

Chemistry 2541

Fall Semester 2010; Final Exam

December 17, Friday, 12:00 to 1:55 pm

This exam has 8 problems (200 pts) on 10 pages. Make sure your copy is complete and correct.

Printed Name (LAST, First) _____

Your final grades will be posted on the web on Saturday morning.

*Please pick up your graded exams on Monday, December 20th
between 8:00 and 11:30 am or 1:00 to 2:00 pm in room Chem 319.
You must report any grading errors by 2:00 pm Monday, December 20.
No grade change will be possible after this time.*

Good Luck!

Chemistry 2541
Fall 2010; Final Exam

This exam has 8 problems on 10 pages. Make sure your copy is complete and correct.

Printed Name (Last, First) _____

Scores:

Problem 1. _____

Problem 2. _____

Problem 3. _____

Problem 4. _____

Problem 5. _____

Problem 6. _____

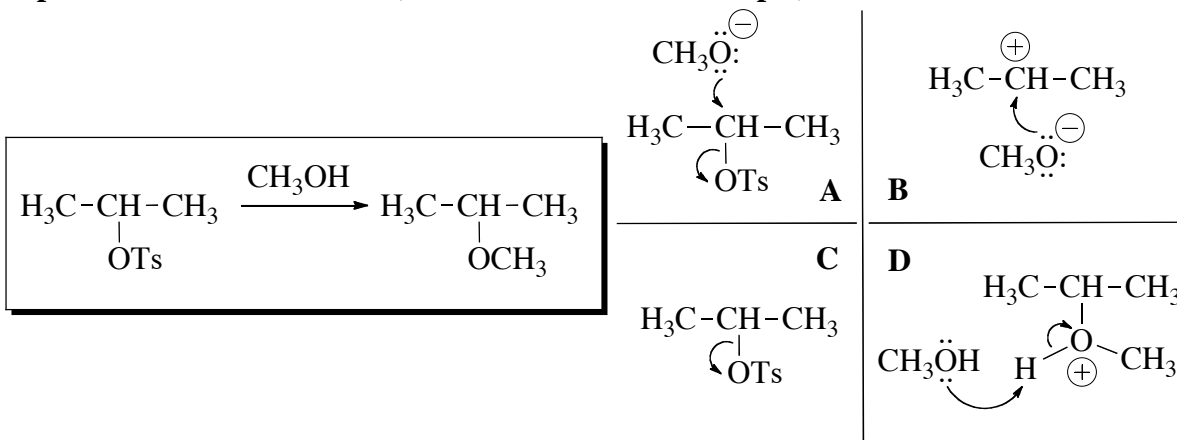
Problem 7. _____

Problem 8. _____

Total: _____

1. (17 pts) Answer the questions on mechanisms of the following reactions:

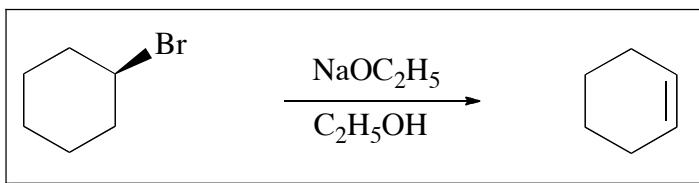
(a) Which one of the following four schemes (A-D) gives the best representation of the **rate-limiting step** of the reaction in the box (circle the correct answer; **5 pts**):



• What type of mechanism this reaction has? (circle correct answer, **3 pts**):

S_N1 S_N2 E1 E2 Electrophilic addition Radical substitution

(b) Answer questions on the mechanism of the reaction in the box:



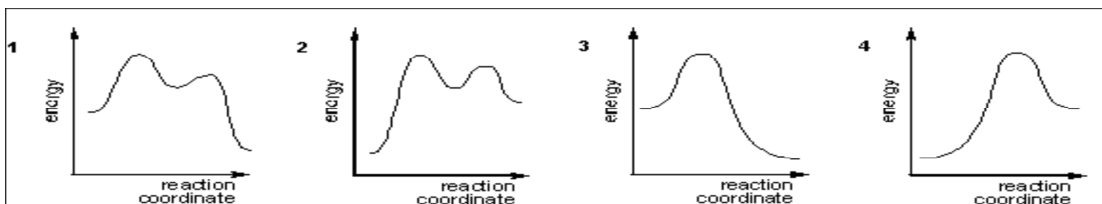
• Circle the correct **rate equation** for this reaction (**3 pts**):

