

CHEM 161
Sample Final
Dr. John C. Vederas

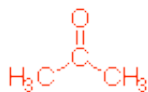
Questions in black, answers in red

PLEASE NOTE THAT COURSE CONTENT VARIES FROM YEAR TO YEAR
Some questions on Aromatic Compounds may be beyond the scope of the present course.
Additional questions on Stereochemistry and Substitution Reactions are likely to be on the exam.
Practice assignment of R and S configuration to stereogenic (chiral) centers!

I. Structure and Nomenclature - 56 Points

A. Draw structures for which names are given, or name the given structures by any correct (systematic or common) nomenclature. Be sure to give cis or trans (or if appropriate Z or E) or R or S assignment to the isomer where indicated by asterisks (***) . **(3 points each)**

1. acetone



2. benzyl chloride



3.



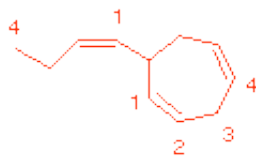
Pyridine

4. [8]annulene



*** 5. 7-(cis-1-butenyl)cyclohepta-1,4-diene

a sperm attractant produced by female gametes of brown algae

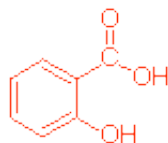


6.

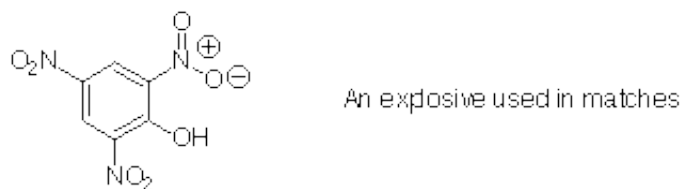


Polyvinyl chloride (PVC)

7. ortho-hydroxybenzoic acid- a metabolite of aspirin



8.

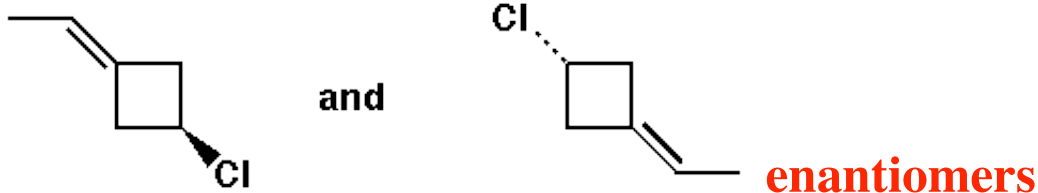


2,4,6-trinitrophenol (picric acid)

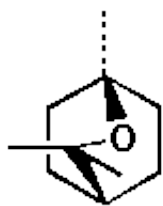
The Next 8 Questions were NOT on the previous exam, but provide some additional practice at looking at structures.

B. Determine whether the following pairs of structures are identical (i.e. different pictures of the same molecule), structural isomers, diastereomers, or enantiomers. (2 points each - 8 pts total).

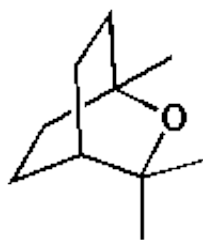
1.



2.

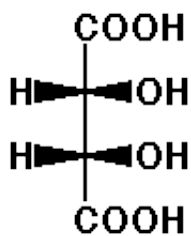


and

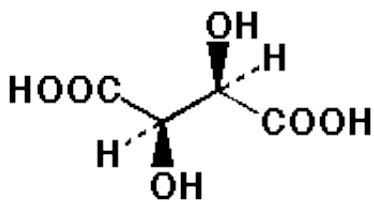


identical

3.

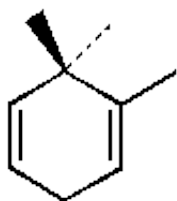


and

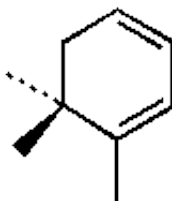


diastereomers

4.



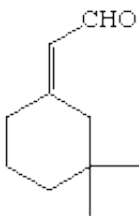
and



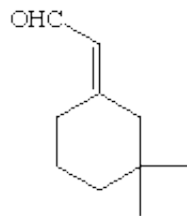
structural isomers

B. Determine whether the following pairs of structures are identical (i.e. different pictures of the same molecule), structural isomers, diastereomers, or enantiomers. (2 points each - 8 pts total).

1.

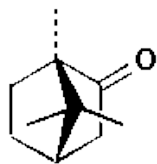


and

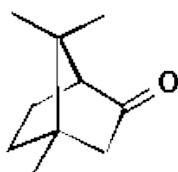


diastereomers

2.

