MCDB 1150-3:Biofundamentals 2014 Midterm 2 Name: _____

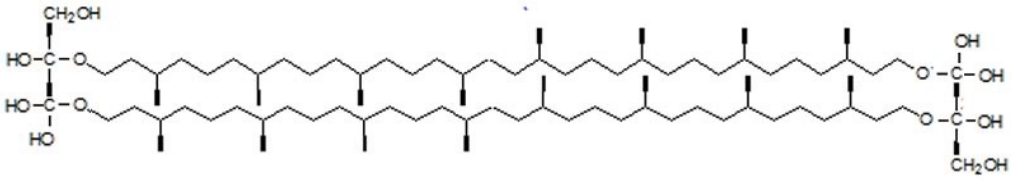
There are 10 two part questions, each worth a maximum of 6 points. For the multiple choice questions, your choice, graph, or drawing (if correct) is worth 3 points, your explanations are worth 3 points each. You always have a choice to pick "no idea" and get +1 point. No written answer is required if you pick "no idea".

1. Compared to van der Waals interactions, "H-bonding" interactions are …
   - ❑ A. non-directional
   - ❑ B. occur between all molecules, regardless of their atomic composition
   - ✔ C. occur when molecules contain of atoms with different electronegativities
   - ❑ NO IDEA

Explain (below) why the incorrect answers are wrong or irrelevant.

A. H-bonds are directional, along the axis of the polarized covalent bonds that are involved in them.
B. H-bonds bonds do not form unless the molecule contains polar bonds

2. Here is a type of lipid. you disperse these molecules into water, draw the most stable structure(s) they might form and explain the logic behind your prediction. Don't worry about being too accurate in your drawing of the molecule.



□ **NO IDEA**

These can form monolayer-type structures, since both ends of the molecule are polar.

3. Draw a reaction diagram for the thermodynamically favorable reaction (products ⇄ reactants) that occurs only very slowly if at all.

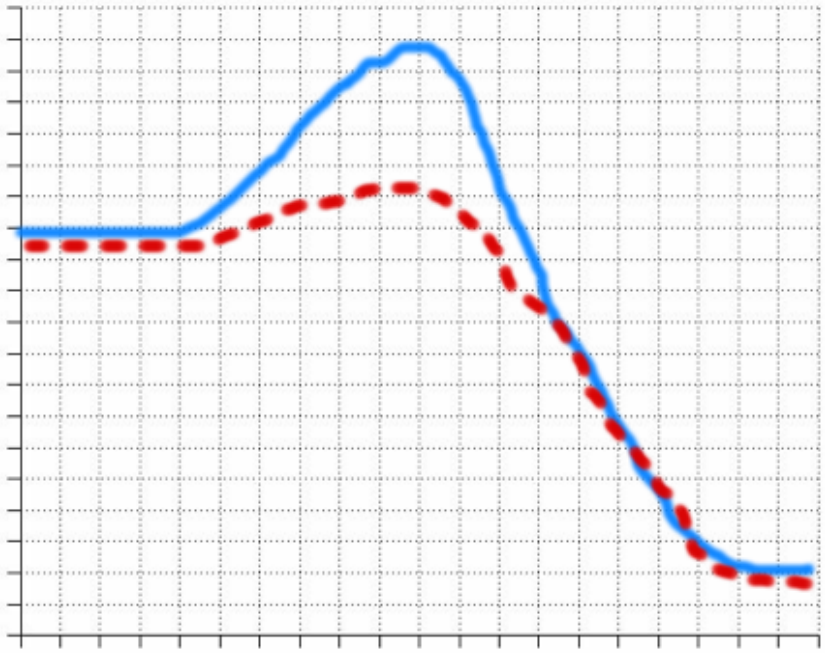
□ **NO IDEA**

Be sure to label the Y-axis.

(Y axis = free energy)

You now add a catalyst, and the reaction proceeds rapidly to equilibrium.