Rate = k [RBr] Rate = k [RBr] [C₂H₅ONa] Rate = k [C₂H₅ONa] Rate = k [C₂H₅ONa] [Br⁻]

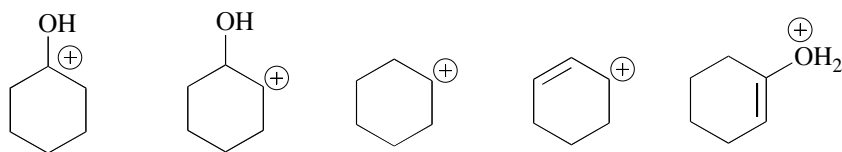
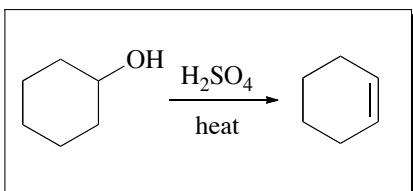
• What type of mechanism this reaction has? (circle correct answer, **3 pts**):

S_N1 S_N2 E1 E2 Electrophilic addition Radical substitution

• Circle the correct energy diagram for this reaction (**3 pts**):



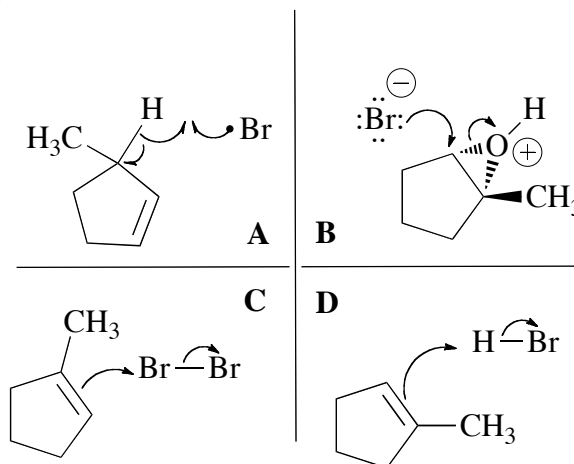
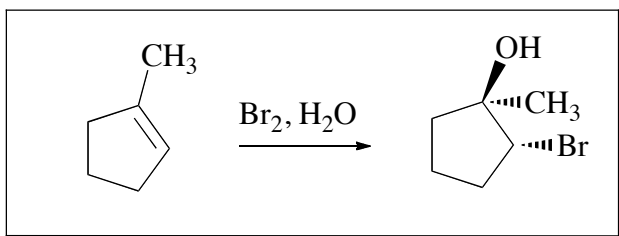
2. (19 pts) (a) Circle the structure of an **intermediate** in the reaction shown in the box (5 pts):



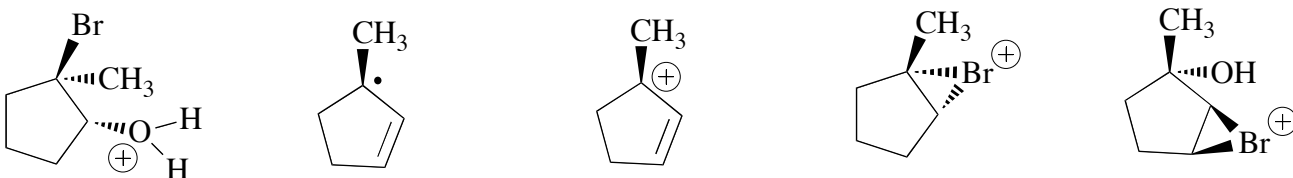
• What type of mechanism this reaction has? (circle correct answer, 3 pts):

S_N1 S_N2 E1 E2 Electrophilic addition Radical substitution

(b) Which one of the following four schemes (A-D) gives the best representation of the *initial step* of the reaction in the box (circle the correct answer; 5 pts):



• Circle the structure of the key **intermediate** of this reaction (3 pts).