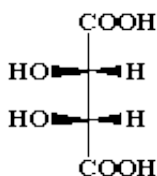


and

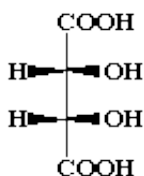


structural isomers

3.

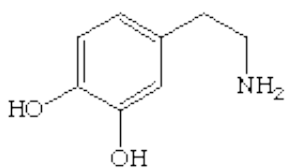


and

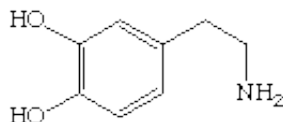


identical

4.



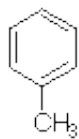
and



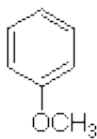
identical

The preceding 8 Questions were NOT on the previous exam, but provide some additional practice at looking at structures.

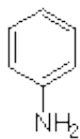
B. Name the compounds below by their correct **common** name: (12 points - 3 points each)



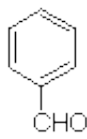
Toluene



Anisole

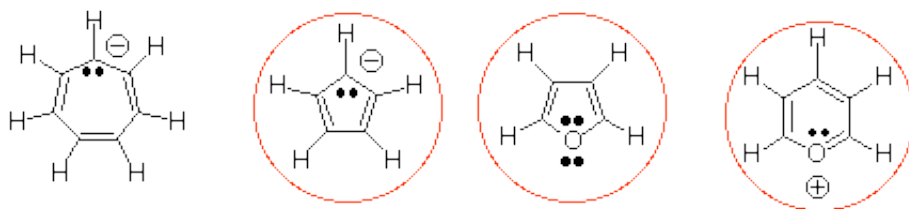
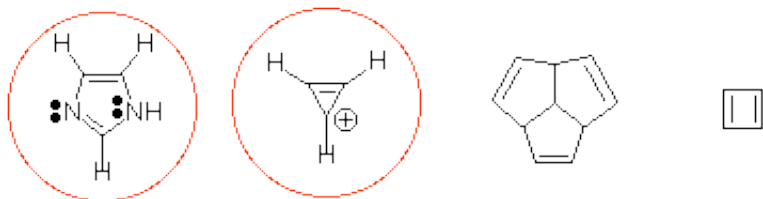


Aniline

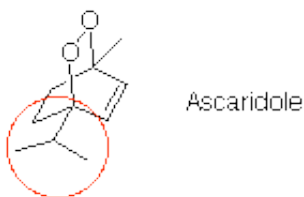


Benzaldehyde

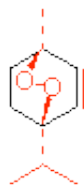
C. Circle all of the aromatic molecules or ions in the group below (8 points).



D. Ascaridole is the principal anthelmintic (a drug used against parasitic worms which are called helminths) in American wormwood (chenopodium). Examine its structure below and answer the questions which follow. (11 points)



1. Redraw the structure in flat projection. Use the six membered ring below as part of your structure. Be sure to indicate three dimensional shape with dark (wedge) and dashed lines. (If you make an error, redraw the ring and begin again) (4 points).



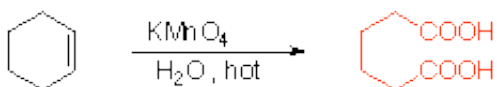
- 2.** Name the oxygen-containing functional group (2 points). **Peroxide**
- 3.** Circle one of the isoprene units on the original structure of ascaridole shown above. (2 points)
- 4.** The correct molecular formula of ascaridole is: (3 points)

C₁₀ H₁₆ O₂

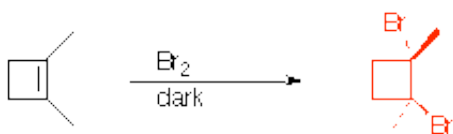
II. Reactions - 54 Points

A. Show the structure of the major organic product of each of the following reactions. Show stereochemistry where indicated by asterisks (**). (4 points each - 24 points total)

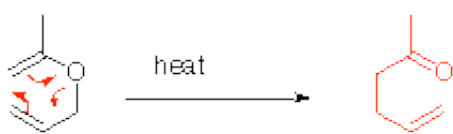
1.



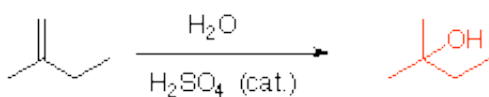
*** 2.



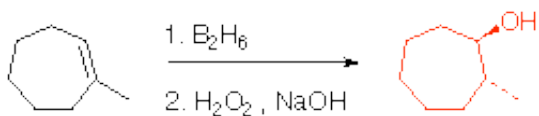
3.



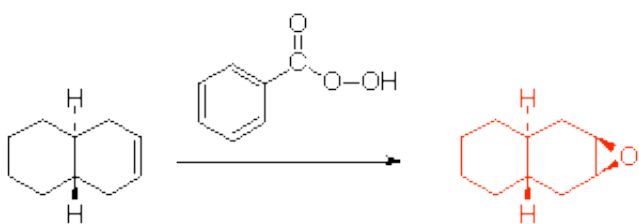
4.



