Exam 3 March 14, 2005 CHEM 3511

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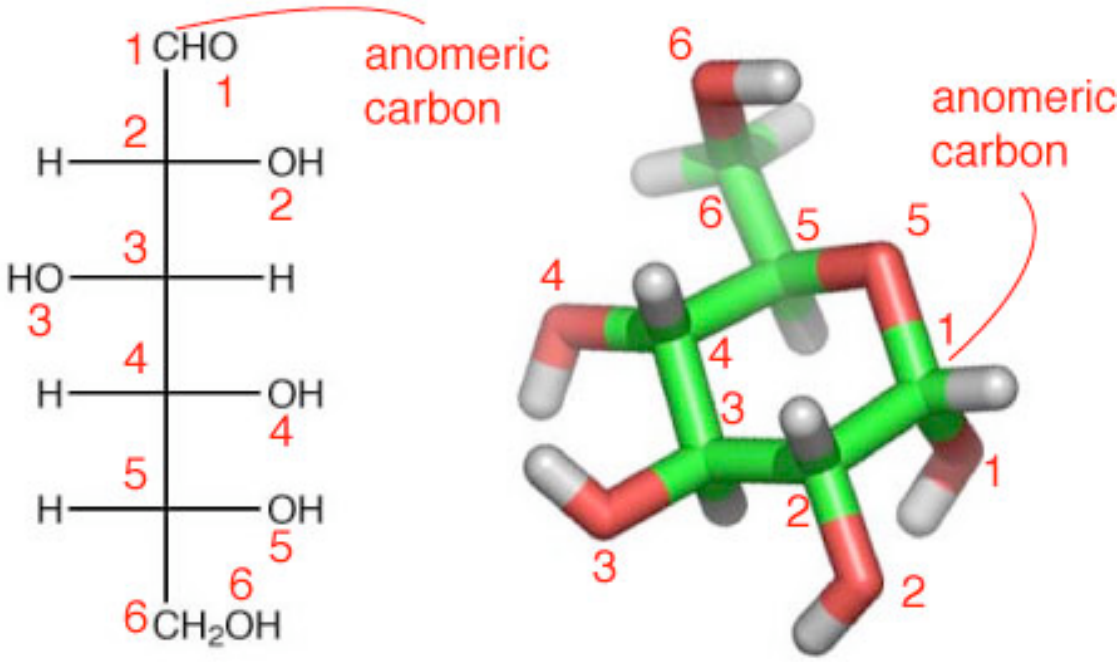
5 pages total.

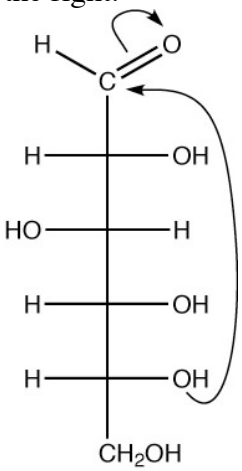
1) Both of the images below are glucose (20 points).



a) Correctly number the carbon atoms and the oxygen atoms on both structures. The top carbon on the left image is carbon 1.

b) Label the anomeric carbon on the left and on the right.

c) Show the chemical reaction by which the molecule on the left converts to the form on the right.



d) The molecule on the right is a component of cellulose / **glycogen** / myoglobin (circle one).

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2) This question is related to Myoglobin (Mb) and Hemoglobin (Hb), and O_2. An oxygen binding protein (Xb) in Amphibians binds to four dioxygen molecules. Xb is similar to Hb in that O_2 binding is cooperative. But Xb *binds* O_2 more *weakly* than Hb and with much *greater* cooperativity (20 points).