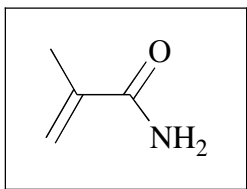


• What type of mechanism this reaction has? (circle correct answer, 3 pts):

S_N1 S_N2 E1 E2 Electrophilic addition Radical substitution

3. (22 pts) Answer the following questions on the structure of the molecules shown in the boxes below.

a) (12 pts) Answer the questions about types of bonds that are present in the following molecule (2 pts each correct answer):



Number of σ bonds formed by overlap of s and sp^2 orbitals: _____

Number of σ bonds formed by overlap of sp^2 and sp^2 orbitals: _____

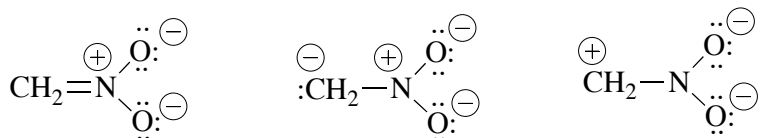
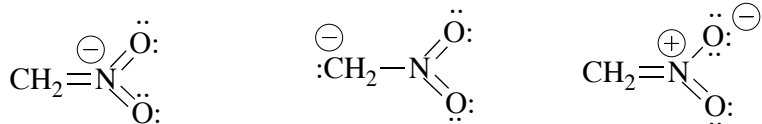
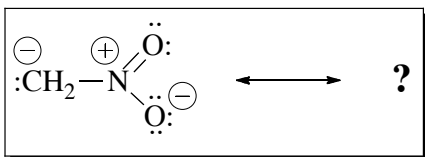
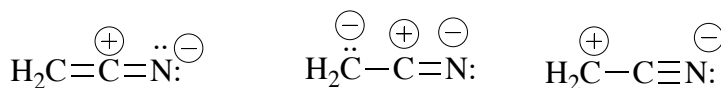
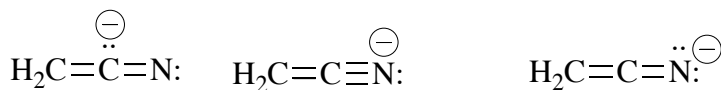
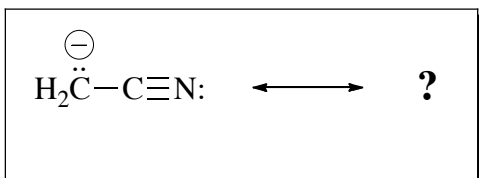
Number of σ bonds formed by overlap of s and sp^3 orbitals: _____

Number of σ bonds formed by overlap of sp^2 and sp^3 orbitals: _____

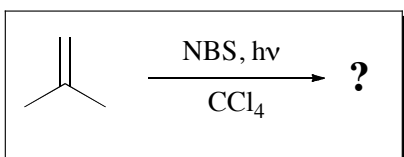
Total number of σ bonds: _____

Total number of π bonds: _____

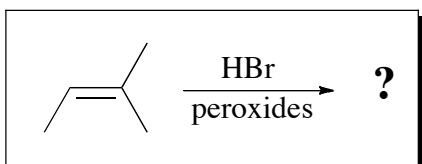
b) (10 pts) Circle the structure of the most important resonance contributors of the molecules in the boxes (5 pts each):



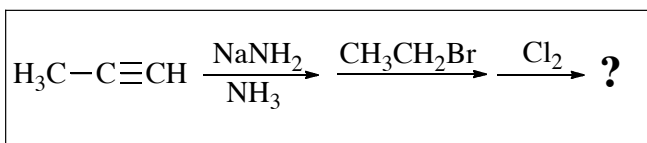
4. (40, 5 pts each) Circle the name of the **major product** in each of the following reactions:



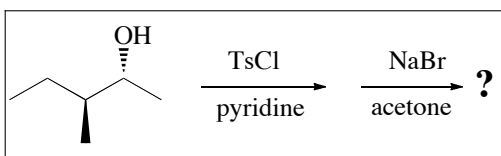
- (*E*)-1-bromopropene 2-bromo-2-methylpropane (*E*)-1,2-dibromopropene
 (*Z*)-1-bromo-2-methyl-1-propene 1,2-dibromo-2-methylpropane
 (*E*)-1-bromo-2-methyl-1-propene 3-bromo-2-methyl-1-propene



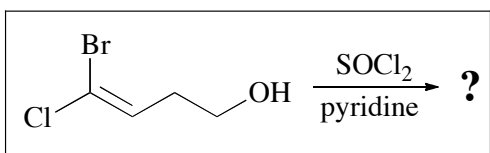
- 1-bromo-3-methyl-2-butene 1-bromo-2-methylbutane
 (*E*)-1-bromo-2-methyl-2-butene 2-bromo-2-methylbutane
 2-bromo-3-methylbutane 1-bromo-2-methyl-2-butene



