Oxygen binding to Myoglobin

To know how tightly the oxygen binds to the myoglobin, we measure the dissociation of oxygen from Myoglobin:

$MbO_2 \leftrightarrow Mb + O_2$

$$K_d = \frac{[Mb] \times pO_2}{[MbO_2]}$$

Define Θ

Θ is the ratio of occupied binding sites on a protein to the total binding sites. When Θ is equal to 1, then all of the protein binding sites are occupied.

$$\Theta = \frac{[PL]}{[PL] + [P]}$$

$[L] = pO_2$

$[MbO_2] = [PL]$

$[Mb] = [P]$

$$\Theta = \frac{[MbO_2]}{[MbO_2] + [Mb]}$$

$$K_d = \frac{[Mb] \times pO_2}{[MbO_2]}$$

rearrange, solve for $[MbO_2]$

$$[MbO_2] = \frac{[Mb] \times pO_2}{K_d}$$

Substitute into equation for theta:

$$\Theta = \frac{[Mb] \times pO_2 / K_d}{([Mb] \times pO_2/K_d) + [Mb]}$$

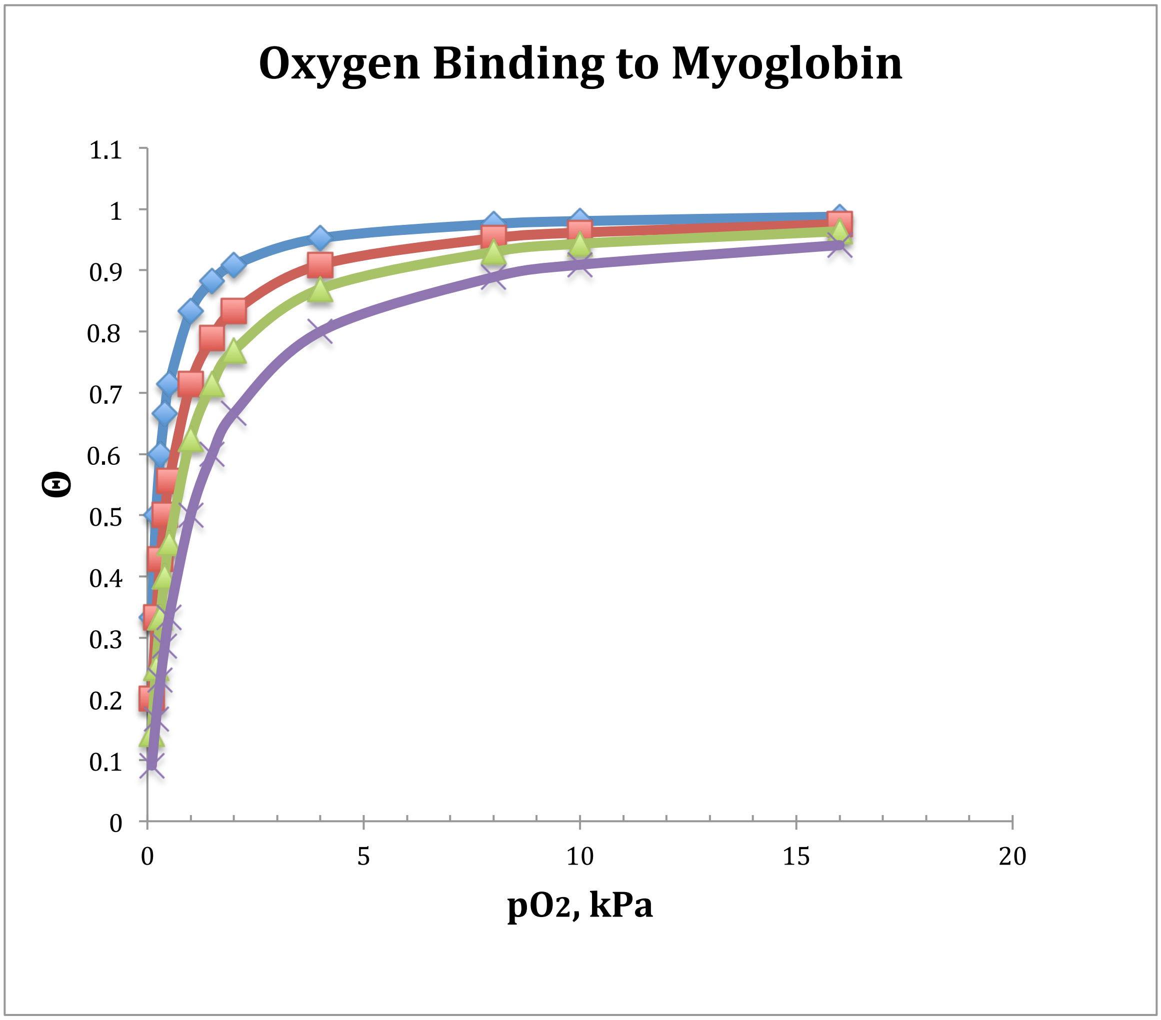
Divide all terms by [Mb]

$$\Theta = \frac{pO_2 / K_d}{((pO_2/K_d) + 1)}$$

Multiply all terms by K_d

$$\Theta = \frac{pO_2}{(pO_2 + Kd)}$$

Plot Θ vs pO_2,



1. What kind of function is this?

2. Solve the equation, when $\Theta = .5$, to get a relationship between pO_2 and Kd at $\Theta = .5$.

$$\Theta = \frac{pO_2}{pO_2 + Kd}$$

3. What is the Kd for the line with X as a marker?

4. Which line (squares, diamonds, triangles, Xs) has the strongest binding of oxygen to Myoglobin?

5. True or false, the amount of myoglobin present determines the dissociation constant, Kd.

6. What is the value for Θ at 4 kPa for the diamonds? (Resting muscle)

7. What is the value for Θ at 1.5 kPa for the diamonds? (Active muscle)

8. What percent of bound oxygen is released in active muscle? (Resting - Active) x 100%

9. What percent of bound oxygen is released in active muscle for the Xs? (Repeat 6,7,8)