Name: _____ **Date:** _____

Answer Key: Shatter the Enigma of Carbon Bonds: Advanced 10th Grade Chemistry Quiz

Synthesize knowledge of isomerism and orbital hybridization to predict the behavior of complex organic structures and reaction mechanisms.

---

1. Which of the following molecules exhibits geometric (cis-trans) isomerism due to restricted rotation and a lack of symmetry on each carbon of the double bond?

Answer: B) But-2-ene

But-2-ene has two different groups (H and CH3) attached to each carbon of the double bond, allowing for cis and trans configurations. 1,1-dichloroethene has two identical groups on the same carbon, precluding this isomerism.

2. According to Valence Shell Electron Pair Repulsion (VSEPR) theory and hybridization rules, a carbon atom involved in a triple bond with nitrogen (a nitrile group) exhibits _____ hybridization.

Answer: C) sp

A carbon atom forming a triple bond (one sigma and two pi bonds) uses sp hybridization to create a linear geometry with a 180-degree bond angle.

3. Enantiomers are a type of stereoisomer that are non-superimposable mirror images of each other, typically occurring at a chiral center.

Answer: A) True

Enantiomers occur when a carbon atom is bonded to four different groups, creating a molecule and a mirror image that cannot be perfectly overlapped, much like a person's left and right hands.

4. In the electrophilic addition of hydrogen bromide (HBr) to an asymmetric alkene like 2-methyl-propene, which intermediate is favored to ensure the major product according to Markovnikov's Rule?

Answer: C) Tertiary carbocation

Tertiary carbocations are the most stable due to inductive effects and hyperconjugation from surrounding alkyl groups, leading to the formation of the major product in electrophilic additions.

5. The systematic IUPAC name for the four-carbon ketone commonly referred to as methyl ethyl ketone is _____.

Name: _____ **Date:** _____

Answer: B) Butan-2-one

A four-carbon chain with a carbonyl group on the second carbon is named butan-2-one. This identifies both the parent alkane chain and the specific functional group position.

6. Phenols are generally more acidic than aliphatic alcohols because the resulting phenoxide ion is stabilized by resonance within the aromatic ring.

Answer: A) True

The delocalization of the negative charge on the oxygen atom into the benzene ring makes the phenoxide ion more stable than an alkoxide ion, facilitating the release of a proton.

7. Which reagent and conditions would effectively synthesize an ester through the process of Fischer esterification?

Answer: A) Carboxylic acid + Alcohol with an acid catalyst

Fischer esterification involves the condensation of a carboxylic acid and an alcohol, typically requiring an acid catalyst like H2SO4 to facilitate the removal of water.

8. Compounds with the same molecular formula but different connectivity in their carbon skeletons are known as _____ isomers.

Answer: B) Structural

Structural (or constitutional) isomers differ in the physical arrangement of atoms and bonds, such as butane and 2-methylpropane, despite sharing the same formula C4H10.

9. In a Nucleophilic Substitution (SN2) reaction, the rate of reaction depends only on the concentration of the substrate and is independent of the nucleophile concentration.

Answer: B) False

SN2 reactions are bimolecular; the rate depends on both the concentration of the substrate and the nucleophile, occurring in a single concerted step.

10. The secondary structure of proteins, such as alpha-helices and beta-pleated sheets, is primarily stabilized by which type of interaction between organic functional groups?

Answer: C) Hydrogen bonding

Name: _____ Date: _____

Hydrogen bonds form between the carbonyl oxygen (C=O) and the amine hydrogen (N-H) of the peptide backbone, creating the characteristic folds of secondary protein structures.