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**Points by question**

1 \_\_\_\_\_ /22

2 \_\_\_\_\_ /16

3 \_\_\_\_\_ /16

4 \_\_\_\_\_ /9

5 \_\_\_\_\_ /8

6 \_\_\_\_\_ /8

7 \_\_\_\_\_ /32

8 \_\_\_\_\_ /22

9 \_\_\_\_\_ /20

10 \_\_\_\_\_ /22

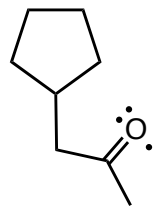
**Points Removed for cover errors** \_\_\_\_/2

**Extra Credit** \_\_\_\_/5

**Total (incl Extra)** \_\_\_\_\_/175+5

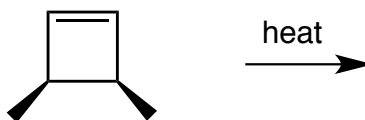
**\*\*YOU ARE NOT ALLOWED TO TAKE SPARE COPIES OF THIS EXAM FROM THE TESTING ROOM\*\***

Question 1 (22 pts.) Show how you would make the target compound on the right from the starting compound on the left. Show reagents and conditions where appropriate, and the structures of important intermediate compounds. Do not show any (arrow pushing) mechanisms. Ignore stereochemistry.



Question 2 (16 pts)

a) Give the curved arrow-pushing for the following electrocyclic ring opening reaction



b) How many electrons are involved in the reaction? \_\_\_\_\_

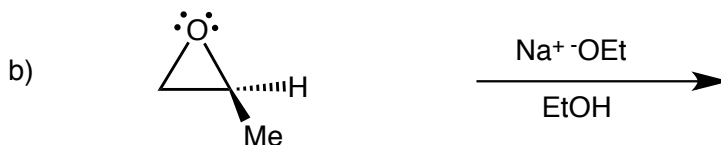
c) Will the ALLOWED reaction proceed via a Huckel or a Mobius transition state?

\_\_\_\_\_

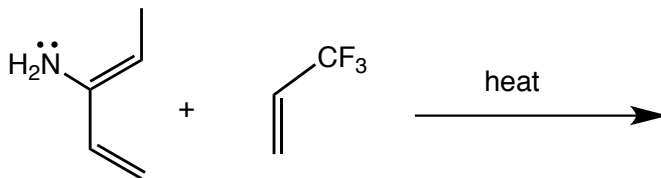
d) Will the ALLOWED reaction proceed via conrotatory or disrotatory ring opening?

\_\_\_\_\_

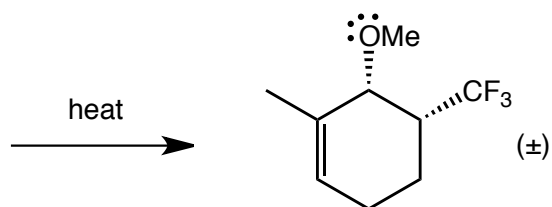
Question 3 (16 pts) Give the major organic products of the following reactions, indicate the stereochemistry using wedged/dashed bonds as appropriate and be sure to indicate the presence of any racemic mixtures.



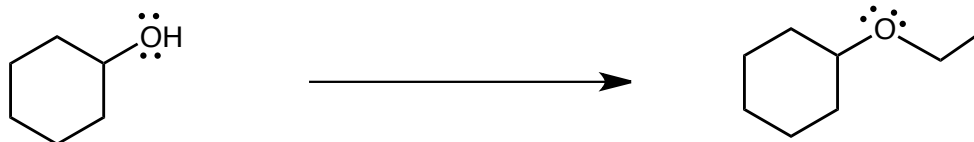
Question 4 (9 pts) Give the major organic product of the following reaction, indicate the stereochemistry using wedged/dashed bonds as appropriate and be sure to indicate the presence of any racemic mixtures. **State whether a solution of the product(s) would be optically active or not, with a very brief explanation.**



Question 5 (8 pts) Give the diene and dienophile that react to give the provided structure in a Diels-Alder reaction

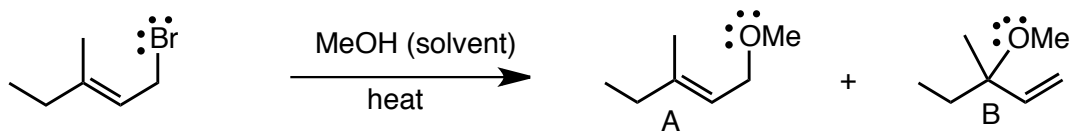


Question 6 (8 pts.) Give the missing reagents/conditions to perform the following reaction



Question 7 (32 pts.)

a) provide a curved arrow-pushing mechanism for formation of both products of the following reaction, indicate the Lewis acid/base at each step, LA/LB, and whether they are also Bronsted acids/bases, BA/BB. **Show all important resonance contributors for the intermediates.**

