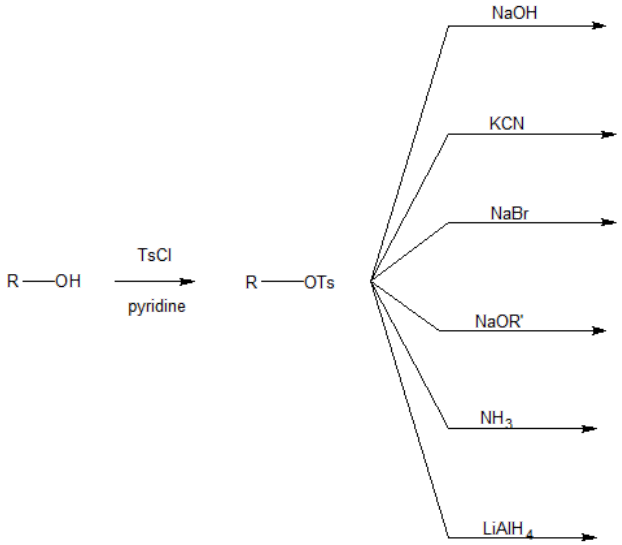
# 14.3: ALCOHOL CONVERSION TO ESTERS - TOSYLATE AND CARBOXYLATE

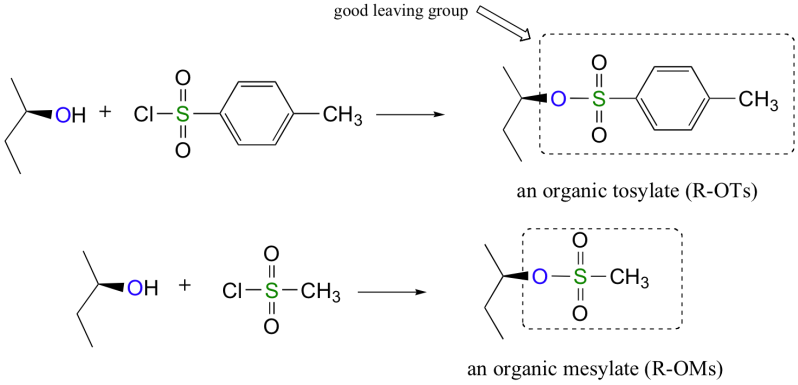
The poor leaving group of alcohols can be overcome by converting the hydroxyl group to a tosylate ester, an excellent leaving group. The tosylate ester undergoes subsequent reactions (typically $S_N1$ or $S_N2$) as part of a multiple step synthesis.




The synthesis of carboxylate esters (the other ester) is commonly the final step of a synthetic pathway.

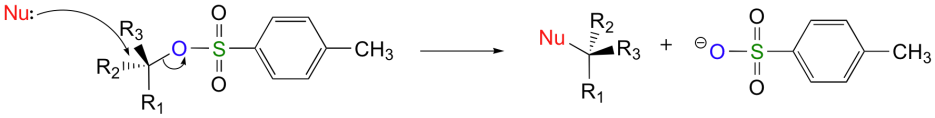
# Tosylate Ester Formation

We can transform an alcohol group into a sulfonic ester using *para*-toluene sulfonyl chloride (Ts-Cl) or methanesulfonyl chloride (Ms-Cl), creating what is termed an organic **tosylate** or **mesylate:**

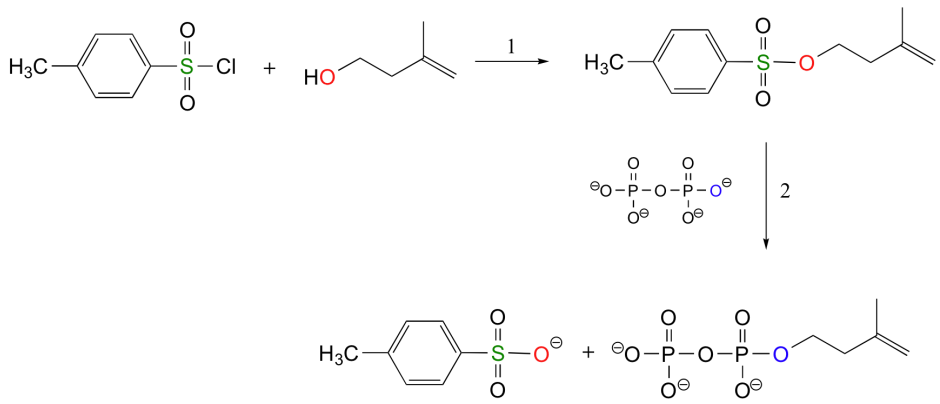



Notice that unlike the halogenation reactions of alcohols with thionyl chloride or phosphorous tribromide, conversion of an alcohol to a tosylate or mesylate proceeds with retention of configuration at the electrophilic carbon.

