1. (10) The organic compound HOCH₂(CH₂SH)(CH₂SH), known as British Anti-Lewisite (BAL) has features that make it suitable for treatment of poisoning by a number of different heavy metals. Provide a brief, clear, chemically-based explanation for the efficacy of this drug.

BAL forms a chelate complex through coordination of the S atoms to the metal; e.g., Pb²⁺ + 2HOCH₂(CH₂SH) → PbS₂⁻ + 2H⁺. The complex is excited. The soft sulfur atoms of BAL interact selectively with soft metal ions such as Pb²⁺ and Hg²⁺.

2. (10) Bonding of an oxygen molecule to one of the iron(II) atoms in hemoglobin causes striking changes in the coordination geometry of iron. Briefly describe these changes at the iron site, and provide a brief, clear rationale as to why they occur.

The Fe(II) site slightly above the plane of the porphyrin ring in the deoxygenated state, and is high-spin (t₄²g). Binding of O₂ switches the Fe(II) to the low-spin state (t₄²g). Removal of electron density from the ơg orbitals lowers metal-ligand repulsion and allows the Fe(II) to fully enter the plane of the porphyrin ligand.

3. (10) A structural diagram of the antibiotic nonactin is shown. Provide a brief description of the mode of action of this compound, based on its physicochemical properties.

Nonactin contains numerous hard ligand atoms (oxygen) and a considerable amount of hydrophobic structure. It is a highly specific
Ligand for K+. Binding of K+ results in a complex nonactin in which the hydrophobic fragments are on the surface. Other hydrophobic particle is able to diffuse through cell membranes (through the lipid bilayer) and

4. (10) What is the usual oxidation state of iron in terrestrial or aquatic environments, and why are other oxidation states not ordinarily found? Provide a brief explanation of why this oxidation state poses problems for many plants and microorganisms in K+ balance.

Fe(III) Fe(II) is generally unstable toward air oxidation.

Lower oxidation states are even more reactive.

Higher oxidation states are strongly oxidizing and would be unstable toward reduction by organic matter, etc. Fe(III) compounds (e.g., Fe(OH)₃) are of very low solubility at neutral or basic pH, and thus difficult to

5. (10) Arrange the ligands that you examined in the preparation of Co(III) pentaammine complexes in order of increasing ligand acquire field strength (the ligands are O-bonded nitrite, N-bonded nitrite, water, ammonia, and chloride). If you had prepared a cyanide complex during this experiment, where do you think it would have fit in your series? Briefly explain your rationale.

weakest field Cl⁻ H₂O NH₃ O-NO M⁻NO₂ strongest field

CN⁻ would produce a stronger ligand field than any of these, due to strong back-bonding.