

1. Draw the structure of  $\text{AuF}_3$ . In what way do the structures of  $\text{AuF}_3$  and  $\text{AuCl}_3$  resemble those of  $\text{NbF}_5$  and  $\text{NbCl}_5$ ? What is the most efficient method for synthesizing each of these complexes?
2. Propose mechanisms for the following reactions:
  - a. Cl- substitution in  $[(\eta^2\text{-C}_2\text{H}_4)\text{PtCl}_3]^-$  by  $\text{Br}^-$  in methanol to give  $\text{trans}-[(\eta^2\text{-C}_2\text{H}_4)\text{PtCl}_2\text{Br}]^-$
  - b. Arene substitution in  $(\eta^6\text{-C}_6\text{H}_6)\text{Mo}(\text{CO})_3$  by  $\text{PPh}_3$  to give  $\text{fac-Mo}(\text{CO})_3(\text{PPh}_3)_3$ . Can the mer isomer be synthesized using the same two starting materials? If so how? If not, how is the mer isomer synthesized?
3. Decacarbonyldirhenium (0) reacts with chlorine to give product A, which upon heating at elevated temperatures releases CO to form compound B. Treatment of B with an equimolar amount of tetraethylammonium chloride affords compound C for which  $\mu_d > 0$ . Reaction of C with 1 mole of  $\text{PPh}_3$  results in the formation of  $\text{Et}_4\text{NCl}$  and compound D, which has the same stereochemistry as compound C. Both compounds B and C exhibit four (CO) bands in their spectra. What are compounds A, B, C, and D? Give mechanisms to explain how each is formed.
4. A paramagnetic metal iodide, A, was treated with a strong reducing agent in the presence of 1,5-cyclooctadiene. The reaction mixture yielded a yellow, air-sensitive, diamagnetic complex B (Anal. C, 70.0; H, 8.7; M, 21.3%). Compound B reacted with allyl iodide at  $-20^\circ\text{C}$  to give a red diamagnetic solid C (Anal. C, 15.8; H, 2.2; I, 5.6%; mol wt  $450 \pm 10$ ). Reaction of C with iodine produced compound A and allyl iodide. Account for all of the above observations and discuss briefly the structure and bonding of compounds A, B, and C.
5. Give point groups, d electron counts, oxidation numbers, and total electron counts for each metal center in this exam.