How does your diagram change (draw with dotted line) and what can you conclude about the free energy of the reaction intermediate?



reaction coordinate

4. The unique properties of water are largely determined by ….

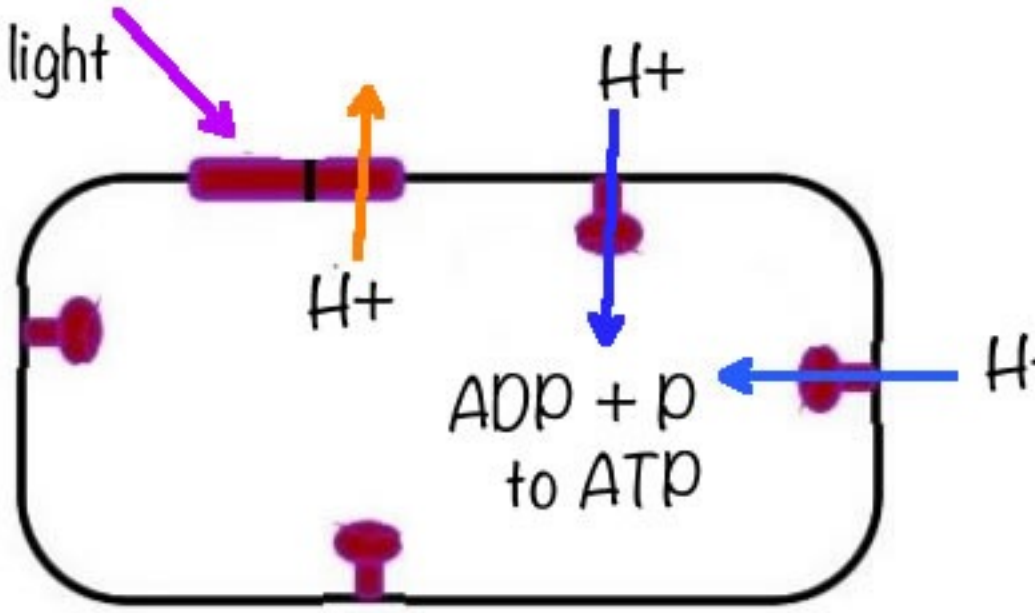
- ✔ **A**. its ability to take part in multiple H-bonds
- ❏ **B**, its ability to interact with other molecules through van der Waals interactions
- ❏ **C**. its small size
- ❏ No idea.

Explain (below) why the incorrect answers are wrong or irrelevant.

B: All molecules can interact via van der Waals interactions (nothing unique about that)

