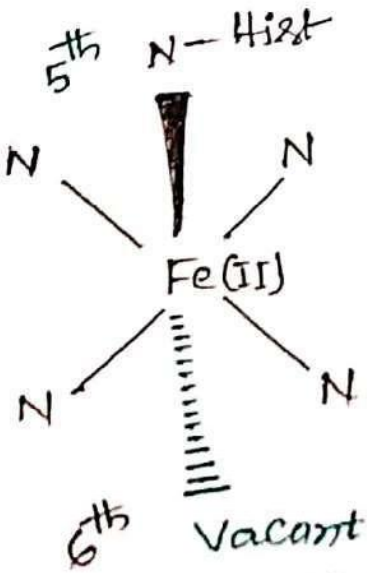
DTS

* Structure and functioning of Hemoglobin(Hb) and myoglobin (Mb) proteins:-

1) STRUCTURE OF HEMOGLOBIN (Hb):-



Deoxy Hemoglobin

* It is tetramer of Myoglobin
* Fe—N porphyrin distance is 206 pm
* Molecular wt of Hb is 64,000 Daltons.

=> The four nitrogen from the porphyrin ring bonded to the Fe-atom and also nitrogen from Histidine (5th position), the 6th Co-ordination is Vacant.

=> The Fe-atom will not be in the plane of porphyrin ring because the pulling effect given by Histidine protein.

⇒ The O_2 molecule served as a powerfull π-acceptor in its interaction with a Fe^{2+} Centre.

⇒ Fe is +2 Oxidation state and High spin

⇒ Fe^{2+} The electronic conf^n $3d^6$ $[t_{2g}^4\ eg^2]$

eg 1 1

t_{2g} 1 1 1

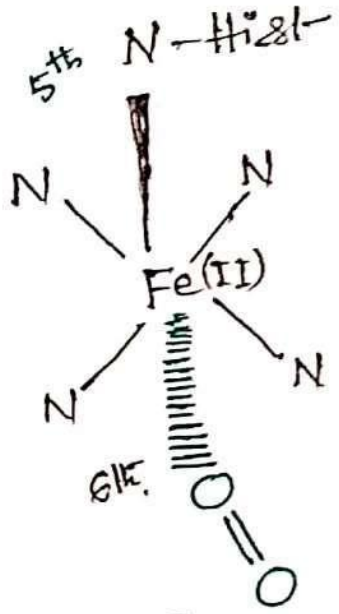
∴ It is "paramagnetic"

⇒ There are FOUR heme units in Hb.

⇒ Hb is "red" in colour but it observing the complimentary colour "green"

⇒ Deoxy hemoglobin is 5-Coordinated It is look like a "Square pyramidal"

Oxyhemoglobin :-



$$Hb + O_2 \rightarrow HbO_2$$

⇒ The co-ordination of O_2 to Fe, the O.S will not be varied [i.e Fe(II)]

⇒ Its co-ordination is 6 and low spin

⇒ After the co-ordination of O_2, Fe will sit on the plane of the porphyrin ring

⇒ Its electronic conf^n $= 3d^6$

$= t_{2g}^6 \; eg^0$

e_g —

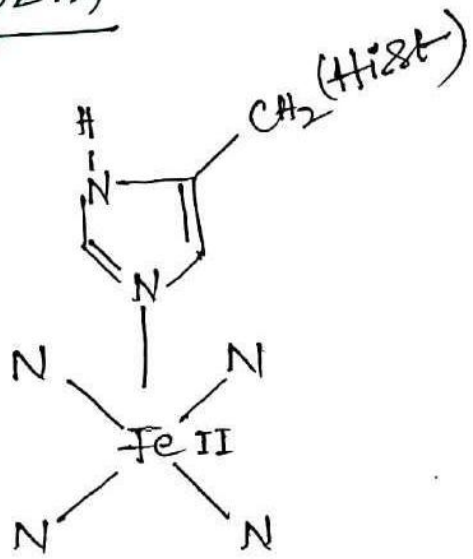
t_{2g} ↿⇂ ↿⇂ ↿⇂

The magnetic moment $\mu = 0$

∴ oxyhemoglobin is "diamagnetic"

* STRUCTURE OF MYOGLOBIN [Mb] :—

Deoxy Myoglobin



⇒ Deoxy myoglobin is 5 co-ordinated high spin complex Fe(II) with four co-ordination positions occupied by the porphyrin

- ring N-atoms. The fifth position is occupied by N-atom of an imidazole ligand of histidine residue which couples the heme to the protein.

