Organic Chemistry I, CHM 3140, Student Learning Outcomes

Upon successful completion of CHM 3140, students will be able to:

1. Predict type(s) of bonding and draw Lewis structures.
2. Recognize resonance patterns and use them to draw resonance structures. Describe the effect of the delocalization of electrons on stability and reactivity.
3. Select from a pair of compounds which one has the higher boiling point or better solubility in a given solvent, and use molecular structure and geometry to defend their choice.
4. Provide a reaction mechanism and predict the products for a given proton-transfer reaction (Bronsted-Lowry acid-base reaction).
5. Select from a pair of compounds which one is the stronger acid (or base), and provide a detailed explanation based on Atom, Resonance, Inductive effects and/or Orbitals, to support their choice.
6. Predict and explain the favored direction of an acid-base equilibrium.
7. Apply the rules of organic nomenclature to name alkanes, haloalkanes, alkenes and alkynes, or provide a drawing if given the name of a compound.
8. Draw the major conformations of alkanes and cycloalkanes, analyze their relative energies, and describe the factors contributing to their stability (or instability).
9. Recognize and apply the fundamental principles of stereochemistry, including chirality, optical activity, identifying and naming stereoisomers, and identifying the relationship between given structures.
10. Provide mechanisms for the formation of reactive intermediates (*e.g.* radicals, and carbocations), predict their relative stabilities, and provide mechanisms for carbocation rearrangements.
11. Draw an Energy vs. Progress of Reaction (Reaction Coordinate) Diagram, and provide transition state structure(s) for a given reaction.
12. Describe factors that affect nucleophilicity, electrophilicity and leaving group ability. Identify strong and weak nucleophiles, and good leaving groups.
13. Analyze an alkyl halide substrate and given reaction conditions in order to predict the major product(s) and provide detailed reaction mechanisms (S_N1, S_N2, E1, E2).
14. Analyze an alcohol substrate and given reaction conditions in order to predict the major product(s) (substitution with HX, dehydration, conversion to a tosylate) and provide detailed reaction mechanisms for substitution and dehydration reactions.
15. Analyze an alkene or alkyne substrate and given reaction conditions in order to predict the major product(s) for electrophilic addition, reduction, oxidation, and alkylation reactions. Provide detailed reaction mechanisms for addition and alkylation reactions.
16. Predict the major product(s) and provide a detailed reaction mechanism for a free-radical halogenation reaction.
17. Predict and explain observed outcomes of various organic reactions (*e.g.*, product ratios, reaction rates, stereochemistry, regiochemistry).
18. Apply the fundamental principles of nucleophilicity, electrophilicity, reaction mechanisms and functional group interconversion to organic synthesis. Perform a retrosynthetic analysis and propose a reasonable synthesis for a given target molecule.
19. Predict ^{1}H and ^{13}C NMR spectra for a given compound, and use NMR data to propose a structure.
20. Describe how organic chemistry is important to the student's academic major, career field, and quality of life.