Massachusetts Institute of Technology
Organic Chemistry 5.13

Friday, October 22, 2004 Prof. Timothy F. Jamison

Hour Exam #2

Name _____

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

Official Recitation Instructor _____

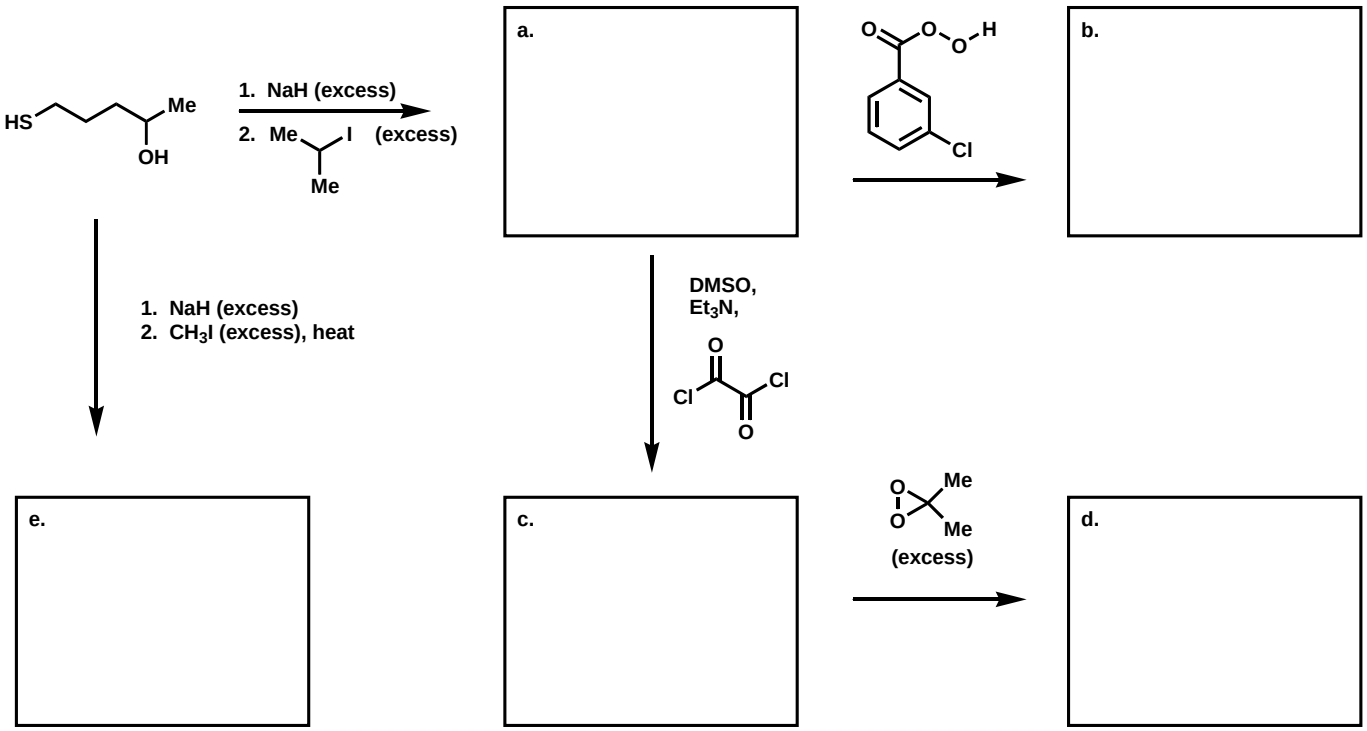
Directions: *Closed book exam, no books, notebooks, notes, etc. allowed. Calculators are **not** permitted for this exam. However, rulers and molecular model sets **are** permitted.*

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.

