1. The current Molecular Biology was developed from many contributions from different scientists. What were the contributions of the following scientists? (10%)
    A. Hershey and Chase
    B. Meselson and Stahl
    C. Nirenberg and Mattei
    D. Kornberg

2. Puromycin is a powerful inhibitor of protein synthesis. It is an analog of the 3' end of aminoacyl tRNA. When puromycin is added to a cell-free system containing all the necessary machinery for protein synthesis, incomplete polypeptide chains are released from the ribosomes. Each such chain has puromycin covalently attached to one end. (10%)
    A. Explain the results.
    B. To which end of the polypeptide chains would you expect the puromycin to be bound? Why?
    C. Would you expect puromycin to bind to the A or P site on the ribosome, or to both? Why?
    D. Assuming that it can penetrate into the cell equally well in both cases, would you expect puromycin to be a better inhibitor of protein synthesis in a eukaryotic cell or in a prokaryotic cell? Why?

3. Rifamycin and actinomycin D are two antibiotics derived from bacterium. Rifamycin binds to the B subunit of E. coli RNA polymerase and interferes with the formation of the first phosphodiester bond in the RNA chain. Actinomycin D binds to double stranded DNA by intercalation. (10%)
    A. Which of the four stages in transcription (binding, initiation, elongation, and termination) would you expect rifamycin to affect primarily?
    B. Which of the four stages in transcription would you expect actinomycin D to affect primarily?
    C. Which of the two inhibitors is more likely to affect RNA synthesis in cultured human liver cells? Why?

4. Explain the effects of the following factors on the protein structure: (10%)
   (1) SDS (sodium dodecyl sulfate)
   (2) β-mercaptoethanol
   (3) urea
   (4) organic solvent, e.g., acetone

5. Please draw the double-reciprocal plot (1/Vo vs. 1/[S]) for the following enzyme reaction. Explain your rationale for the changes of Vmax and Km when increasing the concentration of S_2. (10%)

$$P_1 \quad S_2$$
$$\nearrow \quad \searrow$$
$$E + S_1 \rightleftharpoons ES_1 \rightleftharpoons E'P_1 \rightleftharpoons E' \rightleftharpoons E'S_2 \rightarrow E + P_2$$

6. Describe the fluid mosaic model of biological membranes. (10%)

7. What are the advantages for lipid to be a better stored fuel than glycogen and protein in the biological system? (10%)

8. Why is phosphorylation of a molecule by ATP so important? (5%)

9. What are potential disadvantages of having many catalytic sites together on one very long polypeptide chain? (5%)

10. What factors regulate the metabolic processes? Explain (10%)

11. Oxygen transport can be affected in genetic disorders of glycolysis in red cells. (10%)
    (1) How are glycolysis and oxygen transport linked?
    (2) How is oxygen affinity altered by a deficiency of hexokinase?
    (3) How is oxygen affinity altered by a deficiency of pyruvate kinase?