EXAM 1

Name KEY

This exam is schedule for 75 minutes and I anticipate it to take the full time allotted. You are free to leave if you finish. The exam is split into two sections. Part 1 is multiple choice – select the most correct answer in each question. Part 2 is composed of several multiple part problems which are cumulative by nature.

Part 1. Clearly circle the most appropriate answer. (2 pts each).

1. The hyperchromic effect is a result of _____?
   a. modified pKa values due to adjacent amino acids.
   b. the hydrophobic effect.
   c. modified molar absorbance of aromatic amino acids and bases.
   d. branched chain amino acids.

2. Which amino acid does not have an ionizable proton on the side chain?

   Glutamine Cysteine Tyrosine Histidine

3. Which class of lipid is not typically found in biological membranes?

   sphingolipid phosphoglyceride triglyceride cholesterol

4. Which is a common carbon chain length for lipids in biological membranes?

   10 14 18 22

5. Ribose is a an example of a

   ketopentose ketohexose aldopentose aldohexose

6. Water has a _____ dielectric constant than hydrophobic solvents.

   Lower higher similar

7. Allowable Φ, Ψ angles in globular proteins are restricted to _____ of Ramachandran Plots.

   0% - 25% 25% -50% 50% - 75% 75% - 100%

8. Cytosine is an example of a

   Purine Pyrimidine Pyrole Indole

9. The most common tautomeric form of the purine and pyrimidine bases in nucleic acids is the:

   amide keto ester enol none of the above

   I'll give you either

10. What is the common stereoisomeric form of amino acids in biological systems?

    D-amino acids L-amino acids

11. DNA and RNA polymers are formed through _____ linkages.

    glycosidic peptide disulfide phosphodiester

12. Phosphoglycerides commonly have unsaturated carbon chains attached to which position of the glycerol backbone.

1 2 3 no preference

13. N-linked sugars are typically covalently attached to what amino acid?

Lysine Arginine Asparagine Glutamine

14. In the titration of a strong acid into a weak base, the equivalence point will be

acidic basic neutral

15. Which amino acid has the most relaxed Φ,Ψ restrictions?

proline alanine histidine isoleucine glycine

Part 2 – Not so short answer.

16. Explain the hydrophobic effect. (4 pts)

When hydrophobic molecules (or regions of molecules) are exposed to water, the solvent adjusts by forming a very ordered matrix around the apolar molecule. This lattice is characterized by very strong ($\Delta H < 0$) H-bonds. When the apolar molecule is removed from the polar solvent, the strong H-bonds break ($\Delta H > 0$) and the water returns to its more disordered state ($\Delta S > 0$). This entropic effect overcomes the enthalpic penalty to make an overall spontaneous event ($\Delta G < 0$).

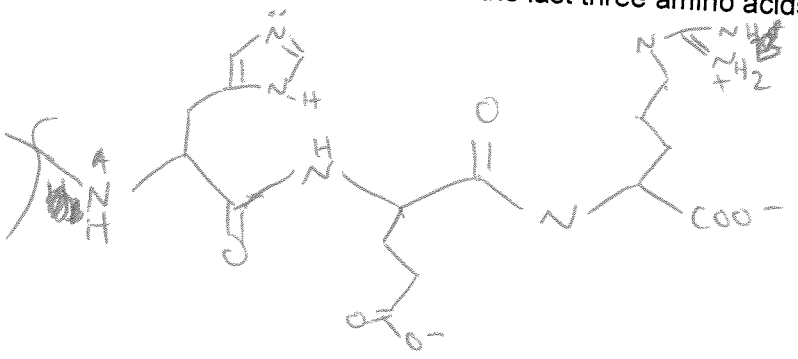
17. You isolated a small protein from a puma that may be responsible for a terminal illness in all felines. After experimenting with this protein, you determine that the **N-terminal heptamer** is likely responsible for a toxic interaction with a critical metabolic enzyme. Sequencing by mass spectrometry indicates that this peptide has the sequence:

PANTHER

a. Which of the common endopeptidases discussed in class could produce this peptide? (2 pts)

