1. Draw A76 of fMet-tRNA^{fMet} and Phe-tRNA^{Phe} as would be found in the ribosome prior to peptidyl transferase showing every atom and bond, identify which sites the two tRNAs occupy. Indicate the mechanism for how peptide bond formation occurs between the two. What is responsible for catalysis of peptide transfer, and where does the energy of peptide bond formation come from?

2. If bacteria have roughly 5,000 genes and humans have around 20,000 genes, humans only have 4 times the amount of genes bacteria do. How do you explain the complexity of "higher organisms"?

3. Some antibiotics are only used in scientific research and not prescribed to humans to treat disease. Puromycin is one of them. What would be the consequence of taking Puromycin? How does this affect translation?

4. Is it true that if glucose is present, the cell won't bother to transcribe the lac gene even if lactose is present?

5. Explain why proteins recognize/read bases in the major groove for DNA and in the minor groove of RNA.

6. How does the H-bonding of Gln 33 help stabilize its interaction of Gln 44 in base recognition?

7. What are the features that distinguish one domain from the other when several domains pack together as one?

8. What would a ramachandran plot look like for proline?

9. From the Fourier synthesis and the equation given in class, what are the component(s) that are obtained from the diffraction pattern and what component(s) need to be determined experimentally? Explain briefly.

10. Explain how tRNA folds on itself.

11. What resolution of holiday junction will give you non-recombinant/true-recombinant. How does this occur?

12. What made Warner and Crick conclude that codons are triplet based on experiments using reticulocytes and goblin mRNA?

13. Why is DNA denatured by high and low pH?

14. What drives the movement of deacylated-tRNA from the ribosomal E site during translocation?
15. The 1200 nucleotide sequence coding for T4 DNA ligase is cloned into the 3200 bp plasmid pBR322 using 5’ EcoRI and 3’ BamH1 restriction sites. Translation of the ligase mRNA results in a 374 aa protein.

16. What is the minimum length of the ligase mRNA transcript?
   a) 1122 nucleotides
   b) 1125 nucleotides
   c) 1139 nucleotides

17. You have isolated the above ligase expression plasmid from *E. coli*. How many base pairs is the plasmid?

18. You run your highly purified plasmid on a DNA agarose gel and are surprised to find not one but three bands corresponding to an apparent lengths of 4600 bp, 4400 bp, and 4200 bp.
   a) Draw the resulting gel and label each band relative to the electrical field.
   b) Following treatment with EcoR1 you observe a single band at 4400 bp. Explain.
   c) Following treatment with ligase you observe only 4400 and 4200 bp bands. Explain.
   d) Following treatment with TopII you observe only 4600 and 4400 bp bands. Explain.


20. In tRNA A9 makes a reverse hoogsteen tertiary interaction with the A23-U12 pair. Draw this structure.

21. Diagram the tRNA clover leaf structure and indicate the location of A9, A23, and U12.

22. Histidine often functions as a proton shuttle in the active site of proteins. Explain this function in 10 words or less.

23. Diagram the above process showing all relevant charges.

24. The ribosome is a ribozyme and contains both RNA and proteins. What does this suggest about the origin of life?

25. RNA is less stable than DNA. Choose the best explanation:
   a) DNA is very stable
   b) RNA may be catalytic
   c) OH of RNA will cleave the backbone
   d) RNA has a 2’ OH that cleaves phosphodiester backbone