The Hill equation for these cooperative binding reactions is:

$$Xb + nO_2 \rightarrow Xb(O_2)_n$$

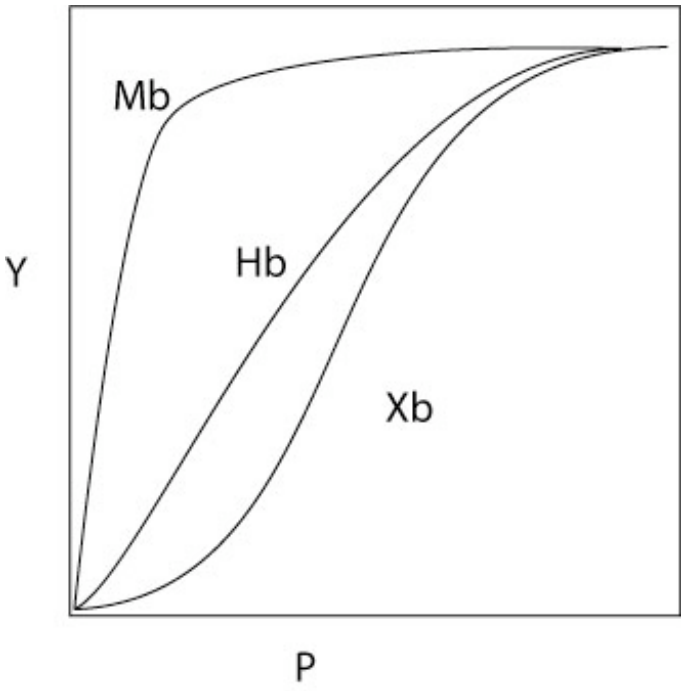
$$Y_{O_2} = \frac{(pO_2)^n}{(p_{50})^n + (pO_2)^n}$$

where n is the Hill constant.

a) If n = 3 for Hb, estimate n for Xb.