Tosylate/mesylate groups are excellent leaving groups in nucleophilic substitution reactions, due to resonance delocalization of the developing negative charge on the leaving oxygen.



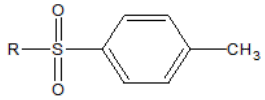

The laboratory synthesis of isopentenyl diphosphate - the 'building block' molecule used by nature for the construction of isoprenoid molecules such as cholesterol and b-carotene - was accomplished by first converting the alcohol into an organic tosylate (step 1), then displacing the tosylate group with an inorganic pyrophosphate nucleophile (step 2) (*J. Org. Chem* **1986**, *51*, 4768).



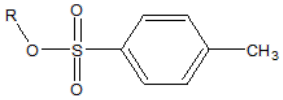
The major reactive species of tosylate chemistry are summarized below.

Tosyl Groups

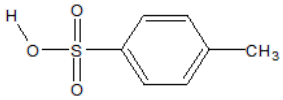
Ts
tosyl group



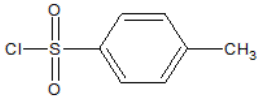
ROTs
tosylate ester



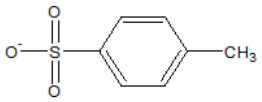
TsOH or p-TSA
tosic acid



TsCl
tosyl chloride

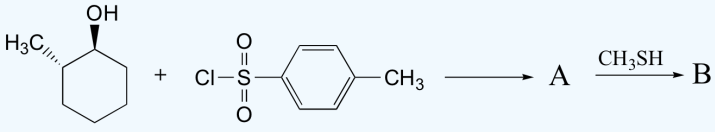


$^{-}$OTs
tosylate ion



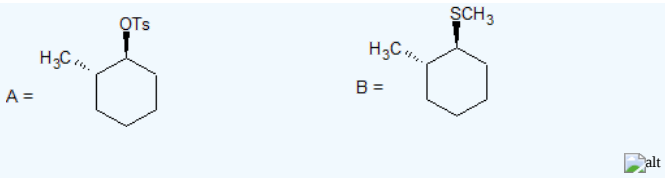
## Exercise

**4.** Predict the structures of A and B in the following reaction.



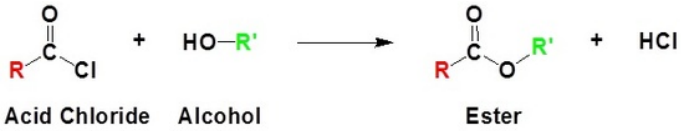
**Answer**

**4.**




## CONVERSION OF ALCOHOLS INTO ESTERS

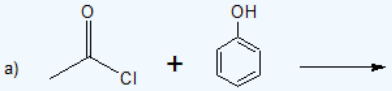
Acid chlorides react with alcohols to form esters

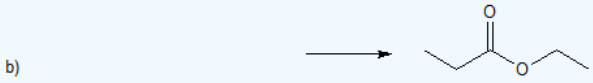



### Example 14.3.1


### Exercise

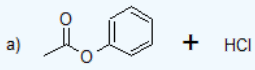
**5.** Predict the products or specify the reagents for the following reactions.

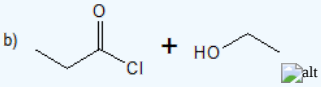



**Answer**

**5.**




## CONTRIBUTORS AND ATTRIBUTIONS

- Dr. Dietmar Kennepohl FCIC (Professor of Chemistry, Athabasca University)
- Prof. Steven Farmer (Sonoma State University)
- William Reusch, Professor Emeritus (Michigan State U.), Virtual Textbook of Organic Chemistry

Organic Chemistry With a Biological Emphasis by Tim Soderberg (University of Minnesota, Morris)