

CHEM 3311-100, Spring 2006

Final Exam

May 8, 2006

Professor Rebecca Hoenigman

Average Score = 168

High Score = 300

Low Score = 36

I pledge to uphold the CU Honor Code:

Signature _____

Name (printed) _____

Last four digits of your student ID number _____

Recitation TA _____

Recitation number, day, and time _____

**You have 2.5 hours to complete this exam.
Exams will be collected at 7:00 pm.**

No model kits or calculators allowed.

Periodic table and scratch paper are provided.

DO NOT TURN PAGE UNTIL INSTRUCTED TO DO SO.

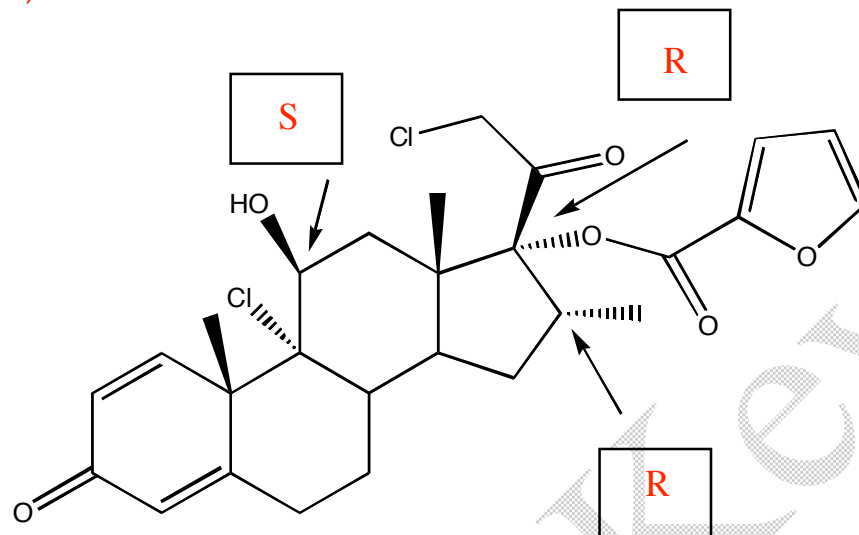
Put your name on ALL pages of the exam

Recitation Sections:

Number	Day	Time	TA
121	Tuesday	8 am	Andrew
131	Tuesday	1 pm	Heather
141	Wednesday	8 am	Chris
151	Wednesday	12 pm	Andrew
153	Wednesday	12 pm	Nicole
152	Wednesday	5 pm	Chris
171	Thursday	12 pm	Heather

Name: _____

1. (18 pts) Mometasone furoate is the active component of the Asmanex[®] Twisthaler[®], which is used to keep the symptoms of asthma under control. (2 pts each)



- A. Circle **all** of the terms below that describe one or more structural features of Mometasone furoate.

(2 pts each)

- | | | |
|---------------------|---------------|-------------------|
| 1° Alcohol | Alkene | Non-aromatic ring |
| 2° Alcohol | Amide | Ester |
| 3° Alcohol | Aromatic ring | Epoxide |
| Amine | Halide | Ketone |
| Heteroaromatic ring | Ether | Aldehyde |

- B. In the boxes above, give the stereochemical designation for the indicated chiral centers.

Name: _____

2. (10 pts) Does an S_N2 reaction always occur with the stereocenter changing from $R \rightarrow S$ or $S \rightarrow R$? Why or Why not?

(2 pts "No", 8 pts explanation)

No, inversion of configuration always occurs in an S_N2 reaction. However, $R \rightarrow S$ or $S \rightarrow R$ inversion depends only on the leaving group and the nucleophile. It is possible to have inversion of configuration occur with the stereocenter label staying R or S.

3. (15 pts) The heats of hydrogenation of cycloheptene and 1,3,5-cycloheptatriene are 110 kJ/mol and 305 kJ/mol, respectively. In both cases cycloheptane is the product. What is the resonance energy of 1,3,5-cycloheptatriene? How does it compare to the resonance energy of benzene (152 kJ/mol)?

