Shown below are two preparative steps in the recent synthesis of a metabolite (7-hydroxycannabidiol) of cannabidiol, a compound found in various preparations of *Cannabis sativa*. Interest in cannabidiol and its metabolites centers on the variety of nonpsychotropic pharmacological effects that the compound possesses.

Provide a reasonable mechanism, including proper use of curved arrow formalism, that shows how the transformations occur. Show all products and byproducts.
The example below is illustrative of a recently-developed method for modification of the double bond in variously-substituted styrenes.

Provide a reasonable mechanism, including proper use of curved arrow formalism, that shows how the given transformation occurs. Show all products and byproducts, and explain why NMP is advantageous as a solvent for this system. Explain, by way of your mechanistic scheme, why a mixture of diastereomers, rather than a single isomer, is formed.

\[
\text{CN} \quad \overset{t\text{-BuOK (30 mol %)}}{\text{NMP, 100 °C}} \quad 3h \quad \text{Ph} \quad 1:1 \text{ cis/trans mixture}
\]

The example below is illustrative of a recently-developed method for preparation of “push-pull” alkenes. Such alkenes are of interest in the construction of non-linear optical devices.

Provide a reasonable mechanism, including proper use of curved arrow formalism, that shows how the given transformation occurs. Show all products and byproducts, and explain why Hünig’s base is advantageous as a component of the reaction system.

What do you think that the term ‘push-pull’ means within the present context? Draw structures that illustrate your idea.