Trypsin + Arg-C both cleave @ C-term of arginine

b. Sketch a trimer composed of the last three amino acids in this peptide at pH 8.0. (4 pts)

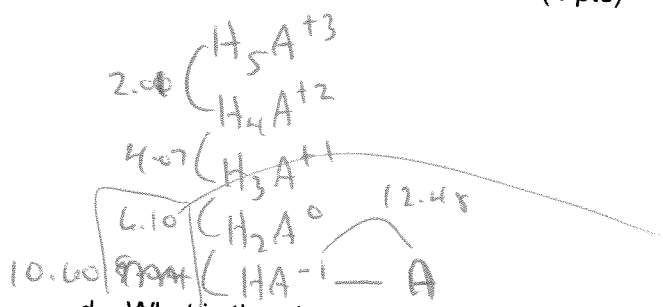


~His is deprotonated

fully protonated N-ter +1 +1 +1 C-ter 0

C-term - 2.00
N-term - 10.60
H - 6.10
E - 4.07
R - 12.48

c. Calculate the pI of PANTHER. (4 pts)



$$\frac{6.10 + 10.60}{2} = pI = 8.35$$

d. What is the charge of PANTHER at pH 6.0? (3 pts)

$H_3N - P - A - N - T - H - E - R - COO^-$

+1 $\quad * \quad -1 \quad +1 \quad -1 \quad = +*$

+0.56

$* = [HA^{+1}]$

$pH = pK_a + \log \frac{[A]}{[HA^+]}$

$HA + A = 1 \qquad A = 1 - HA$

$6.0 = 6.10 + \log \frac{1-HA}{HA}$

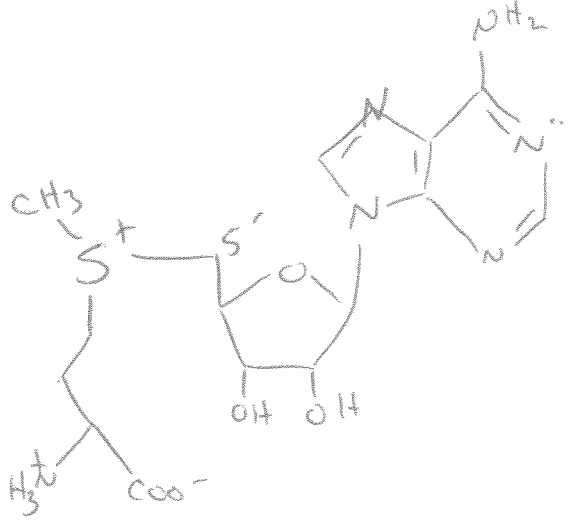
$10^{-0.1} = \frac{1-HA}{HA}$

$0.79\,HA = 1 - HA$

HA = 0.56

18. S-Adenosyl-Methionine is a common cofactor in enzymes.

a. Draw this molecule (attachment is via the 5' carbon). Label charges as appropriate. (5 pts)



b. Based on your chemical intuition, propose a use for this molecule. Justify your answer (you may use a simple sketch if you prefer). (3 pts)

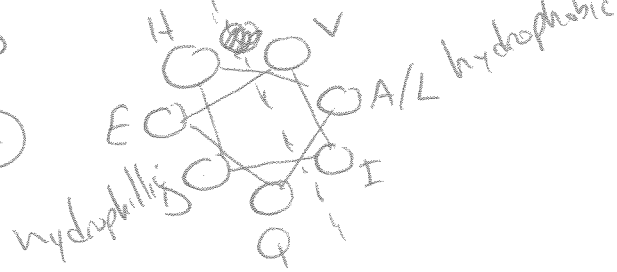
In the CNBr mechanism, we saw that a tertiary S^+ is not stable. This cofactor typically donates a methyl group to relieve the stress of the