Book Problem 11.2

(5 pts for resonance energy, 10 pts for explanation)



If no resonance energy:

$$\Delta H_{H_2}(1,3,5\text{-cycloheptatriene}) = 3 \times 110 \text{ kJ/mol} = 330 \text{ kJ/mol}$$

The resonance energy of 1,3,5-cycloheptatriene is:

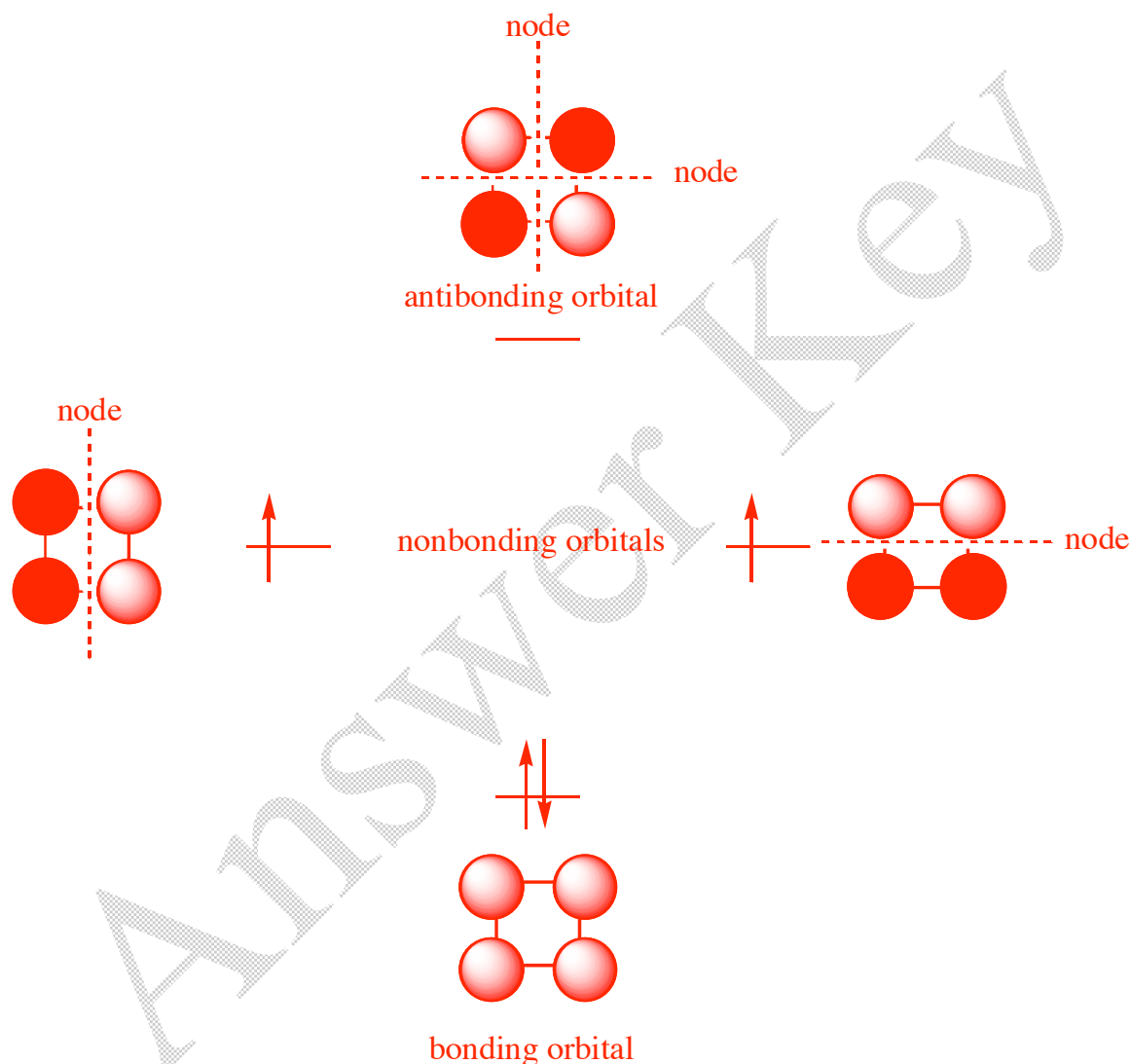
$$305 \text{ kJ/mol} - 330 \text{ kJ/mol} = 25 \text{ kJ/mol}$$

The resonance energy of 1,3,5-cycloheptatriene is much less than that of benzene because benzene is aromatic and 1,3,5-cycloheptatriene is not.

Name: _____

4. (25 pts) Draw the molecular orbital diagram of cyclobutadiene. Be sure to fill in the π electrons in the appropriate orbitals. Label any nodes in your orbital diagram and label the orbitals as bonding, nonbonding, or antibonding. Explain, in one or two sentences, why cyclobutadiene is antiaromatic. Refer to your orbital diagram in your explanation.

