \Psi=0$)
putting in eqⁿ (V) ;

$$0 = A \sin kx_0 + B \cos kx_0$$

$$\Rightarrow 0 = B.$$

$$\Rightarrow B = 0 \text{ (put this value of } B \text{ in eqⁿ (V))}$$

$$\boxed{\Psi(x) = A \sin kx} \rightarrow (VI)$$

2nd boundary condition :- ($x=a, \Psi=0$)
putting in eqⁿ (VI).

$$0 = A \sin ka + 0 \times \cos ka.$$

$$\Rightarrow A \sin ka = 0.$$

$$\Rightarrow \sin ka = 0.$$

$$\Rightarrow ka = n\pi (n\pi = n\pi)$$

$$\Rightarrow ka = n\pi.$$

$$\Rightarrow \boxed{k = \frac{n\pi}{a}}. \rightarrow (VII)$$

Putting the value of $k = \frac{n\pi}{a}$ in eqⁿ (III)

$$k^2 = \frac{8\pi^2 m E}{h^2}$$

$$\left(\frac{n\pi}{a}\right)^2 = \frac{8\pi^2 m E}{h^2}$$

$$\frac{n^2 \pi^2}{a^2} = \frac{8\pi^2 m E}{h^2}$$

$$\frac{n^2}{a^2} = \frac{8mE}{h^2}$$

$$8mEa^2 = n^2 h^2$$

$$\boxed{E = \frac{n^2 h^2}{8ma^2}} \rightarrow (VIII)$$

Since normalized wave function is probability to find a particle between 0 to a is unity.

$$\int_{-\infty}^{+\infty} \Psi^2 dx = 1$$

$$\int_0^a \Psi^2 dx = 1 \rightarrow (IX)$$

Putting the value of $\psi = A \sin kx$ in eqn ④

$$\int_0^a (A \sin kx)^2 dx = 1$$

$$\Rightarrow \int_0^a A^2 \sin^2 \frac{n\pi}{a} x dx = 1 \quad (\because k = \frac{n\pi}{a})$$

$$\Rightarrow A^2 \int_0^a \frac{1 - \cos 2 \frac{n\pi}{a} x}{2} dx = 1$$

$$\Rightarrow \frac{A^2}{2} \left[\int_0^a dx - \int \cos \frac{2n\pi}{a} x dx \right] = 1$$

$$\Rightarrow \frac{A^2}{2} [x]_0^a - \frac{1}{2n\pi} \left[\sin \frac{2n\pi}{a} x \right]_0^a = 1$$

$$\Rightarrow \frac{A^2}{2} [x]_0^a - \frac{a}{2n\pi} \left[\sin \frac{2n\pi}{a} x \right]_0^a = 1$$

$$\Rightarrow \frac{A^2}{2} [a - 0] - \frac{a}{2n\pi} \left[\sin \frac{2n\pi a}{a} - \sin \frac{2n\pi \cdot 0}{a} \right] = 1$$

$$\Rightarrow a \frac{A^2}{2} - \frac{a}{2n\pi} (0 - 0) = 1$$

$$\Rightarrow \frac{A^2}{2} a = 1$$

$$\Rightarrow A^2 = \frac{2}{a}$$

$\Rightarrow A = \sqrt{\frac{2}{a}}$, putting the value of A in eqn ④

$$\psi = \sqrt{\frac{2}{a}} \sin kx$$

$\boxed{\psi = \sqrt{\frac{2}{a}} \sin \frac{n\pi}{a} x} \rightarrow \text{This is the wave function of particle in 1D box.}$

$$E_1 = \frac{h^2}{8ma^2}, n=1 \quad (\text{zero point energy or ground state energy})$$