*** 5.



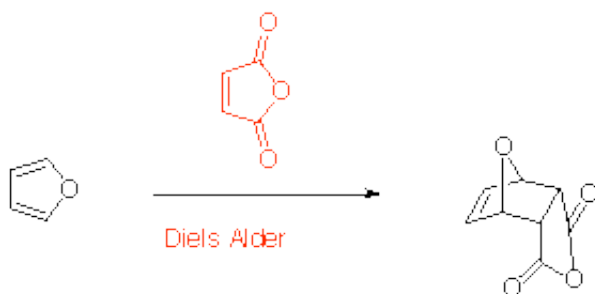
*** 6.



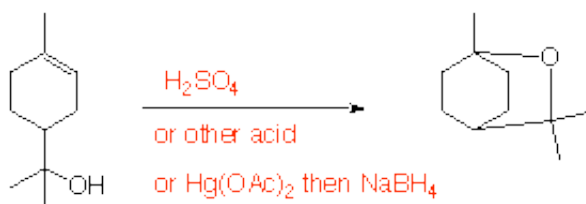
epoxide is cis -
up (shown) or down OK

B. Show reagents that will do the required transformations. In some cases two steps may be necessary. (24 points - 4 points each)

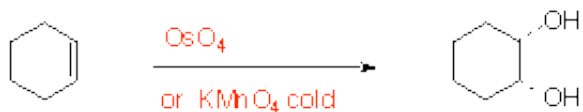
1.



2.



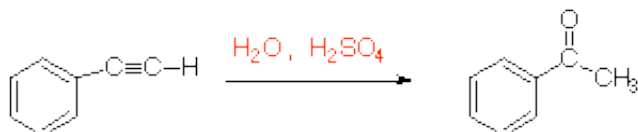
3.



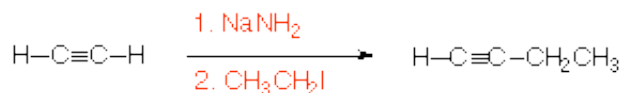
4.



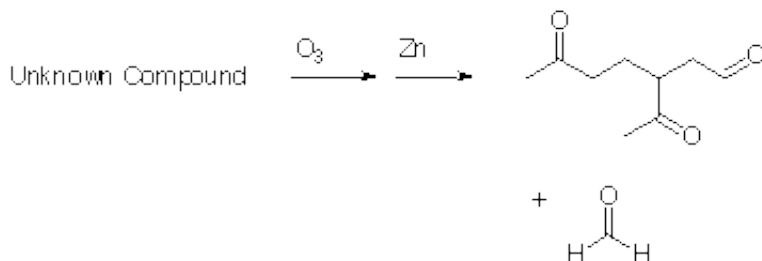
5.



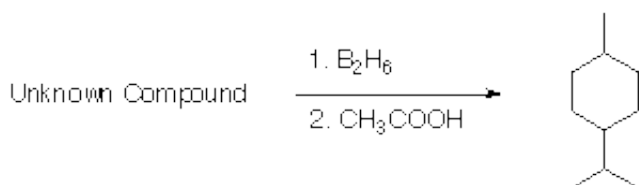
6.



C. The male cotton boll weevil recognizes its food through the presence of the appropriate mixture of monoterpene compounds. Some of these also act as aggregation pheromones. One of these compounds has an **empirical formula** of **C₅H₈**. Reaction of this compound with excess ozone followed by treatment with zinc gave the result shown below:



Treatment of the same compound with excess diborane followed by acetic acid gave the result shown below:



Provide the structure of the unknown compound (6 points):



III. Definitions and Applications - 26 Points

A. Define briefly (15 words or less) and provide an example of the following four concepts.

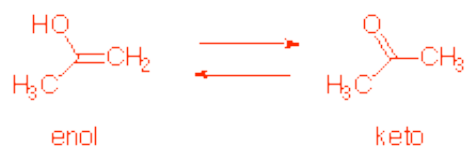
1. Markovnikov Rule

Positive end of addend adds to least substituted end of double bond
(or will accept Addition Reaction proceeds such that most stable carbocation is formed)



