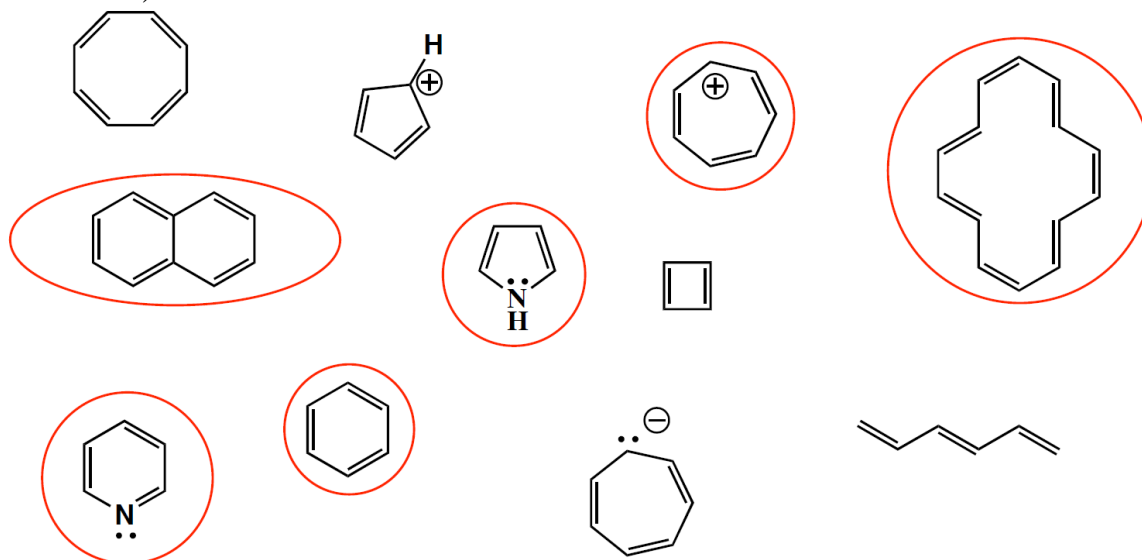
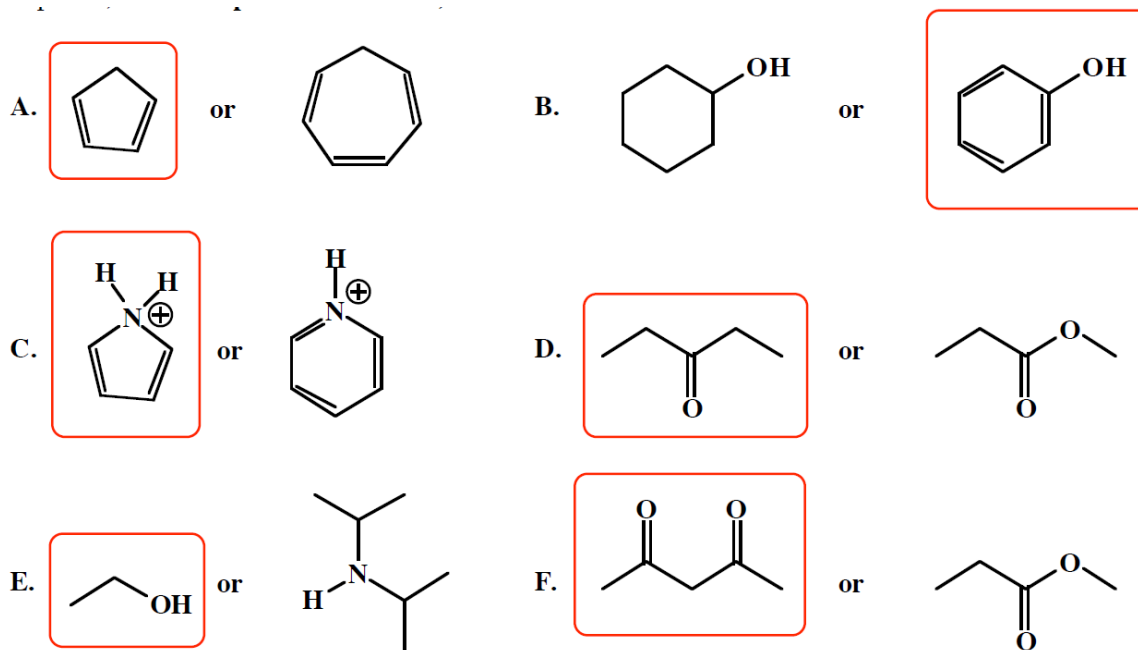


