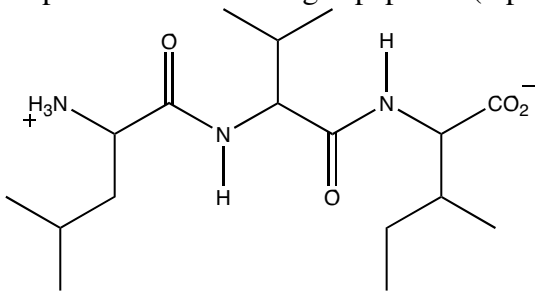
August 14, 2002
Final
Biochemistry
NESA – Summer 2002

Name _____

This exam is open-book and open-notes, but you may not collaborate. You may use the back of the pages if you need to (designate appropriately). You have the entire class period to complete the exam.

Multiple Choice

1. Which set of codons correspond to the following tripeptide? (3 pts)



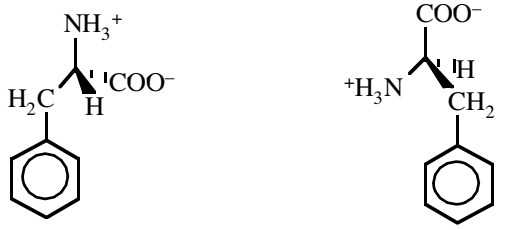
a. GUC-UUG-AUC
b. CUU-GUU-AUU
c. AUA-CUA-GUA
d. GUG-CUC-CUG

2. What amino acid sequence corresponds to the following Anti-Codon sequence? (2 pts)

AAA-UGA-GUA-UCA-CCU

a. Lys-STOP-Val-Ser-Pro
b. Pro-Val-Cys-Asp-Lys
c. Phe-Thr-His-Ser-Gly
d. Gly-Gln-Thr-Leu-Phe

3. The following two structures represent the amino acid phenyl alanine: (2 pts)



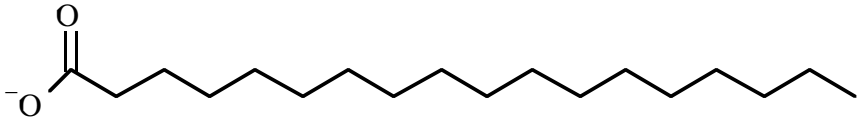
Are these enantiomers or identical?

a. Enantiomers
b. Identical

4. A protein with a quarternary structure is made up at least two subunits. If the two subunits are held together by the interaction between a lysine on one subunit and the glutamate of the other, the bond between them is said to be a: (2 pts)

a. salt bridge.
b. peptide bond.
c. disulfide bond.
d. hydrophobic interaction.

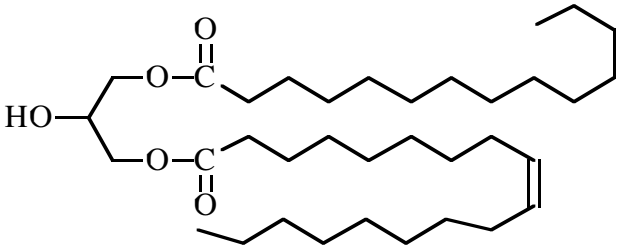
5. Consider the following fatty acid: (4 pts)



If this molecule underwent complete catabolism (i.e. ß-oxidation, Krebs cycle, and oxidative phosphorylation), how many ATP would be produced?

a. 122 b. 121 c. 146 d. 144

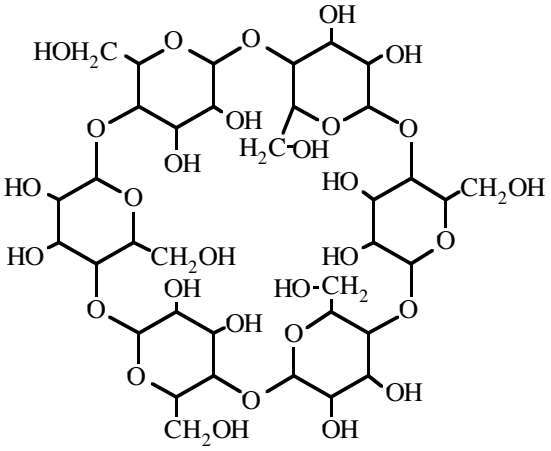
6. The two fatty acids that make up the following diglyceride are: (2 pts)



a. Myristic and Linolenic acids.
b. Palmitic and Oleic acids.
c. Myristic and Oleic acids.
d. Palmitic and Linoleic acids.

Completion

7. Consider the following hexasaccharide molecule: (12 points total)



a. The six monosaccharides that comprise this molecule can be taken to be glucose. The glucose molecules are connected via what type or types of saccharide linkages? Don't worry about stereochemistry. (2)

b. How many water molecules must be used to hydrolyze the molecule into its individual monosaccharides? (2)

c. How many ATP molecules would be produced if this molecule were completely oxidized to CO_2 and water? Show your work. (8)

8. Consider the following single strand of DNA. (17 points total)

5' – AGTTCGATGATGCCTGGCTTCCAATCGGGCGACGGTTAGGGAATT – 3'

a. If this strand were replicated write the sequence of the new strand. Label the ends as in the sequence above. (5)

b. If the strand in **a** is considered the template strand, which nucleic acid sequence would result from transcription? Be sure to label the ends (as in the example strand). (4)

c. What protein sequence would result from translation of the sequence produced in **b**. (5)

d. Which characteristic(s) of nucleic acids allows for such specific sequences to be produced during transcription and translation? (3)