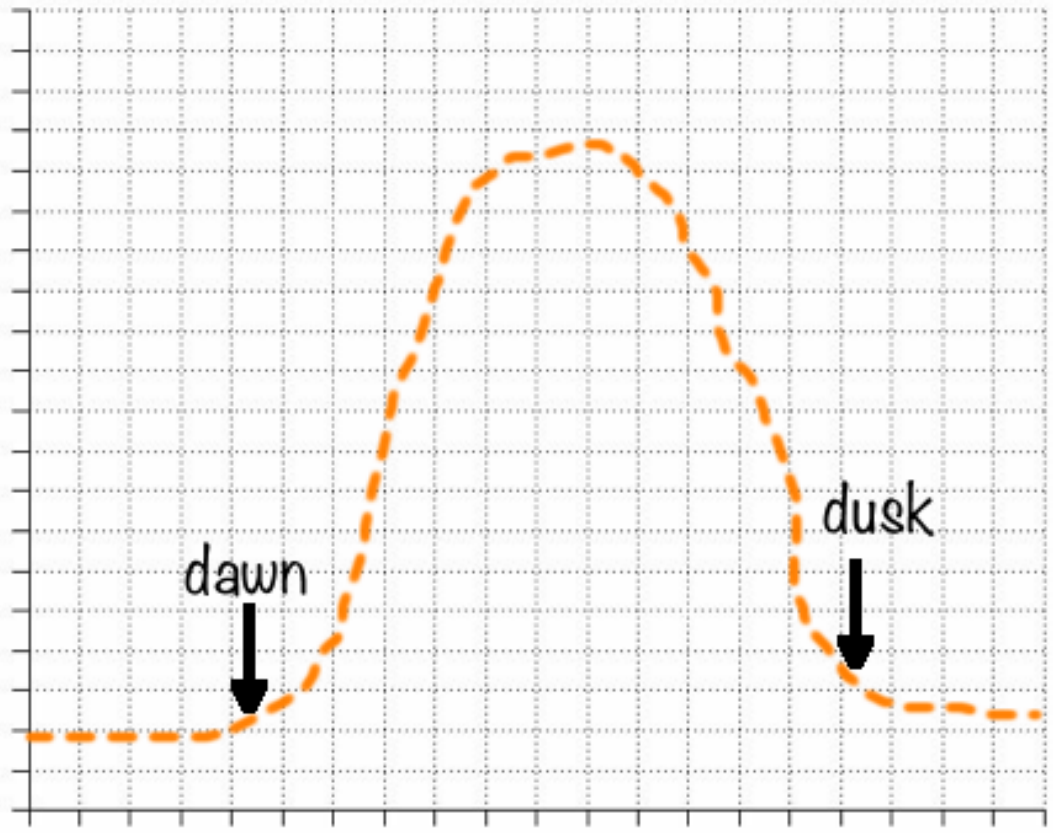
C: If the molecule is small, but non-polar (that is unable to form H-bonds), will behave quite differently from water.

5. Here is a diagram of *Halobium*; indicate where light is absorbed, the direction H+ ions move in response to the absorption of light, and how H+ moves to generate ATP.



You measure the concentration of ATP in the Halobium cells: you start taking measurements beginning at midnight and continue for an entire day (until midnight of the next day).

Draw the graph of the rate of ATP synthesis as a function of time.



midnight **noon** **midnight**

6: Now assume that the cell's membrane contains an H+, glucose symporter AND glucose is present at low concentrations in the environment. During the day, which is the most likely to occur. Glucose will move

- ✔ A. into the cell
- ❑ B, out of the cell
- ❑ C. no movement, since it depends upon ATP hydrolysis
- ❑ No idea.

Explain (below) why the incorrect answers are wrong or irrelevant.

B: Glucose could move out, but only if the Glucose gradient was higher than the H+ gradient, created by the bacteriorhopsin system. (this is rare, because glucose is rapidly used up in cells and converted to other molecules).

C: symporter movement does not require ATP hydrolysis

7. A channel in a membrane is like a catalyst because it …

- ❑ A. increases the speed at which molecules collide with the membrane
- ✔ B. decreases the free energy needed to pass though the membrane
- ❑ C. increases the free energy of the reactants
- ❑ No idea

Explain (below) why the incorrect answers are wrong or irrelevant.

A: the would imply that the catalyst increases the temperature of the system, which it does not do.

C: the catalyst influences the free energy required to reach the rate limiting reaction intermediate, not the free energy of either reactants or products.

8. These two reactions are occurring with a system:
A + B + C ⇄ E (unfavorable ΔG > 0) and E + F ⇄ M (highly favorable, ΔG < 0)

The reaction system has reached equilibrium; now at t = 0 a large amount of M is added to the system, what initially happens to the level of C?

- ✔ A. it increases
- ❏ B. it is unchanged
- ❏ C. it decreases
- ❏ D. impossible to tell
- ❏ no idea

Explain (below) why the incorrect answers are wrong or irrelevant.

Addition of M drives the back reaction in reaction 2, leading an an increase in E and F.
The increase in the presence of E will drive the first reaction backward, leading to an increase in C.

