

**CHEMISTRY 313-61**

FINAL EXAM

June 25, 2005

Name .....

The total number of points is 100. The total exam time is 120 min (2 h). Good luck!

**PART I: CONCEPTS**

1. (10 pts) Mark as true (**T**) or false (**F**) the following statements. Do not explain!
- The resonance structures of a particular compound are always in a state of rapid equilibrium;
  - Transition states are usually the local minima on the potential energy diagrams;
  - The eclipsed conformation of ethane is a local minimum;
  - Free-radical halogenation occurs with formation of electron-deficient species;
  - Polar hydrohalogenation obeys the *Markovnikov* rule;
  - Dehydrohalogenation obeys the *Zaitsev* rule;
  - Diastereomers are non-superimposable mirror images;
  - Both  $S_N2$  and  $E2$  reactions are accelerated by increase of temperature;
  - Antiaromatic compounds are non-planar;
  - Nonaromatic compounds are always acyclic;

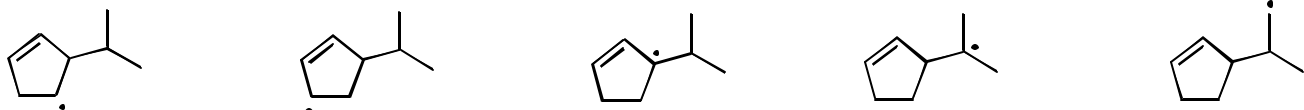
**PART II: CIRCLE ALL THAT APPLY**

2. Circle all that apply:
- A. (3 pts) The *Hammond* Postulate states that:
- a. Related species with similar charges have similar structures;
  - b. Related species with similar energies have similar structures;
  - c. Related species with similar structures have similar dipole moments;
- B. (3 pts)  $E2$  reactions:
- a. Occur with inversion of configuration;
  - b. Require strong bases;
  - c. Obey the *Zaitsev* rule;
  - d. Are subject to stereoelectronic requirements;
- C. (3 pts) *Meso*-compounds:
- a. Are optically active;
  - b. Do not contain chiral centers;
  - c. Contain one chiral center;
  - d. Have non-superimposable mirror images;
- D. (3 pts) Aromatic compounds:
- a. Are all compounds with  $(4n+2)$   $\pi$ -electrons;
  - b. Are always cyclic;
  - c. Are destabilized compared to their acyclic analogs;
  - d. Have lower reactivity;

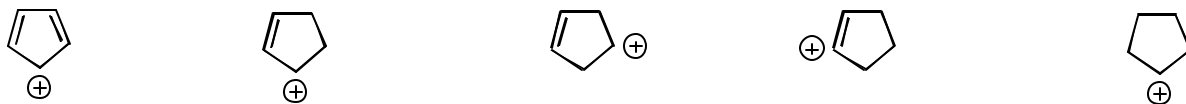
**PART III: MULTIPLE CHOICE**

3. (3 pts) Circle the most stable alkene:
- A. 2-methyl-2-hexene
  - B. 2-methyl-1-hexene
  - C. (*E*)-3,4-dimethyl-3-hexene
  - D. *trans*-cyclopentene
  - E. propene
4. (3 pts) Circle the most acidic of the following compounds:
- A. Potassium hydride (KH)
  - B. 2-methylphenol
  - C. Cyclopentanol
  - D. Phenylacetylene
  - E. Ammonia

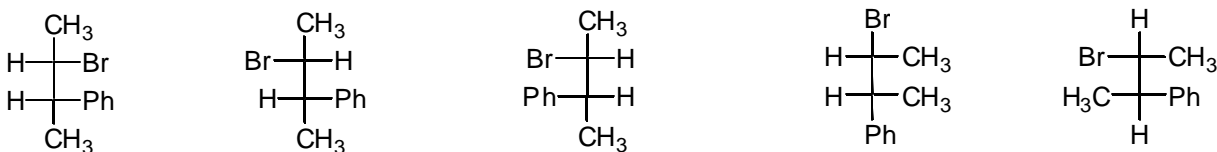
5. (2 pts) Circle the most stable radical. Do not explain!



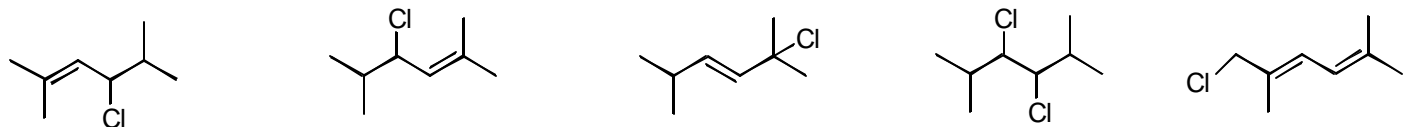
6. (2 pts) Circle the most stable carbocation. Do not explain!



