**QUESTION 1**

1. Looking under a microscope, you identify an organism with a nucleus. Which other components would you expect it to have?

|  |  |  |
| --- | --- | --- |
|  | a. | protein coat, cytoskeleton |
|  | b. | mitochondria, protein coat |
|  | c. | endoplasmic reticulum, cytoskeleton |
|  | d. | circular, cytoplasmic DNA, no internal membranes |

**10 points**

**QUESTION 2**

1. Cells have which of the following in common with viruses?

|  |  |  |
| --- | --- | --- |
|  | a. | The ability to acquire and use energy and the ability to evolve through mutation |
|  | b. | An ability to self-reproduce and an ability to evolve through mutation |
|  | c. | A genetic program and an ability to evolve through mutation |
|  | d. | A genetic program and an ability to self-reproduce |

**10 points**

**QUESTION 3**

1. What are the most likely compositions of the two sets of molecules shown in the picture?

The top is before and the bottom is after.

|  |  |  |
| --- | --- | --- |
|  | a. | Polar water molecules and hydrophilic hydrocarbons |
|  | b. | Hydrophilic hydrocarbons and hydrophobic water molecules |
|  | c. | Nonpolar water molecules and nonpolar ions |
|  | d. | Polar water molecules and hydrophobic hydrocarbons |

**10 points**

**QUESTION 4**

1. What atom would be most likely to be found in the center and why?

|  |  |  |
| --- | --- | --- |
|  | a. | Cl- because it is electronegative. |
|  | b. | C because it is not electronegative. |
|  | c. | H+ because it is electronegative. |
|  | d. | Li+ because it is ionized. |

**10 points**

**QUESTION 5**

1. You use fluorescence recovery after photobleaching (FRAP) to investigate the membrane dynamics of two cells. One recovers quickly, the other more slowly.  How would you interpret these data?

|  |  |  |
| --- | --- | --- |
|  |  | The mobile fraction of membrane proteins in the cell with a smaller recovery time is higher. |
|  |  | The mobile fraction of membrane proteins in the cell with a smaller recovery time is lower. |
|  |  | The mobile fraction is the same in both cells and is not dependent on the recovery time. |
|  |  | The mobile fraction of membrane proteins changes during the course of your experiment. |

**10 points**

**QUESTION 6**

1. Suppose you wanted to study the export of messenger RNA (mRNA) from the nucleus across the nuclear membrane. If you wanted to track export in real time with fluorescently labeled mRNA and later investigate the structure of the mRNA and the nuclear membrane at high resolution, which instruments would you use?

|  |  |  |
| --- | --- | --- |
|  | a. | An LM can be used for tracking fluorescent mRNA and an EM can be used for studying mRNA and membrane structure. |
|  | b. | A light microscope (LM) can be used for all investigations. |
|  | c. | An electron microscope (EM) can be used for all investigations. |
|  | d. | An EM can be used for tracking fluorescent mRNA and an LM can be used for studying mRNA and membrane structure. |

**10 points**

**QUESTION 7**

1. Ligands (molecules that bind) such as insulin bind to receptors in a reversible manner. What properties of noncovalent bonds lend themselves to such interactions?

|  |  |  |
| --- | --- | --- |
|  |  | The ability of enzymes to catalyze the making and breaking of noncovalent bonds. |
|  |  | The high energy needed to break or form each noncovalent bond. |
|  |  | The transient dynamic nature of multiple low-energy noncovalent interactions. |
|  |  | The ability of noncovalent bonds to form very stable interactions. |

**10 points**

**QUESTION 8**

1. Consider a large molecule, such as a protein, that has been dissociated into atoms and small molecules thermally or by other means. How will the distributions of bonds change as it goes from the large molecule to the small molecules and atoms, assuming that the dissociation took place in water?

|  |  |  |
| --- | --- | --- |
|  | A. | Covalent and van der Waals bonds will decrease, while hydrogen bonds will increase or remain the same due to interactions with the water. |
|  | B. | Covalent and van der Waals bonds will increase, while hydrogen bonds will decrease or remain the same due to interactions with the water. |
|  | C. | Hydrogen and van der Waals bonds will decrease, while covalent bonds will increase or remain the same due to interactions with the water. |
|  | D. | Hydrogen and ionic bonds will decrease, while covalent bonds will increase or remain the same due to interactions with the water. |

**10 points**

*Click Save and Submit to save and submit. Click Save All Answers to save all answers.*