B: changing the composition of the system (adding M) will change the concentrations of all other components of the system.

C: No, (see above)

D: It is (almost always) possible to tell, and since the reaction is at equilibrium, we can predict its behavior, we just cannot tell cannot exactly how long it will date.

9. Assume that most biosynthetic reactions in a eukaryotic cell occurs within the cytoplasm, while the aerobic bacterial-progenitors of mitochondria lived within the vesicle that was used to engulf them. What type of molecule is not likely to be useful in the bacterial membrane

- ✔ A. an open H+ channel
- ❏ B. an H+ driven ATP synthase
- ❏ C. an ADP, ATP transporter
- ❏ no idea

Explain (below) the why the incorrect answers are wrong or irrelevant.

To capture energy from chemical (and this is an aerobic, not a photosynthetic bacterium, it will need its ATP synthase.

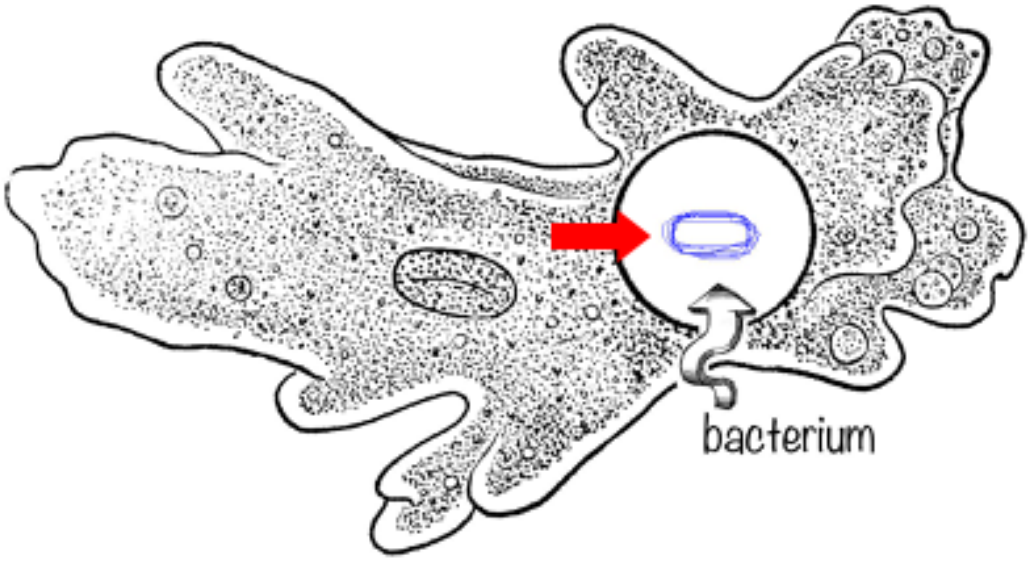
(note: You could argue that the ADP and ATP exporter would be useful as a way to get energy (and raw materials) from the host cell, and to deliver them back to the host cell.

What needs to be true for engulfed bacterial cells to be (metabolically or otherwise) useful to the host cell.

The ADP: ATP transporter

10. Consider a predatory eukaryotic amoeba-like cell. The amoeba engulfs bacteria, capturing them in vesicles and digesting them. To digest the bacteria, the amoeba first makes the interior of the vesicle acidic (higher H+ concentration), which leads to the activation of various digestive enzymes.

Draw (on the picture) the molecular system(s) required to make the vesicle interior acidic.



A pump that uses cytoplasmic ATP to drive H+ into the vesicle. The pump/synthase has a direction (cytoplasmic ATP synthesis: H+ moves into the cell, pump: ATP hydrolysis, H+ moved out of the cell).

For this to occur

- ❑ A. energy is not required
- ❑✔ B. ATP hydrolysis occurs int the cytoplasm
- ❑ C. ATP hydrolysis occurs inside the vesicle
- ❑ no idea

(no justification necessary)