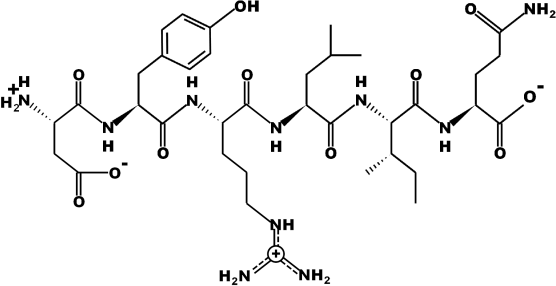
Please read the directions carefully. No cell phones or other electronic devices except for calculators are allowed. The use of our course textbook is allowed; however, the use of notes, workbook activities, the internet or peer collaboration is prohibited during the exam and the use of those materials would be a violation of the BSC Honor Code. Students suspected of violating the honor code will be reported to the honor council for review. This exam will be posted on moodle at 8:00 AM on the scheduled day of the exam. Completed exams must be turned in via the TurnItIn link on moodle by 11:59 PM Central on the scheduled day of the exam. No late exams will be accepted. If you have a question, I will be available via Teams during our normal scheduled class time or can be reached via email at khayden@bsc.edu. Good luck, take your time, and read carefully!

Honor Code: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Using the image below, answer the following questions:

 MW = 806.43 g/mol

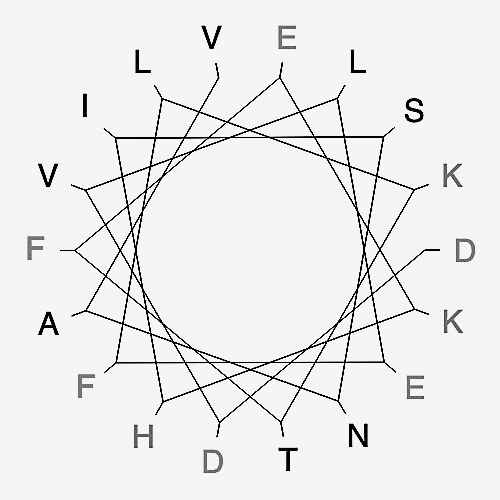
1. Give the amino acid sequence of this peptide using the one letter abbreviations.
2. What is the charge of this peptide at physiological pH (7.3)?
3. Given that the N-terminus and C-terminus pKa’s are 10.70 and 2.13 respectively, calculate the pI of this peptide.

2. The peptide above in question 1a. may be a potential naturally derived COVID-19 antiviral from a plant in the Amazon. Your research advisor has sent you some leaf clippings and asks that you extract and purify this peptide so she can do further testing. Propose and describe a purification protocol (i.e. uses chromatography techniques) that you would use to purify the peptide and justify your reasoning. Be sure to include steps that would verify your purity and include sketches to help illustrate your answer.

3. You are characterizing a new protein, and have run it on a variety of PAGE gels. You observe the data below. Draw and/or describe a protein that fits with these data.

* 1. Native PAGE: one band approximately 150 kDa in size
  2. SDS-PAGE (with 2-mercaptoethanol): three bands approximately 15 kDa, 35 kDa and 100 kDa in size
  3. SDS-PAGE (no 2-mercaptoethanol): two bands approximately 50 kDa and 100 kDa

1. A helix from fructose-1,6-bisphosphatase is shown below. Would you expect this helix to be **fully exposed** to water, **buried** in the protein or on the **surface** of the protein? If you expect it to be on the surface, indicate which side faces water and which side faces in and explain why.



5. Two polysaccharides used for storing sugars include amylopectin and glycogen. These polysaccharides differ in that:

6. Raffinose is a trisaccharide present in beans, broccoli, cabbage, etc. Humans do not possess an α-galactosidase enzyme necessary to break down raffinose. Thus, when ingested, it passes undigested through the stomach and small intestine. However, bacteria in the colon have the necessary enzymes to degrade and ferment raffinose to produce CO2, CH4 and/or H2 gasses - leading to the flatulence commonly associated with eating beans and other vegetables. Digestive aids such as Beano® contain an α-galactosidase. Which of the bonds indicated by the letters is hydrolyzed by the α-galactosidase in Beano®? Explain.

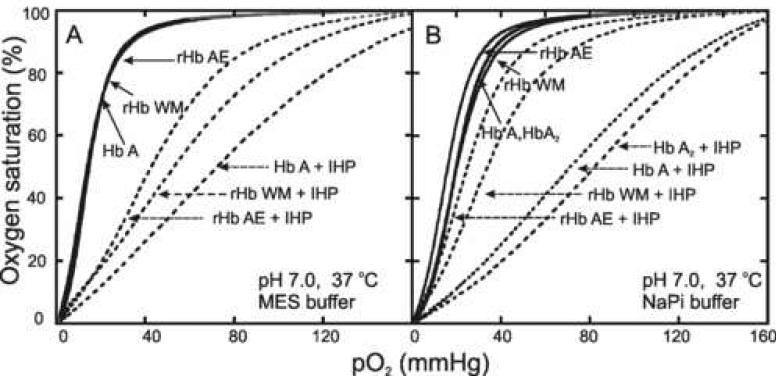
7. Rank the melting points of the following fatty acids from highest to lowest and justify your answer:

|  |  |
| --- | --- |
| (1) | *cis*-Palmitoleic (16:1) |
| (2) | *trans*-oleic (18:1) |
| (3) | *cis-*linolenic (18:3) |
| (4) | arachidic (20:0) |
| (5) | palmitic (16:0) |

8. Snake venom contains the enzyme phospholipase A2. The action of phospholipase A2 cleaves the fatty acid tail from the position 2 of a phospholipid structure. Using the generic structure of a phospholipid, illustrate the action of phospholipase A2 and discuss the structural ramifications of this reaction on the plasma membrane of a cell. Could this be reversed? Explain.

9. Explain how both entropy and enthalpy contribute to spontaneous protein folding to achieve a correct tertiary structure.

10. Researchers at Carnegie Mellon recently([Biochemistry.](http://www.ncbi.nlm.nih.gov/pubmed/21806075) 2011 Aug 30;50(34):7350-60) cloned the DNA for hemoglobin from a frozen Wooly mammoth and characterized its properties. Below is a saturation binding curve for human (HbA), Asian Elephant (AE) and Wooly mammoth (WM) hemoglobin in the absence (solid lines) and presence (dashed lines) of inositol hexaphosphate (IHP). Use the figures below to answer the following questions.



**pO2, torr (mmHg)**

a) Determine **p50** for Wooly Mammoth (WM) and Asian Elephant (AE) hemoglobin in the absence (solid) and presence (dashed) of IHP. Include units.

|  |  |  |
| --- | --- | --- |
|  | p50, no IHP | p50, + IHP |
| WM |  |  |
| AE |  |  |

b) Which has higher affinity for oxygen, wooly mammoth hemoglobin in the **presence** or **absence** of IHP? Explain.

c) Determine nH (Hill constant) for oxygen binding to wooly mammoth hemoglobin \_\_\_\_\_\_\_\_

d) Is binding of oxygen to wooly mammoth hemoglobin cooperative? Explain.

e) The structure of inositol hexaphosphate (IHP) is shown below. What kind of intermolecular forces do you expect to find between IHP and hemoglobin? Name two amino acids would you expect to find in the IHP binding site?