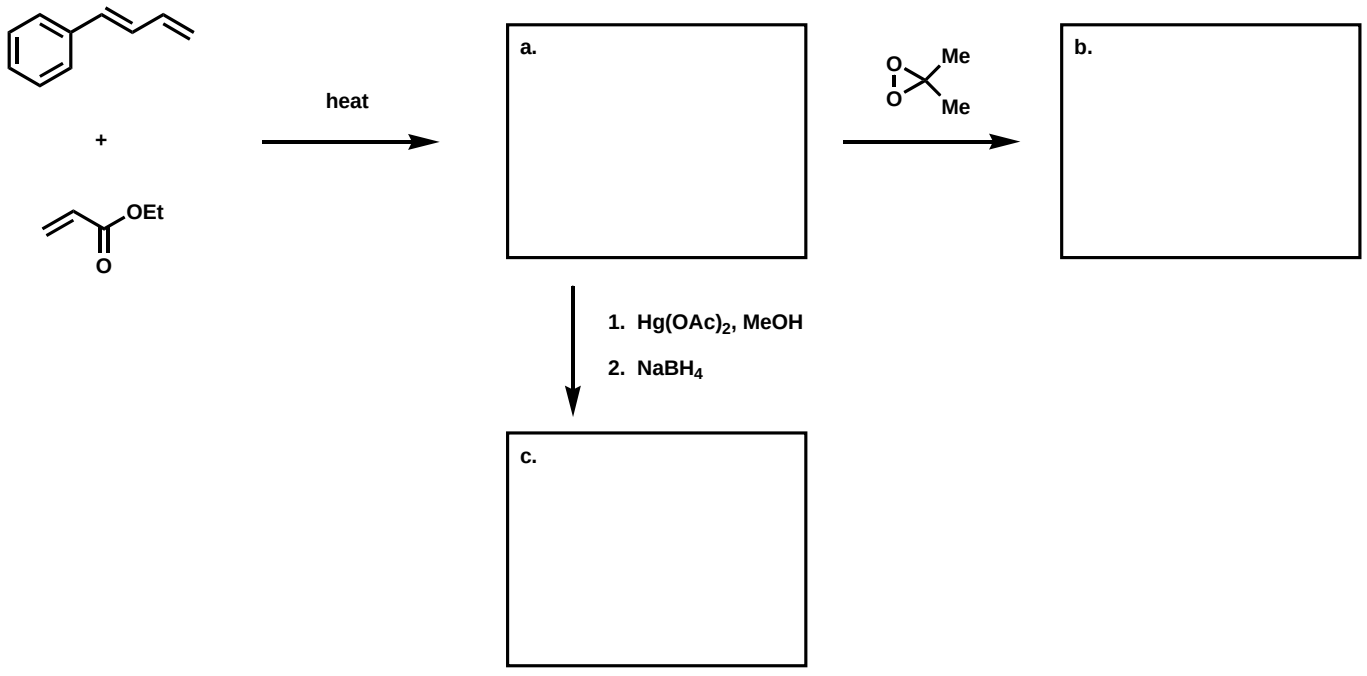
Show all of your work if you wish to receive partial credit. You should have **7** pages total: **5** exam pages including this page and **2** blank pages for scratchwork.

Question:		**Grader:**
1. _____/	**15 points**	_____
2. _____/	**12 points**	_____
3. _____/	**25 points**	_____
4. _____/	**48 points**	_____
Total: _____/	**100 points**	_____

1. (15 points total, 3 points each) In each box below, draw the structure of the **major** product of the reaction. If **no reaction** occurs, put a large **X** in the box.