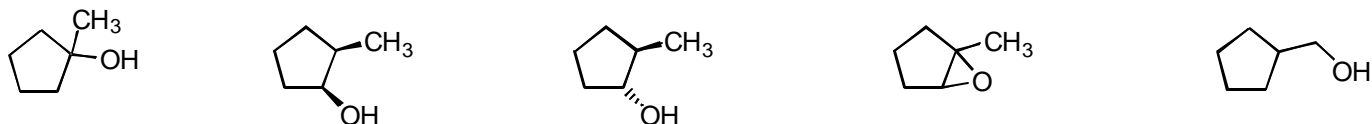
7. (3 pts) Circle the enantiomer of (2*R*, 3*S*)-2-bromo-3-phenylbutane.



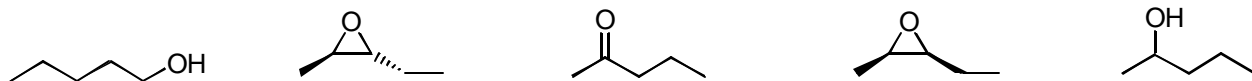
8. (2 pts) Circle the product of conjugate addition of HCl to 2,5-dimethyl-2,4-hexadiene.



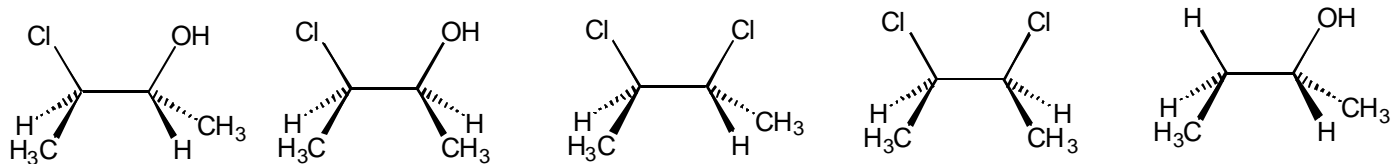
9. (3 pts) Circle the product of hydroboration-oxidation of 1-methylcyclopentene.



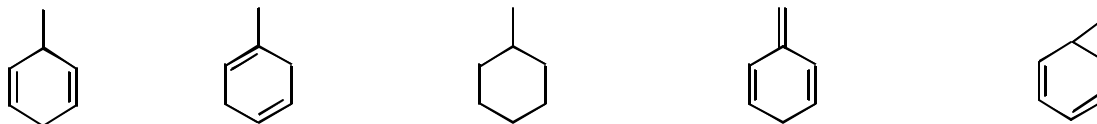
10. (2 pts) Circle the product of epoxidation of (*E*)-2-pentene.



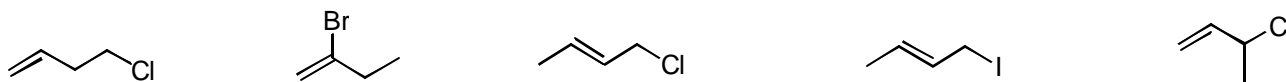
11. (3 pts) Circle the product of reaction of *cis*-2-butene with Cl<sub>2</sub>/H<sub>2</sub>O.



12. (2pts) Circle the product of Birch reduction of toluene.



13. (2 pts) Circle the most reactive substrate in  $S_N2$  reactions.



#### PART IV: NOMENCLATURE

14. (5 pts) Draw the structure of each of the following compounds.



2,6-difluoroaniline



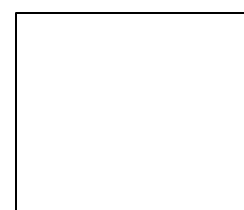
2-ethyl-4-methylphenol



imidazole



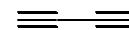
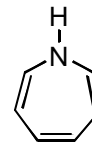
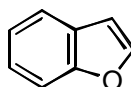
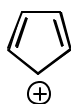
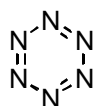
*m*-chlorobenzoic acid



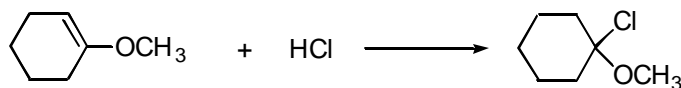
benzyl iodide

#### PART V: THEORY AND MECHANISMS

15. (3 pts) Label each of the structures below as aromatic, antiaromatic or non-aromatic. Do not explain!



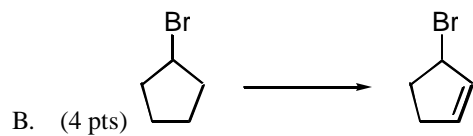
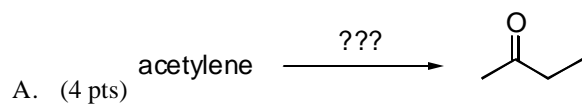
16. (4 pts) The addition of HCl to 1-methoxycyclohexene occurs with the formation of a single regioisomer. Offer a structural rationalization for this phenomenon and suggest a detailed mechanism (structures and equations please!) of the above reaction.



#### PART VI: REACTIONS

17. (28 pts) Predict the principal organic product(s) of each of the following reactions.





20. (3 pts) **BONUS PROBLEM (In order to receive credit for this problem, it has to be solved entirely!!)**. Shown below are some cyclic ketones. Cyclopropanone and cycloheptatrienone are very stable compounds, while cyclopentadienone is extremely unstable. Offer a structural rationalization to account for these facts (More structures, fewer words please!).