$$E_2 = \frac{4h^2}{8ma^2}, n=2 \quad (\text{first excited state})$$

$$E_3 = \frac{9h^2}{8ma^2}, n=3 \quad (\text{second excited state})$$

$$E_4 = \frac{16h^2}{8ma^2}, n=4 \quad (\text{third excited state})$$

4 wave functions:-

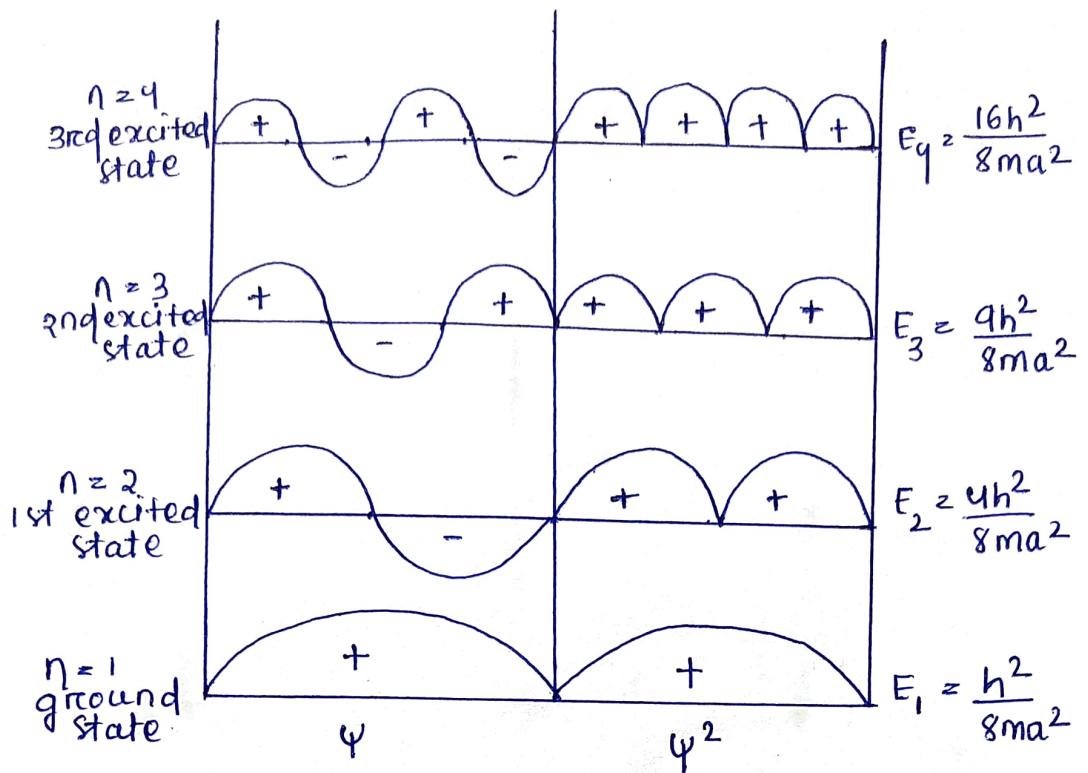
$$\psi_1 = \sqrt{\frac{2}{a}} \sin \frac{\pi}{a} x$$

$$\psi_2 = \sqrt{\frac{2}{a}} \sin \frac{2\pi}{a} x$$

$$\psi_3 = \sqrt{\frac{2}{a}} \sin \frac{3\pi}{a} x$$

$$\psi_4 = \sqrt{\frac{2}{a}} \sin \frac{4\pi}{a} x$$

Energy level diagram :-



Let E_1 & E_2 are the energy associated with an electron at n_1 & n_2 energy level respectively, then the change in energy

$$\Delta E = E_2 - E_1$$

$$= \frac{n_2^2 h^2}{8ma^2} - \frac{n_1^2 h^2}{8ma^2}$$

$$= \frac{h^2}{8ma^2} (n_2^2 - n_1^2)$$

$$h\nu = \frac{h^2}{8ma^2} (n_2^2 - n_1^2)$$

$$\frac{hc}{\lambda} = \frac{h^2}{8ma^2} (n_2^2 - n_1^2)$$

$$\lambda = \frac{hc 8ma^2}{h^2 (n_2^2 - n_1^2)} \Rightarrow \boxed{\lambda = \frac{8ma^2 c}{h (n_2^2 - n_1^2)}}$$

Q1. Calculate the zero point energy of an electron of path length 10 nm.

$$E = \frac{n^2 h^2}{8ma^2}$$

$$n = 1$$

$$m = 9.1 \times 10^{-31}$$

$$E = \frac{1 \times (6.627 \times 10^{-34})^2}{8 \times 9.1 \times 10^{-31} \times (10 \times 10^{-9})^2} \quad a = 10 \times 10^{-9}$$

$$E = 6.032 \times 10^{-22}$$

Q. Calculate the energy associated with an electron at the 3rd energy level of path length 10pm (10^{-12}m)

$$\Rightarrow E = \frac{n^2 h^2}{8ma^2}$$

$$E = \frac{9 \times 6.627 \times 10^{-34} \times 6.627 \times 10^{-34}}{8 \times 9.1 \times 10^{-31} \times 10^{-12} \times 10^{-12}}$$

$$E = 5.42 \times 10^{-15}$$

Q. An electron is moving in an 1D box having 4nm length. What is its 1st excited state energy.

$$E = \frac{n^2 h^2}{8ma^2}$$

$$E = \frac{4h^2}{8ma^2}$$

$$E = \frac{4 \times (6.627 \times 10^{-34})^2}{8 \times 9.1 \times 10^{-31} \times (4 \times 10^{-9})^2}$$

$$E = 1.5 \times 10^{-20}$$

Q. Calculate the wavelength associated with an electron when it moves from 2nd excited state to 1st excited state with the path length 10nm .