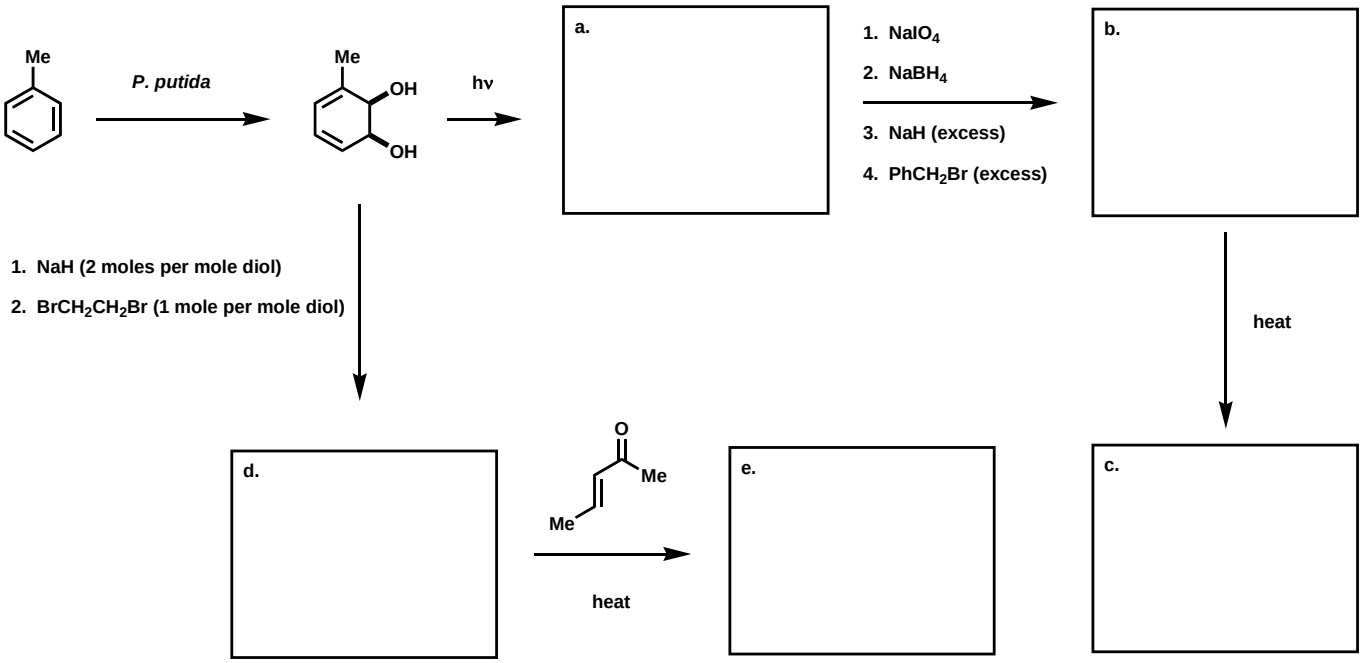


2. (12 points, 4 points each) In each box below, draw the structure of the **major** product of the reaction. *Clearly indicate the* ***relative stereochemistry*** of the major product, where appropriate. If **no reaction** occurs, put a large **X** in the box.



3. (25 points, 5 points per box) The bacterium *Pseudomonas putida* possesses a number of enzymes that are capable of catalyzing several fascinating chemical reactions, including an unusual oxidation of an *aromatic ring*, an enantioselective (and site-selective) dihydroxylation of toluene that affords the diol shown below.

In each box below, draw the structure of the **major** product of the reaction. *Clearly indicate the* ***relative stereochemistry*** of the major product, where appropriate. If **no reaction** occurs, put a large **X** in the box.