If you indicated that something like this must occur, you get credit

19. For each of the following peptides, predict if they are more likely to be **integral** membrane proteins or **peripheral** membrane proteins. If there is no tendency for either, say **neither**. Assume these peptides are NOT part of a water permissive pore in the membrane. (1 pt each)

a. AQEVIDHL (α helix) — Peripheral

one face is polar, other is non polar



b. EHCTQDDNS (β-sheet)

-all polar ⇒ must be solvent = Neither

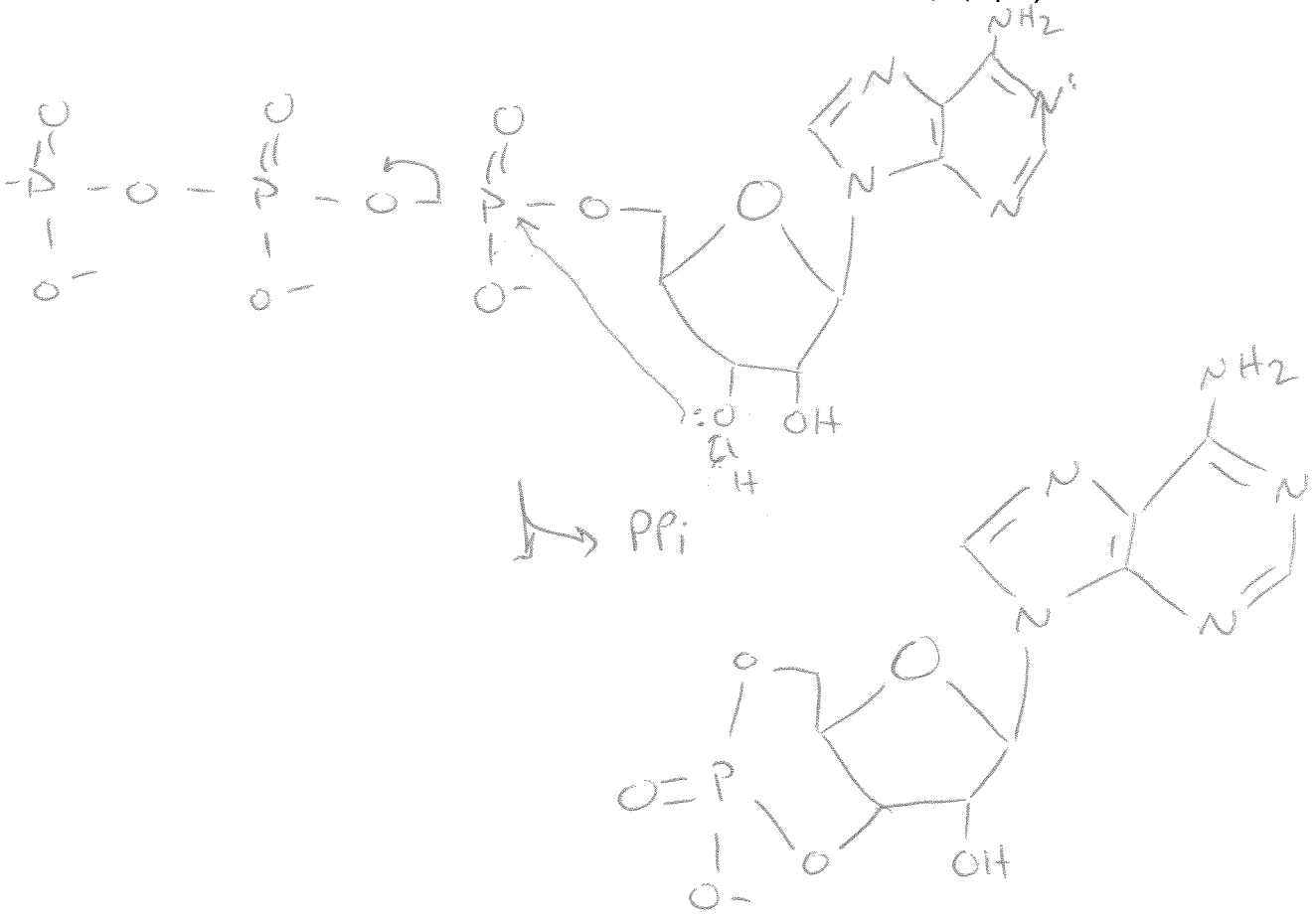
c. $Y(AL)_{12}YP$ (α helix)

-All non polar = integral

d. EFSAKMDF (β-sheet) — Peripheral.

