Depar	tment of Chemistry and Biochemistry
Chemistry 59-230/232	Final Exam
Time: 3 h	Dec. 16, 2005
NAME	ID#

LAB SECTION (or TA name)___

Note: **Please answer on the test paper.** There is an extra sheet for rough work at the back, but it will <u>not</u> be marked. <u>In some questions, there is a choice of questions to answer</u>. If all are answered, all will be marked. There are <u>140</u> marks on this exam.

1. Fill in the blanks with the structural formula or reagents required to complete the equation. Show any required catalysts over the arrow. Make sure your drawings show stereochemistry if it is important. <u>Do any</u> <u>ten (10)</u> (40 marks)





2a. (12 marks total) Draw the structure of *cis* 1-iodo-4-(isopropyl)cyclohexane is its most stable chair conformation. Label the non hydrogen substituents on the cyclohexane as axial or equatorial. In terms of size, an isopropyl is <u>larger</u> than an iodo group. (5 marks)

b. Draw the Newman projection of the following compound in its *least* stable <u>staggered</u> conformation, as viewed down the C2-C3 bond. With respect to size, $CH_2CH_2CH_3 > CH_3 > C(H)=CH_2 > Br > H$. What is the <u>name</u> of this compound, including its stereochemical descriptor(s) ? (7 marks)



3. a. (14 marks total)

Draw the complete mechanism for the following reaction. Take the reaction to completion. Indicate which steps are reversible (or irreversible). Provide a valid IUPAC name for the starting material, including the stereochemical descriptor. (9 marks)



b. In the reaction of an ester (lets say ethyl propanoate) with a Grignard reagents (let's say it's CH₃MgBr) one never gets a ketone as a product. Show by intermediates and reaction steps why is this the case (5 marks). The complete answer will include the structure of ethyl propanoate.

4. (27 marks total) Describe the relationship that exists between the following sets of compounds (i.e., enantiomer, diastereomer, geometric isomer, structural isomer, identical). Indicate any *meso* forms. a.

b. $(H_{3}C)_{2}CH \xrightarrow{H} CH_{3} \qquad H_{3}C \xrightarrow{H} H (H_{3}C)_{2}CH$ b. $(H_{3}C)_{2}CH \xrightarrow{H} CH_{3} \qquad (H_{3}C)_{2}CH$ c. $(H_{3}C)_{2}CH \qquad (H_{3}C)_{2}CH$ c. $(H_{3}C)_{2}CH \qquad (H_{3}C)_{2}CH$ for the term of ter



Also, identify the chiral centres for the right compound in c) as (R)- or (S)- (3 of 27 marks)

d. Draw the Fischer projection of (2S, 3S, 5R)-5-fluoro-2,3-hexanediol. (5 *of the* 27 marks).

e. Identify each carbon atom of the following with its hybridization. (3 marks)

C^{≝C−CH}₃

f. In the above compound (in e), assign the appropriate stereochemical descriptor to each alkene. Show your work (6 marks)

5. On the axes below, draw the energy/reaction coordinate profile for:

a. The reaction between $(CH_3)_3C-CI + NH_3$ to give $(CH_3)_3C-N^+H_3$ (the mechanism should be implied in the answer).

b. A four step reaction between A and B, where A is consumed in the 1^{st} step and B is involved in the 2^{nd} step. The 3^{rd} step is the slowest one.

In each of these cases, give the rate equation for the reaction. (10 marks total)

a)



rate (v) =



6. (**16 marks** total) Rank the following in terms of tendency to undergo $S_N 1$ substitution (as opposed to $S_N 2$). Give reasons for your ordering <u>and</u> the expected products. (13 of the 16 marks) Note the following dielectric constants: H_2O (81); acetone (23); CH_3CN (38); $CHCI_3$ (2).



d. Rank the following from best leaving group to worst leaving group ? (3 of the 16 marks)

CI⁻, Br⁻, I⁻, HO⁻, HS⁻

7. (10 marks) a and b Indicate all *reasonable* resonance forms of the following ions, using curved arrows to indicate electron movement. If there are *unreasonable* resonance forms, <u>either</u> do not draw them or label them as unreasonable. If there is a case for which there are no other resonance forms, state that fact. a.





8. (11 marks total) Show by equation how you carry out the following overall transformations. Show all reagents and the structures of each reaction product. There is quite possibly more than one correct way to accomplish this overall transformation. *DO one of a and b, but answer c regardless.*



c. What is the name of the final product compound in 8b? (3 of the 11 marks)

Bonus: (up to +5)

The reaction of ketones in the presence of hydroxide ion often gives 3-hydroxy ketones in a well known reaction called the aldol condensation. Could you suggest a plausible mechanism for this reaction?