**QUESTION 1**

1. As temperature increases, double stranded DNA breaks apart in two separate stages. Why might this be?

|  |  |  |
| --- | --- | --- |
|  | a. | The sugar-base bonds break, and then the hydrogen bonds break. |
|  | b. | The phosphodiester bonds break, and then the sugar-base bonds break. |
|  | c. | The phosphodiester bonds break, and then the hydrogen bonds break |
|  | d. | The hydrogen bonds break, and then the phosphodiester bonds break. |

**10 points**

**QUESTION 2**

1. You have designed a protein transport system for which proteins diffuse in phospholipid membranes, but the proteins do not diffuse quickly enough. What might you do to increase the diffusion speed in the membrane at room temperature?

|  |  |  |
| --- | --- | --- |
|  | a. | Increase the number of unsaturated glycerols. |
|  | b. | Increase the number of unsaturated fatty acids. |
|  | c. | Decrease the number of unsaturated phosphates. |
|  | d. | Decrease the number of unsaturated glycerols. |
|  | e. | Decrease the number of unsaturated fatty acids. |

**10 points**

**QUESTION 3**

1. What is represented by the red arrows in the following diagram of a protein structure? What type of bond stabilizes it?

|  |  |  |
| --- | --- | --- |
|  |  | Alpha helices stabilized by disulfide bonds. |
|  |  | Alpha helices stabilized by hydrogen bonds. |
|  |  | Beta sheets helices stabilized by disulfide bonds. |
|  |  | Beta sheets stabilized by hydrogen bonds. |

**10 points**

**QUESTION 4**

1. Which of the following tripeptides would be least soluble in an aqueous solvent like water?

|  |  |  |
| --- | --- | --- |
|  |  | N - glutamic acid - aspartic acid - glycine - C |
|  |  | N - tyrosine- methionine - proline - C |
|  |  | N - proline - phenylalanine - serine - C |
|  |  | N - phenylalanine - alanine - valine - C |

**10 points**

**QUESTION 5**

1. Two compounds that are the same monosaccharide have very different properties when they are polysaccharides. How might this arise?

|  |  |  |
| --- | --- | --- |
|  | a. | The electronegativities of the covalent bonds differ between the polysaccharides. |
|  | b. | The number of carbons differ between the polysaccharides. |
|  | c. | The pH values differ between the polysaccharides. |
|  | d. | The types of glycosidic bonds differ between the polysaccharides. |

**10 points**

**QUESTION 6**

1. What are the most likely compositions of the two sets of molecules shown in the picture?

|  |  |  |
| --- | --- | --- |
|  | a. | Nonpolar water molecules and nonpolar ions |
|  | b. | Hydrophilic hydrocarbons and hydrophobic water molecules |
|  | c. | Polar water molecules and hydrophobic hydrocarbons |
|  | d. | Polar water molecules and hydrophilic hydrocarbons |

**10 points**

**QUESTION 7**

1. A histidine side chain (pKa = 6) is known to be critical for enzymatic activity in a given enzyme. It is not clear whether the histidine should be positively charged (having accepted a proton) or uncharged for enzymatic activity to occur. The results of an experiment showing enzymatic activity as a function of pH are shown. Based on these results, is the histidine positively charged or uncharged when the enzyme is active, and is the enzyme likely to be active (>50% maximum activity) at typical intracellular pH?

|  |  |  |
| --- | --- | --- |
|  |  | The histidine will be positively charged when the enzyme is active, and the enzyme is likely to be strongly active at typical intracellular pH. |
|  |  | The histidine will be unchanged when the enzyme is active, and the enzyme is not likely to be strongly active at typical intracellular pH. |
|  |  | The histidine will be uncharged when the enzyme is active, and the enzyme is likely to be strongly active at typical intracellular pH. |
|  |  | The histidine will be positively charged when the enzyme is active, and the enzyme is not likely to be strongly active at typical intracellular pH. |

**10 points**

**QUESTION 8**

1. The following hydropathy plot is for a membrane bound receptor. Based on the hydropathy plot, how many membrane spanning regions would you predict this protein to have and why?

|  |  |  |
| --- | --- | --- |
|  |  | There are 4 predicted transmembrane regions, because there are 4 large positive peaks in the hydropathy plot indicating strong  hydrophobic regions. |
|  |  | There are 3 predicted transmembrane regions, because there are 3 large negative peaks in the hydropathy plot indicating strong hydrophobic regions. |
|  |  | There are 4 predicted transmembrane regions, because there are 4 large positive peaks in the hydropathy plot indicating strong  hydrophilic regions. |
|  |  | There are 3 predicted transmembrane regions, because there are 3 large negative peaks in the hydropathy plot indicating strong hydrophilic regions. |

**10 points**

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