CBE 30357
Fall 2017
Homework 1
Due 9/1/17 (update)

1. TYK: 1.9. Note the there is a typo in the problem. The Henry's coefficient for hemoglobin, H_{Hb} should be 1.5 X 10^{-6} M /mmHg.
2. TYK: 1.11
3. TYK: 1.12
4. A "Tour de France" level cyclist can provide 450 Watts of power to his bicycle continuously for 3 or more hours. He accomplishes this by converting stored energy (in various states in his body) at an efficiency of 40%.

    a. Using the indomitable glucose molecule as the "stored energy", what is his O2 consumption rate during the race?

    b. What is his steady state blood flow if you use the nominal arterial/venous saturation levels for high performance athletes — at a high performance level?

Suppose that this rider is racing an alien creature who does not have a chemically complexing O2 carrier.

    c. What blood flow rate would be necessary to provide the prescribed power output for the alien rider?

    d. From information in problem 1.12, how big would the aliens heart need to be?

5. Use dimensional reasoning to determine a maximal size for a cell. That is, if there is no internal convection and we assume that various reactions that occur within the cell have time scales of 1-10 s, how large could cells be if the size is limited by the need to keep small molecule nutrients well-mixed?