

# Biochemistry Cumulative Examination

May 10, 2011

## Bacterial Heme Protein Biochemistry

1. (10) Draw the structure of a heme, such as protoheme.
2. (10) Gram-positive and Gram-negative bacteria have devised different mechanisms for heme uptake and intracellular transport that are in part associated with differences in cell structure. Describe differences between the structures of these two types of bacteria, using appropriate figures.
3. (30) Describe the steps involved in the uptake and intracellular transport of heme by **either** Gram-negative or Gram-positive bacteria. Include in your discussion a consideration of the cell structure and the mode of binding of heme to particular protein residues.
4. (10) Explain why bacteria have evolved elaborate systems for the uptake, transport and degradation of heme.
5. (10) Heme degradation in both bacteria and eukaryotic cells is typically initiated by heme oxygenases (HOs). Show the reaction catalyzed by these enzymes.
6. (20) Describe the role of heme proteins in respiratory linked energy transduction. Include in your discussion a consideration of the variety of respiratory substrates used by bacteria and the changes that occur in the heme during respiration linked energy transduction.
7. (10) Describe an example of the role of heme proteins in cell signaling.