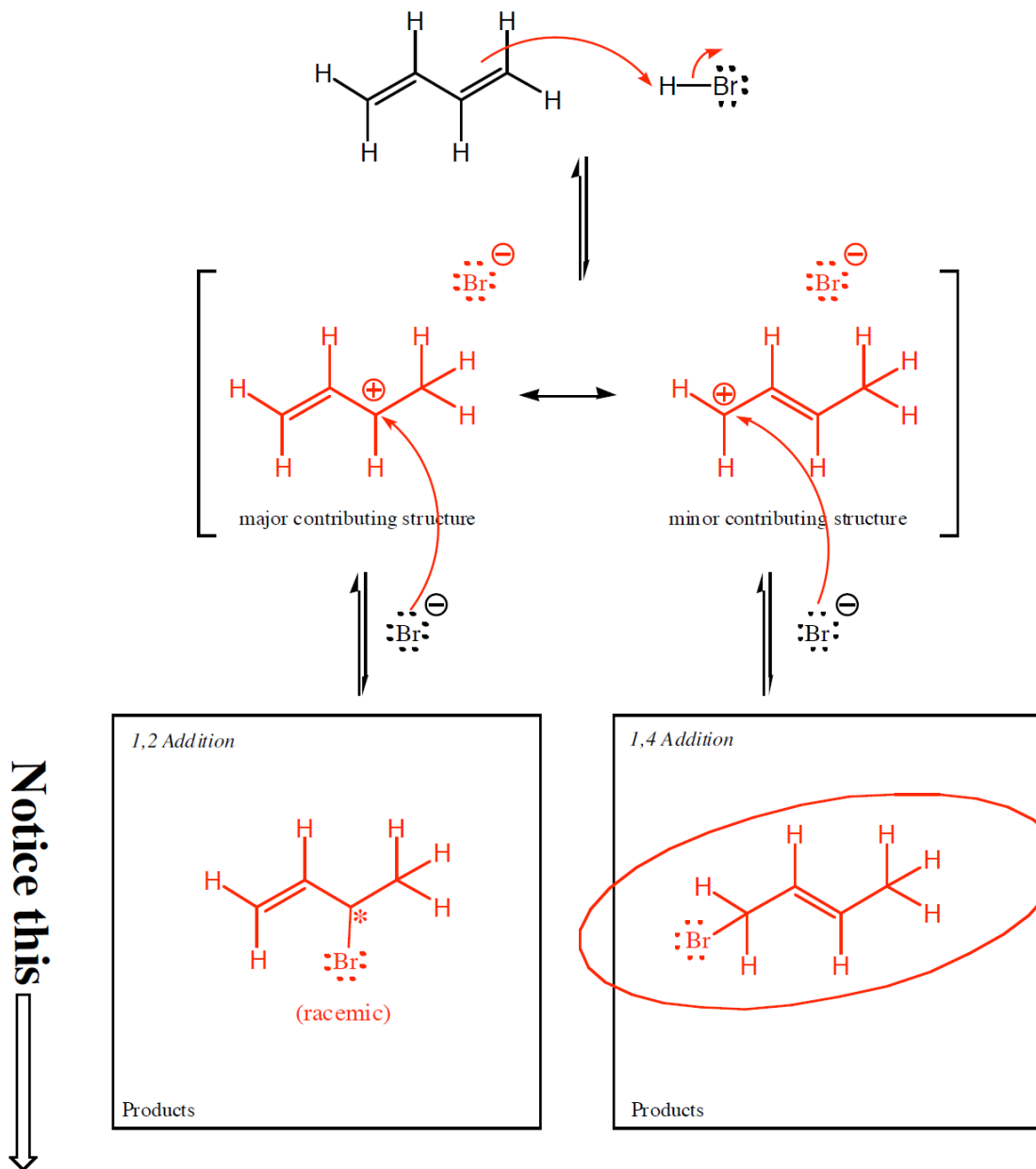
1. Below, circle all the molecules that can be called aromatic. (Do not make any mark on, around, or beside any molecule below that cannot be considered aromatic.)