⇒ Fe is +2 oxidation state

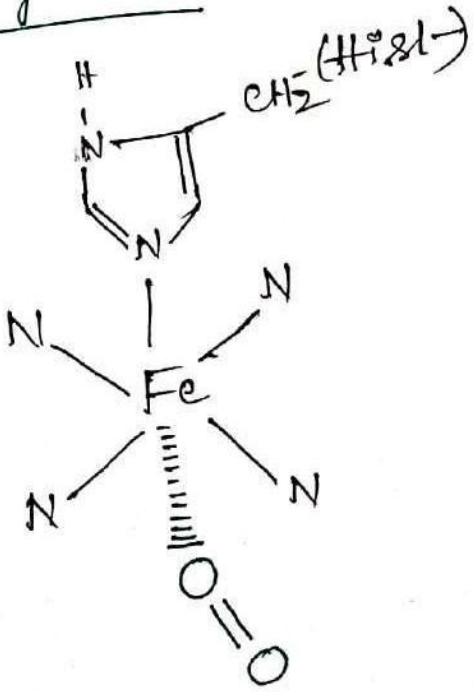
⇒ Fe(II) is lies above the plane of porphyrin ring

⇒ It is Square pyramidal str

⇒ It is monomer ∴ It has only one heme unit

⇒ It is High Spin & $\mu = 5$ $[t_{2g}^4 e_g^2]$

Oxymyoglobin :-



$\Rightarrow$ $\boxed{Mb + O_2 \rightarrow MbO_2}$

$\Rightarrow$ The co-ordination of O_2 to Fe the O.S of Fe will not be changed [Fe(II)]

$\Rightarrow$ Its C.N is 6 and low-spin

$\Rightarrow$ After the co-ordination of O_2 The Fe will sit on the plane of the porphyrin ring

$\Rightarrow$ It is diamagnetic i.e $\mu = 0$ $[t_{2g}^6 \, e_g^0]$

NOTE :- Hemoglobin and Myoglobin exist in two forms i.e

1) Deoxy form : NO oxygen is bound to Iron

2) oxy form : dioxygen (O_2) is bound to Iron

* Functions of Hb and Mb :-

Hemoglobin (Hb) carries O_2 from lungs to tissues where it is transferred to myo-globin (Mb) and stored therein for meta bolic requirements. To make this process thermodynamically possible, the oxygen affinity of Hb in lungs where oxygen concentration is high should be greater than Myoglobin and reverse condition should arise in the tissues where oxygen concentration is less.

