

Chemistry 2521
Fall 2007; Final Exam

This exam has 8 problems on 11 pages. Make sure your copy is complete and correct.

Printed Name (Last, First) Key

Scores:

Problem 1: 15

Problem 2: 20

Problem 3: 25

Problem 4: 35

Problem 5: 20

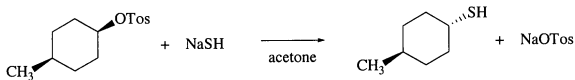
Problem 6: 20

Problem 7: 30

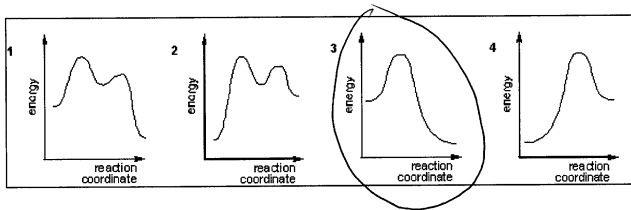
Problem 8: 35

Total: 200

1. (15 pts) Answer the questions on mechanism of the following reaction:



a) Which of the following energy diagrams best represents the course of this reaction (circle the correct answer, 3 pts)?



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

$$\text{Rate} = k \times [\text{RTos}]$$

$$\text{Rate} = k \times [\text{RTos}] \times [\text{acetone}]$$

$$\text{Rate} = k \times [\text{RTos}] \times [\text{HS}^-]$$

$$\text{Rate} = k \times [\text{acetone}] \times [\text{HS}^-]$$

c) Circle the **nucleophile** in this reaction (3 pts):

 Cl^-

acetone

 CH_3
 Na^+

Tos

 TosO^-
 HS^-

d) Circle the **leaving group** in this reaction (3 pts):

 Cl^-

acetone

 CH_3
 Na^+

Tos

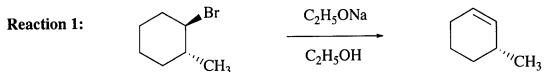
 TosO^-
 HS^-

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

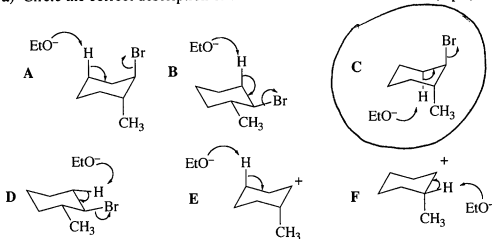
 $\text{S}_{\text{N}}1$
 $\text{S}_{\text{N}}2$
 $\text{E}1$
 $\text{E}2$
 $\text{E}1\text{cb}$

radical substitution

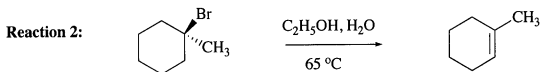
2. (20 pts) Answer the questions on mechanisms of the following reactions:



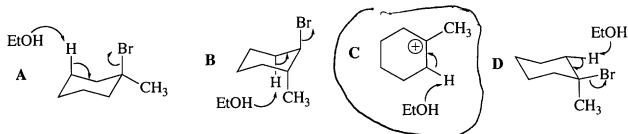
a) Circle the correct description of the mechanism for this reaction (7 pts):



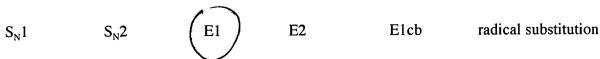
b) What type of mechanism this reaction has? (circle correct answer, 3 pts)



a) Circle the correct description of the mechanism for this reaction (7 pts):

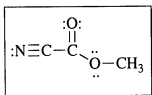


b) What type of mechanism this reaction has? (circle correct answer, 3 pts)



3. (25 pts) Answer the following questions on the structure of the molecules shown in the boxes below.

a) (15 pts) Answer the questions about types of bonds that are present in the following molecule (3 pts each correct answer):



Number of σ bonds formed by overlap of sp^2 and sp^3 orbitals: 1

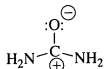
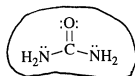
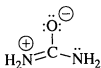
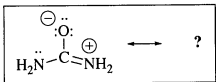
Number of σ bonds formed by overlap of sp^2 and sp orbitals: 1

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

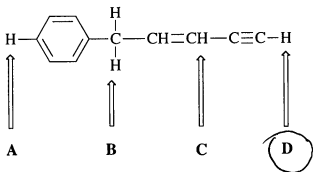
Total number of σ bonds: 8

Total number of π bonds: 3

b) (5 pts) Circle the structure of the most important resonance contributor of the molecule in the box:

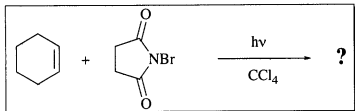


c) (5 pts) Circle the letter (A-D) indicating the most acidic hydrogen in the following molecule:



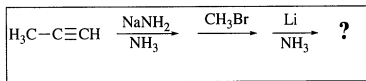
4. (35)) Circle the name of the **major product** in each of the following reactions:

5 pts



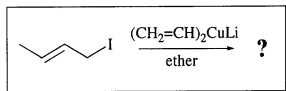
4-bromocyclohexene **3-bromocyclohexene**
 bromocyclohexane 1-bromocyclohexene
trans-1,2-dibromocyclohexane

