Function of Hb and Mb :- (See Video lecture next week)

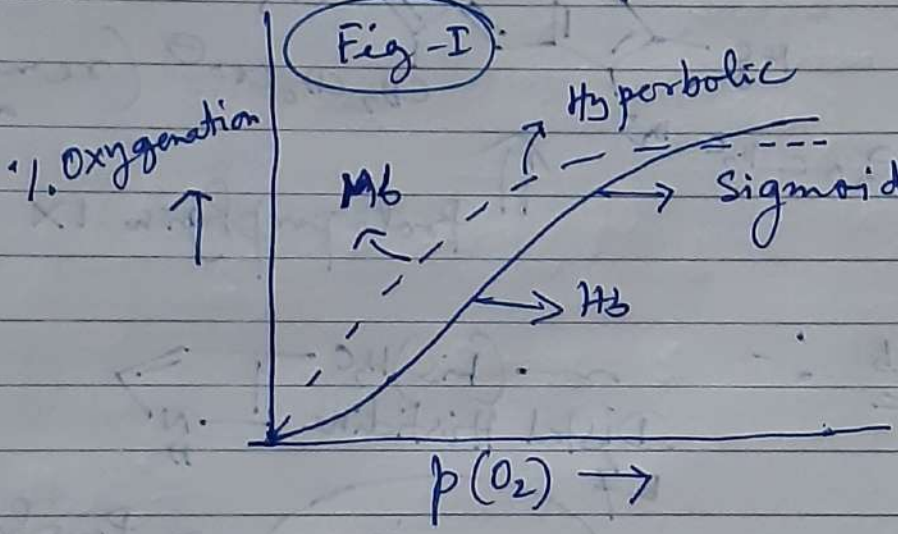
Hb → Hemoglobin

Mb → Myoglobin

Hemoglobin carries O_2 from lungs to tissue where it transferred to myoglobin and stored therein for metabolic requirements. To make this process thermodynamically possible, the oxygen affinity of Hb in lungs where oxygen concentration is high should be greater than that of Mb and the reverse condition should arise in the tissue where oxygen concentration is less.

Oxygenation Curves for Hb and Mb :-

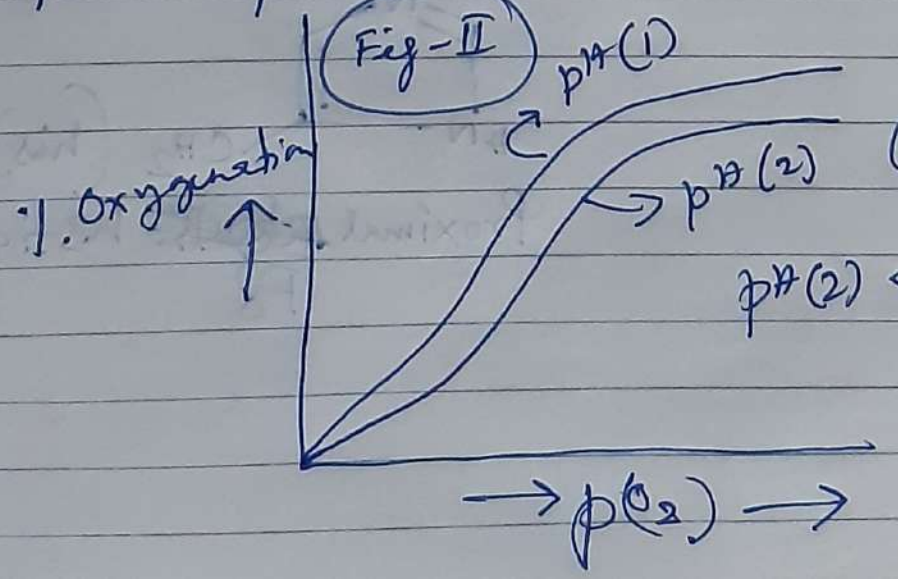
Fig-I



Effect of pH on oxygenation :- (Hb)

(Graphical representation)

Fig-II



Characteristics of O_2-binding interaction with Hb and Mb :-

The relative O_2 affinity of Hb can be explained by different types of allosteric interactions by O_2, $H^{\oplus}$, CO_2, $Cl^{\ominus}$ and 2,3-diphophoglycerate towards O_2 binding with Hb. These allosteric effect is absent in Mb.

① Co-operativity, Hill-plot and allosteric effect :-

The O_2-binding curves (Fig-I) can be explained by co-operative interaction among four heme units of Hb and non-co-operative interaction O_2 binding with heme unit of Mb.

