CH/BI 308 Biochemistry Exam I Fall 2020 Name:_____

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: _____

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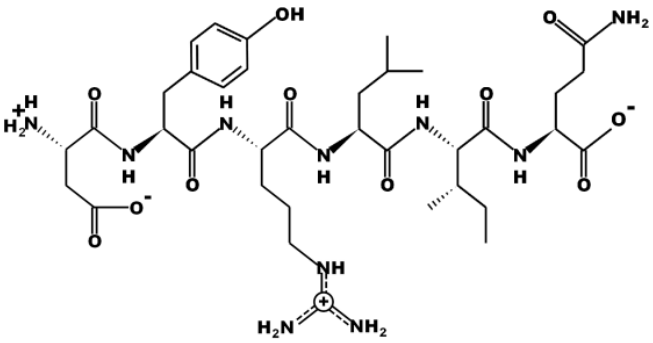
1. Using the image below, answer the following questions:



MW = 806.43 g/mol

5 a. Give the amino acid sequence of this peptide using the one letter abbreviations.

DYRLIQ

5 b. What is the charge of this peptide at physiological pH (7.3)?

0

10 c. Given that the N-terminus and C-terminus pKa's are 10.70 and 2.13 respectively, calculate the pI of this peptide.

$$\frac{3.90 + 10.46}{2} = 7.18$$

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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.

10 ✓ Ion exchange

10 ✓ Size exclusion

X affinity (we do not know any binding information)

10 · SDS-PAGE for purity

10 · must discuss parameters of experiments.

Left Blank Intentionally

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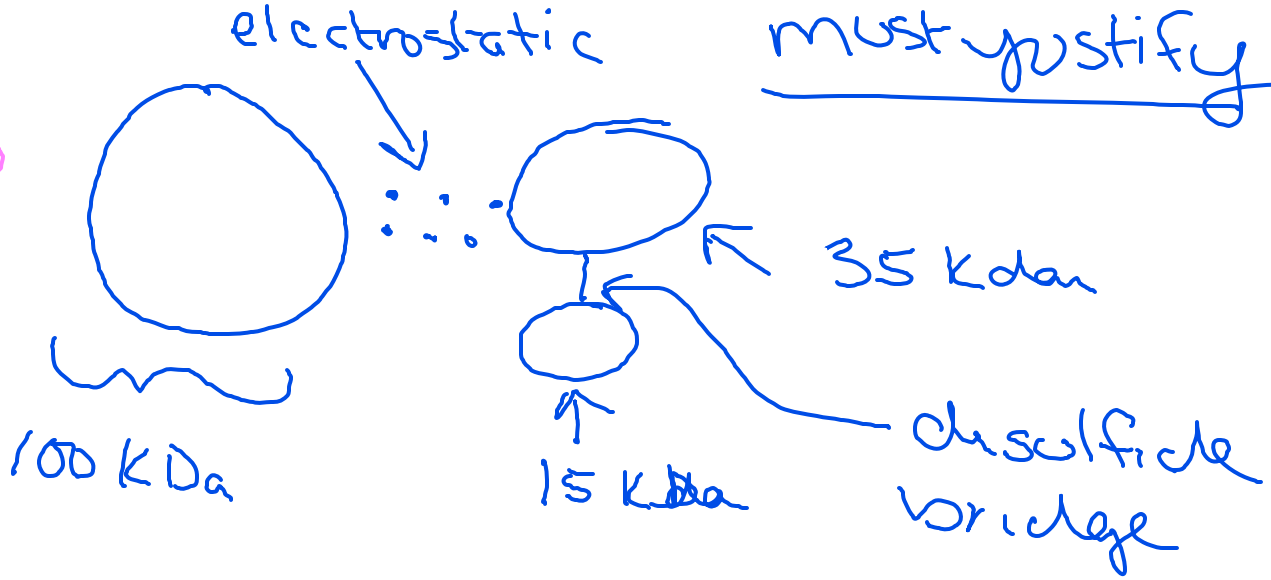
3. You are characterizing a new protein, and have run it on a variety of PAGE gels. You observe the data below. Draw and/or describe a protein that fits with these data.

