1. (10) Define each of the following and give examples.
   a. structural isomers　b. coordination isomers　c. optical isomers

2. (10) Use the MO model to predict the magnetism and bond order of the NO^+ and CN^- ions.

3. (10) Calculate the $[H^+]$ in
   a. 1.0 M HCN ($K_a = 6.2 \times 10^{-10}$)
   b. 1.0×10^{-4} M HCN ($K_a = 6.2 \times 10^{-10}$)

4. (10) What is the definition for state function?　What are state functions in the following list: $\Delta E, \Delta H, q, w, \Delta V$

5. (10) Assign formal charges to the atoms in carbon monoxide.　Use these to explain why CO has a much smaller dipole moment than is expected on the basis of electronegativity.

6. (10) How to predict the spontaneity of a reaction based on the values of entropy and free energy?

7. (10) Explain both Schottky defects and Frenkel defects in cryatalline ionic solids.

8. (10) A buffered solution contains 0.25 M NH_3 ($K_b = 1.8 \times 10^{-5}$) and 0.40 M NH_4Cl.　(a) Calculate the pH of this solution　(b) Calculate the pH of the solution that results when 0.10 mol of gaseous HCl is added to 1.0 L of the buffered solution from part a.

9. (10) Why is hydrogen a theoretically good choice for use as a fuel but a poor practical choice for use as a fuel ?

10. (10) Give three different structural types of solids and provide one example for each