$$\lambda = \frac{8ma^2 c}{h(n_2^2 - n_1^2)}$$

$$\lambda = \frac{8 \times 9.1 \times 10^{-31} \times (10 \times 10^{-9})^2 \times 3 \times 10^8}{6.627 \times 10^{-34} (9-4)}$$

$$\lambda = \frac{8 \times 9.1 \times 10^{-31} \times (10 \times 10^{-9})^2 \times 3 \times 10^8}{6.627 \times 10^{-34} \times 5} = 6.59 \times 10^{-5}$$

Q. Calculate the frequency of the radiate light when the e's moves from 2nd energy level to 1st energy level having nucleo distance 10pm (10^{-12}m).

$$\gamma = \frac{h}{8ma^2 (n_2^2 - n_1^2)}$$

$$\gamma = \frac{6.627 \times 10^{-34} \times (9-1)}{8 \times 9.1 \times 10^{-31} \times (10 \times 10^{-12})^2}$$

$$\gamma = \frac{6.627 \times 10^{-34} \times 3}{8 \times 9.1 \times 10^{-31} \times (10 \times 10^{-12})^2}$$

$$\gamma = 2.73 \times 10^8$$

Molecular orbital theory :-

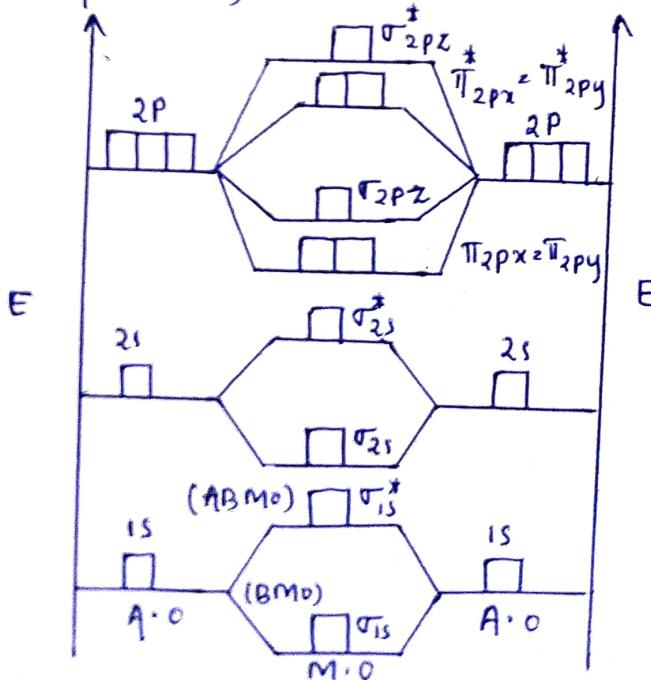
→ This theory was proposed by Hund and Mulliken. So this theory is known as Hund Mulliken theory.

Postulates:-

- The atomic orbital combines and form an orbital which is known as molecular orbital.
- Orbitals of same energy level of each bonded atom involved in a molecule formation loose their identity and merge together to give rise an equivalent no. of new molecular orbital.
- All these electrons pertaining to both the bonded atoms are considered to be moving along the entire molecule under the influence of all the nuclei.
- Electrons while filling the molecular orbital follow Pauli's exclusion principle, Hund's rule as well as Aufbau's principle.
- The nomenclature. Spd used for atomic orbitals is replaced by σ, π & δ for the molecular orbital.
- The no. of molecular orbital formed is equal to the no. of atomic orbitals involved in their formation thus two atomic orbitals after interaction will produce 2 molecular orbitals, one is bonding molecular orbital & other is antibonding M.O.
- Electrons which are present inside the shell of atoms & do not take part in bond formation are non bonding electron.
- The antibonding molecular orbital is represented by a superscript asterisk (*). The bonding molecular orbitals are stable & ABMO are unstable.
- Combining of atomic orbitals must have same or nearly same energy.

