Massachusetts Institute of Technology
Organic Chemistry 5.13

Wednesday, October 22, 2003 Prof. Timothy F. Jamison

Hour Exam #2

Name _____

(please both **print** and **sign** your name)

Official Recitation Instructor _____

Directions: *Closed book exam, no books, notebooks, notes, etc. allowed. However, calculators, rulers, and molecular model sets **are** permitted.*

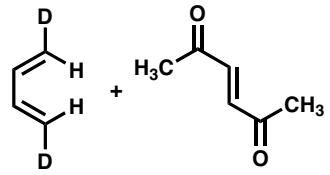
Please read through the entire exam before beginning, in order to make sure that you have all the pages and in order to gauge the relative difficulty of each question. Budget your time accordingly.

Show all of your work if you wish to receive partial credit.

You should have **7** pages total: **5** exam pages including this page and **2** blank pages for scratchwork.

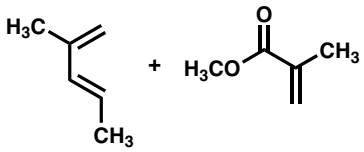
Question:		**Grader:**
1. _____/	**64 points**	_____
2. _____/	**18 points**	_____
3. _____/	**18 points**	_____
Total: _____/	**100 points**	_____

1. (**64 points total, 4 points each**) In each box below, draw the structure of the **major** product of the reaction. **Indicate** relative **stereochemistry** where appropriate. If **no reaction** occurs, put a large **X** in the box. (Note: "D" = deuterium, ^2H)



Δ

a.

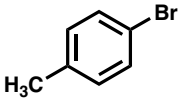


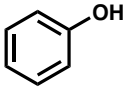
Δ

b.

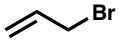
c.

NaOH

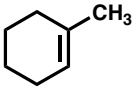




NaOH



d.



O_3

e.

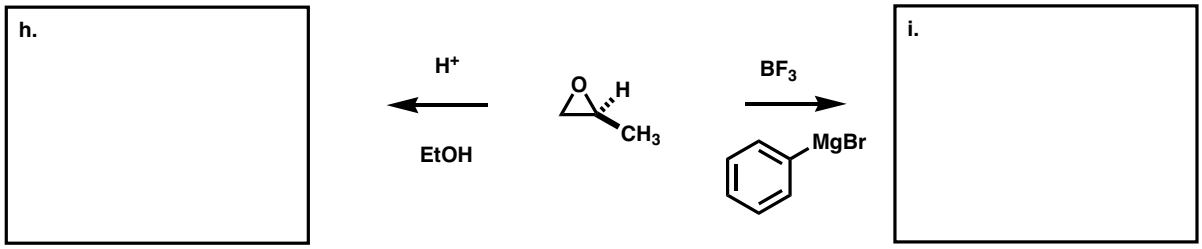
$(CH_3)_2S$

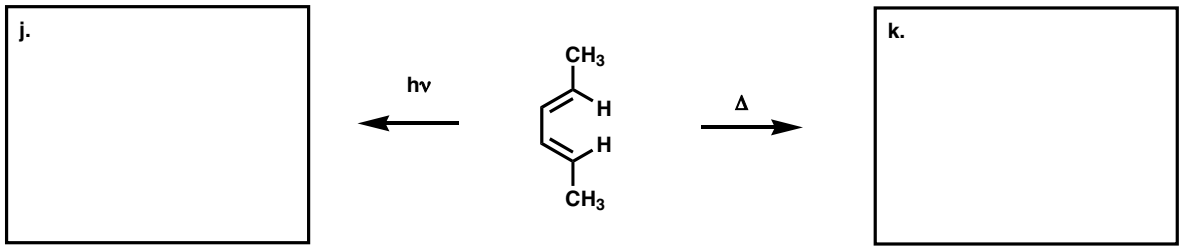
f.

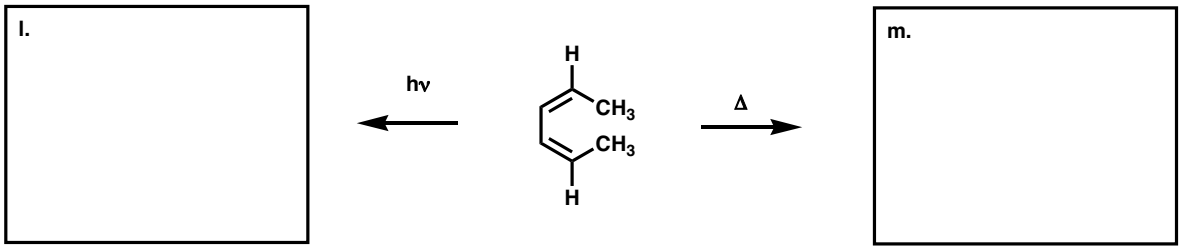
$NaBH_4$

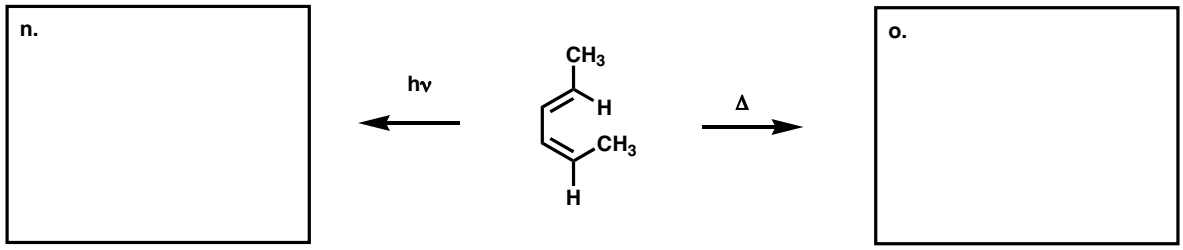
g.

(1., continued – see previous page for directions)

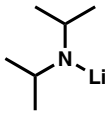








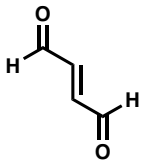
2. (**18 points**) Using ***only*** **lithium diisopropylamide (LDA), 1,3-butadiene, iodomethane, fumaric dialdehyde, triphenylphosphine,** and any other **inorganic reagents**, propose a synthesis of *trans,trans*-(1,5)-cyclodecadiene. Write your synthesis in the forward direction (not retrosynthetic analysis), with the reagents (if any) required for each step above each arrow.



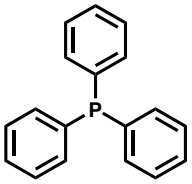
LDA

1,3-butadiene

iodomethane

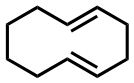


fumaric dialdehyde



triphenylphosphine

(This is the target molecule.)



***trans,trans*-(1,5)-cyclodecadiene**

3. (18 points) The relative energy levels of the molecular orbitals for the **cyclopropenyl cation, anion, and radical** can be derived using **Frost's Circle ("Polygon Rule")** (below).

a. **(3 points) Clearly** draw the "**zero energy" line** on all three diagrams below, i.e. for all three species (cation (A.), anion (B.), radical (C.)).

b. **(3 points)** In the ***box next to*** the **energy level for each orbital**, write "bonding", "non-bonding", or "anti-bonding", as appropriate.

c. **(6 points**) **Populate** the orbitals (**bold horizontal lines**) of each species (cation (A.), anion (B.), radical (C.)) with the appropriate number of electrons to indicate the **ground state configuration** (lowest energy) in each case.

d. **(6 points**) In the ***shaded, rounded box to the right of* each** diagram, indicate whether the species is **aromatic** or **anti-aromatic** as defined by Hückel's rule.