Objectives for Chapter 10 – Alkyl Halides II

I. Elimination Reactions of Alkyl Halides

Introduction

1. Explain the difference between a substitution reaction and an elimination reaction.

Mechanisms

1. Correctly draw the mechanisms for the E2 and E1 reactions, including all arrows, charges, and intermediates.

2. Identify the acid and base in each reaction.

Beta hydrogens, constitutional isomers, and stereoisomers

1. Explain the spacial relationship between the halogen and hydrogen that are removed in an elimination reaction, and why it won't work if you try to remove the wrong one.

2. Explain how you can get different alkenes as products of an elimination reaction which are constitutional isomers of each other.

3. Locate all beta hydrogens on an alkyl halide, and write out all constitutional isomers which would result from a specific elimination reaction.

4. Explain how you can get different alkenes as products of an elimination reaction which are stereoisomers of each other.

5. Identify products which will have more than one stereoisomer formed in an elimination reaction.

6. Explain why some elimination products are formed in higher amounts than others.

7. Rank products in an elimination reaction according to which is formed in the greatest amount.

E2 vs. E1

1. Explain how E2 and E1 are alike, as well as how they are different.

2. Explain why E2 reactions require a strong base, while E1 reactions only occur with a weak base.

Strong and Weak Bases

1. Explain the difference between how a base reacts and how a nucleophile reacts.

2. Explain how charge, electronegativity, size, and steric hindrance affect the strength of a nucleophile.

3. Explain how charge, electronegativity, size, and steric hindrance affect the strength of a base; then compare them to how these factors affect a nucleophile.

4. Identify which reactions (SN2, SN1, E2, E1) a given reagent can undergo, and explain how you made this decision.

Rate laws

1. For both the E2 and E1 reactions, draw an energy diagram, identify the rate limiting step, draw the structure of the transition state for this step, identify the order of reaction for each reagent, and write the rate law.

2. Explain how the identity of the halide (I, Br, Cl, F) affects the rate of the reaction for both E2 and E1 reactions.

3. Explain how the structure of the alkyl halide (3^o, 2^o, 1^o, or methyl) affects the rate of the reaction for both E2 and E1 reactions.

Rearrangements

1. Explain why some carbocations undergo rearrangements, and the two types of rearrangements that they can do.

2. Explain which elimination reaction can undergo rearrangements, and why.

3. Draw the correct products including rearrangements in an elimination reaction.

Stereochemistry

1. Explain under what conditions an elimination reaction will give only one of two possible stereoisomers as products.

2. Use models to predict which product will be formed in the above circumstance.

3. Explain how the relationship between two alkyl halides which give only one stereoisomer can be used to predict the relationship of the products.

Solvents

1. Explain what kinds of solvents are best for E2 and E1 reactions, and explain why.

Eliminations of Vinyl and Aryl Halides

1. Explain what is needed for an aryl or vinyl halide to undergo elimination.

II. Elimination vs. Substitution

1. Explain why substitution and elimination are competing reactions.

2. Explain how to choose between 1^{st} order and 2^{nd} order reactions.

3. Explain how to use reaction rates to choose between elimination and substitution reactions.

4. Explain how large reagents, hindered reagents, starting materials without beta hydrogens, and starting materials with the potential for resonance can further limit which reactions will occur.

5. Determine which of the four reactions will occur for any given alkyl halide and reagent.

III. Synthesis Using Elimination

1. Identify products which can be synthesized using elimination reactions.

2. Explain what factors make a reaction a good synthesis.

3. Explain what problems can occur in an alkene synthesis, and what you can do to fix them, if possible.

4. For a given alkene, determine what possible alkyl halides could be used as starting materials, and explain which will be good choices and why.

5. Write a reaction which could be used to synthesize a given alkene.