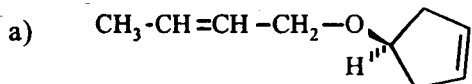


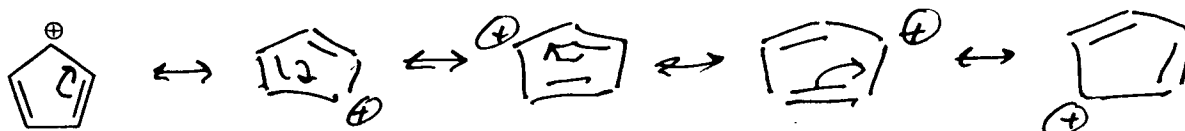
1. (14) Name the following, including stereolabels where appropriate.



b)

a) IUPAC 4-(2-butenoxy)cyclopenteneCommon 2-butenyl 3-cyclopentenyl etherb) 2-(2-cyclobutylpropyl)-1-ethoxy-4-(4-nitrophenyl)benzene2. (4) A Bronsted acid is defined as a proton donorA Bronsted base is defined as a proton acceptorA Lewis acid is defined as an electron pair acceptorA Lewis base is defined as an electron pair donor

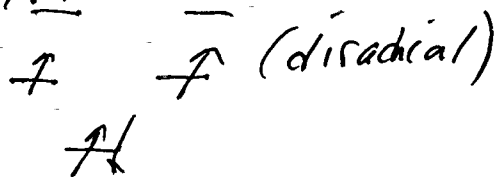
3. a) (3) Give all of the remaining resonance structures for the cyclopentadienyl cation (below).



b) (3) The resonance structures predict that this should be a highly stabilized structure. Yet it is actually very unstable, with bonding quite unlike that suggested above. Explain briefly why the resonance method fails here, and give a better description of the bonding in this structure.

The Hückel $4n(4n+2)$ test applies to this structure. With 4 π electrons, the test predicts instability.

Better:

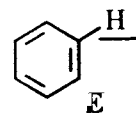
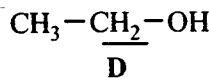
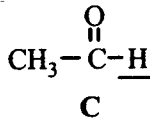
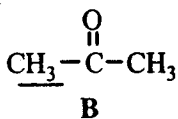
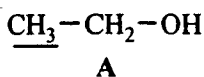
4. a) (3) The K_a of acetylene is about 1×10^{-26} . Define K_a for his compound.

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{H-C}\equiv\text{C}^-]}{[\text{H-C}\equiv\text{C-H}]} = 1 \times 10^{-26}$$

b) (3) Explain briefly why acetylene is a stronger acid than ethylene (K_a about 10^{-45}) and ethane (K_a about 10^{-62}).

Its conjugate base is relatively more stable because the sp hybrid orbital puts the electron pair closer to the nucleus. $\text{H-C}\equiv\text{C}^- \leftarrow \text{sp}$

5. (5) For the labeled protons in the compounds below, arrange their NMR chemical shifts in order of decreasing magnitude.

largest δ (ppm) C > E > D > B > A smallest δ (ppm)