6 pts



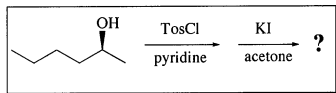
(Z)-2-butene **(E)-2-butene**
 (Z)-2-pentene 1-butene 2-butyne
 1-butanol 2-butanone

6 pts



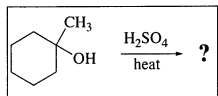
(Z)-2-pentene (E)-2-pentene
 (Z)-1,3-pentadiene (E)-1,3-pentadiene
 (Z)-1,4-hexadiene **(E)-1,4-hexadiene**

6 pts



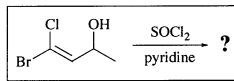
(S)-2-chlorohexane (R)-2-chlorohexane
(R)-2-iodohexane (S)-2-iodohexane
 (E)-2-hexene (Z)-2-hexene 1-hexene

6 pts



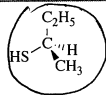
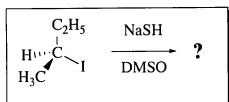
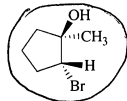
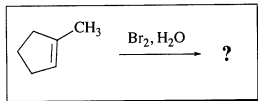
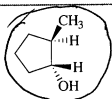
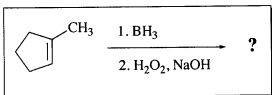
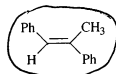
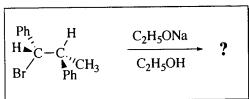
1-methylcyclohexene 3-methylcyclohexene
 4-methylcyclohexene (Z)-2-hexene
 (E)-3-heptene (Z)-3-heptene

6 pts

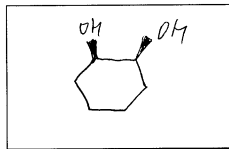
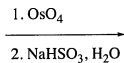
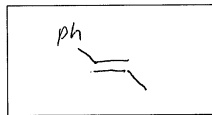
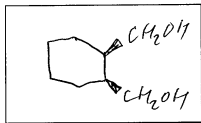
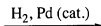
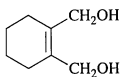
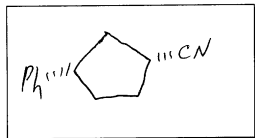
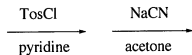
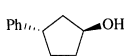


(E)-1-bromo-1,3-dichloro-1-butene 4,4-dichloro-3-buten-2-ol
 (Z)-1-bromo-1,3-dichloro-1-butene 4,4-dichloro-3-buten-1-ol
 (E)-1-bromo-1,3-dichloro-2-butene 4,4-dibromo-3-buten-2-ol

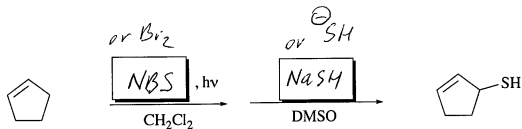
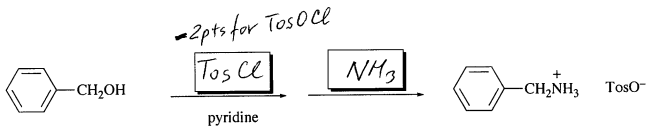
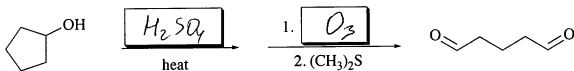
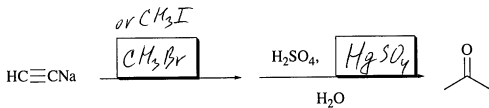
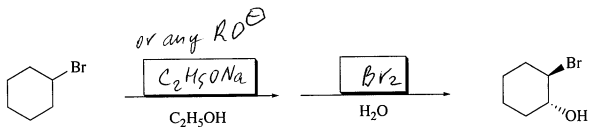
5. (20, 5 pts each) Circle the structure of the **major product** in each of the following reactions:



6. (20; 5 pts each) Draw the structure of the main product for each the following **stereoselective** reactions. Draw *skeletal* structures in the provided boxes; make sure to show the correct **stereochemistry** for the substituents (-2 pts for wrong stereochemistry).



7. (30, 3 pts each box) Place in each box the molecule of a reagent that is required to perform each of the following reactions:

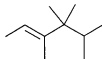
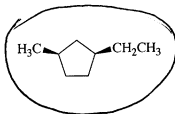
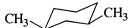


8. (35, 5 pts each) For each of the following questions (a)-(g) **circle** the item that is the correct answer.

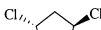
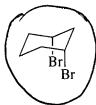
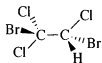
(a) Which one of the following compounds has the **highest acidity**?



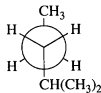
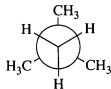
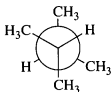
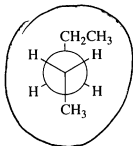
(b) Which one of the following molecules is **chiral**?



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



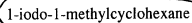
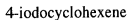
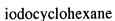
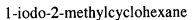
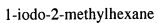
(d) Which of the following Newman projections represents **n-pentane**?



(e) Which of the following species is *NOT* a **nucleophile**?



(f) Which of the following compounds is the most reactive in the **S_N1** reaction with H₂O?



(g) Which of the following compounds will have a *characteristic IR* peak at about 1700 cm⁻¹ and a *molecular ion* M⁺ = 84 in **mass-spectrum** (atomic mass of C = 12, H = 1, O = 16)?

