1. Devise a synthesis for each product for the given starting material (Smith 7th Ed. 10.63)
2. Devise a synthesis of each compound from cyclohexane as the starting material (Smith 7th Ed. 10.64)
3. Draw the reactants for each of the following reactions (Smith 7th Ed. 11.38)

4. One plausible mechanism is shown below. The primary carbocation is resonance stabilized.
5. This is a plausible mechanism. The stereochemistry is not so important for the purpose of this class. A good tip is to count your carbons with these cyclization questions. (Klein 4th Ed. 8.108)
6. Each pi bond, C-O, C-N, and C-X counts as an oxidation. Compound B has an oxidation of 3 because it has 3 C-O bonds. Try determining the oxidation level for the other molecules.

![Diagram of molecules]

B > A > C > D

An oxidation results in an increase of C-O, C-N, C-X, or pi bonds. Reduction results in an increase of C-H bonds.
7. Start by identifying major functional groups on the final product and starting materials. In the product, we see an ether and alcohol. In the starting material, we see an epoxide. Next, think about all possible reactions of these functional groups. With epoxides, we know that they can be attacked and opened with strong nucleophiles, and that ethers are made through displacement reactions (SN2). The alcohol can be made from hydration of alkene, epoxide opening, halohydrin formation, hydroboration oxidation, etc. Using this information, we can start to think about how we can disconnect this molecule. The epoxide can be opened with a strong nucleophile, such as sodium acetylide. This will install all carbon atoms on the left side of the molecule. This can be reduced to the alkene and reacted under hydroboration-oxidation conditions to yield the primary alcohol (Note: hydration using $\text{H}_2\text{SO}_4$ and $\text{H}_2\text{O}$ would give the secondary alcohol, not primary). On the left side of the molecule, the alcohol can be treated with a base and benzyl bromide to make the ether. When constructing a forward synthesis, it is important to make sure that multiple functional groups do not react at the same time. For example, I could not alkylate the alcohol resulting from the epoxide opening once I have performed the hydroboration-oxidation because I could have alkylation at both alcohols.
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Forward:
1. \( \text{Na} \)  
2. \( \text{H}_2\text{O} \)

Epoxy Opening
1. \( \text{KOBu} \)
2. \( \text{Br} \)  
Or \( \text{H}_2 \), Lindlar's Catalyst

Alkyne Reduction

Hydroboration-Oxidation

Alkylation

Epoxide Opening

Alkyne Reduction