What Are SN1 and SN2 Substitution Reactions?

Worksheet

SN1 is a two-step mechanism through a carbocation intermediate (order-1 kinetics, favored by weak nucleophiles and polar solvents). SN2 is one-step, direct attack with inversion of configuration (order-2 kinetics, favored by strong nucleophiles and polar aprotic solvents).

Questions

1. Tertiary alkyl bromide + weak nucleophile + polar protic solvent ?

A) SN2
B) SN1
C) E2
D) No reaction

2. What does 'Walden inversion' mean?

A) Carbocation forms
B) Configuration flips during backside attack
C) Solvent changes
D) Nucleophile weakens

3. Primary alkyl halide + CN in DMF kinetics?

A) First-order
B) Second-order
C) Zero-order
D) Mixed

4. Which solvent favors SN2?

A) Ethanol
B) DMSO
C) Water
D) Acetic acid

5. Predict the mechanism for (CH)C-Br with CN in DMSO.

6. What happens with CH-I and HO (protic solvent)?

7. Explain the stereochemistry when (R)-2-bromobutane reacts via SN2.

8. Define: What is SN1 and SN2?

9. Define: Which is faster: SN1 or SN2 with a strong nucleophile?

10. Define: Stereochemistry of SN2?

Answer Key

1. B) SN1 - SN1 is favored: bulky substrate (carbocation stability), weak Nu, polar protic solvent.

2. B) Configuration flips during backside attack - SN2 backside attack causes inversion of stereochemistry.

3. B) Second-order - SN2 is bimolecular rate = k[RX][Nu] (second-order).

4. B) DMSO - DMSO is polar aprotic - does not solvate nucleophile as strongly, keeping it reactive.

5. Substrate: tertiary alkyl halide (favors carbocation) Nucleophile: CN (strong) Solvent: DMSO (polar aprotic) Conclusion: SN2 dominates due to strong Nu and polar aprotic solvent. Product: (CH)C-CN with inversion.

6. Substrate: primary alkyl halide Nucleophile: HO (weak in protic solvent) Solvent: HO (polar protic) Conclusion: SN2 is favored for primary. Product: CH-OH (methanol) with inversion.

7. SN2 requires backside attack. Walden inversion occurs. Configuration inverts from R to S. Product: (S)-2-nucleophile-butane.

8. SN1 = unimolecular substitution (2 steps, carbocation). SN2 = bimolecular (1 step, direct).

9. SN2 is faster - direct attack, single activation barrier.

10. Inversion of configuration (Walden inversion) due to backside attack.