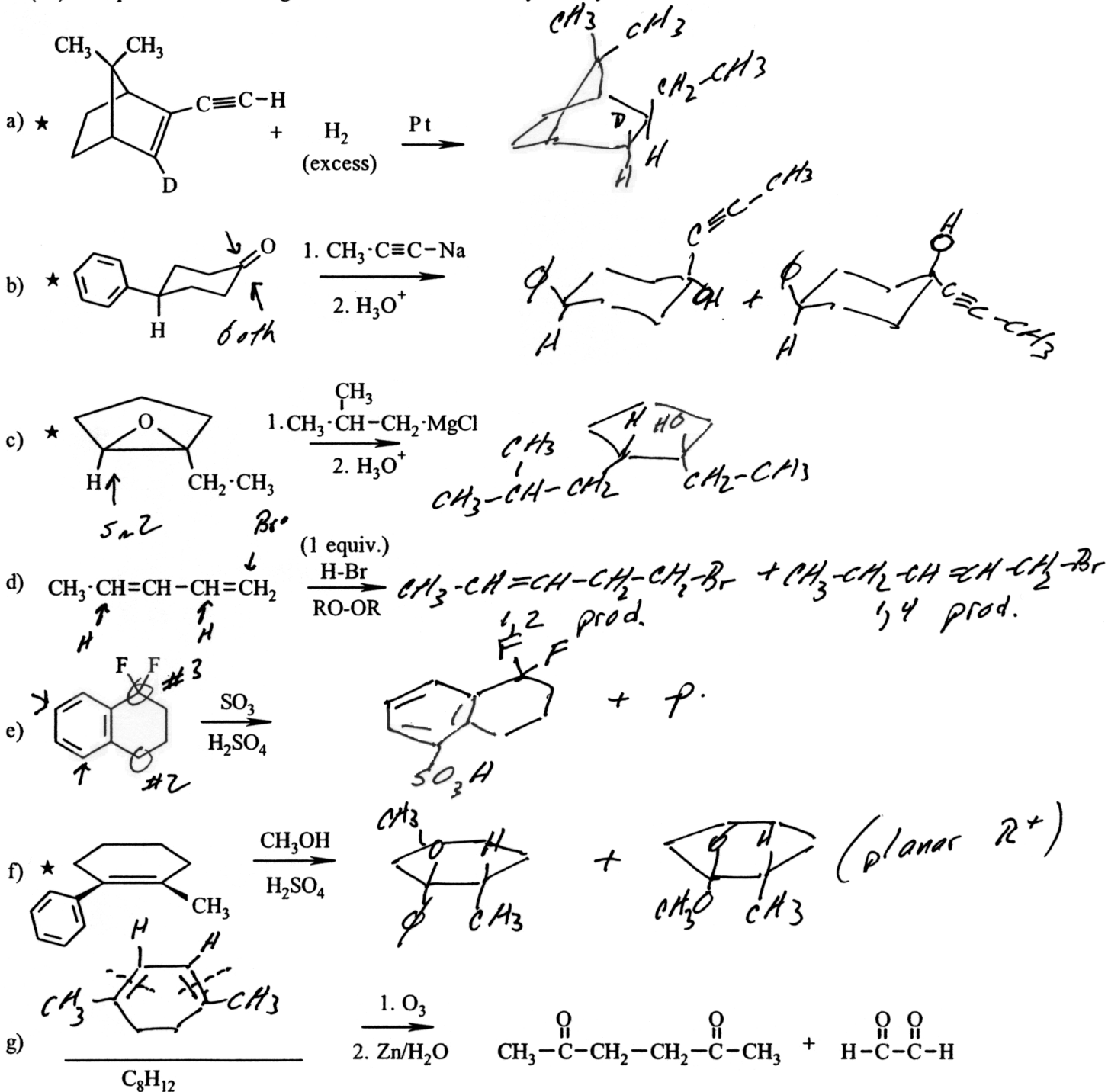
6. (7) A compound having the molecular formula $C_7H_{14}O$ exhibits the proton NMR spectrum tabulated below. Without reference to NMR chemical shift tables, indicate the part-structure suggested by each resonance, and predict the structure of the molecule. Label the hydrogens in your structure that correspond to the observed peaks.

