# Multistep Organic Synthesis: Reaction Roadmaps

## INSTRUCTOR ANSWER KEY

Instructions: Select the best answer for questions 1–8 and briefly justify your choice using substrate, reagents, or reaction conditions. For 9–10, explain your reasoning in complete sentences.

1. **First transformation for 1-bromopropane → 1-propanol:**

   A. Aqueous NaOH (SN2)  B. PCC  C. $H_2$/Lindlar  D. $CrO_3/H_2SO_4$

   **Answer: A. Aqueous NaOH (SN2)**

   Explanation: Hydroxide displaces bromide on a primary carbon.

2. **Convert 1-propanol to propanal with:**

   A. PCC  B. Jones reagent  C. Excess hot $KMnO_4$ aqueous  D. $NaBH_4$

   **Answer: A. PCC**

   Explanation: Mild oxidation avoids overoxidizing the aldehyde to acid.

3. **Convert propanal to propanoic acid with:**

   A. Aqueous oxidant  B. PCC exclusively  C. $NaBH_4$  D. $LiAlH_4$

   **Answer: A. Aqueous oxidant**

   Explanation: Aldehydes can be oxidized to carboxylic acids.

4. **Why work backward from the target?**

   A. Identify feasible bond/functional group changes  B. Avoid balancing equations  C. Make the molecule longer automatically  D. Ignore the starting material

   **Answer: A. Identify feasible bond/functional group changes**

   Explanation: Retrosynthesis breaks a target into plausible precursor transformations.

5. **A proposed route changes $C_3$ starting material into $C_4$ product with no C–C bond formation. What is the concern?**

   A. Carbon-count mismatch  B. Solvent color  C. Temperature only  D. No issue

   **Answer: A. Carbon-count mismatch**

   Explanation: Carbon count must be conserved unless a deliberate carbon-forming step is included.

6. **To retain an aldehyde from a primary alcohol, avoid:**

   A. Aqueous Jones oxidation  B. PCC  C. Dess–Martin periodinane  D. Swern oxidation

   **Answer: A. Aqueous Jones oxidation**

   Explanation: Strong aqueous Cr(VI) conditions often overoxidize to acid.

7. **Best two-step route: primary bromide → aldehyde?**

   A. Substitution to alcohol, mild oxidation  B. Excess $H_2$/Pd, bromination  C. Strong oxidation first, SN1 later  D. Radical chlorination, reduction

   **Answer: A. Substitution to alcohol, mild oxidation**

   Explanation: Primary SN2 then PCC gives the requested aldehyde.

8. **If a route requires SN2 at a tertiary carbon, one should:**

   A. Redesign the route  B. Assume fast SN2  C. Ignore sterics  D. Increase concentration only

**Answer: A. Redesign the route**

Explanation: Tertiary carbons are unsuitable for normal SN2 attack.

9. **Write a two-step conversion of 1-bromopropane to propanal.**

**Suggested response: 1-Bromopropane + aqueous NaOH → 1-propanol; then PCC in anhydrous solvent → propanal.**

10. **Why should Jones oxidation not be used for the second step when propanal is the target?**

**Suggested response: Aqueous Cr(VI) oxidation generally oxidizes primary alcohols beyond the aldehyde to the corresponding carboxylic acid.**