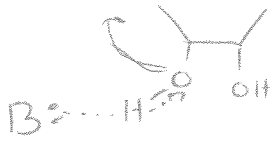
20.

a. Propose a mechanism for the production of 3'-5' cyclic adenosine monophosphate (cAMP) from ATP. Draw the structures completely. (8 pts)

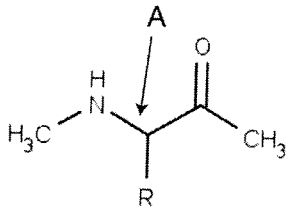


b. The enzyme adenylate cyclase catalyzes this reaction in biological systems. Based on your mechanism, propose an important feature of the enzyme active site. (3 pts)

In the mechanism, the $-\ddot{O}-H$ acts as a nucleophile. If a base is positioned near this functional group, it will facilitate a partial deprotonation and activate the resulting $-O\cdots H$ as a nucleophile



21. In the image to the right:
    a. Is 'A' the bond associated with the Φ or Ψ angle? (3 pts)

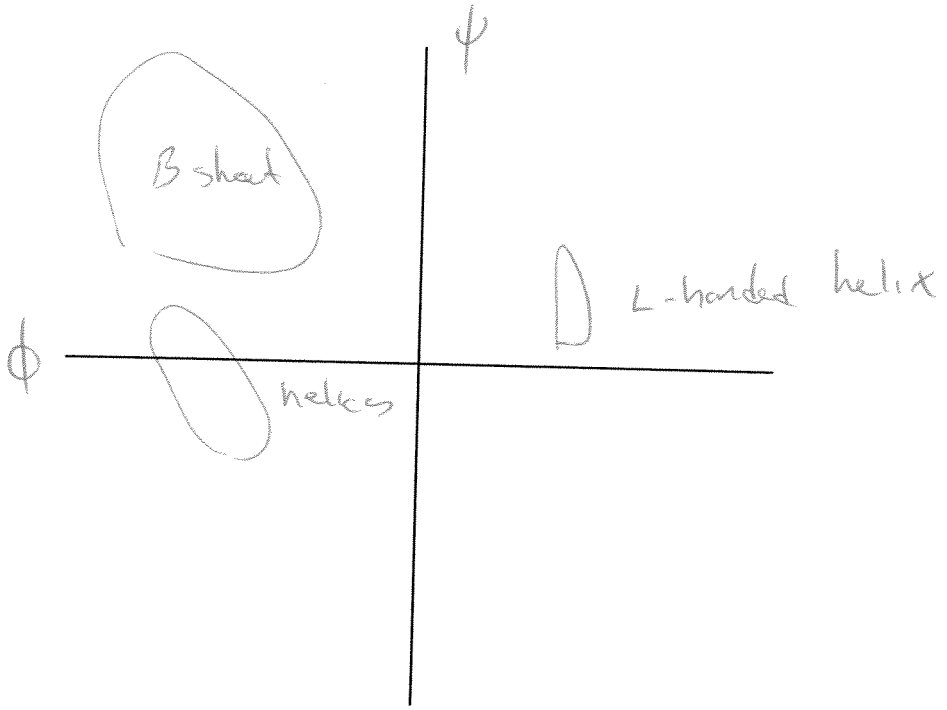


ϕ

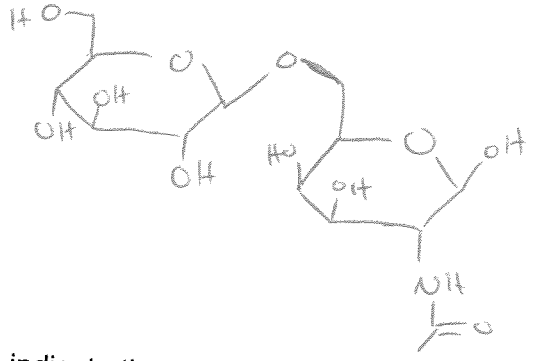
    b. In a fully extended peptide, what value is associated with this angle? (2 pts)

