1. Consider a Diels-Alder reaction between the following two substrates:

Assuming that the reaction is concerted, and that only one molecule of A and one molecule of B are involved in the reaction, draw all the possible products (including regioisomers, diastereomers, and enantiomers).

2. Sketch molecular orbital pictures (C=C bond $\pi$-system only) for the two reacting species. What do you know about the relative size of the coefficients in the HOMO and LUMO orbitals? Try to incorporate this into your sketch.

**Note:** for exceptions to this reasoning, and a much more thorough treatment, see: Fleming, p. 121.
3. What is a normal-demand Diels-Alder reaction? What is an inverse-demand Diels-Alder? What would you consider this reaction to be? Use the MO diagrams you drew in question 2 to predict the **regiochemical** outcome of this reaction.

Normal demand = electron rich diene, electron poor dienophile
Inverse demand = electron poor diene, electron rich dienophile
This is a normal demand Diels-Alder.

4. Define *endo* and *exo*, as they relate to the Diels-Alder reaction. Use the MO diagrams you drew in question 2 to predict the **relative stereochemical** outcome (i.e. diastereoselectivity) of this reaction, for both an *endo*- and *exo*-selective transformation. Which product do you think you’d be more likely to get, if you were to try this reaction in the lab?

*exo*:  
less steric repulsion

*endo*:  
secondary orbital overlap between the carbonyl and the back orbitals of the diene

*endo is generally favoured at modest temperatures.*

5. What can you say about the **absolute stereochemical** outcome (i.e. enantioselectivity) of this reaction? How might you propose to control this? (You don’t need an actual chemical example here – I’m just looking for a general strategy.)

**Must** get both enantiomers in equal amounts (reaction is **racemic**).

6. How well would you expect this reaction to work? Rationalize your answer.

Possibly **not** a great reaction, due to the difficulty of the diene accessing the s-cis conformation required for reactivity.