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

Trimer



must justify 10

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4. 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.

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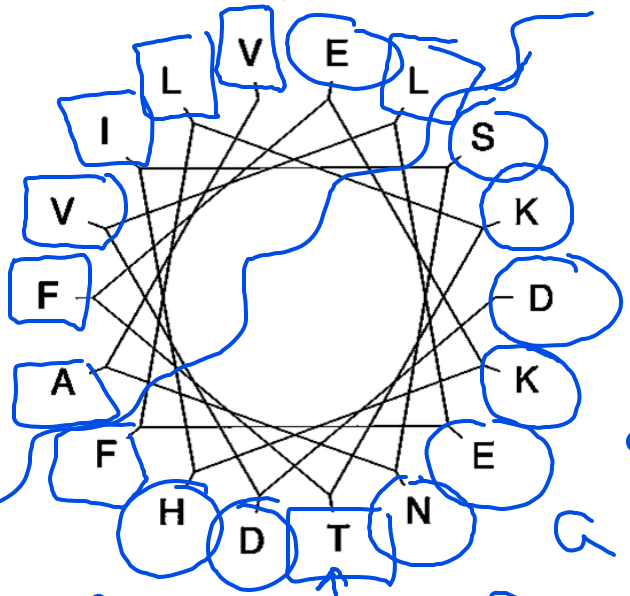
faces interior



□ = hydrophobic
○ = hydrophylic

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Probably Suface
Since there is a clean hydrophobic and hydrophilic face.

10

faces water

eh..

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

glycogen has more branches

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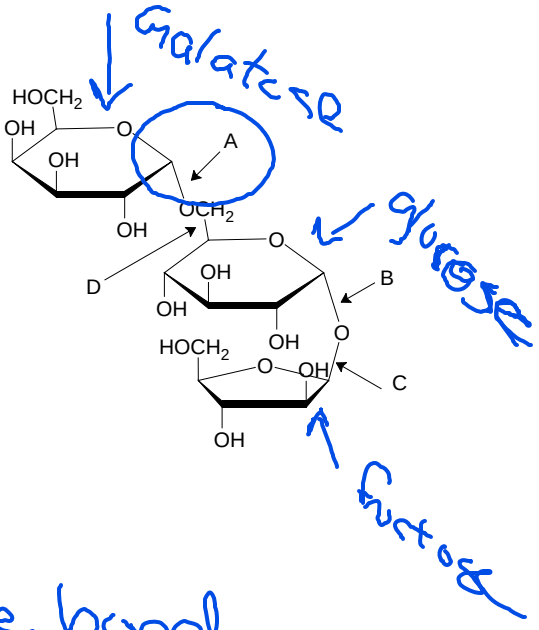
6. Raffinose is a trisaccharide present in beans, broccoli, cabbage, etc. Humans do not possess an α-galactosidase enzyme necessary to break down raffinose. Thus, when ingested, it passes undigested through the stomach and small intestine. However, bacteria in the colon have the necessary enzymes to degrade and ferment raffinose to produce CO_2, CH_4 and/or H_2 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.



A is the only α-galactose bond

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

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

5

5

(4) > (2) > (5) > (1) > (3)

20:0 18:1 trans 16:0 16:1 18:3

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8. Snake venom contains the enzyme phospholipase A_2. The action of phospholipase A_2 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 A_2 and discuss the structural ramifications of this reaction on the plasma membrane of a cell. Could this be reversed? Explain.

16 16

converts 2 tail lipid that prefers bilayer structures to a 1 tail lipid that prefers micelles. Plasma membranes will decompose and cells / tissues will die. Bc membranes can spontaneously self seal; if the enzymes are inhibited in time, the membranes can close on their own.

