MCDB 1111:Biofundamentals '08 Spring Midterm II Name: _____

1. You have a solution that contains two different types of molecules. At any particular temperature, which (on average) will have more kinetic energy?

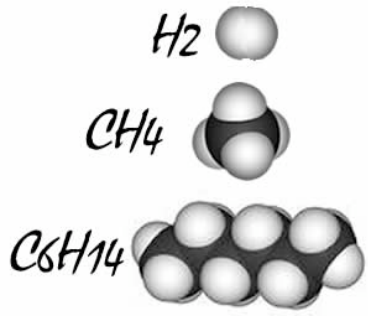
✔ **A**. both types of molecules will have the same average kinetic energy

☐ **B**. the larger (heavier) molecules have more average kinetic energy

☐ **C**. the smaller (lighter) molecules have more average kinetic energy

Although the smaller will be traveling faster (on average)

2. Consider these three molecules; they interact with their neighbors through van der Waals interactions **only**; assuming you have pure sample of each, predict which has the highest boiling point (that is, the temperature at which it changes from a liquid to a gas.)



☐ **A**. H2 ☐ **B**. CH4 ✔ **C**. C6H14

More surface area to interact with other molecule, and it moves slower at a particular temperature. question cannot be answered unless I know

_____

3. Of the three compounds, H2, CH4, and C6H14, which would you expect to be the most soluble in water and why.

✔ **A**. H2 ☐ **B**. CH4 ☐ **C**. C6H14

Its present perturbs interactions the interactions between water molecules least

4. In water lipid molecules can self-assemble into micelles and bilayers. Both micelles and bilayers seem more ordered than individual lipid molecules. Why does the formation of these structures not violate the rule that disorder increases?

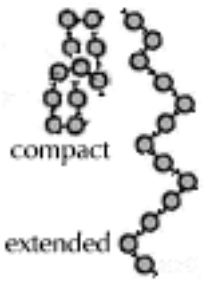
☐ **A**. Its not just the entropy of the lipids we have to consider

☐ **B**. Because both micelle and bilayer formation required the input of energy

☐ **C**. Because heat is released when the lipid molecules attract one another.

we have to consider to entropy of the water as well

5. You are studying a molecule composed of 13 subunits. Each subunit has both a hydrophilic surface and a hydrophobic surface. When dissolved in water, which is the most likely structure the molecule will assume?



✔ **A**. compact

☐ **B**. extended

☐ **C**. the molecule will be completely insoluble ☐ **no idea**

That minimizes hydrophobic-water and maximize hydrophilic-water interactions.

6. When a hydrophobic molecule is dissolved in water it ....

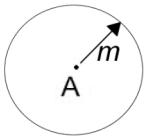
☐ **A**. forms H-bonds with the water molecules

☐ **B**. forms H-bonds with other hydrophobic molecules

✔ **C**. gets in the way of formation of H-bonds between water molecules

so water molecules are organized in a shell around the hydrophobic molecule

7. At time 0 the particles are at point A; at time "n" later, the average particle has moved to the distance marked by the circle, which has radius "m". Where will the average particle be at time 5 times n ?

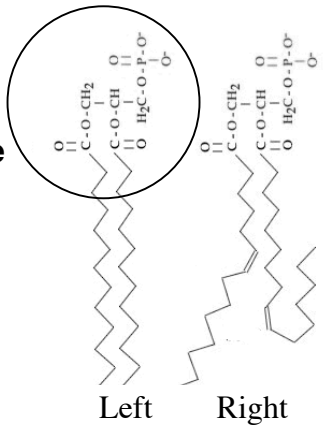


- ☐ **A**. no way of knowing, the movements are random.
- ☐ **B**. 5 times m
- ✔ **C**. significantly less than 5 times m

Distance traveled is no a linear function of time

8A. (2 points) Here are two lipid molecules. Draw a circle around the hydrophilic part of the left hand lipid.

8B (3 points) Assume you have a bilayer composed entirely of either the lipid to the left or the lipid to the right. Which would "melt" at a lower temperature?



- ❏ **A**. the left-hand lipid
- ✔ **B**. the right-hand lipid
- ❏ **C**. both have similar melting points

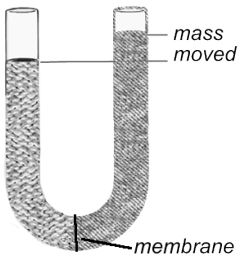
The "kinked" chains cannot pack as tightly, leading to less surface area of interaction (smaller van der waals forces).

9. Why is it difficult for a large hydrophilic molecule to pass through a lipid bilayer membrane?

- ✔ **A**. it is held back by the interactions with water
- ❏ **B**. it is repelled by the hydrophobic part of the membrane
- ❏ **C**. it moves too slowly ❏ **no idea**

because it makes H-bonds with water

10. Osmosis (that is, the net flux of water) can do work. In the case described in our reading, osmosis was able to lift a mass of water. Where did the energy for that movement come from?



