1) Prove that a filled $\pi$-orbital contributes no angular momentum (neither spin nor orbital) and therefore a filled $\pi$-orbital (or indeed any completely filled orbital) can be ignored in the determination of a molecular term symbol.

2) Using the numbering scheme below, set up (but do not solve!) the Hückel MO theory determinantal equation for naphthalene.

3) (a) Set up and solve the determinantal equation for cyclobutadiene (shown below) to obtain the Hückel $\pi$-electron energies. (Help on solving determinants is given in Barrante, Chapter 9 (page 132).

(b) Fill the resulting molecular orbitals with electrons to determine the ground state electron configuration of this molecule.
(c) Discuss the stability of cyclobutadiene relative to two isolated ethylene molecules (recall, an ethylene molecule has the $\pi$-electronic energy $2\alpha + 2\beta$ (McQuarrie, page 413)). Is it more or less stable?

4) Using the energy level diagram in Figure 9-11(b) of McQuarrie, calculate the electron configuration of (i) diatomic carbon, $C_2$ and (ii) the acetylide ion, $C_2^2^-$. Calculate the bond order in each case and hence comment on the relative bond lengths and bond strengths you would expect to observe. Draw the electron configurations on an energy level diagram for each species.