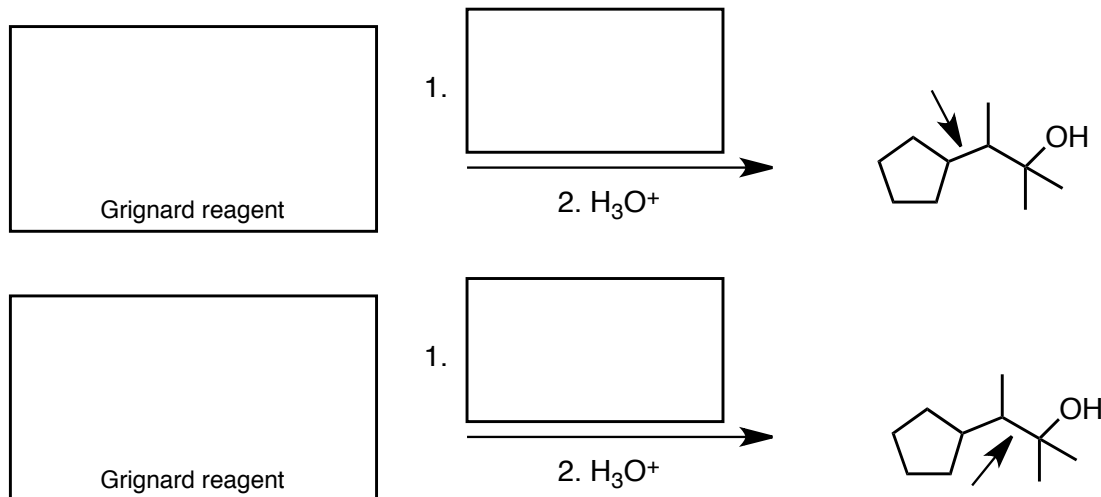


- b) give the number of steps in your mechanism for product A \_\_\_\_\_  
give the number of steps in your mechanism for product B \_\_\_\_\_

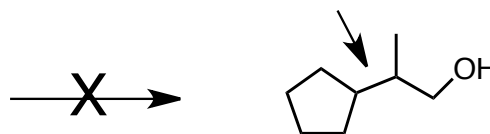
c) Indicate which product would be formed under conditions of kinetic control and which would be formed under conditions of thermodynamic control, AND, which would be the major product at high temperatures AND at low temperatures, **give a BRIEF explanation**

## Question 8 (22 pts.)

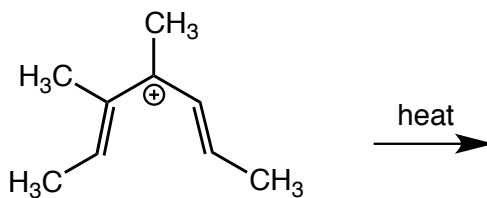
a) For the C-C bonds in the provided structure indicated by the arrow, give the Grignard reagent and the structure it would react with to make that bond. Put the structures in the relevant boxes (the acid workup step is already included for you). Ignore stereochemistry in these problems.



b) BRIEFLY explain why the bond indicated in the structure below could not be made in a Grignard reaction

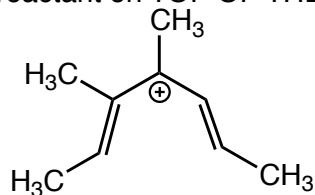


Question 9 (20 pts) The following cation undergoes an electrocyclic ring closure reaction



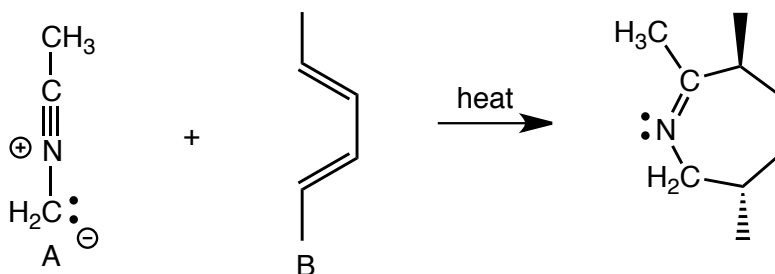
a) Give the curved arrow-pushing and the product of the reaction, and indicate whether the product is achiral, a racemic mixture or a meso compound

b) Draw the HOMO of the reactant on TOP OF THE STRUCTURE below



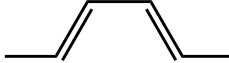
c) Does the allowed reaction proceed via a conrotatory or a disrotatory ring closure?

Question 10 (22 pts.) In this question you are going to work out whether the reaction **SHOWN** would be allowed or forbidden *based on the rules for pericyclic reactions*  
For this reaction.....



a) Draw the arrow-pushing to account for the bond breaking/making

b) Draw the HOMO of reactant **A** on **TOP** of the structure  $\longrightarrow$   **A**  
**re-drawn for you here**

c) Draw the LUMO of reactant **B** on **TOP** of the structure  $\longrightarrow$   **B**  
**re-drawn for you here**

d) Would an **ALLOWED** reaction between these two species be suprafacial/suprafacial or suprafacial/antarafacial? \_\_\_\_\_

e) Would an **ALLOWED** reaction between these two species proceed via a Huckel or a Mobius transition state? \_\_\_\_\_

f) Assuming the reaction is **SUPRAFACIAL** for reactant A, is **THE REACTION SHOWN** above allowed or forbidden? \_\_\_\_\_

Extra Credit (5 pts) Which of the following chemical properties enables the pharmacological activity of the drug olanzapine?

aromatic

non-aromatic

anti-aromatic