(10 pts orbitals, 5 pts labels, 5 pts electrons, 5 pts explanation)



Cyclobutadiene is an open-shell molecule, with 2 unpaired electrons (it's a diradical). This electronic configuration makes cyclobutadiene very unstable (and anti-aromatic).

Name: _____

5. (15 pts) On standing, 1,3-cyclopentadiene is transformed into a new compound called dicyclopentadiene, having the molecular formula $C_{10}H_{12}$. Hydrogenation of dicyclopentadiene gives the compound shown.

Book Problem 10.39

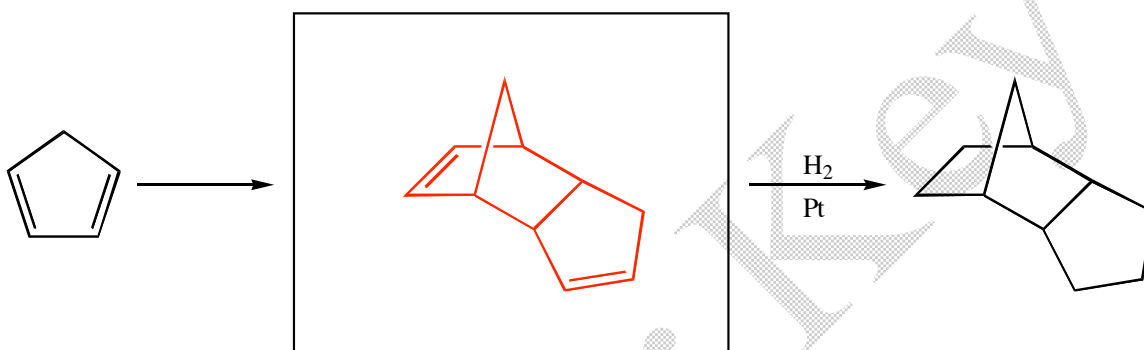
A. In the box below, suggest a structure for dicyclopentadiene.

(10 pts)

B. What kind of reaction is occurring in its formation?

(5 pts)

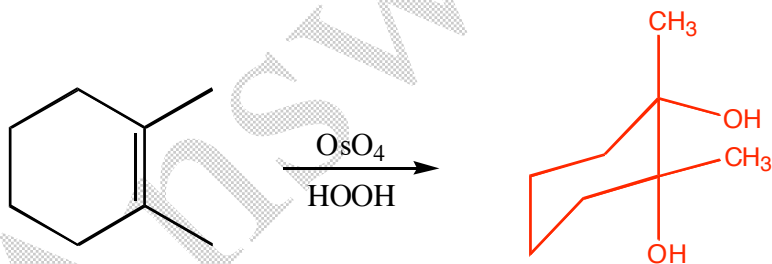
Diels-Alder



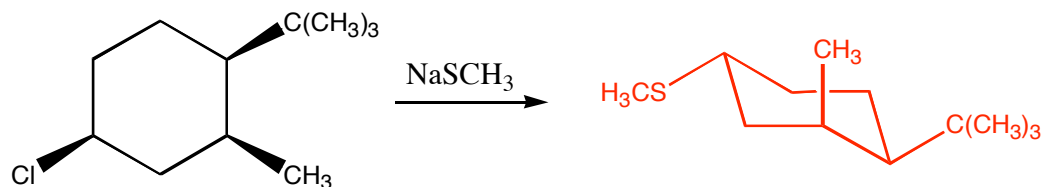
6. (20 pts) Draw the most stable chair conformations of the products of the following reactions.

(10 pt each -- 5 pts product, 5 pts chair)

A.



B.

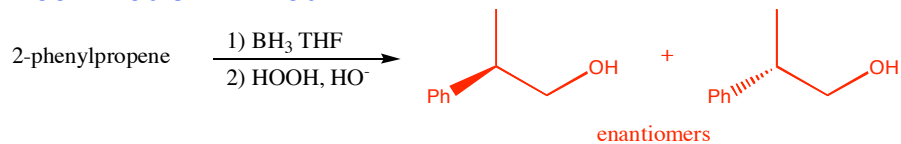


Name: _____

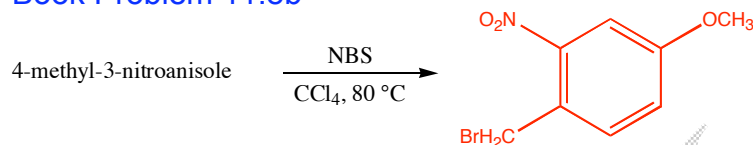
7. (48 pts) Give the organic products for the following reactions. If necessary, clearly show the stereochemistry of the products. Write NR if no reaction occurs. Clearly label any enantiomers or diastereomers.

