

Name: _____ Date: _____

Answer Key: Bonding Brilliance: 12th Grade Organic Synthesis Quiz

Scholars analyze complex reaction mechanisms, steric hindrance in nucleophilic substitutions, and the resonance stability of aromatic intermediates.

1. A student attempts to synthesize an ether using the Williamson ether synthesis. If they react potassium tert-butoxide with 2-bromo-2-methylpropane, what is the primary organic product observed?

Answer: B) 2-methylpropene

Due to extreme steric hindrance on the tertiary alkyl halide, the bulky tert-butoxide acts as a base rather than a nucleophile, favoring E2 elimination over S_N2 substitution.

2. In the electrophilic aromatic substitution of nitrobenzene, the nitro group acts as a(n) _____ director for the incoming electrophile.

Answer: C) meta

The nitro group is strongly electron-withdrawing through both inductive and resonance effects, destabilizing the carbocation intermediate at the ortho and para positions.

3. The Enantiomeric Excess (ee) of a racemic mixture is 0%.

Answer: A) True

A racemic mixture contains equal amounts of both enantiomers (50:50), meaning neither is in excess, resulting in 0% optical purity.

4. Which of the following describes the first step of the Grignard reaction between methylmagnesium bromide and pentan-3-one?

Answer: C) Nucleophilic attack on the carbonyl carbon

The Grignard reagent acts as a carbanion/nucleophile, attacking the electrophilic carbonyl carbon to form a tetrahedral alkoxide intermediate.

5. The reduction of a nitrile (R-CN) using Lithium Aluminum Hydride (LiAlH₄) followed by an acid workup yields a(n) _____.

Answer: B) Primary amine

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LiAlH_4 is a powerful reducing agent that adds four hydrides across the triple bond of a nitrile to produce a primary amine ($\text{R-CH}_2\text{NH}_2$).

6. The $\text{S}_\text{N}1$ reaction mechanism involves a pentacoordinate transition state.

Answer: B) False

The pentacoordinate transition state is characteristic of the $\text{S}_\text{N}2$ mechanism; $\text{S}_\text{N}1$ involves a planar carbocation intermediate.

7. According to Hückel's Rule, which of the following criteria must a molecule meet to be considered aromatic?

Answer: C) A cyclic, planar system with $4n+2$ pi electrons

Aromaticity requires the molecule to be cyclic, planar, fully conjugated, and possess $(4n + 2)$ pi electrons (where n is an integer).

8. In the acid-catalyzed dehydration of alcohols, the rate-determining step for 2-methyl-2-propanol is the formation of a _____.

Answer: C) Carbocation

For tertiary alcohols, dehydration follows an E_1 mechanism where the slow, rate-determining step is the loss of water to form a stable tertiary carbocation.

9. Equatorial substituents in a cyclohexane chair conformation are generally more stable than axial substituents due to the relief of 1,3-diaxial interactions.

Answer: A) True

Placing bulky groups in the equatorial position minimizes steric strain caused by interactions with other axial hydrogens on the same side of the ring.

10. Predict the major product of the hydroboration-oxidation of 1-methylcyclopentene.

Answer: B) trans-2-methylcyclopentanol (Anti-Markovnikov, Syn-addition)

Hydroboration-oxidation results in Anti-Markovnikov hydration with syn-stereospecificity; the H and OH add to the same face, placing them trans to the original methyl group.