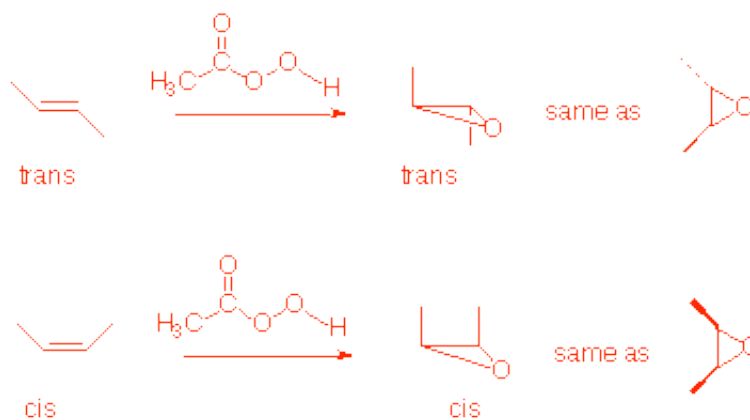
2. Tautomers

Rapidly interconverting structural isomers



3. Stereospecific Reaction

Process in which stereochemistry of starting material determines stereochemistry of product



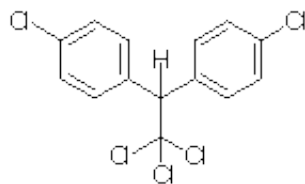
4. E1 Reaction

Elimination which proceeds stepwise via a carbocation intermediate



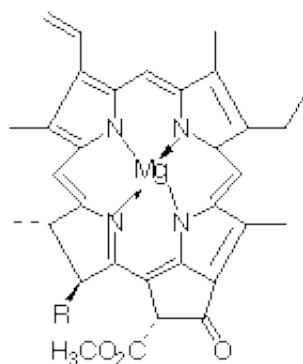
B. The structures of two important substances which were discussed in class are shown below. (10 points)

1. Identify each of them by common name
2. Specify for each compound whether it is produced naturally (e.g. plants or animals) or is only made by chemists
3. Specify for each compound its commercial use or practical importance.
4. For compound **A** specify problems associated with its occurrence
5. For compound **B** specify what colour it has when dilute



Compound A

1. DDT
2. Not natural
3. Insecticide
4. Accumulates in environment
Thins egg shells of birds

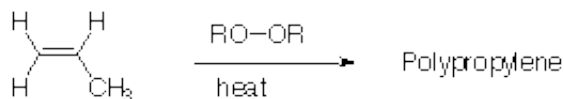


Compound B

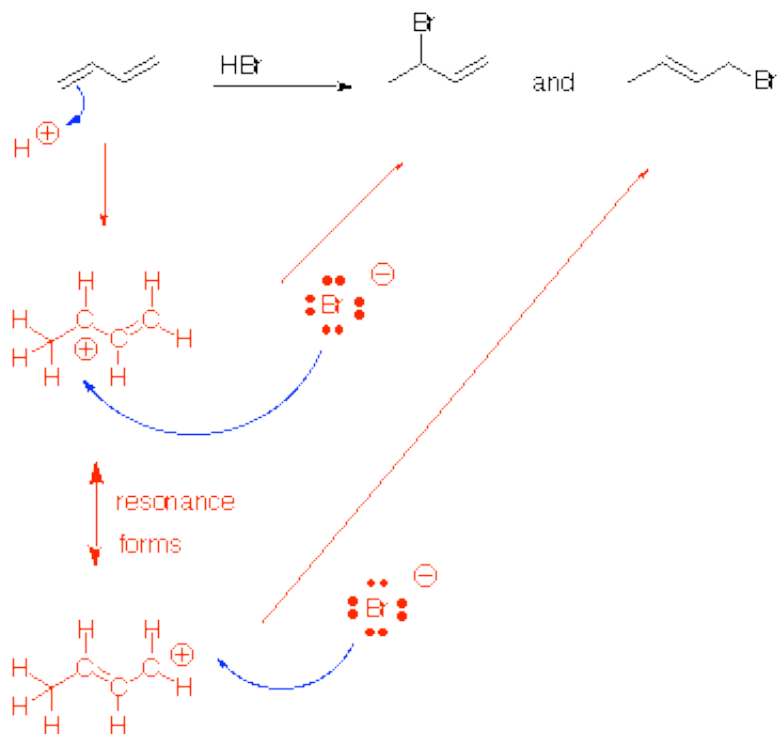
1. Chlorophyll
2. Occurs in plants
3. Absorbs light for photosynthesis
4. Green

IV. Mechanism - 15 Points

A. Draw a chemical mechanism for the first several steps of polypropylene formation from propene. Be sure to show the structures of the intermediate growing polymer chain. Also show the structure of polypropylene using the usual convention. (7 points).



A. Draw a detailed chemical mechanism which explains why the reaction of butadiene with HBr (no peroxides) gives two products. Be sure to use arrows to show the movement of electrons and draw the structures of the key intermediate(s). (8 points)



EXTRA CREDIT (3 Points): Name one person who won this year's Nobel Prize in Chemistry

John Polanyi - University of Toronto - Nobel Prize 1986