1. Give electron configurations and determine the number of unpaired electrons in the ground state for the following elements. (12%)
   a. \( \text{N} \)
   b. \( \text{Ni} \)

2. Predict the largest and smallest ion in each series: (10%)
   a. \( \text{S}^2- \quad \text{Cl}^- \quad \text{K}^+ \quad \text{Ca}^{2+} \)
   b. \( \text{Fe}^{3+} \quad \text{Fe}^{2+} \quad \text{Fe}^{2-} \)

3. Determine the point groups of the following molecules. (20%)
   a. \( \text{NH}_3 \)
   b. \( \text{BF}_3 \)
   c. \( \text{C}_6\text{H}_6 \)
   d. \( \text{CHClFBr} \)

4. Which of the following in each pair has the larger bond angle? Why? (12%)
   a. \( \text{CH}_4 \) and \( \text{NH}_3 \)
   b. \( \text{NH}_3 \) and \( \text{NF}_3 \)

5. Sketch all isomers of the following formula. (12%)
   a. \( \text{MA}_4\text{B}_2 \)
   b. \( \text{MA}_3\text{B}_3 \)

6. Give molecular orbital configurations and bond order of the following diatomic species: (14%)
   a. \( \text{O}_2 \)
   b. \( \text{O}_2^- \)

7. Draw the electron configuration of a \( d^6 \) ion in strong and weak octahedral field. (10%)

8. The electronic spectra of \( [\text{M(H}_2\text{O})_6]^2+ \) (M = Ti, Cr, Mn, Fe, Co, Cu) indicate that the molar absorptivity of \( [\text{Mn(H}_2\text{O})_6]^2+ \) is smaller than other species. Explain. (10%)