* O_2 binding - Cooperativity effect :-

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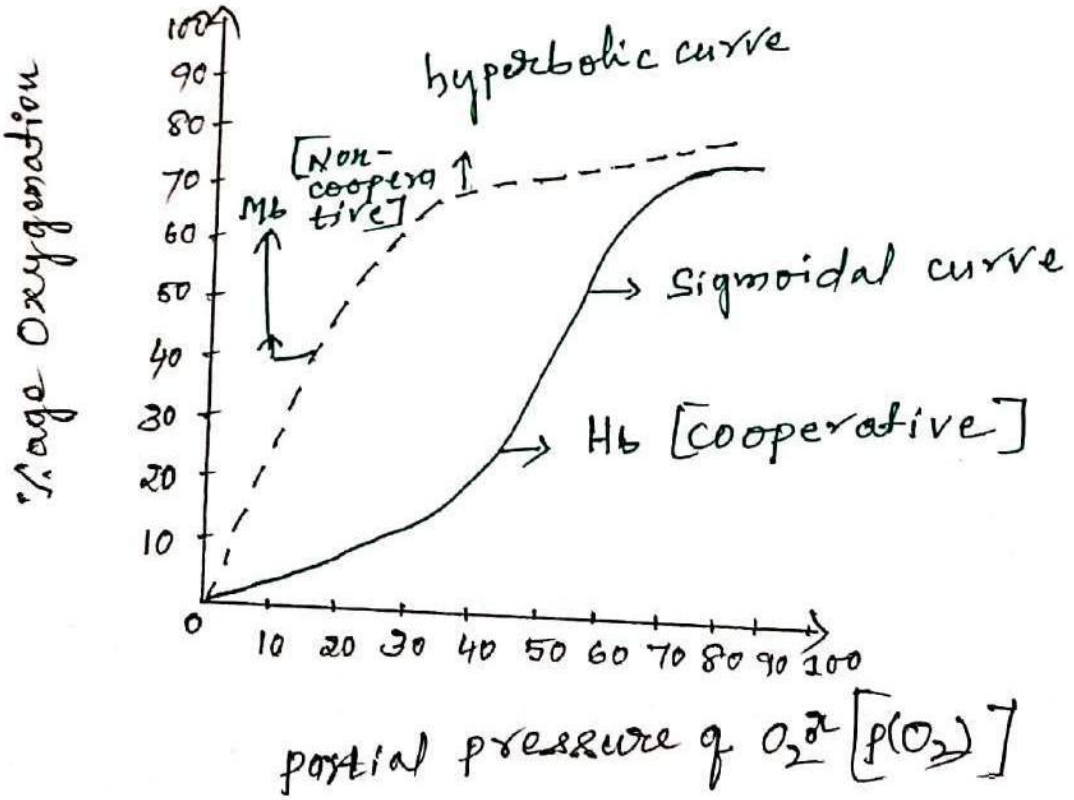
The oxygen binding curve - can be cleared to explained by - considering the cooperative interaction among the four heme units of Hb and non-cooperative O_2 - binding with heme unit of Mb.



* % age of oxygenation is along y-axis
* partial pressure of O_2 is along x-axis

=> Mb [Storage]

i) Myoglobin binds to O_2 molecule quickly
ii) Myoglobin has a strong affinity for O_2
iii) Myoglobin does not release O_2 until the partial pressure of O_2 drops to a low quantity.
iv) Myoglobin O_2 binding curve is "hyperbolic curve" and "pH is independent."

=> Hemoglobin [Hb] [Transport] :-

i) Hemoglobin shows a "Sigmoidal curve" (S-shape), this curve shows that Hb binding oxygen with less affinity than Mb
ii) Hemoglobin is much poorer oxygen

binder compared to myoglobin

iii) Hb has lower affinity for oxygen than Mb

iv) Hb release O_2 much more readily than Mb

v) Hb is perfect oxygen carrier : it can easily bind O_2 in the lungs and release O_2 to the tissues

v) The p^H is dependent for O_2-binding with Hb

Very imp

NOTE :- NET-CSIR - 4m

i) Hemoglobin = Sigmoidal curve and P^H is dependent

ii) Myoglobin = Hyperbolic curve and P^H is independent.

iii) Myoglobin does not exhibit Sigmoidal curve nor a bohr-effect.

* Co-operative effect :—

The phenomenon where the addition of oxygen to one heme group facilitates its addition of other heme group of hemoglobin is known as "co-operative effect."

* Bohr-effect :—

The binding power of Hb with oxygen is P^H dependent. This is called "Bohr-effect."

The binding power of Hb decrease in P^H. Hence the transfer of oxygen from oxy-hemoglobin to myoglobin is more efficient in the working muscles where CO_2 concentration is higher than the resting muscles, CO_2 being acidic decrease the P^H.