9. Consider the following peptide: (9 points total)

Ala–Glu–Phe–Gly–Arg

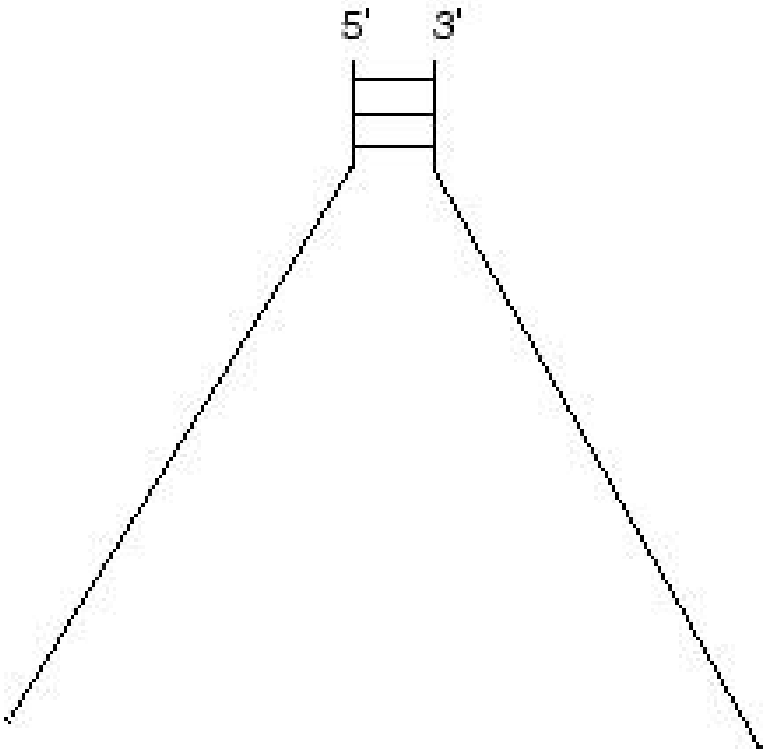
a. Draw the structure of this peptide. Include the charges of any acid or base groups as they would exist in aqueous solution at pH 7. Mark the amino and carboxy termini. Assume the following pK_a values: (5)

Group	pK_a
Amino terminus	9
Carboxy terminus	3
Acid sidechain	4
Arg sidechain	12

b. If all of the peptide bonds in this molecule were hydrolyzed the product would be the individual amino acids. Draw one of these amino acids. Assume that it is in aqueous solution at pH 1. (4)

10. Suppose that 22% of the nucleotides of a DNA molecule are deoxyadenosine, and during the replication the relative amounts of available deoxynucleoside triphosphates are 22% dATP, 22% dCTP, 28% dGTP, and 28% dTTP. What deoxynucleoside triphosphate would be limiting the replication? Explain. (5 pts)

11. On the following diagram: show where new DNA strands are synthesized using the two original strands as templates. Show which strands will have continuous and discontinuous replication. Indicate which direction each new strand is being synthesized. Where is the DNA polymerase positioned on the continuous strand at this point in the replication? (8 pts)

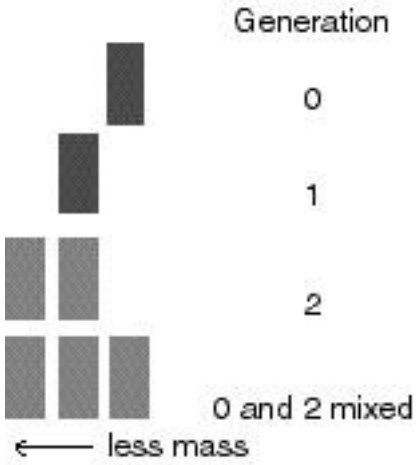


Extra Credit

12. Below are some data that were used to discover the manner in which DNA replicates. Bacteria were initially grown in media that contained $^{15}NH_4Cl$ and no other sources of nitrogen. The result is any compound containing nitrogen produced by the bacteria would contain ^{15}N instead of the more abundant isotope ^{14}N. Any compound containing ^{15}N instead of ^{14}N would have a higher mass. This first growth of bacteria was called generation 0. Successive generations of bacteria were grown in media containing $^{14}NH_4Cl$ or <u>absent</u> of large amounts of ^{15}N. So following generations now have nitrogen containing compounds with ^{14}N and <u>not</u> ^{15}N in them. At certain time intervals bacteria were removed and their DNA

isolated. These DNA were then separated by mass using a sedimentation technique. (10 points total)

A row in the following diagram represents a time point from the experiment. A "Generation" is a time point before a cell division, so the bacteria in the population are about the same age. Each band represents a different mass of DNA. In generation 0 we see the largest mass of all observed bands. This DNA consists mostly of ^{15}N containing nucleic bases. By analogy the lightest and would consist mostly of ^{14}N containing DNA. The intensity of the band is related to amount of DNA present in the band, darker is more.



a. What properties of DNA structure and replication have we learned about that explain the above data? (5)

b. Sketch the labeling patterns for DNA that you would observe for generations 0 – 2. (5)