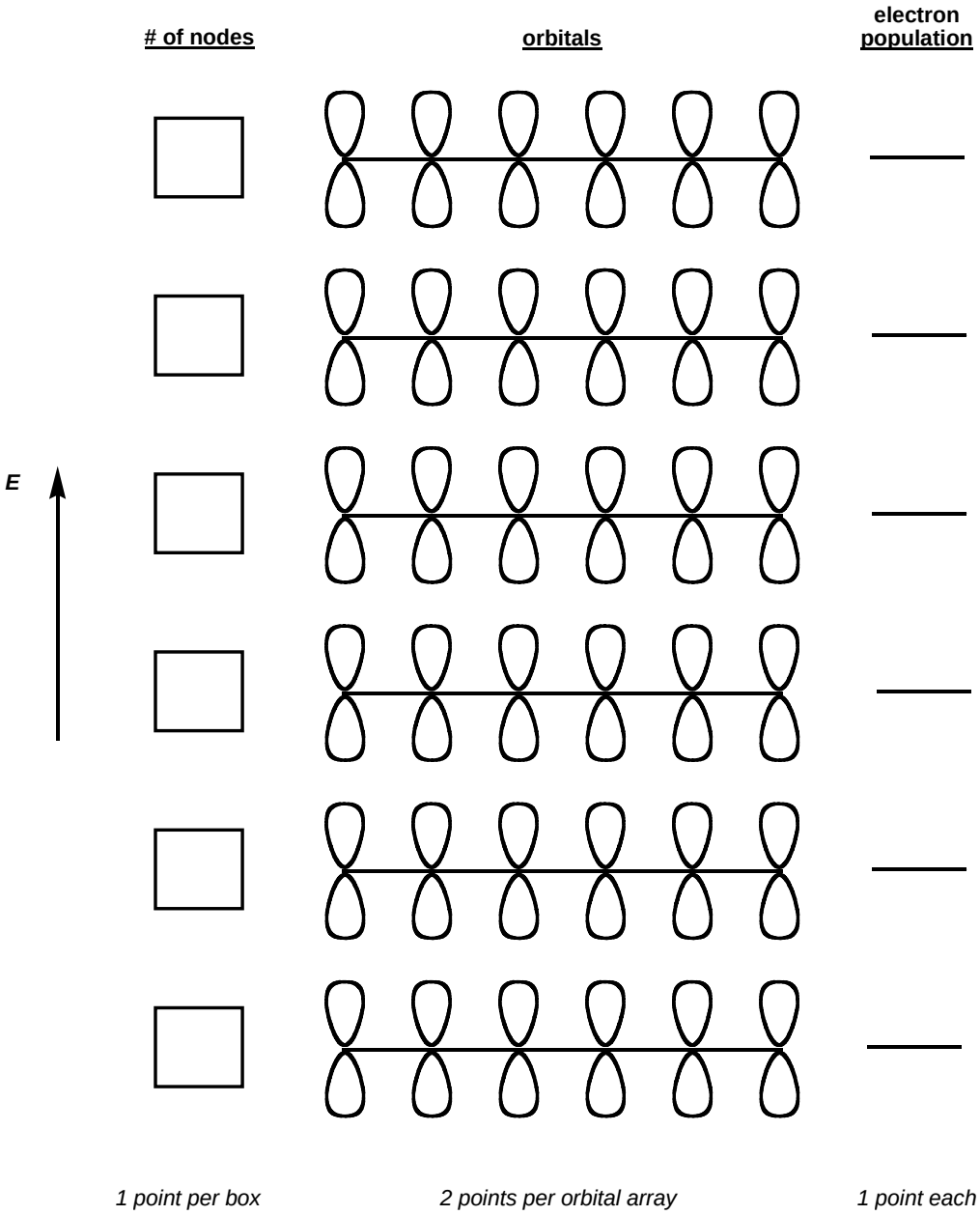


4. (48 points total)

a. Draw the **orbitals** (by shading the lobes appropriately) at each energy level for **1,3,5-hexatriene** (2 points each).

b. Write the **number of nodes** in the box to the left of each orbital array (1 point each).

c. For the ground state of 1,3,5-hexatriene, **draw** the **electron population** for each orbital on the line to the right of each orbital array. For each electron, clearly indicate whether it is "spin up" or "spin down". If there are no electrons in a given orbital, leave it blank (1 point each).



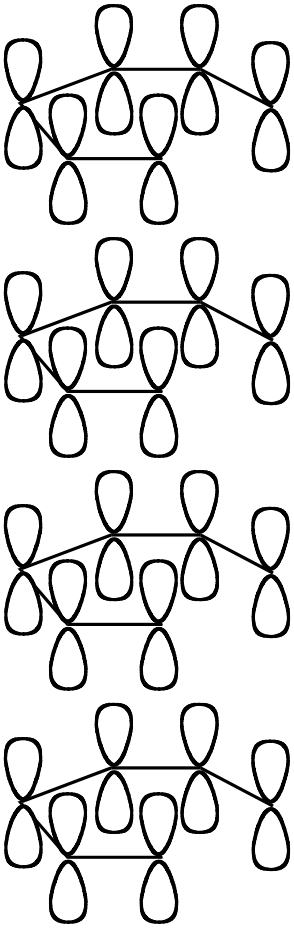
1 point per box *2 points per orbital array* *1 point each*

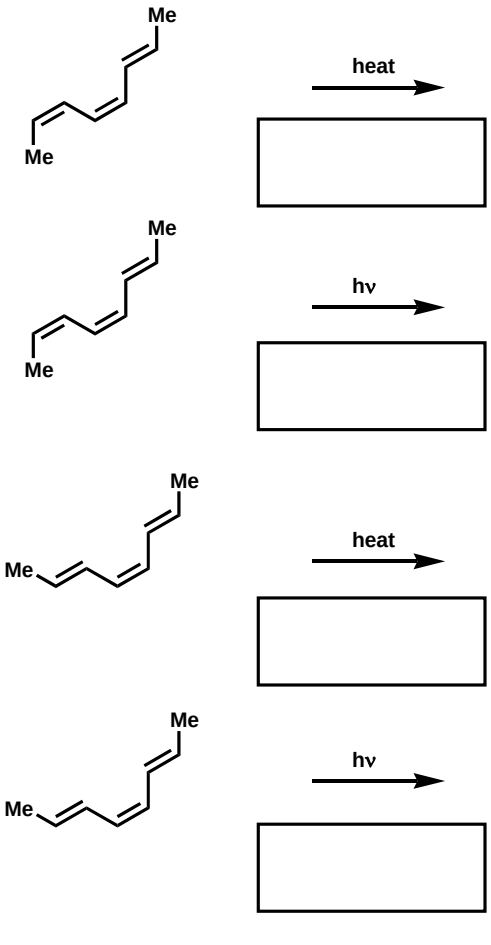
4. (continued)

d. For each reaction shown below, indicate which energy level is used to predict the stereochemical outcome by **shading the appropriate lobes of the entire orbital array**. (The methyl groups are omitted for clarity; you do not have to draw them.)

e. In the box under each reaction arrow, **write conrotatory** or **disrotatory**, as appropriate.

f. In the box to the right of each reaction arrow, **draw** the **major product** of the reaction, ***clearly*** **indicating the relative stereochemistry**.





(shade appropriate lobes)
2 points each

(write "conrotatory" or "disrotatory")
1 point per box

(draw major product - show stereochemistry)
3 points per box