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

Favorable intermolecular interactions such as H. bonds, ionic bonds can stabilize the structure lowering the energy of the protein which releases heat so ΔH is negative. However the strongest driving force is often the release of trapped waters on hydrophobic surfaces which greatly $\uparrow \Delta S$.

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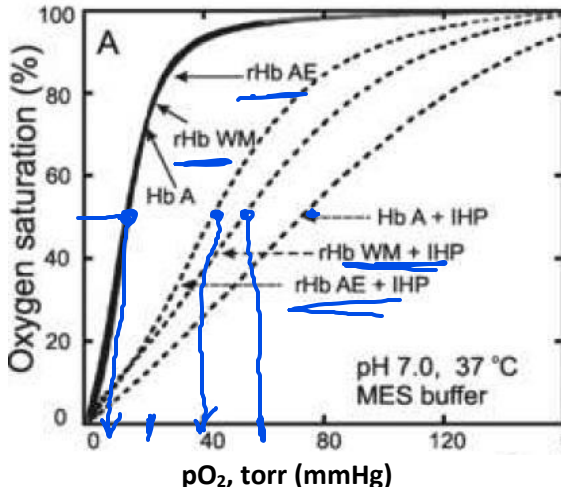
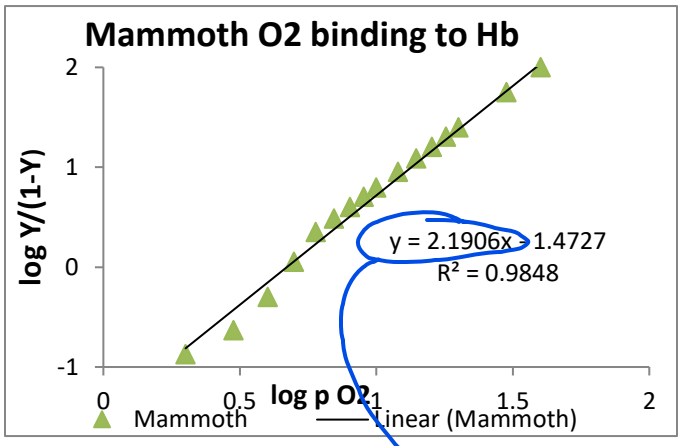
10. Researchers at Carnegie Mellon recently cloned the DNA for hemoglobin from a frozen Wooly mammoth and characterized its properties. Below is a saturation binding curve for human (HbA), Asian Elephant (AE) and Wooly mammoth (WM) hemoglobin in the absence (solid lines) and presence (dashed lines) of inositol hexaphosphate (IHP). Use the figures below to answer the following questions.





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

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	p50, no IHP	p50, + IHP
WM	~10 torr	~50 torr
AE	~10 torr	~40 torr

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

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In the absence b/c p50 is smaller, meaning it takes less O_2 to saturate the protein

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c) Determine n_H (Hill constant) for oxygen binding to wooly mammoth hemoglobin _____ 2.19

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

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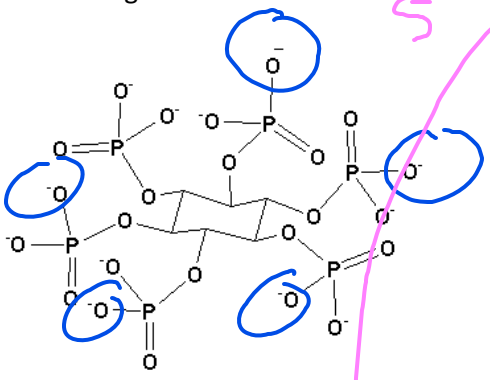
Yes. S-shaped curve

$n_H > 1$

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?



Inositol Hexaphosphate

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Lots of negative charges ∴ Ionic

So any basic amino acids.

W/ (+) charge R groups ∴ Lysine

Arginine

Glutamine

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