2. For each pair of molecules, circle the one that is more acidic.



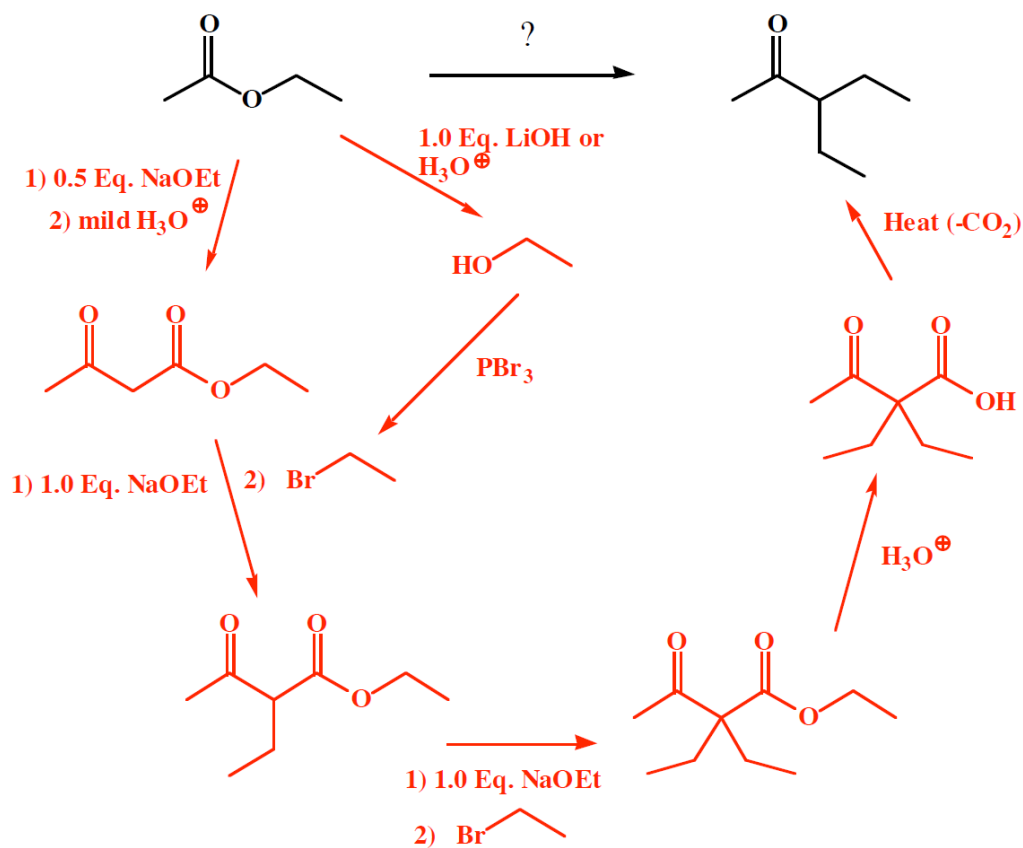
12. (18 pts) Complete the mechanisms below that shows how HBr adds to a conjugated diene to give both 1,2 addition and 1,4 addition. Use arrows to show the movement of all electrons, and be sure to draw all lone pairs of electrons and all formal charges. If a racemic product is formed, just put an asterisk (\*) next to the chiral center and write "racemic" under it.



(4 pts) Draw a circle around the product you drew that will predominate when the reaction is run under conditions of **thermodynamic control**.

15. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When in doubt, draw the molecule!

