Name _____

Chem 352 - Spring 2009 - Exam III

1. Photosystems I & II have what is referred to as a "special pair".
   a. The "special pair" refers to a pair of _____
   b. What role do these special pairs play in photosynthesis?

2. In class we discussed the evolution of photosynthetic systems. The more primitive systems contained either photosystem I (PSI) or photosystem II (PSII) along with the cytochrome *bc* complex, while the more advanced systems contained both PSI and PSII along with the cytochrome *bf* complex.
   a. Use check marks to indicate the products that each of the follow combinations of components produces.

Components	Only ATP	Only $NADPH + H^+$	Either ATP or $NADPH + H^+$	Both ATP and $NADPH + H^+$
PSI and cyt *bc*				
PSII and cyt *bc*				
PSI, PSII and cyt *bf*				

   b. Describe the roles that the cyt *bc* and cyt *bf* complexes play in each of these photosystems?

3. What role in photosynthesis does the enzyme *rubisco* play?

4. Using structural formulas for the intermediates, write a series of balanced chemical equations for the the reduction stage of the Calvin cycle

   a. What other metabolic pathway contains this same series of reactions? _____

   b. What is the source of the reduced NADPH + H^+ used in these reactions?_____

5. Each round of fatty acid synthesis involves the conversion of acetyl-CoA to malonyl-CoA

   a. Using structural chemical formulas for the intermediates, write a balanced chemical equation for this reaction.

   b. What coenzyme is required for this reaction?_____

   c. What role does this reaction play in fatty acid synthesis?

6. In class we discussed two reactions that are used to to assimilate ammonia into biological molecules.

   a. Using structural formulas, write a balanced chemical equation for one of these reactions:

   b. What is the name of the enzyme that catalyzes the reaction you chose above?

      _____

7. Using structural formulas for the intermediates, write the pathway for the synthesis of the amino acid alanine.

8. Watson and Crick published the landmark article reporting their proposed structure for DNA in 1953 in the journal *Nature*. They concluded their article with the following statement, "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material."

   a. Using structural formulas, illustrate the pairing that they proposed for deoxyguanosine and deoxcytidine. (Include both the deoxyribose sugars and nucleotide bases in your structures.)

   b. Explain what Watson and Crick were implying by their statement.

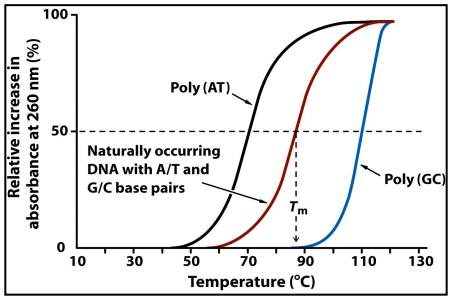
9. Throughout the semester we have seen nucleotides in roles other than to serve as building blocks for nucleic acids. Name three examples:

   a. _____

   b. _____

   c. _____

10. The graph shown to the right compares the melting curves for two synthetic DNA molecules, one made with a strand of polyadenosine plus a strand of polythymidine (Poly (AT)), and the other made with a strand of polyguanosine plus a strand of polycytidine (Poly (GC)). Explain these results.



11. The primary chemical difference between DNA and RNA involves the ribofuranose ring, which forms the core of the nucleotides used to make these two nucleic acids.

    a. Illustrate this chemical difference by drawing the structural formulas for the ribofuranose rings used to make DNA and RNA:

    DNA: _____ RNA: _____

    b. Describe the effect that this chemical difference has on the structure of RNA when compared to DNA.

12. Restriction endonucleases are nucleases that cleave DNA at specific sites along a DNA molecule.

    a. Describe a common characteristic that is observed for these cleavage sites.

    b. Describe how restriction endonucleases are used in DNA fingerprinting?

13. As DNA polymerase III moves along a DNA molecule and replicates it, it duplicates both strands simultaneously.

    a. DNA polymerase is only able to synthesize a new DNA strand in the 5'→3' direction. What problem does this present for the replication of DNA by DNA polymerase III?

    b. How is this problem solved?

c. DNA polymerase III also contains a 3'→5' exonuclease activity. What is this used for?

14. In the 1970's Frederick Sanger developed a method for sequencing DNA molecules.

a. His method makes use of modified nucleotides; describe this modification.

b. What effect do these modified nucleotides have on DNA polymerization and how is this used to determine a DNA sequence?

c. Sanger received the 1980 Nobel Prize in Chemistry for his method for sequencing DNA. For what discovery did Frederick Sanger receive the 1958 Nobel Prize in Chemistry?

Extra Credit:

1. Ask the one question that you wanted me to ask, but I did not ask. (1 point will be awarded for an insightful, probing and well-worded question, which I can use on the Final Exam.)

2. Answer the question you posed in part 1. (2 points will be awarded for answering your question correctly.)