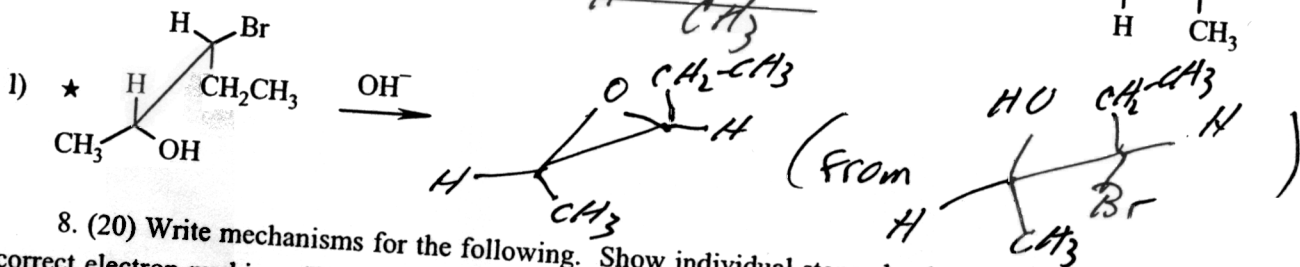
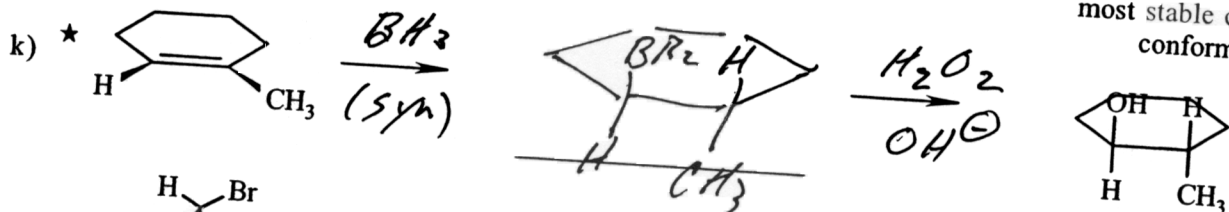
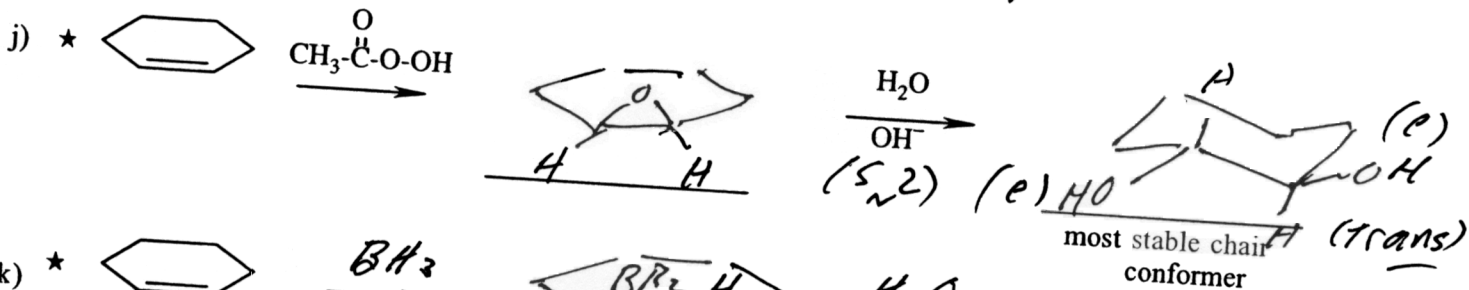
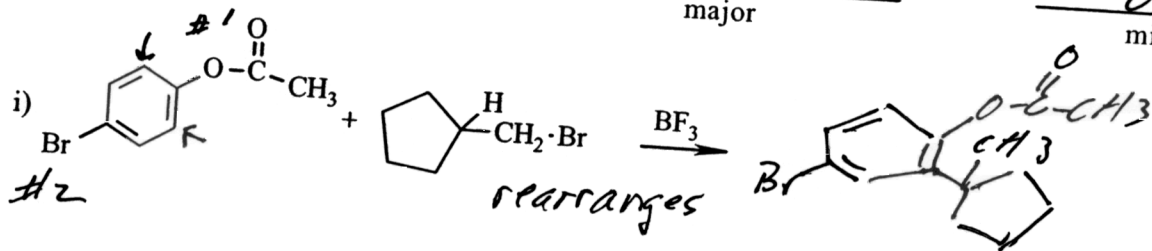
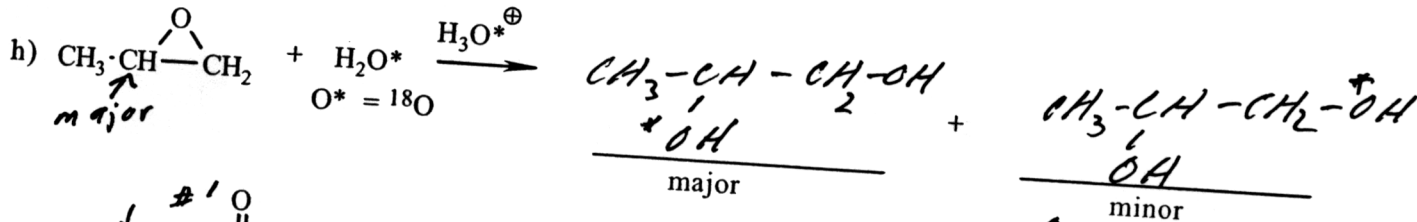
IHD = 1