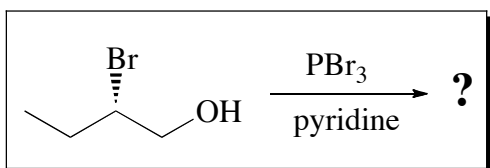
- (*E*)-2-pentene (*E*)-2,3-dichloro-2-pentene
 (*Z*)-2,3-dichloro-2-pentene (*E*)-1,2-dichloro-2-pentene
 (*Z*)-1,2-dichloro-2-pentene 1-chloro-2-pentyne



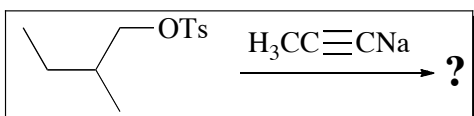
- (*S*)-2-bromo-3-methylpentane (*R*)-2-bromo-3-methylpentane
 (2*R*,3*S*)-2-bromo-3-methylpentane (2*S*,3*R*)-2-bromo-3-methylpentane
 (2*S*,3*S*)-2-bromo-3-methylpentane (2*R*,3*R*)-2-bromo-3-methylpentane



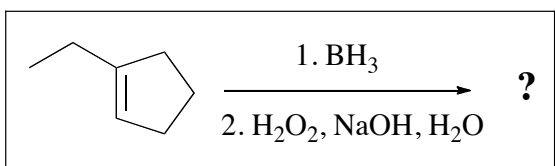
- (*E*)-1-bromo-1,4-dichloro-1-butene 4,4-dichloro-3-buten-1-ol
 (*E*)-1-bromo-1,4-dichloro-2-butene 4,4-dichloro-3-buten-2-ol
 (*Z*)-1-bromo-1,4-dichloro-1-butene 4,4-dibromo-3-buten-1-ol



- (2*S*,3*S*)-2,3-dibromobutane (2*R*,3*S*)-2,3-dibromobutane
 (*S*)-1,2-dibromobutane (*R*)-1,2-dibromobutane
 (2*R*,3*S*)-2,3-dibromobutane (2*R*,3*R*)-2,3-dibromobutane

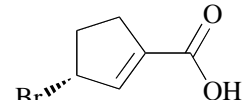
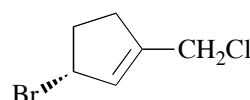
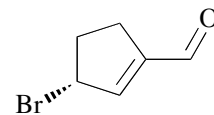
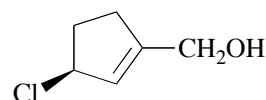
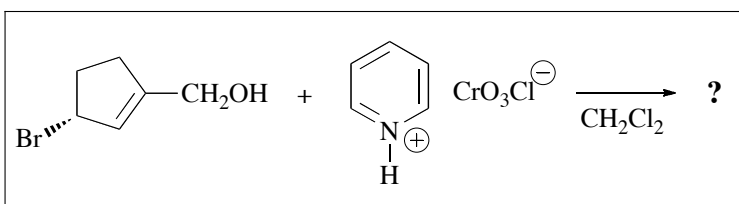
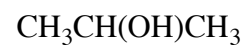
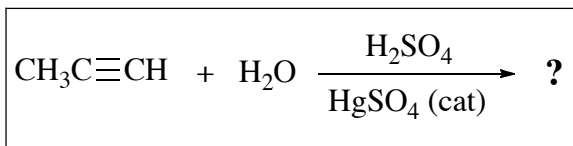
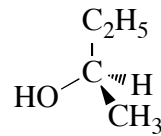
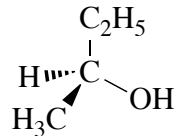
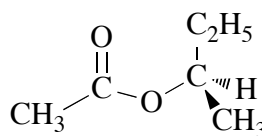
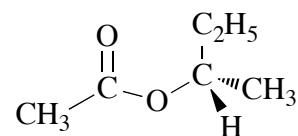
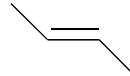
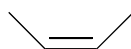
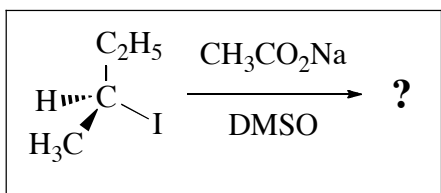
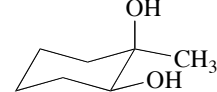
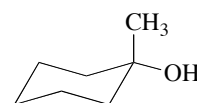
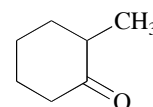
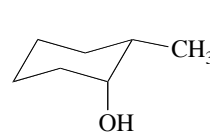
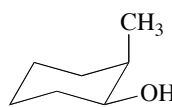
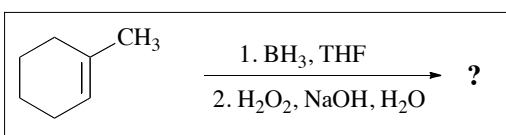
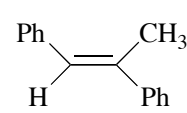
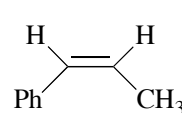
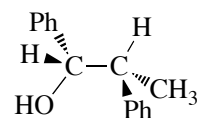
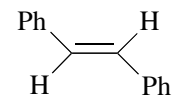
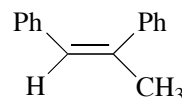
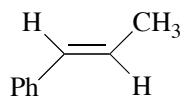
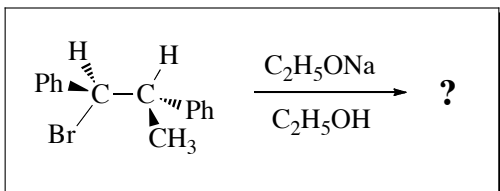