(8 pts each)

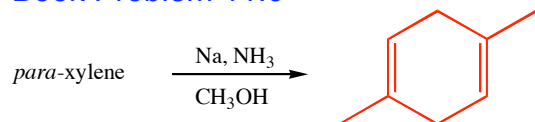
A. Book Problem 11.13b



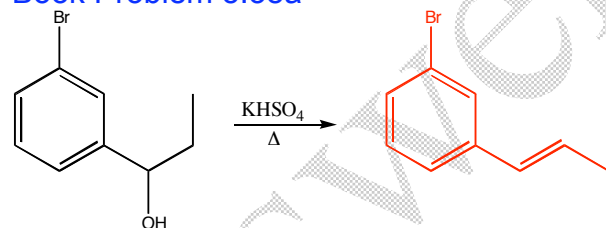
B. Book Problem 11.8b



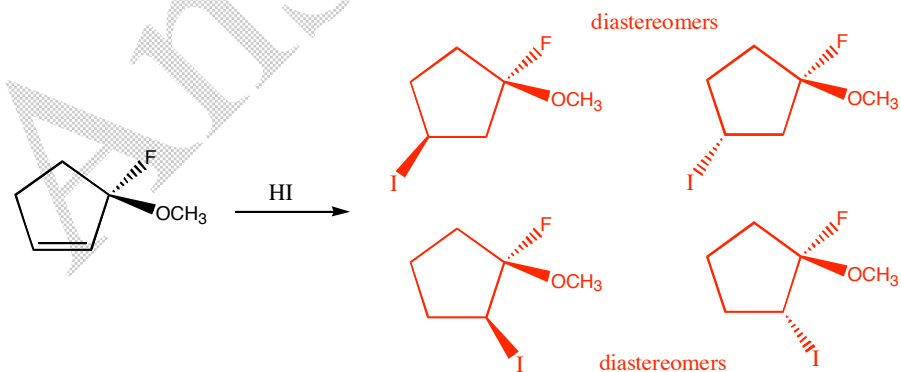
C. Book Problem 11.6



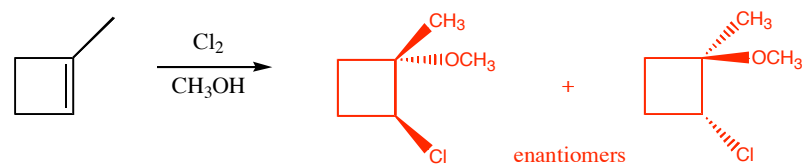
D. Book Problem 5.38a



E.



F.



Name: _____

. (42 pts) Circle the more stable compound in each of the following pairs and give the reason for your choice in the adjacent box.

(2 pts circle, 5 pts explanation)

A. (1*R*,2*R*)-1-ethyl-1-methyl-2-isopropylcyclohexane

or

(1*S*,2*R*)-1-ethyl-1-methyl-2-isopropylcyclohexane

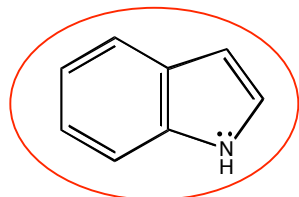
There are less 1,3-diaxial repulsions since the larger groups are equatorial.

B. $(\text{CH}_3)_3\text{C}^+$ or $(\text{CF}_3)_3\text{C}^+$

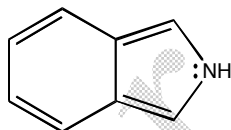
Book Problem 4.10

Fluorine is electron withdrawing, which destabilizes the cation.