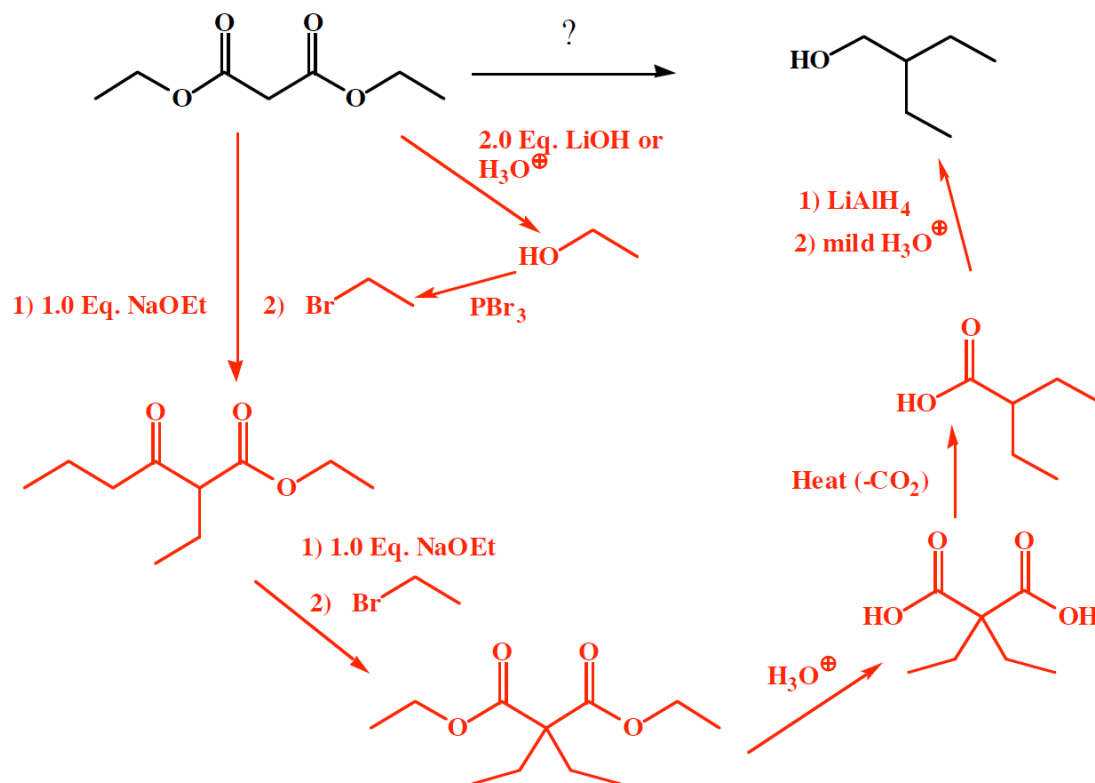
B) (16 pts)



**Recognize** this as the methyl ketone (KRE) product of an acetoester synthesis. **Recognize** also that acetoester is the product of a Claisen reaction derived from the starting ethyl acetate. **Recognize** also that the required two carbon unit needed for alkylation can be derived from hydrolysis of the starting ethyl ester, followed by reaction with  $\text{PBr}_3$ .

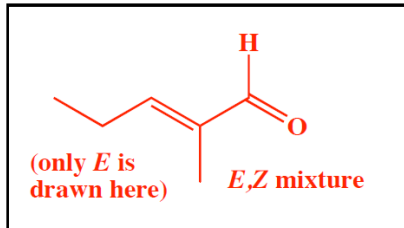
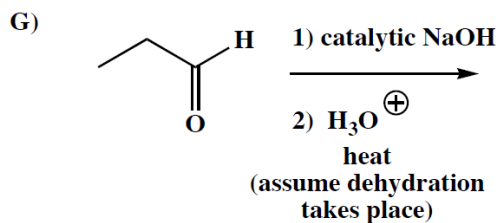
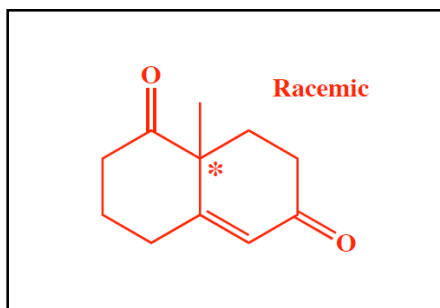
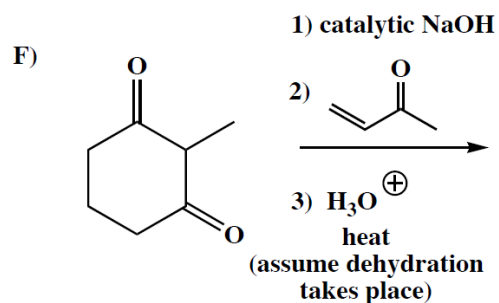
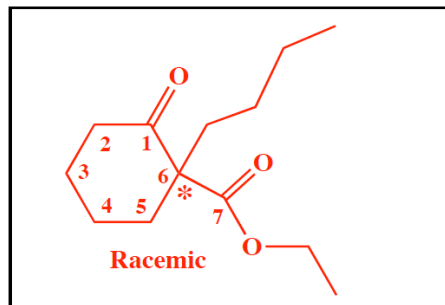
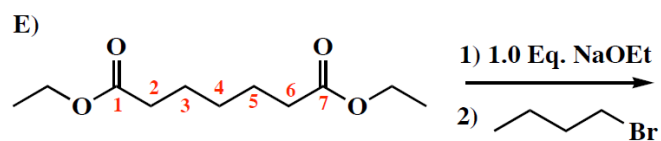
15. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

