

Name: _____ Date: _____

Answer Key: Shatter Stereocenters: Senior Synthetic Chemistry Quiz

Can you predict regioselectivity in complex aromatic substitutions? Solve advanced mechanisms involving resonance effects and Baldwin's rules.

1. When subjecting 1-methylcyclohexene to hydroboration-oxidation, which specific stereochemical and regiochemical outcome is observed?

Answer: B) Anti-Markovnikov addition with syn-stereochemistry

Hydroboration-oxidation is a pericyclic reaction where the boron and hydrogen add simultaneously to the same face (syn) of the double bond, with boron attaching to the less hindered carbon (anti-Markovnikov).

2. According to Hückel's Rule, the cyclopentadienyl anion (C₅H₅⁻) is considered aromatic because it possesses 6 pi electrons in a planar, cyclic conjugated system.

Answer: A) True

The anion has 4 electrons from double bonds and 2 from the lone pair on the sp² hybridized carbon, totaling 6 (4n+2 where n=1), satisfying Hückel's criteria.

3. In the Electrophilic Aromatic Substitution (EAS) of nitrobenzene, the nitro group acts as a strongly deactivating group and directs the incoming electrophile to the _____ position.

Answer: C) Meta

The nitro group is electron-withdrawing via induction and resonance, destabilizing the carbocation intermediate at ortho and para positions more than at the meta position.

4. Identify the primary product formed when (S)-2-bromobutane undergoes an SN₂ reaction with sodium ethoxide (NaOEt) in ethanol.

Answer: A) (R)-2-ethoxybutane

SN₂ reactions proceed via backside attack, resulting in a 100% inversion of configuration at the stereocenter.

5. The Claisen Rearrangement is a powerful synthetic tool classified as a [3,3]-_____ reaction.

Answer: B) Sigmatropic

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The Claisen rearrangement involves the concerted migration of a sigma bond across a pi system, which defines a sigmatropic rearrangement.

6. The E2 elimination mechanism requires a periplanar transition state, preferably 'anti-periplanar', for the base to successfully abstract a proton and expel the leaving group.

Answer: A) True

The anti-periplanar geometry minimizes electronic repulsion and allows for the optimal orbital overlap required to form the new pi bond.

7. Which of the following compounds would exhibit the highest frequency for the carbonyl (C=O) stretch in an IR spectrum?

Answer: A) Formaldehyde

Alkyl groups and aromatic rings provide electron density or resonance that weakens the C=O bond, lowering the frequency; formaldehyde lacks these, maintaining the strongest bond.

8. In Proton NMR (¹H NMR) spectroscopy, a signal that appears as a septet integrated for 1H, coupled with a doublet integrated for 6H, is highly characteristic of a(n) _____ group.

Answer: C) Isopropyl

In an isopropyl group, the six equivalent methyl protons split the lone methine proton into a septet (n+1 rule), while the methine proton splits the methyl protons into a doublet.

9. A Friedel-Crafts Alkylation can be performed on an aniline molecule (phenylamine) using AlCl₃ as a catalyst to add an alkyl chain to the ring.

Answer: B) False

Aniline reacts with the Lewis acid catalyst (AlCl₃) to form a complex that places a strong positive charge on the nitrogen, making the ring too deactivated for Friedel-Crafts reactions.

10. During the acid-catalyzed dehydration of 3,3-dimethyl-2-butanol, what is the most likely major product formed after carbocation rearrangement?

Answer: B) 2,3-dimethyl-2-butene

The reaction forms a secondary carbocation which undergoes a 1,2-methyl shift to form a more stable tertiary carbocation, followed by elimination to form the most substituted (Zaitsev) alkene.