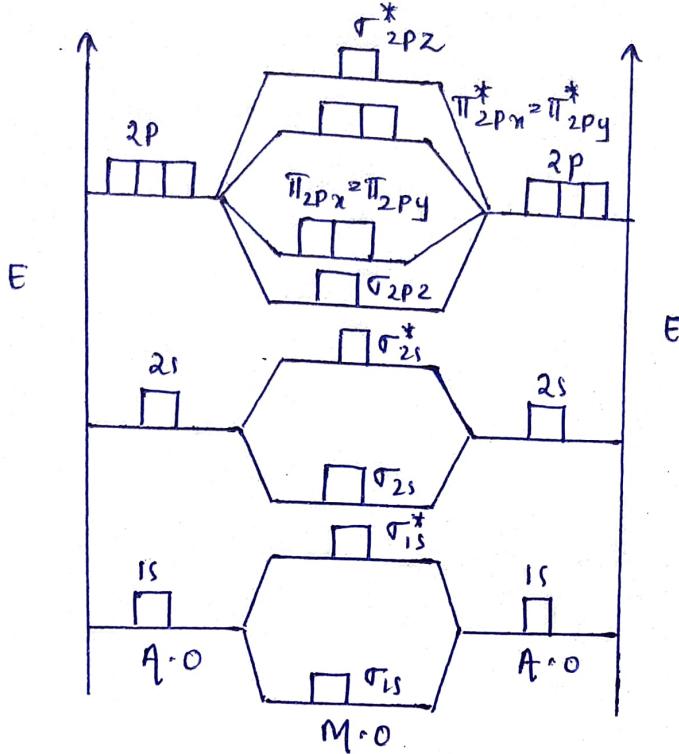
Rules for filling electrons in M.O.:-

- The molecular orbital are filled up in the order of increasing energy. The M.O with least energy is filled first (According to Aufbau principle).
- Maximum capacity of e^- in a molecular orbital is 2 with opposite spin (According to Pauli).
- If there are 2 or more M.O of same energy or same plane is present, first single filled in all the M.O then after starts pairing (According to Hund's rule).



$$\sigma_{1s} < \sigma_{1s}^* < \sigma_{2s} < \sigma_{2s}^* < \pi_{2p_x} = \pi_{2p_y} \\ < \pi_{2p_z}^* < \pi_{2p_x}^* = \pi_{2p_y}^* < \sigma_{2p_z}^*$$

→ The molecular orbital in order of their increasing energy up to nitrogen molecule.
 → But beyond N the order is as follows (O_2 , F_2 , Ne_2).



Bond order

It is defined as the no. of covalent bond present in a molecule.

$$\frac{L}{2} \times (N_b - N_a) = \text{Bond order}$$

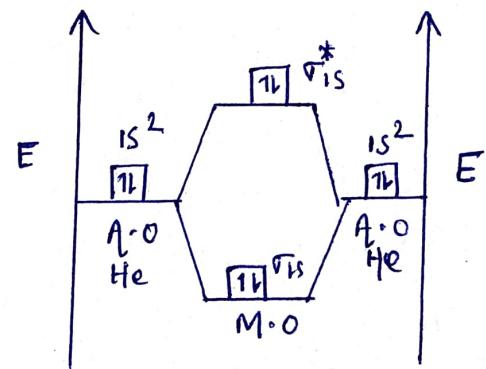
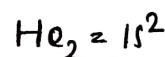
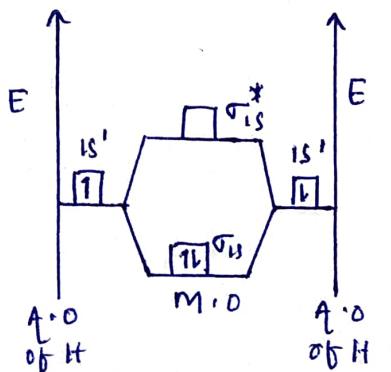
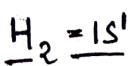
where, N_b = No. of bonding e⁻
 N_a = No. of antibonding e⁻

Bond order \propto stability.

\propto Bond strength

\propto Bond dissociation energy.