δ (ppm)	Part-structure
A 0.9 (3H, t)	$\boxed{CH_3}-CH_2-$
B 1.6 (2H, sex)	$CH_3-\boxed{CH_2}-CH_2-$
C 2.3 (2H, t)	$-\overset{O}{\parallel}C-\boxed{CH_2}-CH_2-$

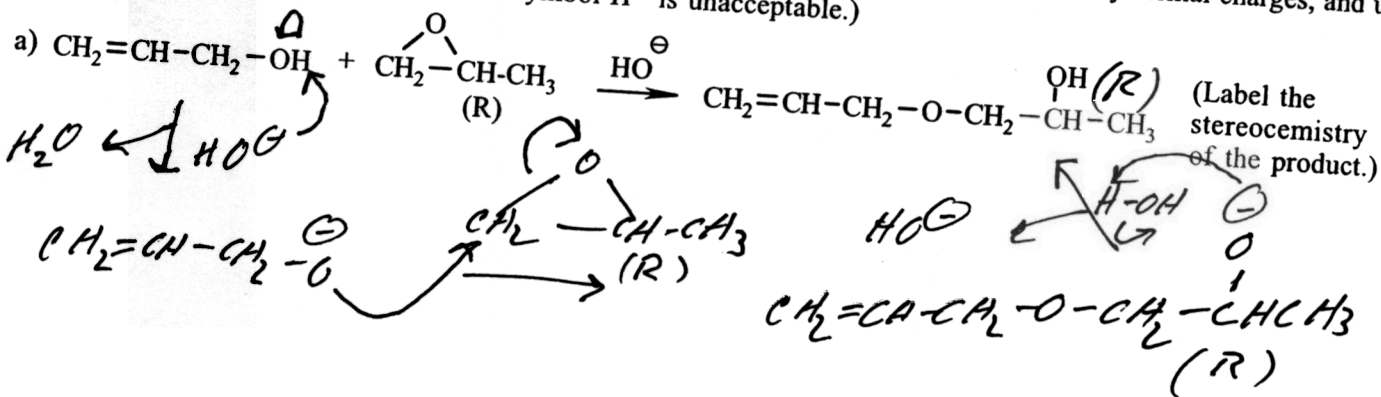
$A \quad B \quad C \quad \overset{O}{\parallel}$
 $CH_3-CH_2-CH_2-C-CH_2-CH_2-CH_3$

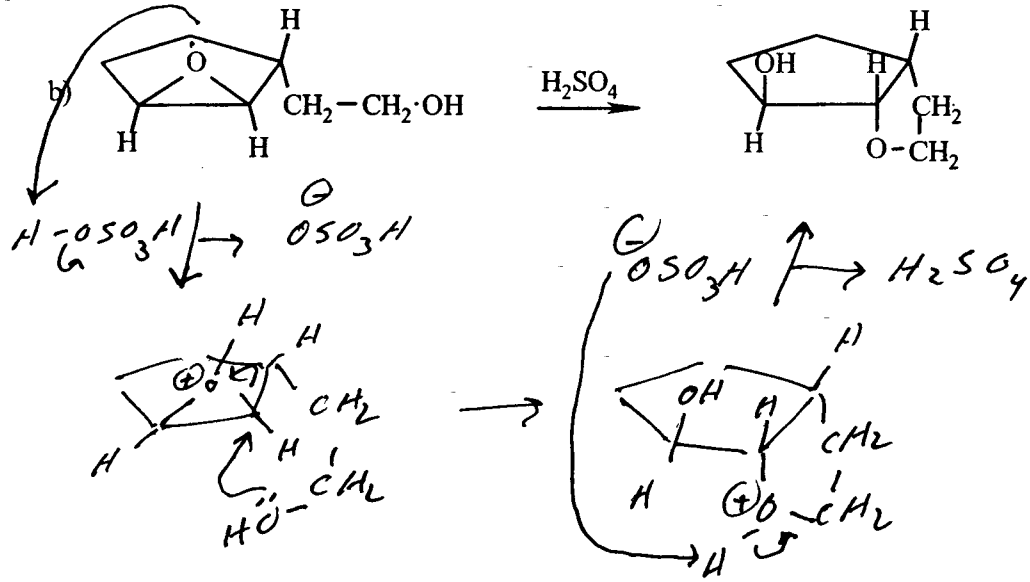
7. (72) Complete the following. Indicate stereochemistry clearly for those marked with a star.