C. Book Problem 11.25

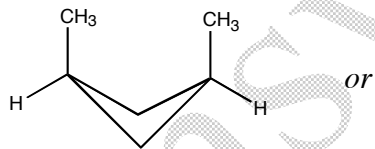


or

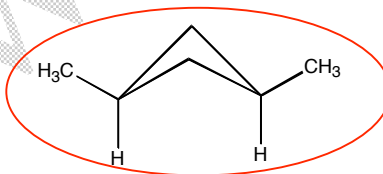


More aromaticity

D. Book Problem 3.23

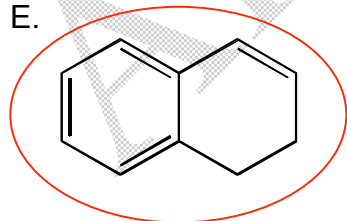


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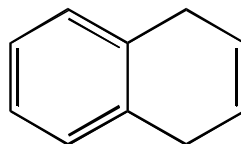


Less steric strain

E.

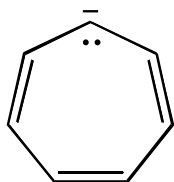


or

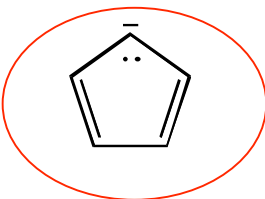


More conjugation

F.



or

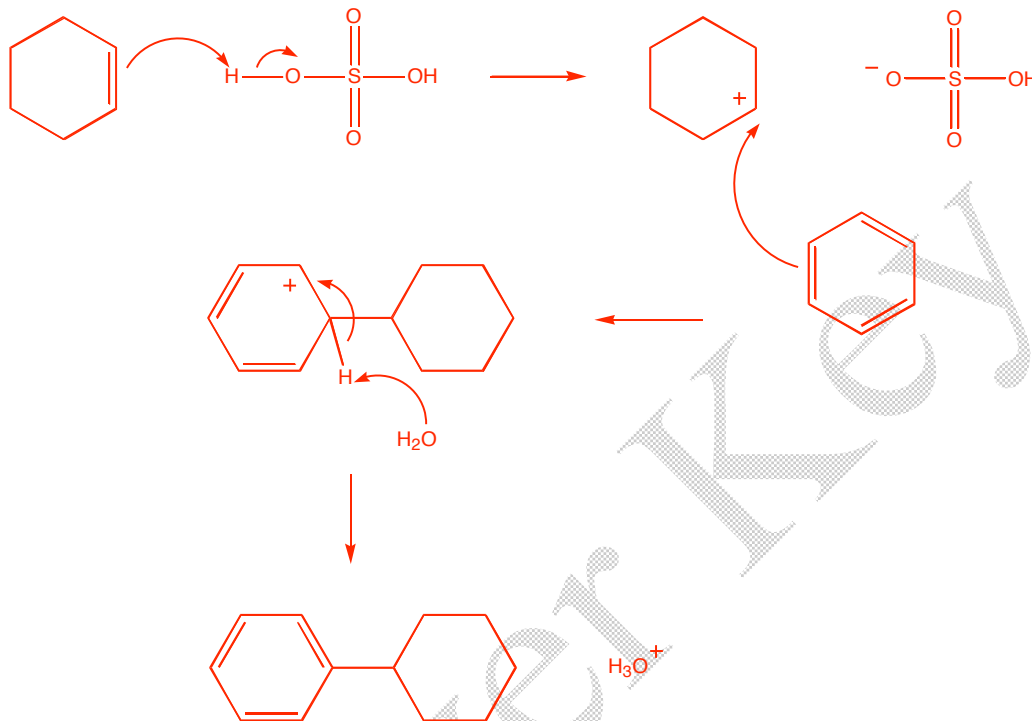


It is an aromatic anion, while the other anion is antiaromatic.