-180

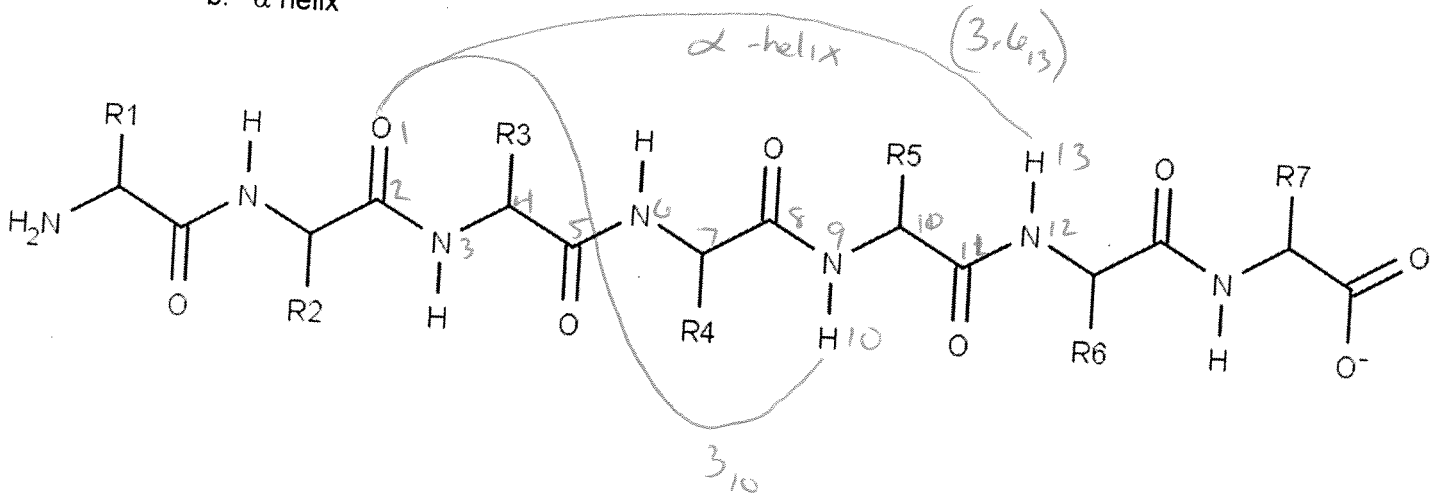
22. In the empty Ramachandran Plot below, appropriately label the axis, circle regions of common secondary structure and label what type of secondary structure will be found there. (4 pts)



23. Sketch the disaccharide β-D-Glucose (1→6) D-N-acetyl-galactosamine. (4 pts)



24. On the image below, indicate the H-bonding pattern for (5 pts)
    a. 3_{10} helix
    b. α helix



25. Using Trypsin and Asp-N, describe how the following peptide could be sequenced. You may use Edman Degradation or Mass Spectrometry. Use as much detail as you think is necessary to fully describe this process. You do not have to draw a mechanism, just describe the process. Use the back of this sheet if needed. (10 pts)

MKETCDIFGYDEKVNYIQGDLQTVDISGVSQILKAIADENAKITYALCQD

overlap will look like this

Trypsin - MK VNYIQGDLQTVDISGVSQILK ITYAL

Asp-N - MKETC DEKVNYIQG DISGVSQILKAIA

Trypsin - ETC DIFGYDEK

Asp-N - DIFGY DLQTV AIADENAK

DENAKITYAL

(1) Reduce any potential disulfides with BME + block with IAm

(2) Split into 2 reaction vials (1) = Trypsin (2) = Asp-N

(3) Sequence by Edman Degradation (sequence reads N→C) or Mass spec (C→N)

(4) Line up sequences to determine full sequence.