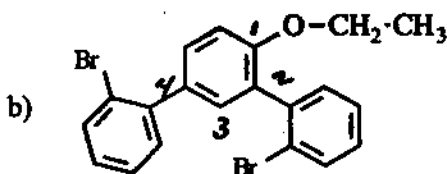
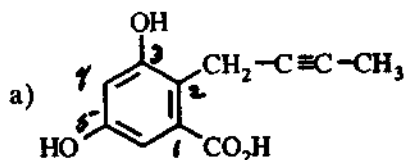
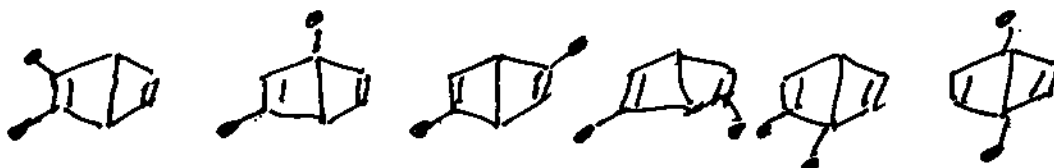
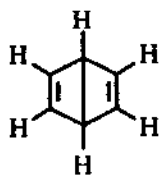


1. (12) Name the following:

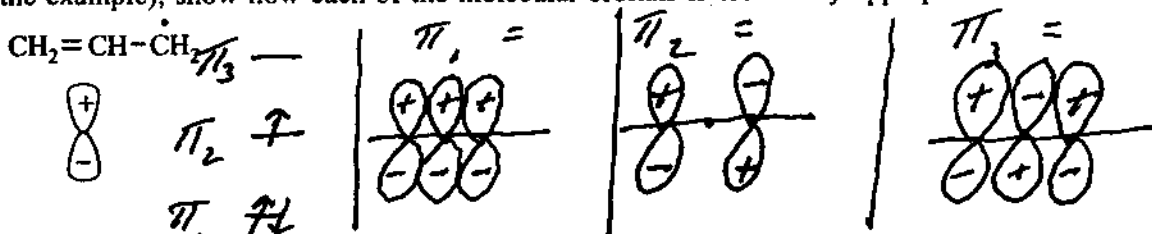


a) 2-(2-butynyl)-3,5-dihydroxybenzoic acid
b) 2,4-di(2-bromophenyl)-1-ethoxybenzene

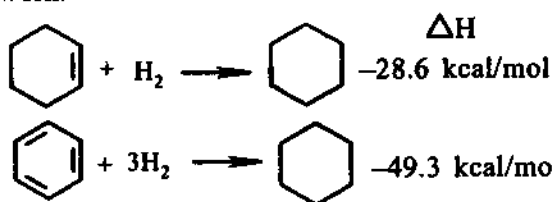
2. (6) One of the structures historically proposed for benzene is called Dewar benzene, shown below. Dewar benzene was rejected as the correct structure because it was expected to give more disubstituted isomers (for example, dibromides) than the three actually observed (now known as ortho, meta and para). Give structures for all possible dibromo substitution isomers of Dewar benzene.



3. (6) a) Prepare a molecular orbital energy level diagram for the allyl radical, showing how the available electron are distributed in the available pi molecular orbitals. b) Using 2p orbitals with plus and minus amplitudes on the lobes (see the example), show how each of the molecular orbitals is created by appropriate combinations of 2p orbitals.



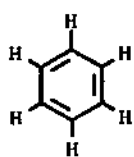
4. (6) Estimate (calculate) the resonance energy of benzene using the heats of hydrogenation given below. Show your work.



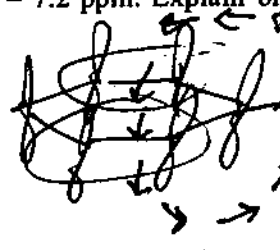
$3 \times 28.6 = 85.8$

$85.8 - 49.3 = \underline{\underline{36.5 \text{ kcal/mol}}}$

5. (4) The NMR spectra of aromatic compounds show their protons to be strongly deshielded. Benzene protons, for example, resonate at $\delta = 7.2$ ppm. Explain briefly using words and appropriate diagrams why the protons in benzene are so deshielded.