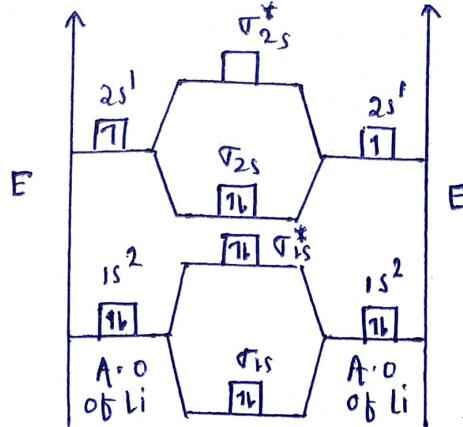
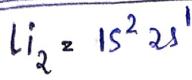
\propto $1/\text{Bond length}$.



$$\begin{aligned} \text{Bond order} &= \frac{1}{2} (N_b - N_a) \\ &= \frac{1}{2} (2 - 0) \\ &= \frac{1}{2} \times 2 = 1 \end{aligned}$$

$E.C. \text{ of } H_2 = (\sigma_{1s})^2 (\sigma_{1s}^*)^0$
 magnetic property
 \rightarrow diamagnetic

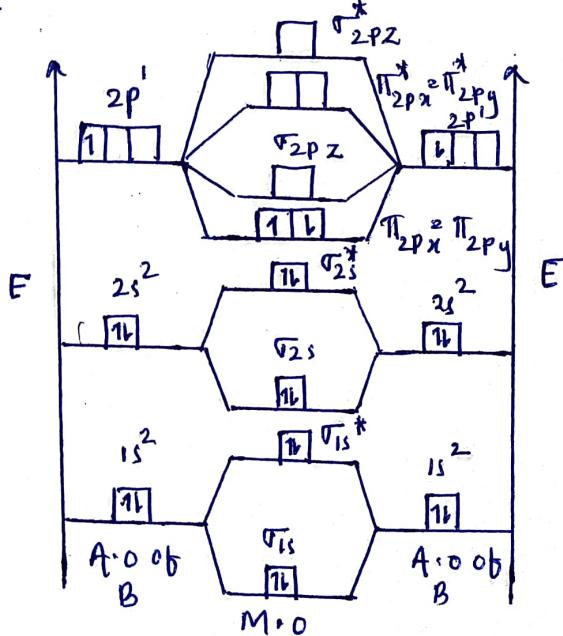
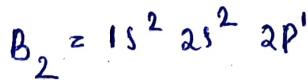
$$\begin{aligned} \text{Bond order} &= \frac{1}{2} (2 - 2) = 0 \\ E.C. &= (\sigma_{1s})^2 (\sigma_{1s}^*)^2 \\ \text{magnetic property} &\rightarrow \text{diamagnetic} \end{aligned}$$



$$\text{Bond order} = \frac{1}{2}(4-2) = 1$$

$$E \cdot C = (\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2$$

Magnetic property - diamagnetic



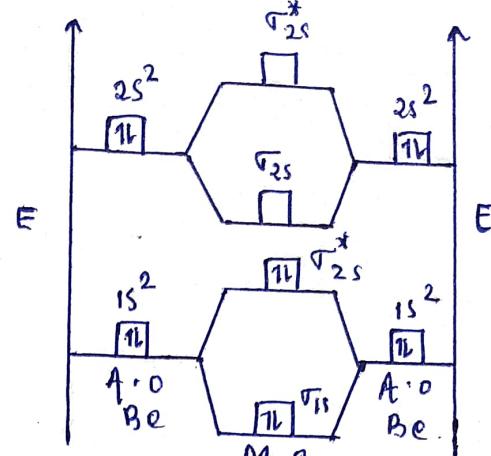
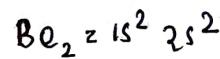
$$\text{Bond order} = \frac{1}{2}(6-4)$$

$$= \frac{1}{2} \times 2 = 1$$

$$E \cdot C \text{ of } B_2 = (\sigma_{1s})^2 (\sigma_{1s}^*)^2$$

$$(\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\pi_{2p_x})^1 (\pi_{2p_y})^1$$

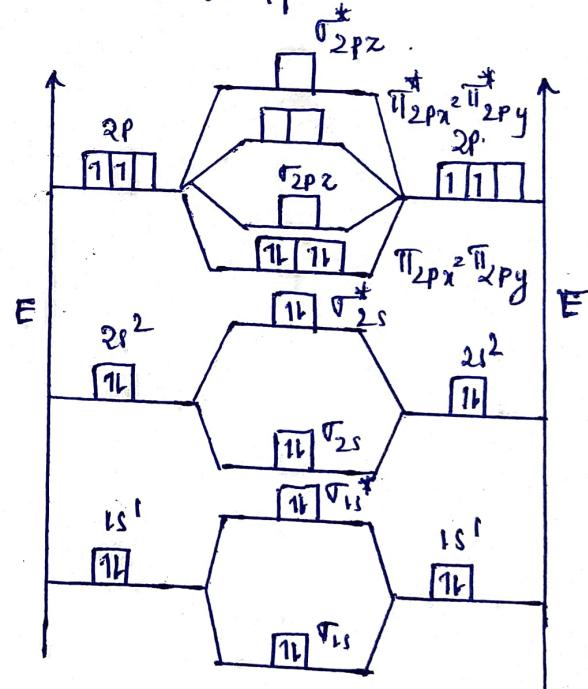
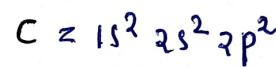
Magnetic property
= paramagnetic



