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

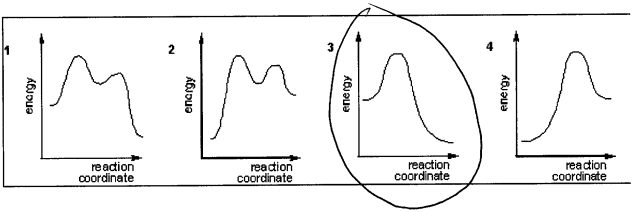
Problem 7. 30

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):

Rate = k x [RTos] Rate = k x [RTos] x [acetone] Rate = k x [RTos] x [HS^-] Rate = k x [acetone] x [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):

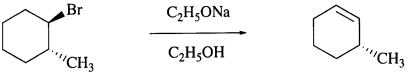
Cl^- acetone CH_3 Na^+ Tos $TosO^-$ HS^-

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

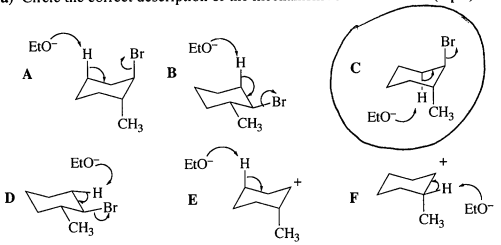
S_N1 S_N2 E1 E2 E1cb radical substitution

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

Reaction 1:



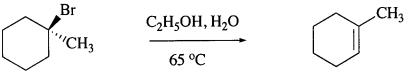
a) Circle the correct description of the mechanism for this reaction (7 pts):



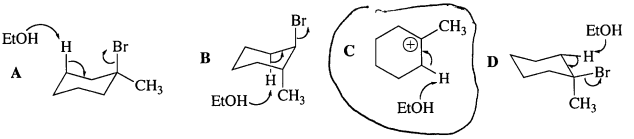
b) What type of mechanism this reaction has? (circle correct answer, 3 pts)

S_N1 S_N2 E1 E2 E1cb radical substitution

Reaction 2:



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

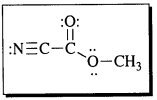


b) What type of mechanism this reaction has? (circle correct answer, 3 pts)

S_N1 S_N2 E1 E2 E1cb radical substitution

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

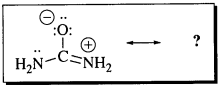
Number of σ bonds formed by overlap of sp^2 and sp orbitals: 1

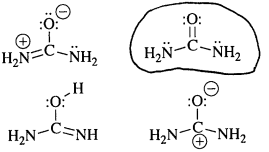
Number of σ bonds formed by overlap of s and sp^3 orbitals: 3

Total number of σ bonds: 8

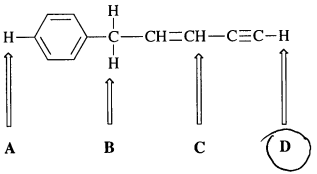
Total number of π bonds: 3

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



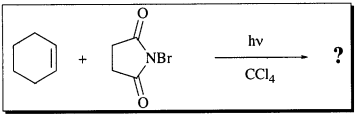


c) (5 pts) Circle the letter **(A-D)** indicating the most acidic hydrogen in the following molecule:



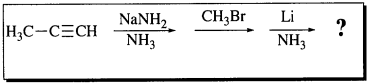
4. (35) Circle the name of the **major product** in each of the following reactions:

5pts



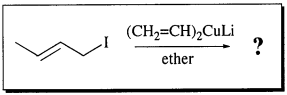
4-bromocyclohexene 3-bromocyclohexene
bromocyclohexane 1-bromocyclohexene
trans-1,2-dibromocyclohexane

6pts



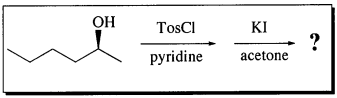
(*Z*)-2-butene (*E*)-2-butene
(*Z*)-2-pentene 1-butene 2-butyne
1-butanol 2-butanone

6pts



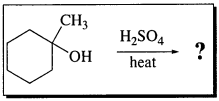
(*Z*)-2-pentene (*E*)-2-pentene
(*Z*)-1,3-pentadiene (*E*)-1,3-pentadiene
(*Z*)-1,4-hexadiene (*E*)-1,4-hexadiene

6pts



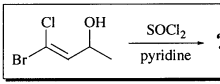
(*S*)-2-chlorohexane (*R*)-2-chlorohexane
(*R*)-2-iodohexane (*S*)-2-iodohexane
(*E*)-2-hexene (*Z*)-2-hexene 1-hexene

6pts



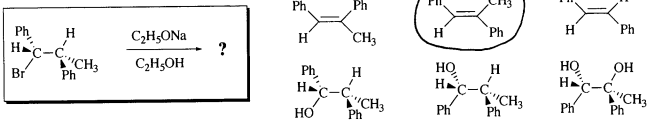
1-methylcyclohexene 3-methylcyclohexene
4-methylcyclohexene (*Z*)-2-hexene
(*E*)-3-heptene (*Z*)-3-heptene