- ❏ **A**. pumps in the membrane
- ✔ **B**. differences in water concentration
- ❏ **C**. the breakdown of water into H+ and OH- ❏ **no idea**

Established at the start of the experiment (by the investigator)

11. A difference between antiporters/symporters and pumps is ....

- ❏ **A**. pumps use energy stored in concentration gradients
- ✔ **B**. pumps can store energy in concentration gradients
- ❏ **C**. pumps don't have to be in a membrane to function

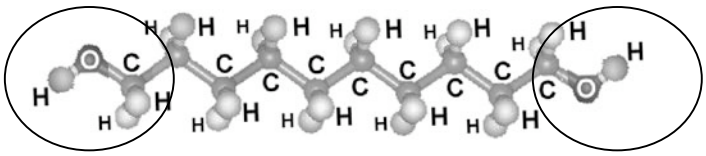
because porters dependent upon pre-existing gradients to generate net flux

12. A long time ago, it appears that one of our ancestors engulfed a bacterium, and that over time that bacterium was transformed into mitochondria. For this occur, our ancestral cell is assumed to not have a rigid cell wall. What can we assume about the environment in which that ancestral cell lived?

- ❏ **A**. probably dry land
- ✔ **B**. probably a very salty water solution
- ❏ **C**. probably in fresh water ❏ **no idea**

To minimize osmotic effects that might be associated with the absence of a cell wall

13A (2 points). You have discovered the molecule shown. Circle the hydrophilic part(s).



13B (3 points) What type of structure would it most likely form in aqueous (water) solution?

❑ **A**. a bilayer ❑ **B**. a micelle ✔ **C**. a monolayer

could form a bilayer if it folded in the middle, but monolayer is simpler.

14. A channel protein in a membrane is like a catalyst ....

❑ **A**. it requires energy to act

❑ **B**. it alters the free energy of the reactants and the products

✔ **C**. it reduces the energy required to pass through the membrane

Passing through the membrane is analogous to the activation energy of chemical reaction.

15. Consider the purple bacterium *Halobium*, which captures energy from light using the pigment molecule retinal attached to a protein. What happens when retinal absorbs a photon of light?

❑ **A**. it move across the membrane, from inside to outside of the cell

✔ **B**. it changes shape, and releases an H+ outside the cell

❑ **C**. it directly catalyzes ATP synthesis inside the cell

leading to H+ gradient, which is used to drive ATP synthesis

16. *Halobium* uses the pigment retinal to capture energy from light, while the green algae *Cyanobacterium* uses the pigment chlorophyll. On its own, this observation would be suggest that...

✔ A. the two light capturing systems are analogous

❑ B. the two light capturing system are homologous

❑ C. the two systems differ in their primary functions

because the structures at their core are different. we could check this to determine if the structure of the proteins to which the pigments are associated are also different (further evidence of analogy) or similar (evidence for homology)

17. To determine whether the H+-dependent ATP synthases of purple bacteria and human mitochondria are homologous or analogous, I need to know….

❑ **A**. whether they are both located in membranes

❑ **B**. whether they catalyze similar reactions

✔ **C**. whether they are structurally similar

We already know that they act similarly, catalyzing ATP synthesis using energy in H+ gradients

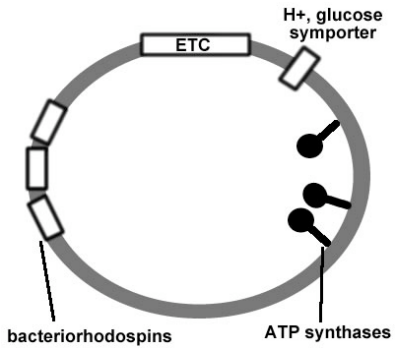
18. You add a very efficient H+ channel to the membrane of a purple bacterium, which will change ?

❑ **A**. how much light is absorbed

✔ **B**. how much ATP is made

❑ **C**. how much H+ is pumped out of the cell

Channel will no effect action of bacteriorhodopsin, but will inhibit formation of the H+ gradient



19. In the cell illustrated in Q18, what happens to intracellular glucose concentration while the light is on?

✔ **A**. goes up ❑ **B**. goes down ❑ **C**. stays constant

As the H+ gradient increases (through bacteriorhodopsin action in the light) the symporter will be able to bring glucose into the cell. question cannot be answered unless I know

20. Consider the reactions: **A + B ⇔ C (reaction 1)**

(relax, read slowly, and take your time) **E + D ⇔ F (reaction 2)**

G + K ⇔ H reaction 3)

The system is at equilibrium. At time 0 more A is added to the system, at some later time we can expect the concentration of H to …

❑ **A**. increase

✔ **B**. be unchanged

❑ **C**. decrease

H is not coupled to A by any of the other reactions