

Student Name (first, last):

Student Number:

CHEMISTRY 3311
FIRST MIDTERM EXAMINATION

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February 10, 2011

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

- In the ground electronic state, the π 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 σ 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, CH_2FCOOH , has a higher pK_a than acetic acid, CH_3COOH .
- 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).
- CO_2 has a larger dipole moment than H_2O .
- The molecule of ammonia, NH_3 , is planar.
- The molecule of boron trifluoride, BF_3 , is planar.
- A molecule of an alkene contains a $\text{C}=\text{C}$ bond with approximately sp^2 hybridized carbon atoms.
- Isobutane is a different name for 2-methylbutane.
- The methyl cation, 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).

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.

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.

