BCHM465 **Your Name:** _____

Biochemistry III, Molecular Genetics **Prof. Jason Kahn**

Final Exam **May 22, 2001**

You have 120 minutes for this exam. It is worth 150 points.

Explanations should be concise and clear. Read the question being asked!

You will not need a calculator for this exam. No other study aids or materials are permitted.

Generous partial credit will be given, i.e., if you don't know, guess.

1. (10 pts) Briefly describe the GTPase clock that functions in translation, and explain how it enhances translational fidelity.

2. (10 pts) Briefly describe a fundamental role of NTP hydrolysis besides fidelity and driving covalent chemistry, in replication, repair, splicing, and translation. Give two examples.

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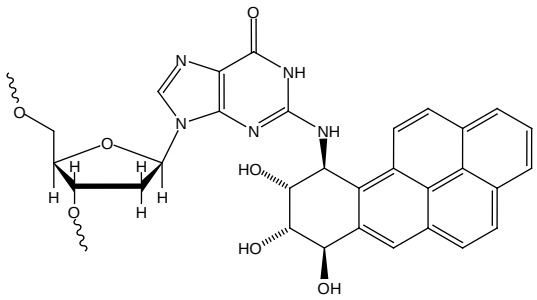
3. (10 pts) What general type of repair system is likely to repair the lesion pictured below? What is probably the attribute of the lesion recognized by the repair system? What proteins constitute this repair system in *E. coli*?



4. (10 pts) Briefly discuss two fundamental differences between eukaryotic and prokaryotic transcriptional regulation.

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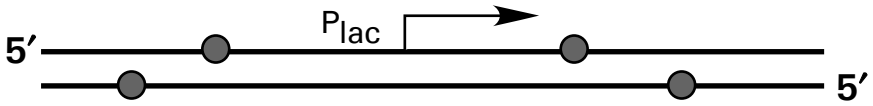
5. (10 pts) What's the last (worst) thing the cell wants to do with a DNA lesion, and why? Which lesion in the following picture will be repaired most rapidly, assuming they are all chemically the same and that the cells are induced with IPTG? How might you test the idea that the result has something to do with transcription?



6. (10 pts) A research article in the May 18 issue of Science is entitled "RNA-catalyzed RNA Polymerization: Accurate and General RNA-Templated Primer Extension." What is the RNA world hypothesis, and how does this work support it? What specific Cech reaction described in class was the intellectual forerunner of this work, and in what way does the new work represent a significant advance?

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7. (10 pts) Which two eukaryotic GTFs are known to have enzymatic activities, what are the activities, and what are their functions?

8. (9 pts) What are the two basic rationales offered in class for the evolutionary preservation of RNA chemistry in splicing and translation? Why have proteins taken over everything else?

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9. (10 pts) How, in general, does biology improve upon the rather poor specificity of Watson-Crick base pairing interactions that is available from base pairing thermodynamics alone? Give examples from DNA replication and translation.

10. (10 pts) Sketch the chemistry of peptidyl transfer from the A site to the P site aa-tRNA. Represent the tRNA part of the aa-tRNA as R-O-, with the –O being the 3' end of the terminal A residue. Why is aa-tRNA called an adapter molecule?

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11. (6 pts) What is the best single piece of evidence for ribosome = ribozyme? How is the 23S RNA believed to catalyze peptidyl transferase?

12. (6 pts) Give two reasons why are there many more distinct human proteins than there are human genes, whereas with bacteria the numbers are very similar.

13. (8 pts) What is the role of U4 in RNA splicing, and why might it be necessary to have this RNA chaperone?

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14. (10 pts) Early models for prokaryotic methyl-directed mismatch repair proposed that looping through solution brought MutS, L and H into contact with one another. What important aspect of mechanism did this fail to explain (sketch to illustrate)? How are the observed DNA loops formed?

15. (5 pts) An antiterminator protein loads onto a ternary elongation complex at a pause site and alters the sensitivity of RNA polymerase to downstream rho-independent termination sites. What do you think an antiterminator protein might be doing to the structure of the elongation complex?

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16. (10 pts) It has been observed that moving the binding site for the *E. coli* transcriptional activator AraC 5 base pairs upstream from its usual position significantly reduces the efficiency of transcriptional activation, whereas moving it an additional 5 base pairs upstream restores activity. Suggest an explanation. Similar experiments in eukaryotes usually show a much weaker helical phasing effect. Why do you think this is the case?

17. (6 pts) Describe something you learned while doing the group projects which corrected something we did in class, or something that you wished you had heard more about in class, and why.

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