$$\text{Bond order} = \frac{1}{2}(4-4) = 0$$

$$E \cdot C = (\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2$$

Magnetic property = diamagnetic



$$\text{Bond order} = \frac{1}{2}(8-4)$$

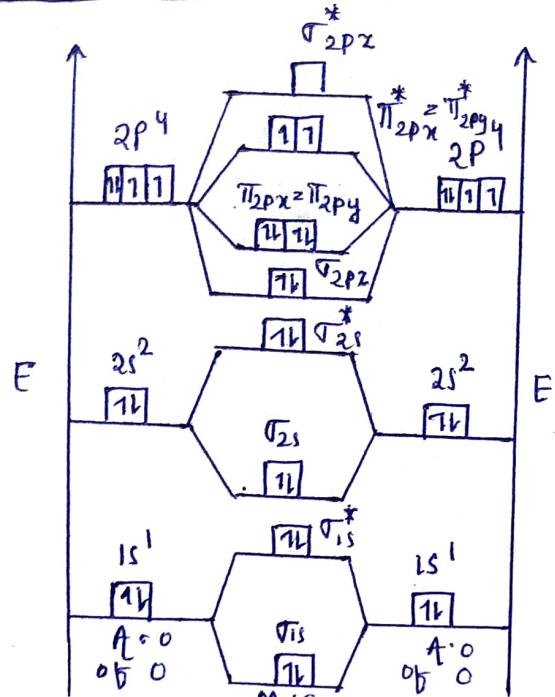
$$= \frac{4}{2} = 2$$

$$E \cdot C \text{ of } C_2 = (\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2$$

$$(\sigma_{2s}^*)^2 (\pi_{2p_x})^2 (\pi_{2p_y})^2$$

Magnetic property
→ diamagnetic

O = 1S² 2S² 2P⁴



$$\text{Bond order} = \frac{1}{2} (10 - 6)$$

$$= \frac{1}{2} \times 4 = 2$$

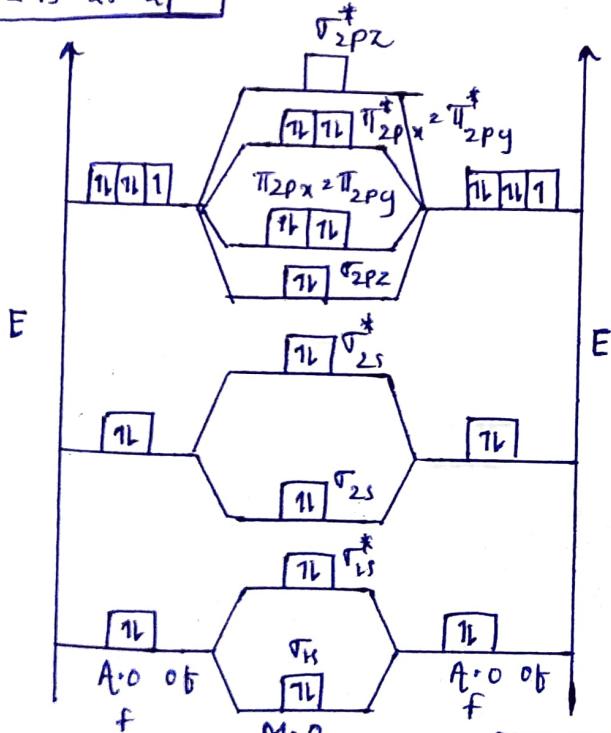
$$\text{E.C of } \text{O}_2 = (\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2$$