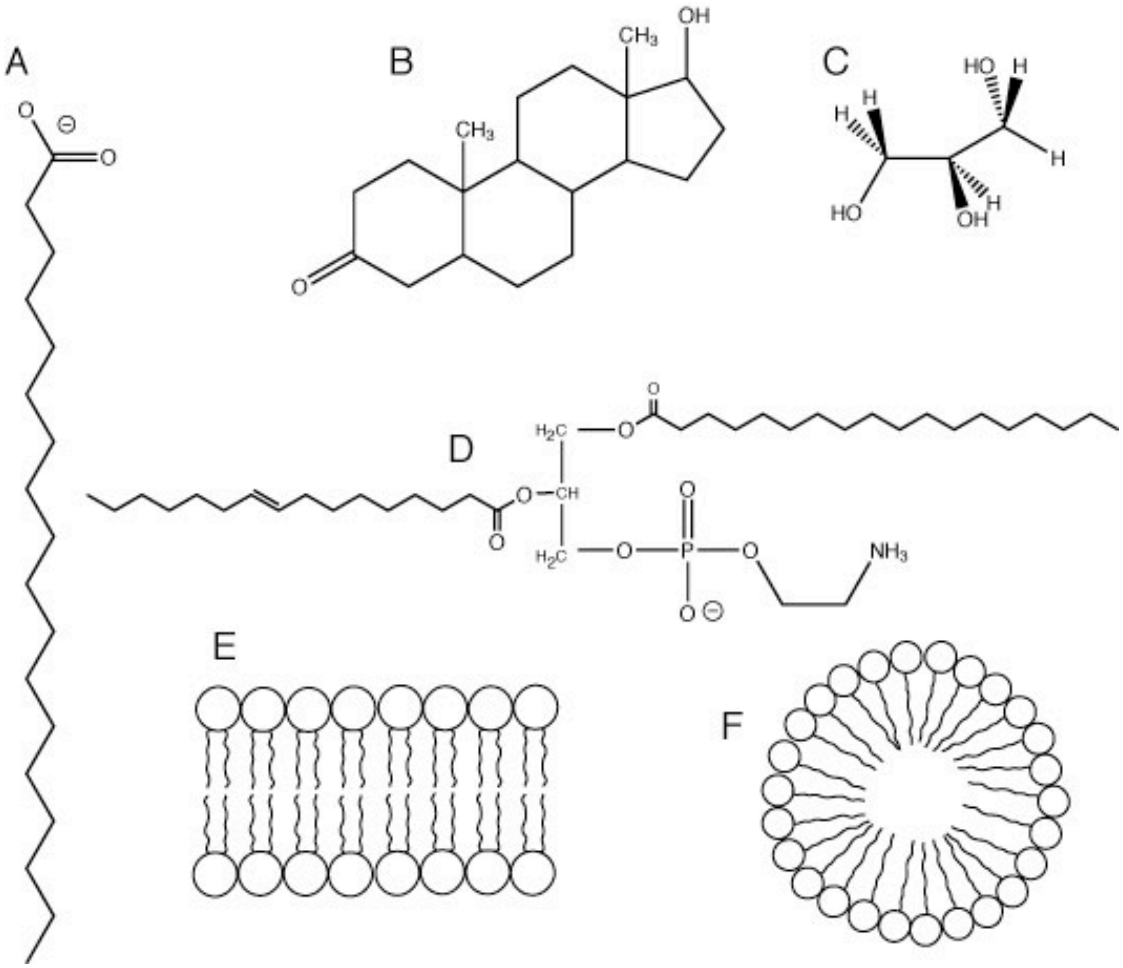
3 < n < 4, between 3 and 4

b) On a single graph sketch pO_2 vs Y_{O_2} for Mb, Hb and Xb.



The Xb line is shifted to the right, and is steeper than the Hb line. All three lines should asymptotically approach Y = 1

Print Name: Key Signature _____



Identify the molecules/assemblies above (15 points).

A) fatty acid (give the general class to which this molecule belongs)

B) steroid (give the general class to which this molecule belongs)

C) glycerol (give the name of this molecule)

D) glycerophospholipid (give the general class to which this molecule belongs)

E) membrane or bilayer (what is this assembly?)

F) micelle (what is this assembly?)

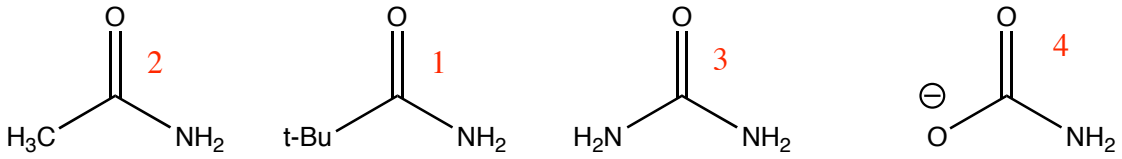
Print Name: Key Signature _____

4) Membranes (14 points).

a) Consider an alpha-helix of the following sequence:
KAWVLIMFD
Where would you expect to find this alpha-helix?

Spanning a membrane, with the two charged residues on either side of the membrane.

b)



Rank the molecules above by their ability to diffuse across a lipid bilayer. Number them 1 through 4, with 1 having the fastest rate of diffusion.

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5 True and False. (2 pts each, 32 total)

a) Hemoglobin binds oxygen in the lungs and releases it in the capillaries.
(**T**/F)
b) Hemoglobin has three conformational states (R, S and T).
(T/**F**)
c) Increasing pH promotes the release of O_2 from hemoglobin
(T/**F**)
d) D-glucose has 4 chiral centers, giving 2^4 possible stereoisomers.
(**T**/F)
e) In cellulose, glucose molecules are linked by β(1-4) bonds.
(**T**/F)
f) Cellulose is highly branched.
(T/**F**)
g) Glycogen is highly branched.
(**T**/F)
h) Chitin is highly branched.
(T/**F**)
i) Double bonds in fats are nearly always in the cis configuration.
(**T**/F)
j) The carbon in sugars is less reduced than the carbon in fats.
(**T**/F)
k) Bilayer fluidity varies with temperature.
(**T**/F)
l) Bilayer fluidity varies with cholesterol content.
(**T**/F)
m) Sphingolipids are amphipathic.
(**T**/F)
n) Integral membrane proteins can extend to each side of a membrane.
(**T**/F)
o) Integral membrane proteins frequently 'flip', switching their intra and extra cellular domains.
(T/**F**)
p) In the fluid mosaic model, proteins can diffuse in two dimensions.
(**T**/F)