1. Determine the point groups of the following molecules. (20%)
   a. $\text{NH}_3$
   b. $\text{BF}_3$

2. Predict the shapes of the following molecules. (20%)
   a. $\text{PF}_3$
   b. $\text{ClF}_3$
   c. $\text{SO}_3$

3. Determine the ground state term symbol of $3\text{P}^2$. How many microstates are there in this ground state term? (15%)

4. Draw the electron configuration of a d$^4$ ion in strong and weak octahedral fields, respectively. (15%)

5. For a d$^1$ complex a single absorption band, corresponding to excitation of a t$_{2g}$ electron to an e$_g$ orbital, might be expected. However, the spectrum of [Ti(H$_2$O)$_6$]$^{3+}$ shows two apparently overlapping bands rather than a single band. How is this possible? (15%)

6. Predict and explain which of the complexes $[\text{V}(\text{CO})_6]^{2+}$, $[\text{Cr}(\text{CO})_6]^{2+}$, and $[\text{Mn}(\text{CO})_6]^{2+}$ has the shortest C-O bond. (15%)