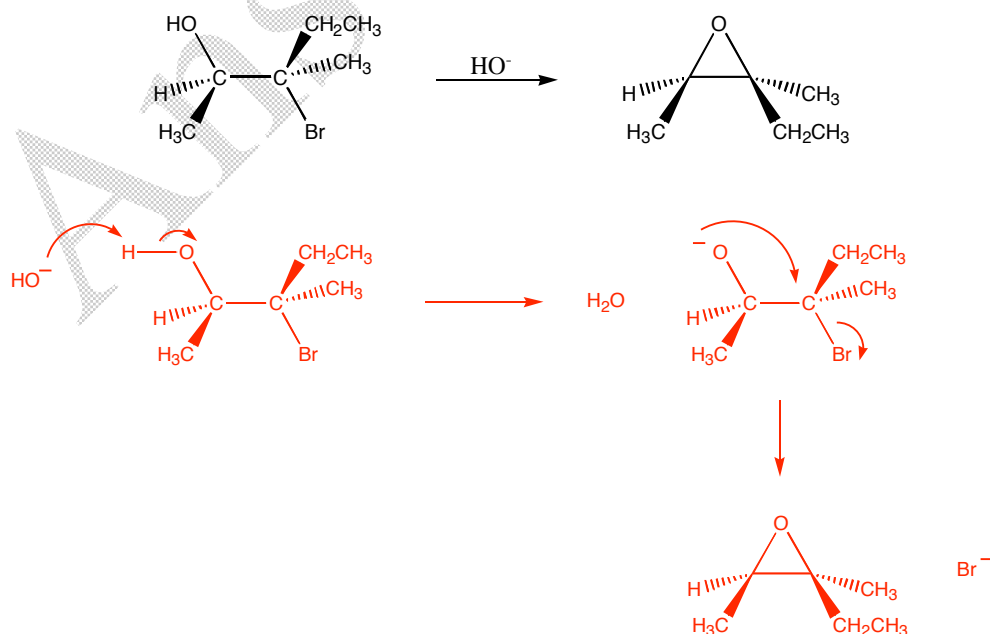
Name: _____

9. (20 pts) Write a reasonable mechanism for the formation of cyclohexylbenzene from the reaction of benzene, cyclohexene, and 50% sulfuric acid.

Book Problem 12.5



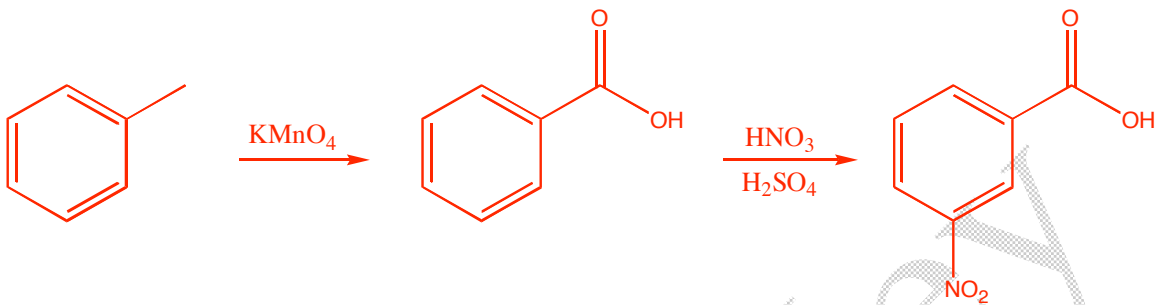
10. (15 pts) When allowed to react with base, a halohydrin can be converted to an epoxide. Give a mechanism for this reaction.



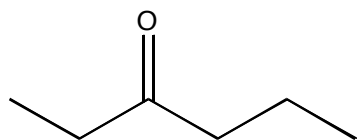
Name: _____

11. (72 pts) Give a synthetic route for the following transformations. You may use any reagents you like. (12 points each)

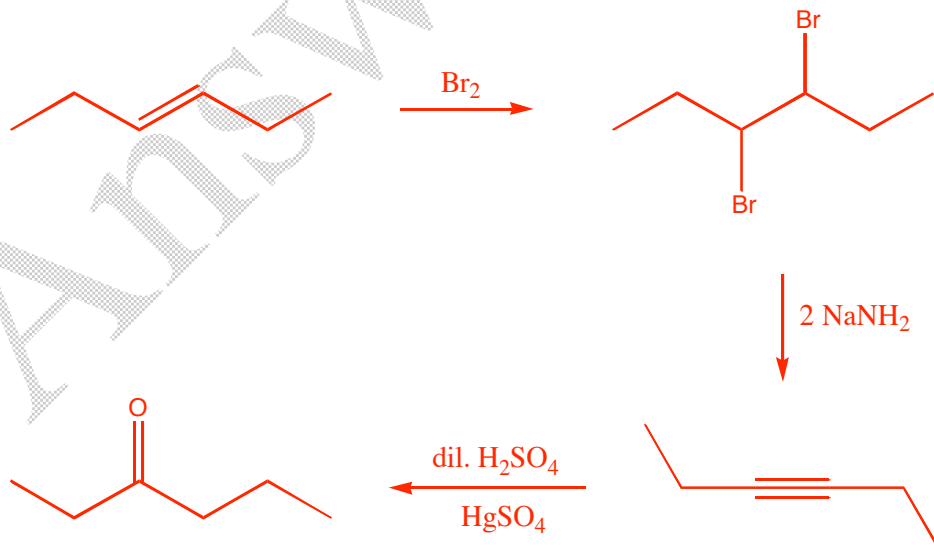
A. *meta*-nitrobenzoic acid from toluene
Book Problem 12.19



B.