- 2-methyl-2-butene 4-methyl-2-hexyne isopropylmethylacetylene
 5-methyl-1-hexyne 5-methyl-2-heptyne isopropylacetylene

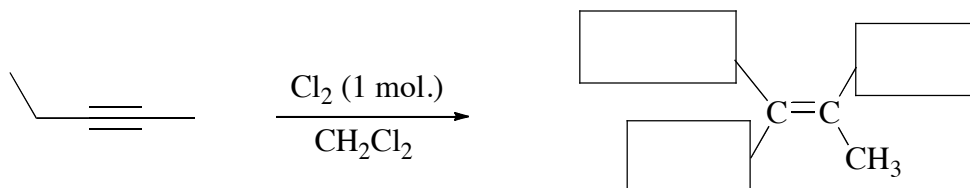
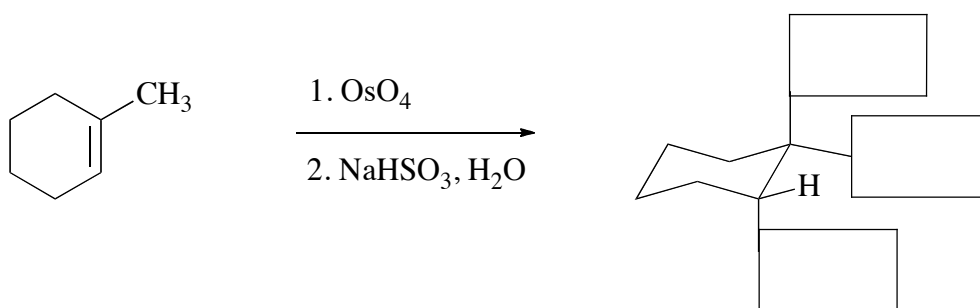
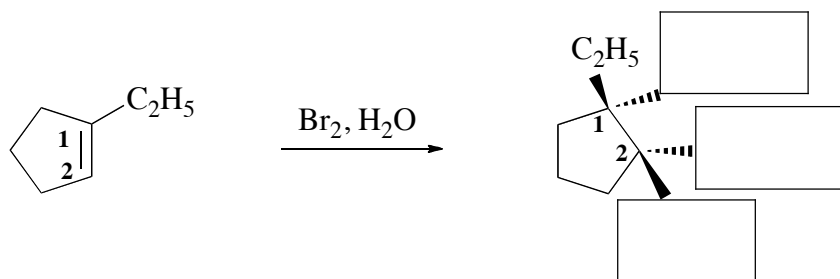
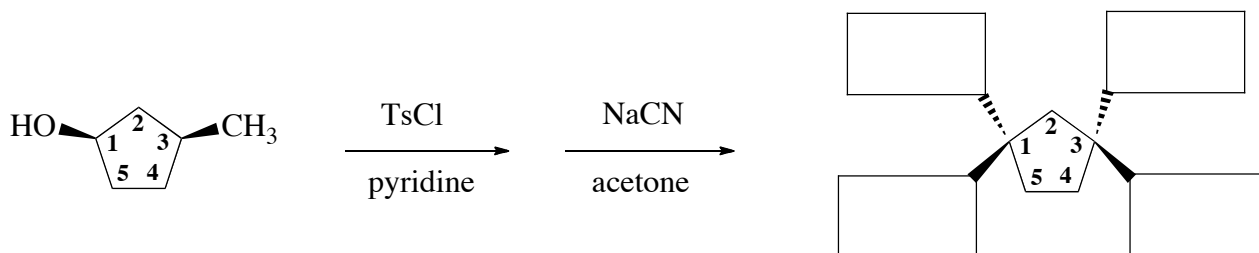