C) (16 pts)



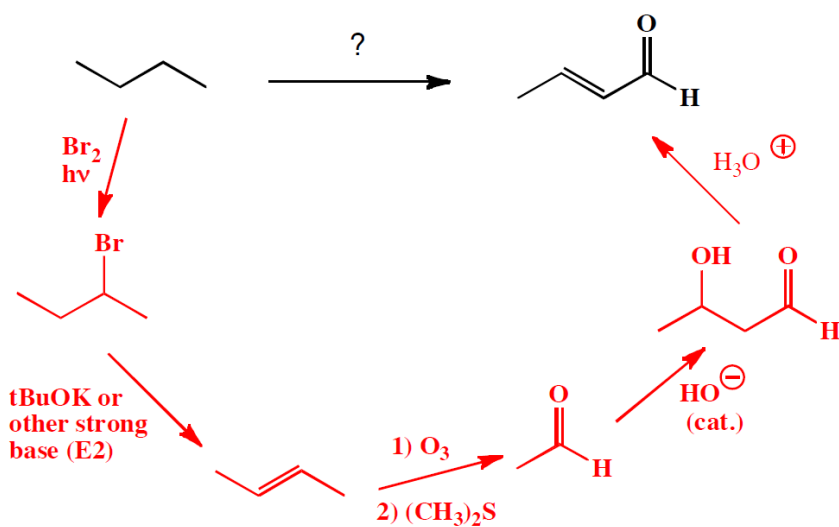
**Recognize** this as a malonic ester synthesis because malonic acid is the starting material given. The required two carbon piece can be derived from ethanol liberated by hydrolysis of the diethyl malonate followed by conversion to a primary alkyl halide using PBr<sub>3</sub>. The hard part of this one is seeing that the product does not have a KRE directly, but needs to be **recognized** as a reduced carboxylic acid, a transformation that requires LiAlH<sub>4</sub> and mild acid workup.

10. (3 or 5 pts each) For the following reactions, draw the predominant product or products. **When a new chiral center is created, mark it with an asterisk (\*) and if a racemic mixture is produced, you must write "racemic" under your structure. If an E,Z mixture is produced as the result of a dehydration step, write "E,Z mixture", but you only have to draw one isomer, not both.** These directions are different than you may have seen before, and are intended to make it easier for you. You should read them again so you know what we want.



14. (10 pts) Using any reagents turn the starting material into the indicated product. All carbon atoms must come from the starting material. Draw all molecules synthesized along the way. When in doubt, draw the molecule! Label all chiral centers with an asterisk (\*) and make sure to right "Racemic" where appropriate.

Remember, all of the carbons of the product must come from the given starting material.



**Recognize** the final product as resulting from dehydration of the aldol product ( $\beta$ -hydroxy aldehyde). The required aldehyde for the aldol reaction is acetaldehyde, which can be derived from the ozonolysis of 2-butene. **Recognize** that 2-butene can be derived from the starting material through the sequence of free radical halogenation followed by E2 elimination in base.