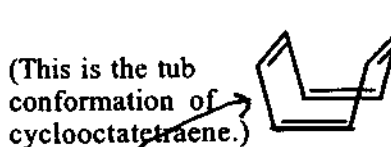
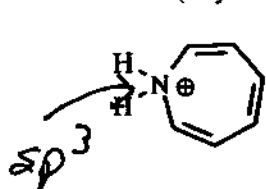


↑ applied H_0



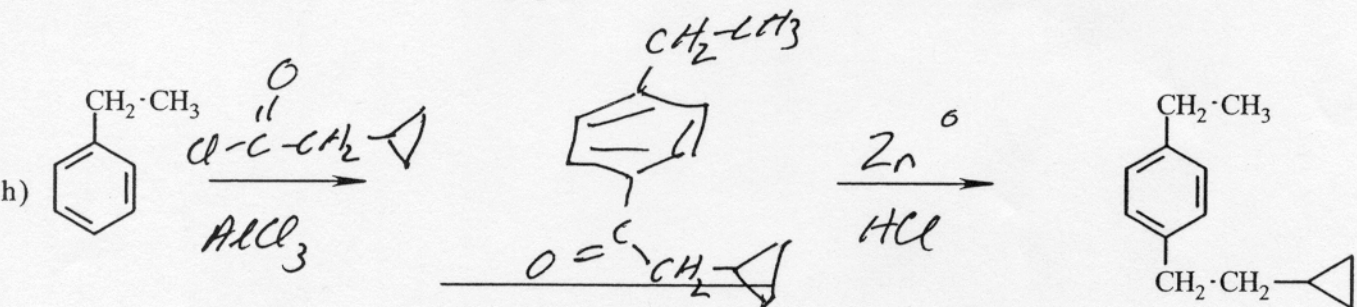
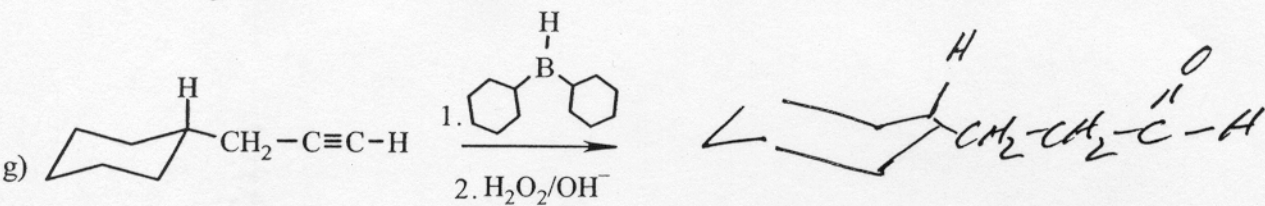
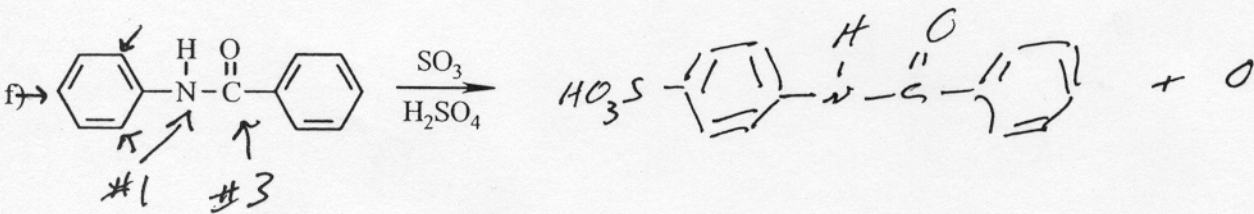
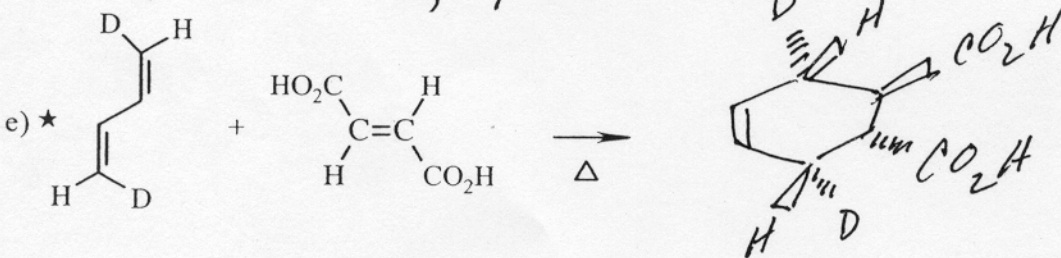
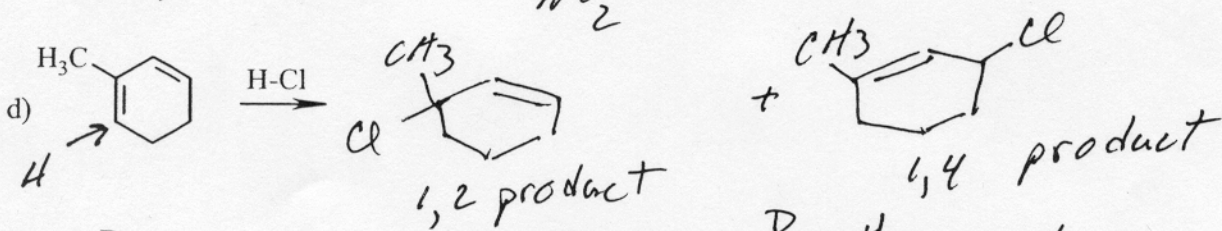
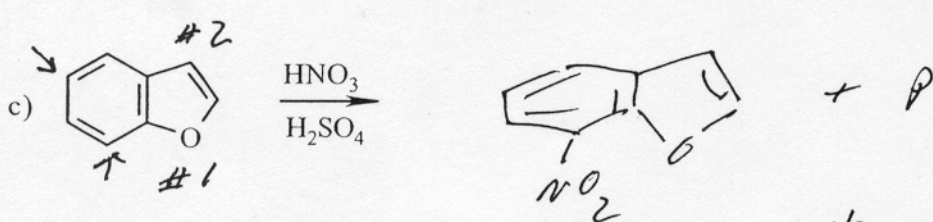
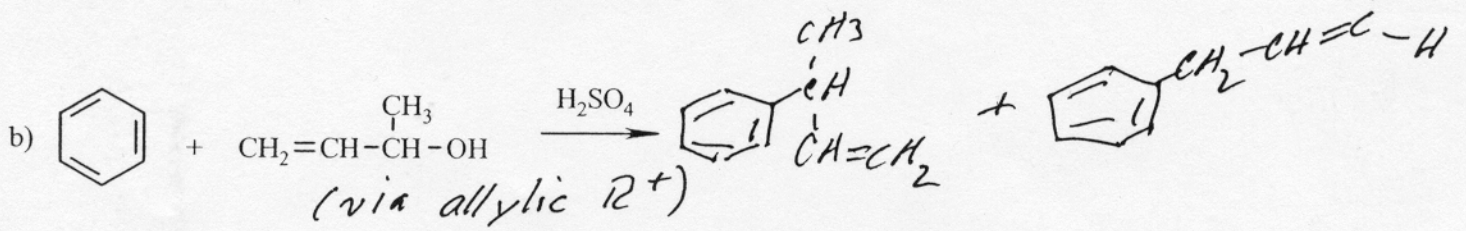
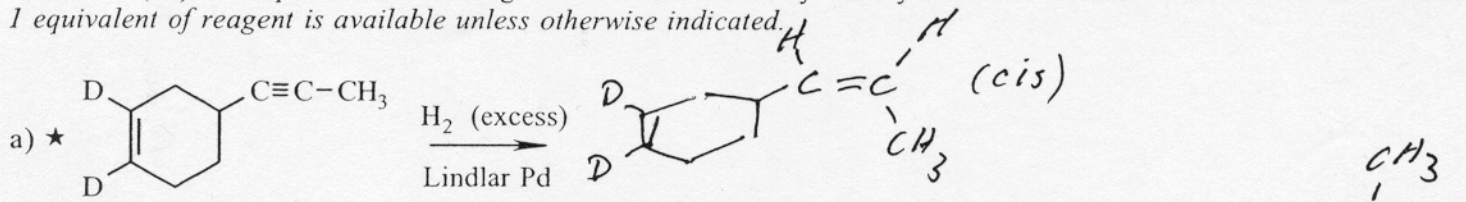
↑ circulation of the π electrons ("ring current") induces a new magnetic field that adds to H_0 at the proton. Less strong H_0 is needed = deshielding.

6. (6) a) Indicate the number of pi electrons in each structure below, and b) indicate whether or not the Huckel $4n/(4n+2)$ test can be applied to the structure. If yes, c) indicate whether the test predicts stability or instability for the structure. (If your answer to b) is no, leave c) blank.)



no overlap here

7. (48) Complete the following. Show stereochemistry clearly for those marked with a star. Assume that 1 equivalent of reagent is available unless otherwise indicated.



8. (9) a) Write a mechanism for the following reaction. Show all steps clearly, include formal charges where necessary, and use correct electron pushing. (The use of the symbol H^+ is unacceptable.)

b) (3) Also show all resonance structures for the benzenonium ion.