- trans*-2-ethylcyclopentanol *cis*-2-ethylcyclopentanol
 1-ethylcyclopentanol 2-ethylcyclopentan-1,2-diol
 1-ethyl-1,2-cyclopentanediol 3-ethylcyclopentanol

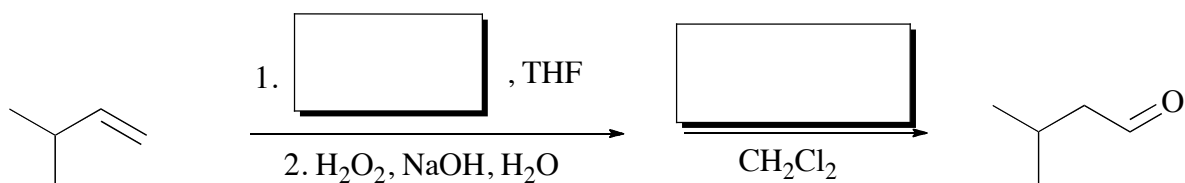
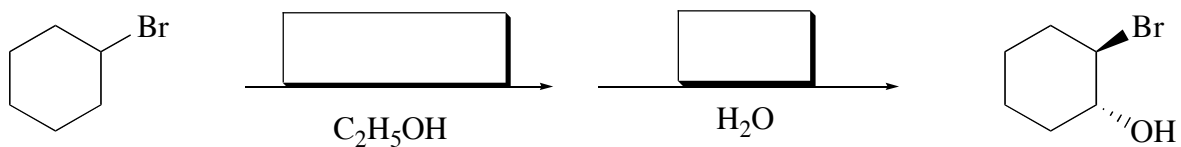
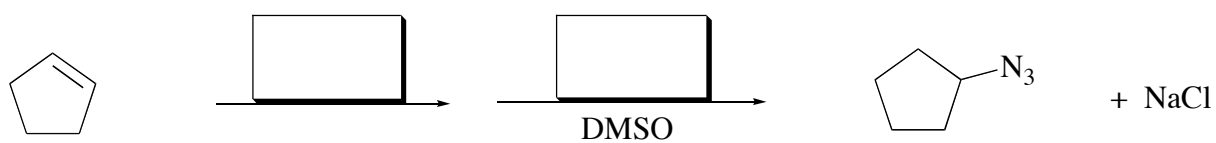
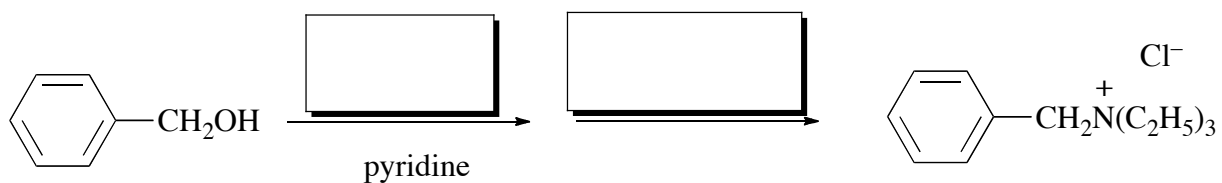
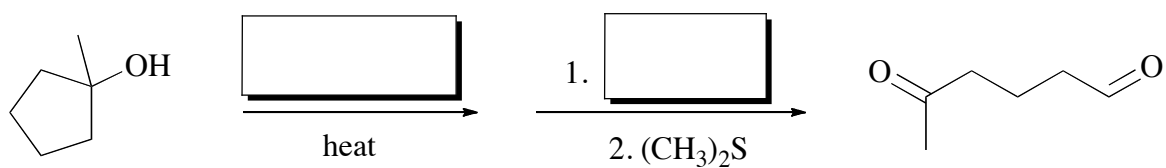
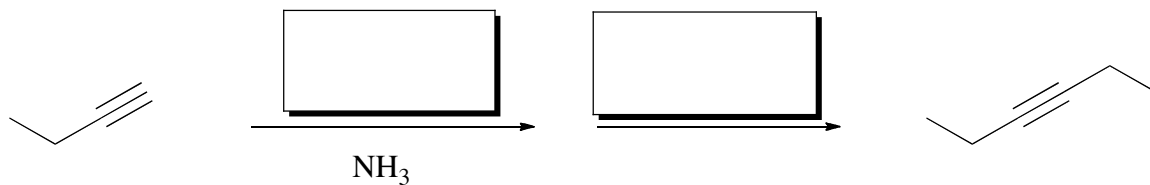
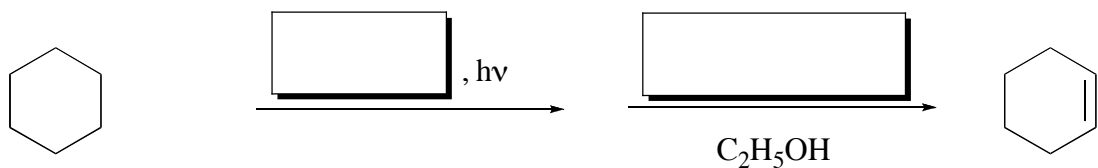
5. (20, 4 pts each) Circle the structure of the **major product** in each of the following reactions:



6. (26 pts) Finish drawing the structures of the products in these reactions by placing appropriate substituents (including H) in the boxes on the bonds (2 pt each missing part).

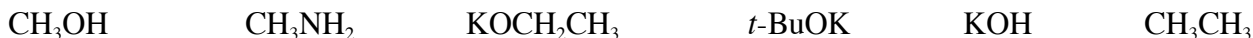


7. (28, 2 pts each box) Place in each box the molecule of a reagent that is required to perform each of the following reactions:



8. (28, 4 pts each) For each of the following questions (a)-(g) **circle** the item that is the correct answer.

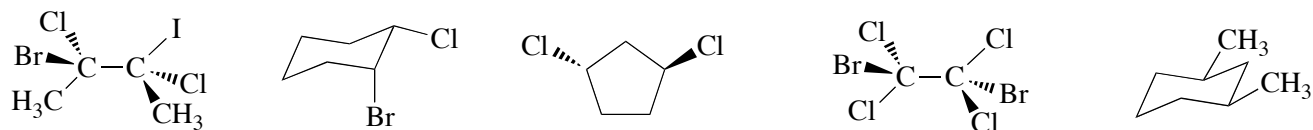
(a) Which one of the following compounds is the **strongest base**?



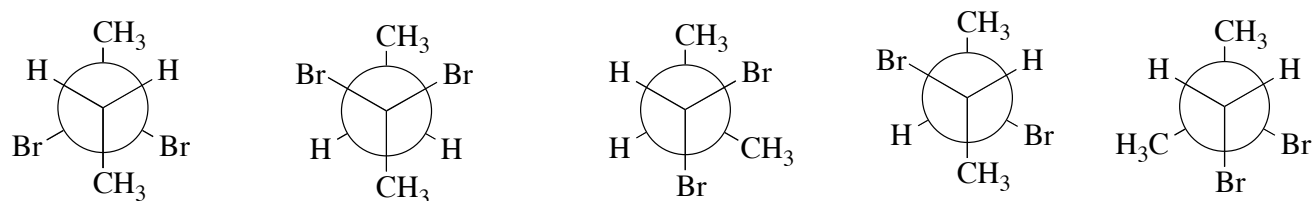
(b) Which one of the following compounds has the most **acidic C–H bonds**?



(c) Which one of the following molecules is a **meso** compound?



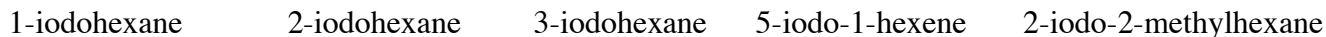
(d) Which of the following Newman projections represents **2,3-dibromobutane**?



(e) Which one of the following compounds will have the **highest** boiling point?



(f) Which of the following compounds is the **most reactive** in the **S_N2** reactions?



(g) Which of the following compounds is the **most reactive** in the **S_N1** reactions?