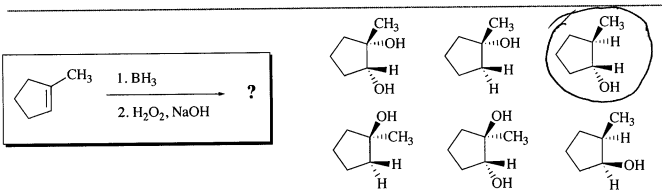
6pts

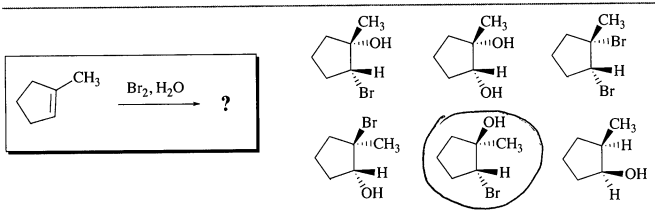


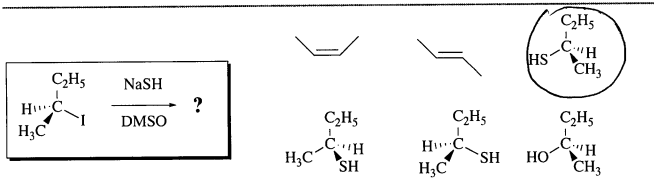
(*E*)-1-bromo-1,3-dichloro-1-butene 4,4-dichloro-3-buten-2-ol
(*Z*)-1-bromo-1,3-dichloro-1-butene 4,4-dichloro-3-buten-1-ol
(*E*)-1-bromo-1,3-dichloro-2-butene 4,4-dibromo-3-buten-2-ol

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

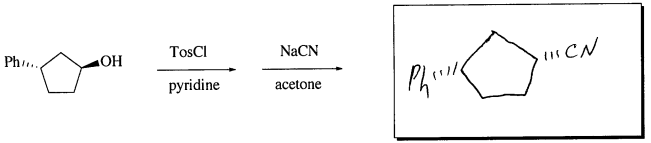


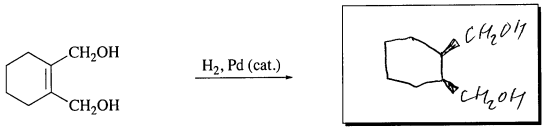


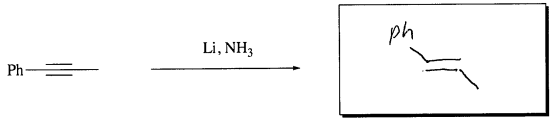


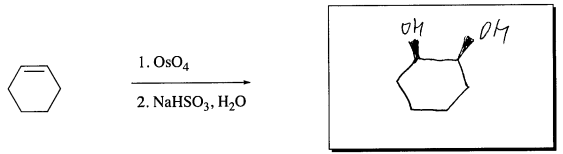


6. (20; 5 pts each) Draw the structure of the main product for each the following **stereoselective** reactions. Draw *skeletal* structures in the provided boxes; make sure to show the correct **stereochemistry** for the substituents (-2 pts for wrong stereochemistry).

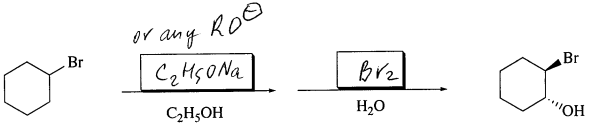


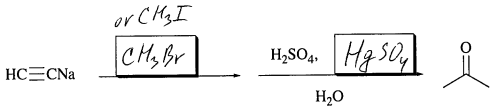


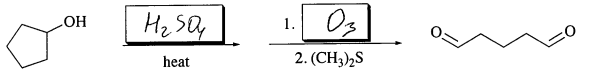


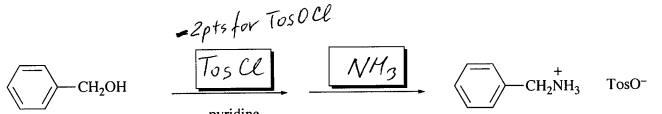


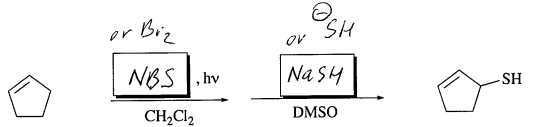
7. (30, 3 pts each box) Place in each box the molecule of a reagent that is required to perform each of the following reactions:









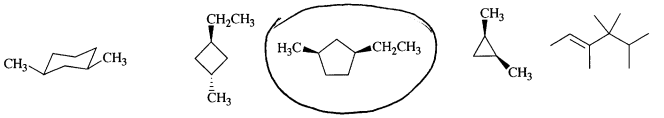


8. (35, 5 pts each) For each of the following questions (a)-(g) **circle** the item that is the correct answer.

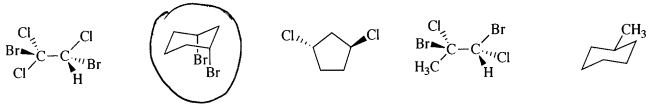
(a) Which one of the following compounds has the **highest acidity**?

CH_3I H_2O CH_3OH Li_2SO_4 $(CH_3)_3CLi$ $(CH_3)_3COH$ CH_3CO_2H CH_4

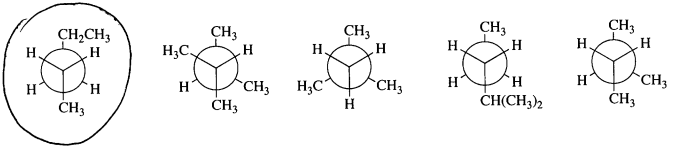
(b) Which one of the following molecules is **chiral**?



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



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

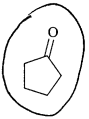
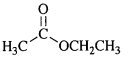


(e) Which of the following species is ***NOT*** a **nucleophile**?

Cl^- PH_3 C_2H_5OH CH_3Li HO^- BH_3 NH_3

(f) Which of the following compounds is the most reactive in the $\mathbf{S_N1}$ reaction with H_2O?

1-iodo-2-methylhexane 1-iodo-2-methylcyclohexane 3-iodohexane

iodocyclohexane 4-iodocyclohexene 1-iodo-1-methylcyclohexane

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