

AVERAGE: 67  
LOW SCORE: 23 HIGH SCORE: 93<sub>1</sub>

Student Name (first, last):

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Student Number:

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CHEMISTRY 3311  
FIRST MIDTERM EXAMINATION

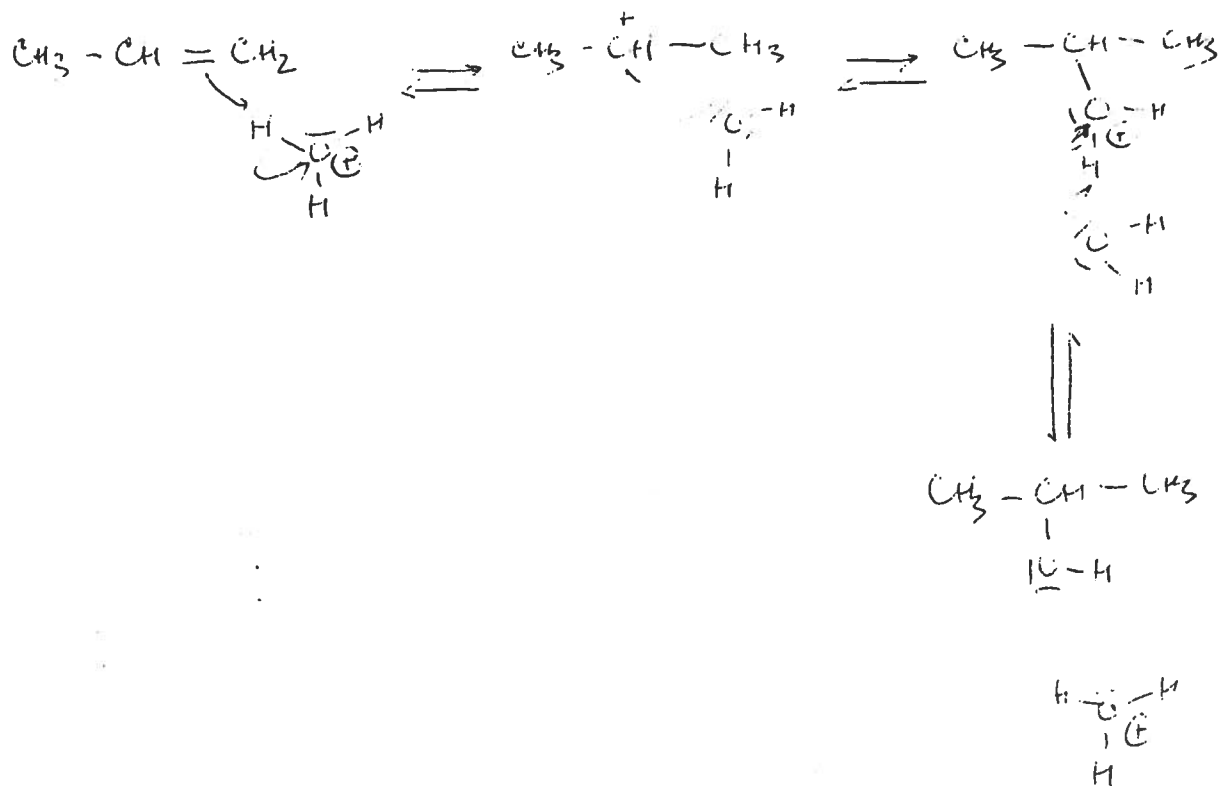
Josef Michl  
February 10, 2009

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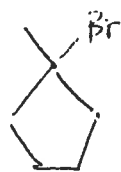
1. (20 points) Check the correct statements only:

- In the ground electronic state, the  $\pi$  orbitals of ethylene contain six electrons.
- An orbital is a region of space where an electron is likely to be found.
- The H-Br molecule contains a polar  $\sigma$  bond.
- Fluorine is a more electronegative atom than iodine.
- An electrostatic potential map (EPM) is a picture of the total electron density in a molecule, color coded to show areas of negative charge in red and areas of positive charge in blue.
- Fluoroacetic acid,  $\text{CH}_2\text{FCOOH}$ , has a higher  $\text{pK}_a$  than acetic acid,  $\text{CH}_3\text{COOH}$ .
- An electrostatic potential map (EPM) is a picture of the ease with which a positive point charge can be brought from infinity to various locations in a molecule (red, easier, and blue, harder).
- $\text{CO}_2$  has a larger dipole moment than  $\text{H}_2\text{O}$ .
- The molecule of ammonia,  $\text{NH}_3$ , is planar.
- The molecule of boron trifluoride,  $\text{BF}_3$ , is planar.
- A molecule of an alkene contains a  $\text{C}=\text{C}$  bond with approximately  $\text{sp}^2$  hybridized carbon atoms.
- Isobutane is a different name for 2-methylbutane.
- The methyl cation,  $\text{CH}_3^+$ , has an octet of valence electrons on the carbon atom.
- 1-Hexene and cyclohexane have the same unsaturation number.
- 2,3-Dimethyl-2-butene has a more negative heat of formation than 2-ethyl-1-butene.
- In general, secondary carbocations are more stable than tertiary carbocations.
- The slowest step in a multistep reaction sequence is called the rate determining step.
- A catalyst is a compound whose presence speeds up a reaction and which is consumed irreversibly in the reaction.
- According to the Hammond postulate, energies of transition states for reactions involving unstable intermediates resemble the energies of the intermediates themselves.
- When the free energy of activation of a reaction is lowered, the reaction proceeds faster.

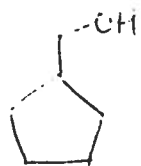
2. (25 pts) Write a plausible mechanism for the acid-catalyzed hydration of propene (include all steps and intermediates and use curved arrows to indicate electron movement in each step).



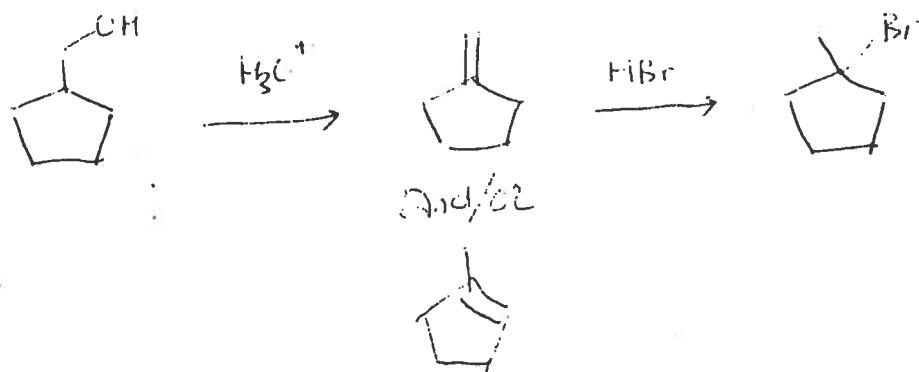
3. (20 pts) Propose a reaction sequence for the synthesis of 1-bromo-1-methylcyclopentane (A) from hydroxymethylcyclopentane (B) and inorganic reagents. Show all steps and all reagents (no mechanisms, no curved arrows, no solvents).



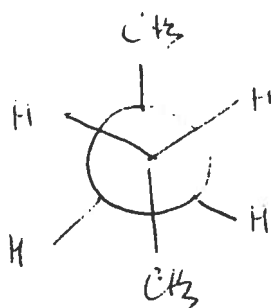
A



B

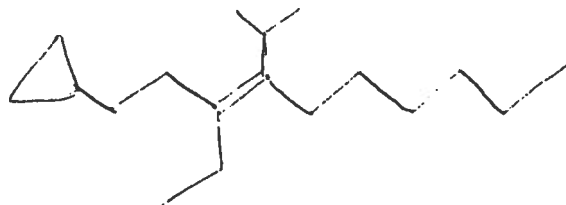


4. (10 pts) Draw the Newman projection of the most stable conformer of *n*-butane (view along the C(2)-C(3) axis) and write down the name of this conformation.



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5. (10 pts) Draw the structural formula of (Z)-1-cyclopropyl-3-ethyl-4-isopropyl-3-decene.



6. (15 pts) Write the structures of the principal organic product in the following reactions. You do not need to show solvents, mechanisms, or curved arrows.

