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Organic Chemistry Reactions (Quick Study Academic)

Quick Study Academic

ORGANIC CHEMISTRY REACTIONS

Features of an Organic Reaction

- Mechanism:** Describes the overall reaction with a series of smaller steps.
- Reaction:** Catalyst, reagents and products using the balanced equation and molar masses.
- Kinetics:** Study of the reaction rate and mechanism.
- Theoretical Yield:** Mass of product given by a complete reaction; % yield = $\frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100\%$ = % product mass / theoretical yields.
- Equilibrium:** Reaction does not proceed to completion, instead, it reaches a balanced state of reactants and products.

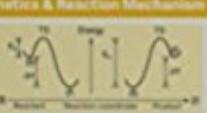
Major Reaction Types

- Acid
- Base
- Oxidation-reduction
- Condensation
- Substitution (S_N1 , S_N2)
- Addition
- Isomerization
- Witting: Converting aldehydes/ketones to alcohols

Important Named Reactions

- Wittig-Horner: Form cyclic ethers
- Friedel-Crafts: Add aryl or alkyl group
- Griegard: Add alkyl or aryl group
- Wolff-Kishner, Clemmensen: Reduce ketones/aldehydes
- Reductive: Converting aldehydes/ketones to alcohols

Kinetics & Reaction Mechanism



Activation Energy (E_a): Energy of the TS relative to the reactants. The change in enthalpy (ΔH°) is > 0 for exothermic reactions and < 0 for endothermic reactions.

Transition State (TS): Maximum on the reaction coordinate curve, the least stable intermediate.

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Activation Energy (E_a): Energy of the TS relative to the reactants. The change in enthalpy (ΔH°) is > 0 for exothermic reactions and < 0 for endothermic reactions.

Hammond-Loffler Postulate: The TS is more like the reactant or product that is closer in energy. The endothermic TS is like the reactant and the exothermic TS is like the reactant.

Kinetic vs. Thermodynamic Control: K_p and K_{eq} describe thermodynamic stability. If K_p is large and negative (exergonic), the product formation is likely controlled by "Thermodynamics." A large K_{eq} corresponds to a large percent of product, relative to reactant. A large K_p may give rise to "Kinetics" control, the energy of the TS controls the reaction, instead of the product's energy.

Solvent Effects: A solvent may stabilize an intermediate, decreasing the E_a and increasing the rate of the reaction. Charged complexes are stabilized by polar solvents.

Organic Acid & Base

Acid:

- Electron-pair acceptor (Lewis acid)
- Proton donor (Bronsted-Lowry acid)
- KA: Carboxylic acid

Base:

- Electron-pair donor (Lewis base)
- Proton acceptor (Bronsted-Lowry base)
- KA: Amine

Factors Enhancing Acid Strength (KA):

- Weaker H-A bond
- Greater electronegativity of "A"
- Inductive effect of substituents on "A" (electron withdrawal)
- More "s" character in hybrid orbital (s-orbital is lower in energy than p-orbital)
- Resonance-stabilized conjugate base (A⁻)

Factors Enhancing Base Strength

- Resonance of acid strength (delocalization)
- A base is a nucleophilic, electron-rich species which shift electron density to the atom with the lone pair increases basic strength

Alkane $\text{C}_n\text{H}_{2n+2}$

Properties:

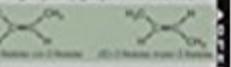
- Similar to alkanes: non-polar, flammable
- Nonconductors

Isotopes:

- Isotopes: $\text{C}_n\text{H}_{2n+2}$
- Constitution: $\text{C}_n\text{H}_{2n+2}$
- Polymerization: Paraffin: 2 or more $\text{C}_n\text{H}_{2n+2}$
- Alkanes: Alkanes: $\text{C}_n\text{H}_{2n+2}$
- Methane: CH_4 (1C, 4H)
- Alkyl Group: $\text{R}_n\text{C}_m\text{H}_{2m+2-n}$
- Vinyl: $\text{R}_n\text{C}_m=\text{CH}_2$ (1C, 2H, 1C=O)
- Conjugated: Alkene: C=C and C=C (conjugation)
- Alkenes: 2 conjugated C=C (e.g., butadiene, isobutene and isobutene isotene about C=C bond)
- Alkynes: 3 conjugated C=C
- Alkynes: Cycloalkyne: monocyclic compound C_n (3C, 2H, 1C≡C)
- Aromatic: Cycloalkyne: Cyclopentadiene anion; cycloheptadiene cation (6 electrons)

Isomers:

- 1C: 1 isomer of $\text{C}_n\text{H}_{2n+2}$
- 2C: 2 isomers grouped by atomic weight (2C = higher priority groups on the same side)



(2S)-2-Methylpropane (2S,2S)-2-Methylbutane (2S,2S,2S)

Noncyclic: C=C is less stable (more bond energy)

- Cyclic: C=C is more stable
- Hydrogen Rule: From the least substituted alkene
- Markovnikoff's Addition: H adds to C with more Hs
- Zaitsev Elimination: Form alkene with more substitution

Synthesis:

- Dehydrohalogenation (H, heat/irradiation)
- Dehydrohalogenation halide (heat, heat)
- Dehydrogenation: via dilute H_2 , acidic workup
- Hydrogenation: alkynes

 - Anti, Zaitsev-isomer: H_2 , Pd catalyst
 - Anti, Ettman-isomer: LiAlD_4 , NaBH_4 , -78°C
 - Witting: Aldehydes/ketones + phosphorus ylide

Reaction:

- Combustion: O_2
- Hydrogen and D_2 alcohol (H_2O , D_2O , F from HF)
- Hydrogen to alkene: H_2 (heat, heat)
- Hydrogen to alkene: H_2 (heat, heat, Markovnikov's)
- Hydrogenation: dilute H_2 (heat)
- Hydrogenation (D_2) (Markovnikov's)
- Hydrogen (H_2C_2): via dehalogenation (X_2C_2 , NaBH_4 , H_2C_2 , anti-addition)
- Hydrogen: to form a 1,2-diol (KMO_4 , cold H_2O_2 , anti-addition)
- Oxidation to carboxylic acid (KMnO_4 , hot H_2O_2)
- Oxidation to ketone: CrO_3 , $\text{Zn}, \text{H}_2\text{O}_2$
- Hydrogen to alkene (H_2 , Ni , syn-addition)
- Polymerization
- Alkylation: R_3C^+
- Acidic Substitution (Cl_2C_2 , heat)
- Witting: Aldehydes: Cycloalkyne from diene + alkene/alkyne



Synopsis

Quick Reference for the core essentials of a subject and class that is challenging at best and that many students struggle with. In 6 laminated pages our experienced chemistry author and professor gathered key elements organized and designed to use along with your text and lectures, as a review before testing, or as a memory companion that keeps key answers always at your fingertips. As many students have said "a must have" study tool. Suggested uses: o Quick Reference instead of digging into the textbook to find a core answer you need while studying, use the guide to reinforce quickly and repeatedly o Memory refreshing your memory repeatedly is a foundation of studying, have the core answers handy so you can focus on understanding the concepts o Test Prep no student should be cramming, but if you are, there is no better tool for that final review

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Great resource.

Very easy to work with. Quick service. A++++

great product good condition

High quality product, a great gift.

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