$$(\sigma_{2p_z})^2 (\pi_{2p_x}^*)^2 = (\pi_{2p_y}^*)^2$$

$$(\pi_{2p_x}^*)^1 = (\pi_{2p_y}^*)^1$$

magnetic property = paramagnetic

f = 1S² 2S² 2P⁵⁻

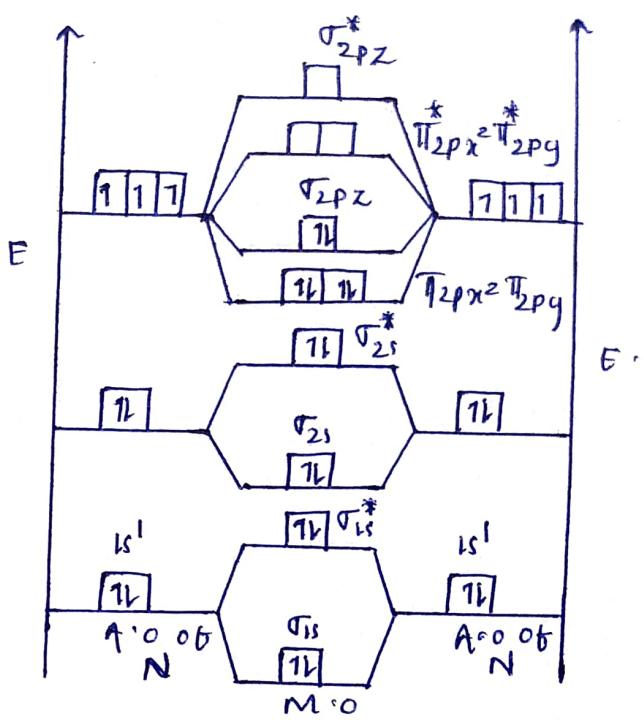


$$\text{Bond order} = \frac{1}{2} (10 - 8) = 1$$

$$\text{E.C of } f_2 = (\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2$$

$$(\sigma_{2p_z})^2 (\pi_{2p_x}^*)^2 = (\pi_{2p_y}^*)^2 (\pi_{2p_x}^*)^2 (\pi_{2p_y}^*)^2$$

N = 1S² 2S² 2P³



$$\text{Bond order} = \frac{1}{2} (10 - 4)$$

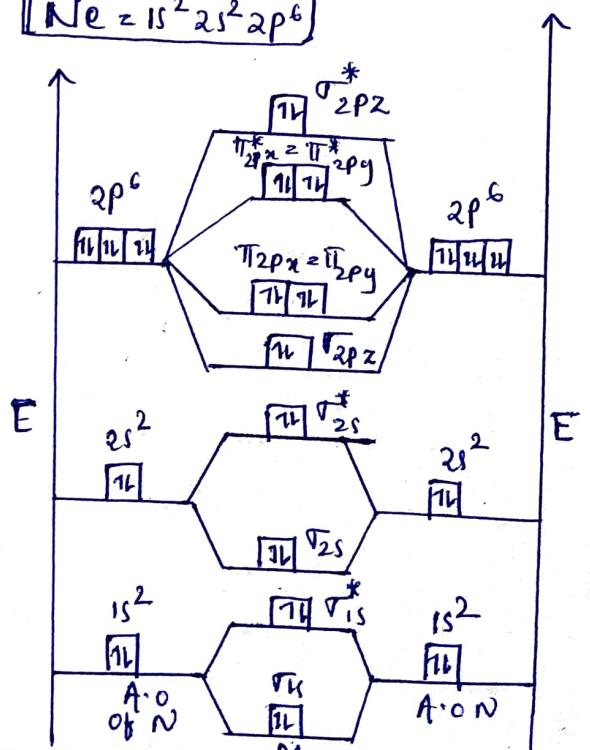
$$= \frac{1}{2} \times 6 = 3.$$

$$\text{E.C of } \text{N}_2 = (\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2$$