For Mb the curve is hyperbolic.

For Hb the curve is S-shaped (sigmoid)

$$Mb + O_2 \rightleftharpoons MbO_2 \,, \quad K_M = \frac{[MbO_2]}{[Mb]\,[p(O_2)]} \quad \text{---(1)}$$

$$f(M) = \frac{[MbO_2]}{\{[Mb] + [MbO_2]\}} \quad \text{---(2)}$$

Then, $K_M = f_M / \{(1 - f_M)\}\{p(O_2)\}$ ---(3) { Substituting eq^n (2) in eq^n (1) we get,

At the value of $f_M = 0.5$ (i.e, 50% of total Mb is oxygenated), the corresponding $p(O_2)$ is denoted by p_{50} and it leads to

$$\frac{1}{K_M} = p_{50}$$

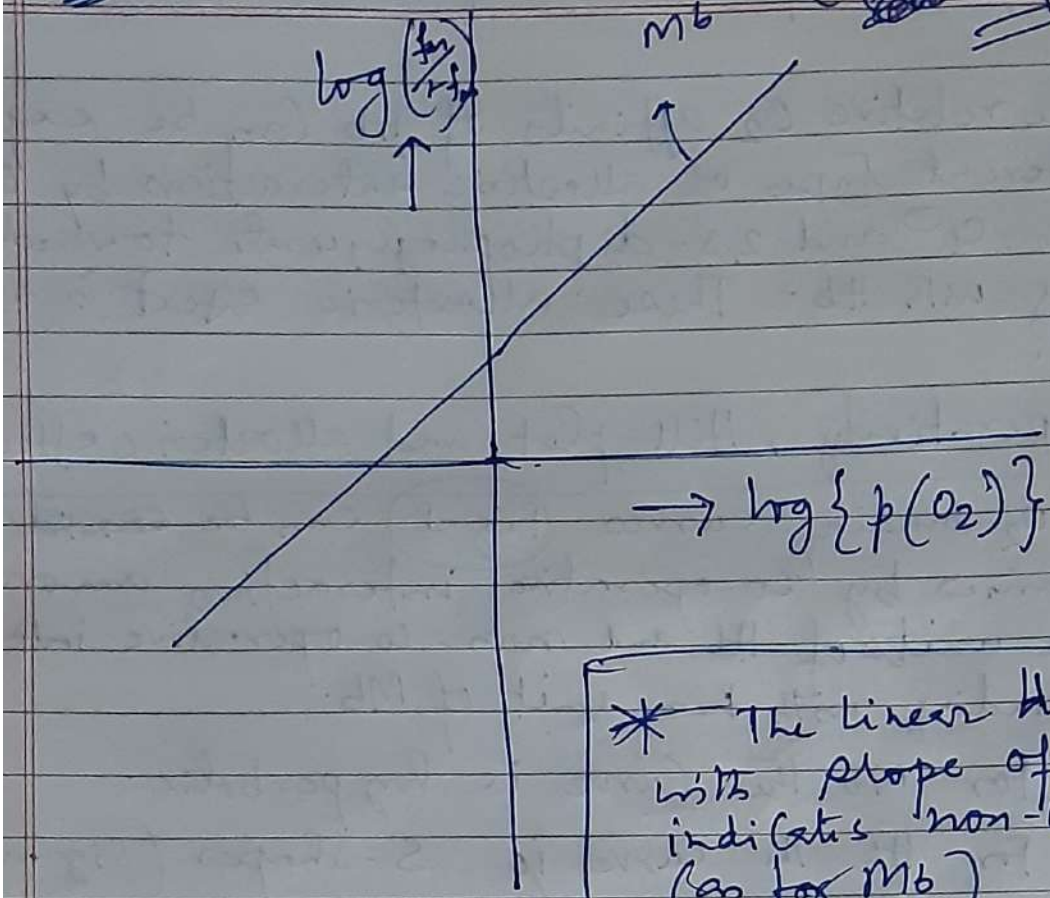
The corresponding Hill equation is

$$\log\left(\frac{f_M}{1 - f_M}\right) = \log\{p(O_2)\} + \log K_M$$

$$= \log\{p(O_2)\} - \log p_{50}$$

For Mb → Hill plot for Mb

(Non-cooperative) slope = 1



* The linear Hill plot with slope of unity indicates non-cooperativity (as for Mb)

$$\log\left(\frac{f_m}{1-f_m}\right) = \log\{p(O_2)\} - \log p_{50}$$

slope = 1

For Hb :-