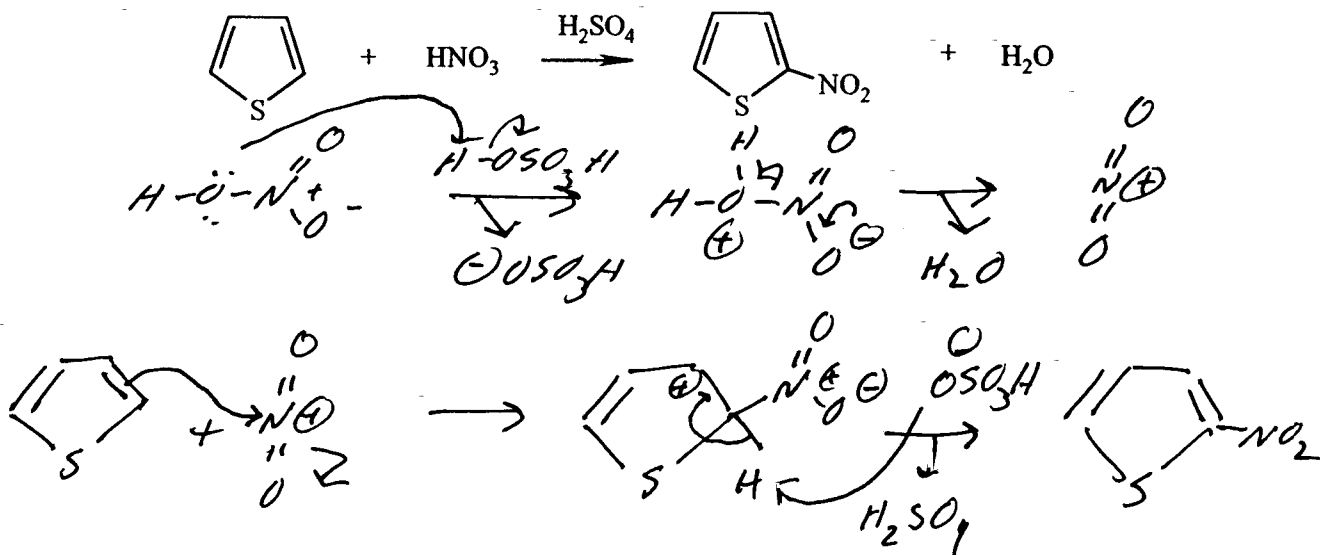


8. (20) Write mechanisms for the following. Show individual steps clearly, include any formal charges, and use correct electron pushing. (The use of the symbol H^+ is unacceptable.)

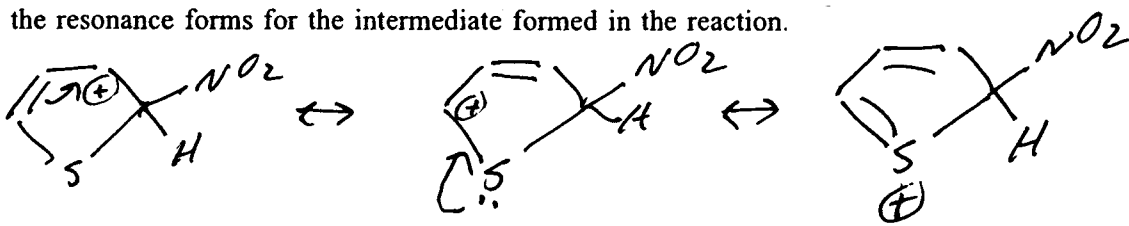




9. (12) The compound below (thiophene) exhibits aromatic behavior, including the electrophilic substitution reaction shown. a) Give a mechanism for the reaction. Show individual steps clearly, include any formal charges, and use correct electron pushing. (The use of the symbol H^+ is unacceptable.)



b) Give the resonance forms for the intermediate formed in the reaction.



10. (10) Suggest a synthesis for the following target molecule, from the indicated starting materials as well as any other necessary reagents. Show all intermediate reaction products. (Note. Mechanisms are not wanted here, just a sequence of reactions, showing the reagents and product for each one.)

