(1) Use the MO diagram you constructed for Bis(cyclobutadiene)nickel in Problem Set 6. Assume that the complex is reduced by two electrons to yield the 2^- ion.

(a) Derive the symmetries of the ground state, dipole moment operator and the two lowest lying excited states.

(b) Assign the electronic transitions. Are these electronic transitions allowed?

(c) I. What type of transitions are these?
II. What intensities would you expect?

(d) Assuming that the metal is now Zn, to yield the 2^- Bis(cyclobutadiene)zinc(II), repeat questions (a) - (c).

(2) Use the MO diagrams that you derived for square planar complexes with d^8 electronic configuration in Problem Set 5. Assign the low-lying allowed transitions you would expect for the following types of complexes. Comment on the types of transitions and intensities.

(a) σ-donor ligands

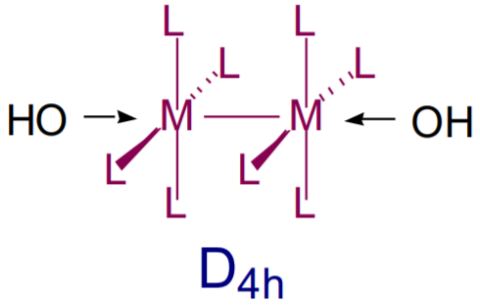
(b) π-acceptor ligands

(c) π-donor ligands

(3) Consider the metal-metal MO diagram on the reverse side of the page for the D_{4h} complex $M_2(L)_8$.

(a) Assign the lowest energy allowed transitions.

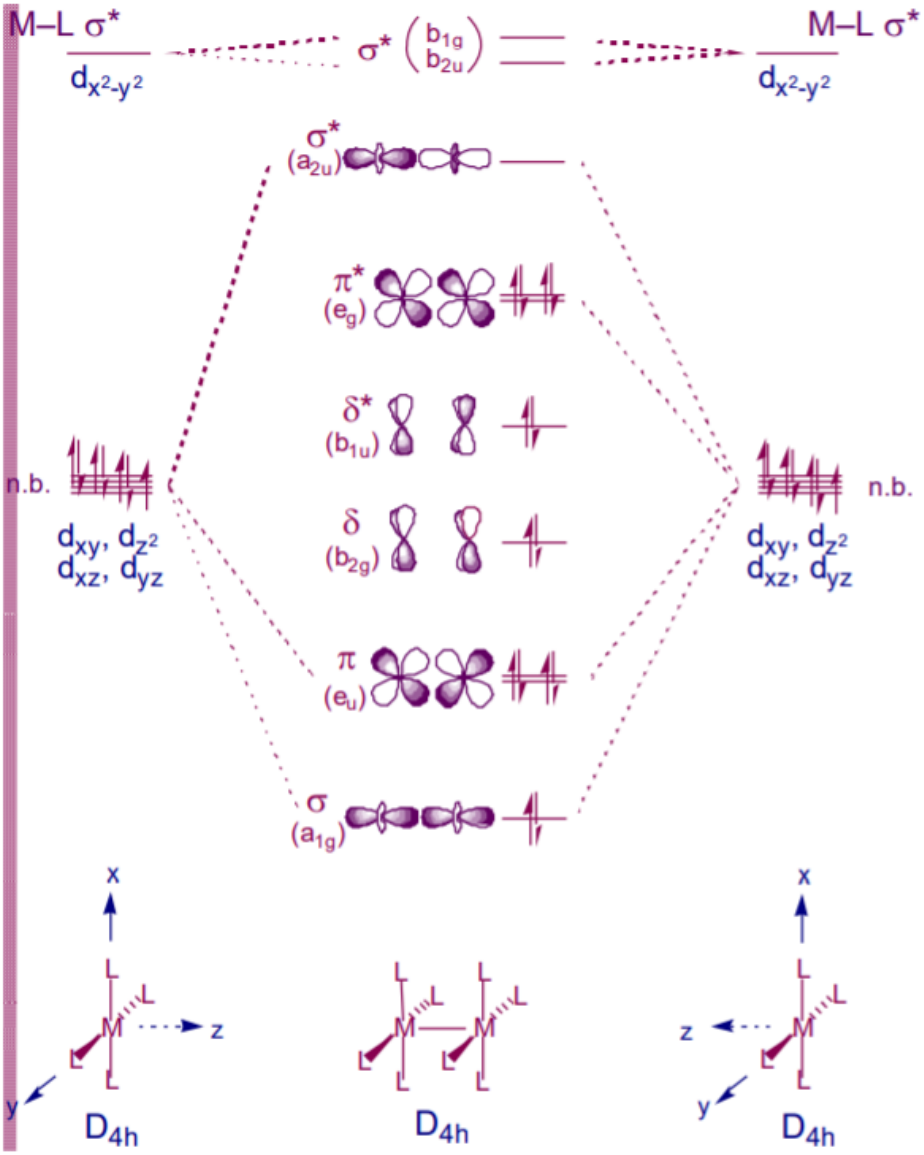
(b) What changes would you expect in the MO diagram of the complex when two hydroxide ligands bind in the axial positions (consider σ-only) as shown below.



(c) How would you expect such axial binding to affect the electronic spectrum of the complex?

(d) Would you expect the use of a better σ-donor to affect the spectrum? How? And a weaker σ-donor?

(e) Assuming a d^4 metal is used in the $M_2(L)_8$ complex, assign the allowed d-d transitions.


M–L σ*
$d_{x^2-y^2}$
σ* (b_{1g} b_{2u})
M–L σ*
$d_{x^2-y^2}$
σ* (a_{2u})
π* (e_g)
δ* (b_{1u})
n.b.
d_{xy}, d_{z^2}
d_{xz}, d_{yz}
δ (b_{2g})
π (e_u)
σ (a_{1g})
n.b.
d_{xy}, d_{z^2}
d_{xz}, d_{yz}
x
z
y
M
L
D_{4h}
D_{4h}
D_{4h}