$$(\sigma_{2s}^*)^2 (\pi_{2p_x}^*)^2 = (\pi_{2p_y}^*)^2 (\sigma_{2p_z})^2$$

magnetic property → diamagnetic

Ne = 1S² 2S² 2P⁶

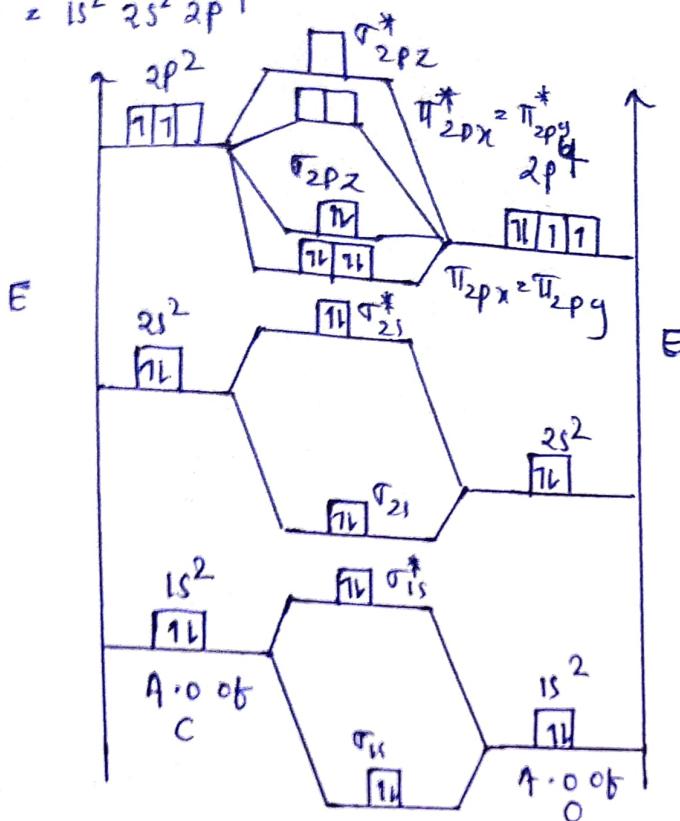
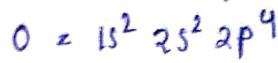
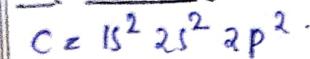


$$\text{B.O} = 0, \text{ E.C} = (\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2$$

$$(\sigma_{2s}^*)^2 (\pi_{2p_x}^*)^2 = (\pi_{2p_y}^*)^2 (\pi_{2p_x}^*)^2 (\pi_{2p_y}^*)^2$$

$$(\sigma_{2p_z}^*)^2 \text{ MP = diamagnetic.}$$

M.O diagram of CO:-



$$E_C = (\tau_{1s})^2 (\tau_{1s}^*)^2 (\tau_{2s})^2 (\tau_{2s}^*)^2$$

$$(\pi_{2p_x})^2 = (\pi_{2p_y})^2, (\sigma_{2p_z})^1$$

$$\text{Bond order} = \frac{1}{2} (10 - 4) = 3$$

Magnetic property
= diamagnetic.

$$1 = 0.5$$

$$2 = 1$$

$$3 = 0.5$$

$$4 = 0$$

$$5 = 0.5$$

$$6 = 1$$

$$7 = 0.5$$

$$8 = 0$$

$$9 = 0.5$$

$$10 = 1.0$$

$$11 = 1.5$$

$$12 = 2$$

$$13 = 2.5$$

$$14 = 3$$

$$15 = 2.5$$

$$16 = 2$$

$$17 = 1.5$$

$$18 = 1.0$$

$$19 = 1$$

$$20 = 0$$

$$H_2 = 1$$

$$H_2^+ = \frac{1}{2}$$

$$H_2^- = \frac{1}{2}$$

$$He_2 = 0$$

$$He_2^+ = \frac{1}{2}$$

$$Li_2 = 1$$

$$Li_2^+ = \frac{1}{2}$$

$$Be_2 = 0$$

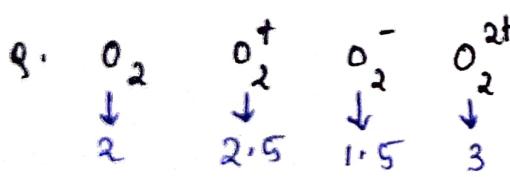
$$B_2 = 1$$

$$C_2 = 2$$

$$N_2 = 3$$

$$N_2^+ = 2.5$$

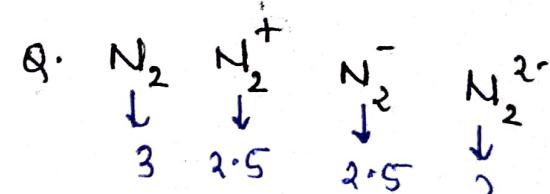
$$N_2^- = 2.5$$



$$\text{Bond order} = O_2^{2+} > O_2^+ > O_2 > O_2^-$$

$$\text{Bond length} = O_2^- > O_2 > O_2^+ > O_2^{2+}$$

$B.O \propto \frac{1}{\text{Bond length}}$



$$\text{Bond length} = N_2^{2+} > N_2^- = N_2^+ > N_2$$

$$\text{Bond order} = N_2 > N_2^+ = N_2^- > N_2^{2+}$$

$$\text{Bond strength} = N_2 > N_2^- = N_2^+ > N_2^{2+}$$