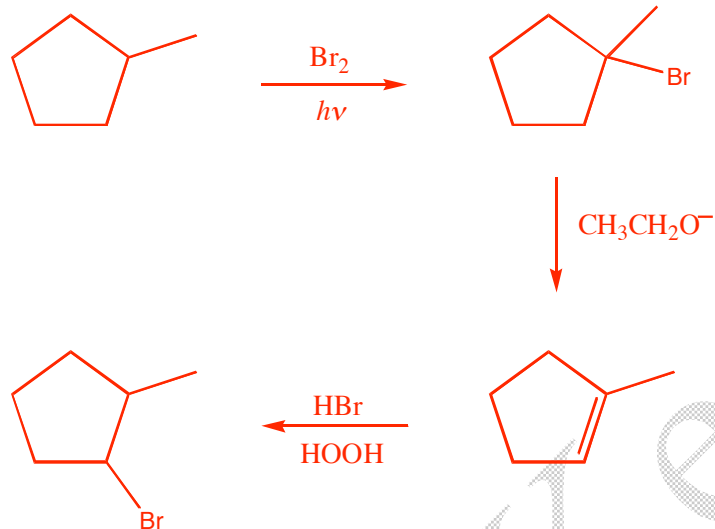


from 3-hexene

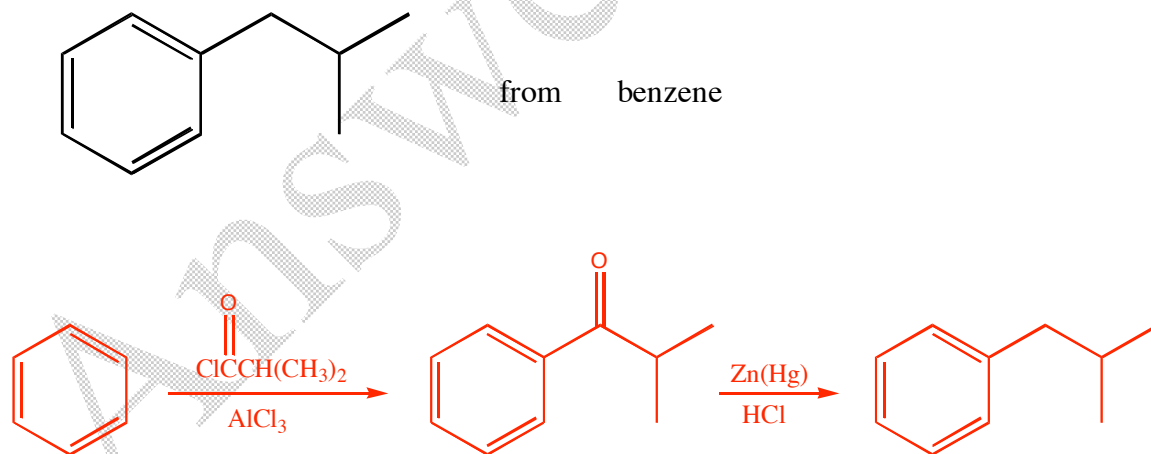


Name: _____

C. 1-bromo-2-methylcyclopentane from methylcyclopentane

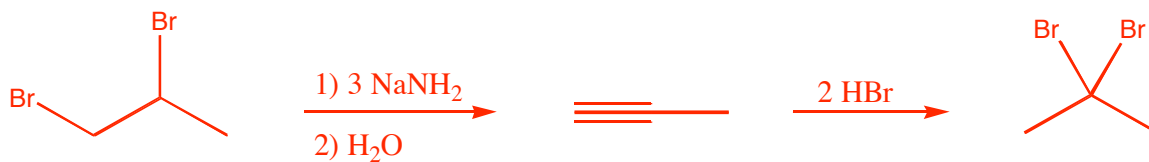


D. Book Problem 12.9a

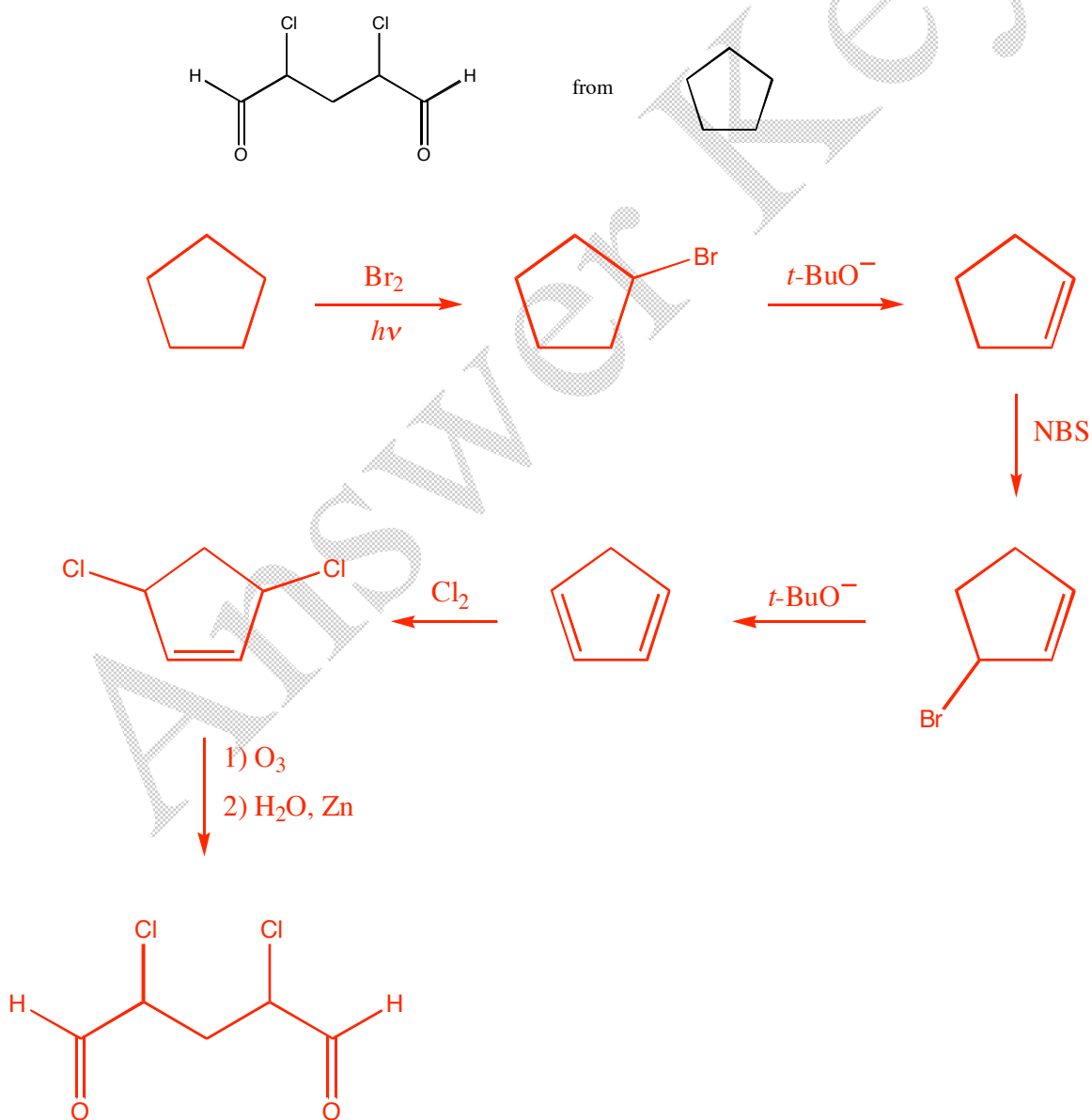


Name: _____

E. 2,2-dibromopropane from 1,2-dibromopropane
Book Problem 9.33b



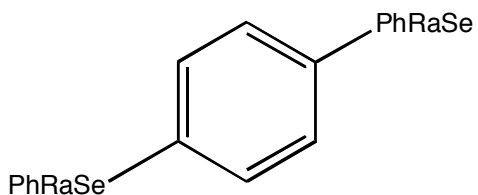
F. Out of lecture notes



Name: _____

Extra Credit: (10 pts)

Draw a parody of aromatic nomenclature. For example, below is paraphrase.



Score:

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Total _____/300