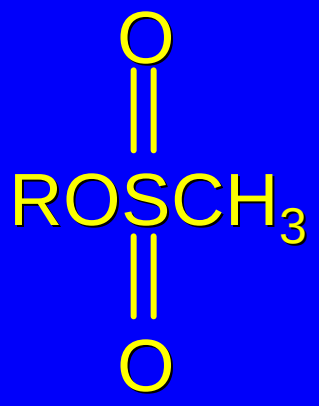
# 8.14
# Sulfonate Esters
# as
# Substrates in Nucleophilic Substitution

## *Leaving Groups*

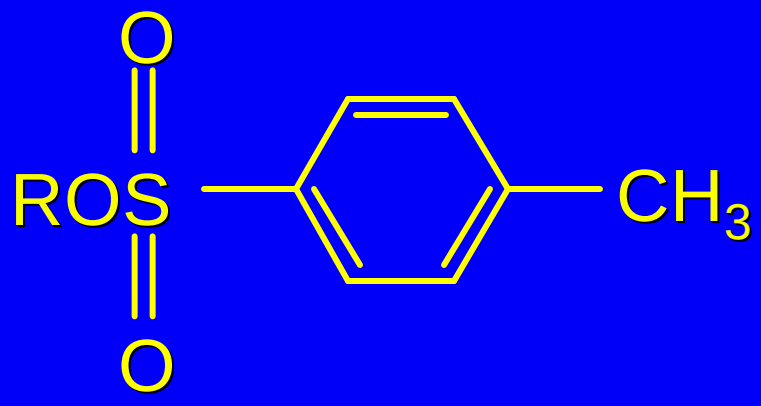
we have seen numerous examples of nucleophilic substitution in which X in RX is a halogen

halogen is not the only possible leaving group though

# *Other RX compounds*




Alkyl
methanesulfonate
(mesylate)

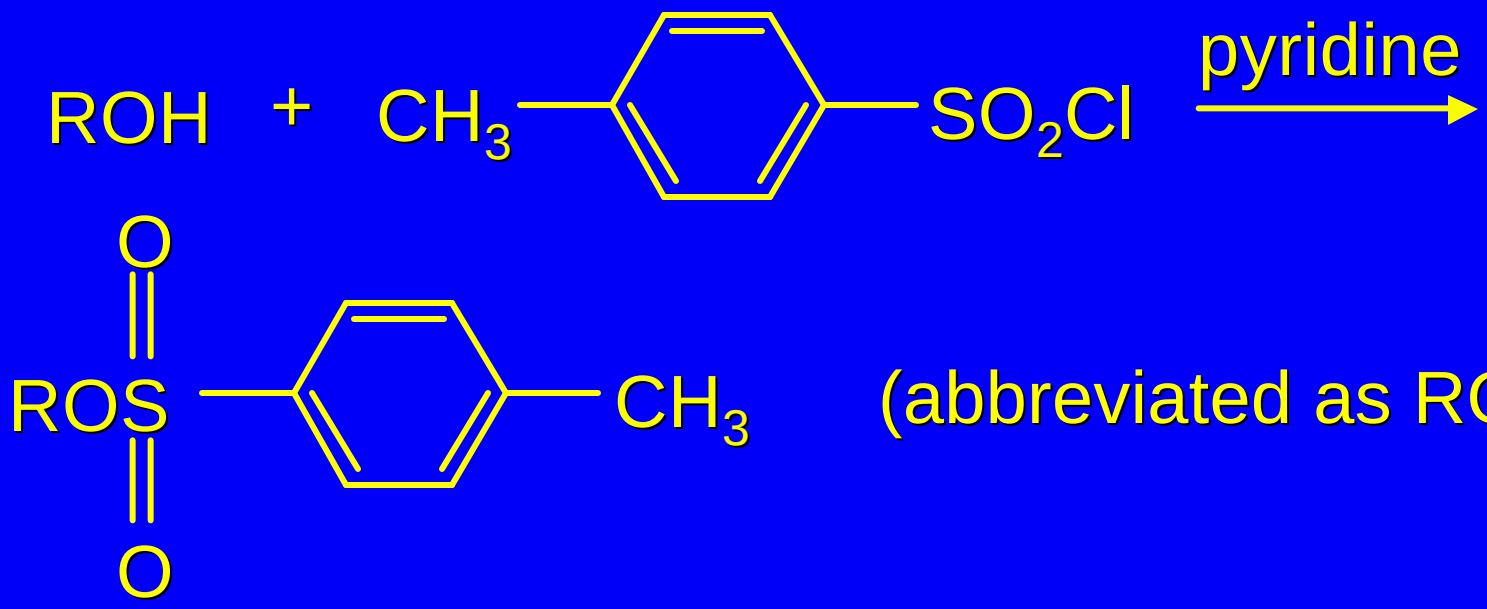



Alkyl
*p*-toluenesulfonate
(tosylate)

undergo same kinds of reactions as alkyl halides

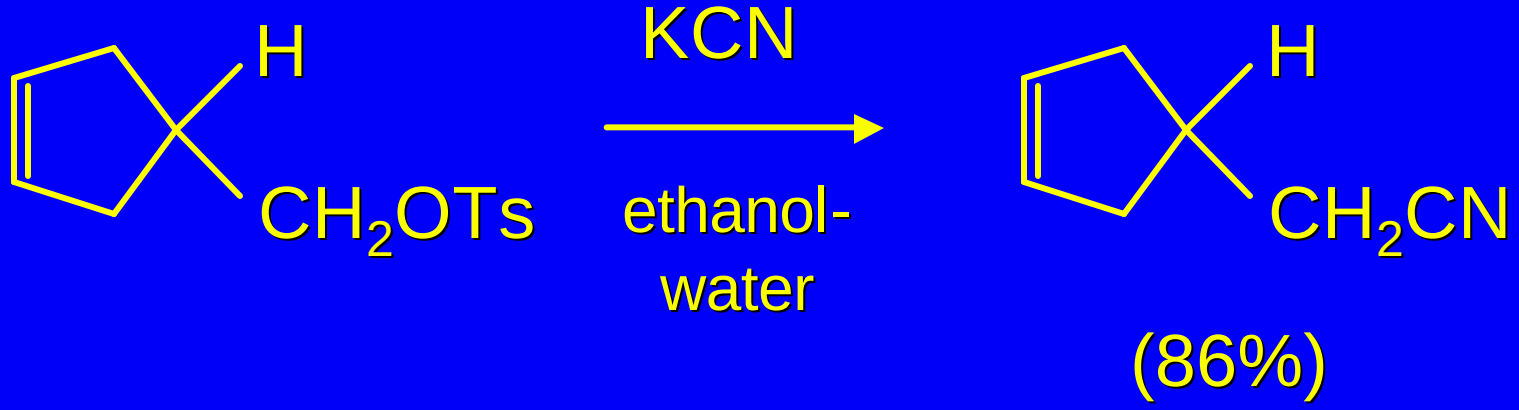
## *Preparation*

Tosylates are prepared by the reaction of alcohols with *p*-toluenesulfonyl chloride (usually in the presence of pyridine)




(abbreviated as ROTs)

*Tosylates undergo typical nucleophilic substitution reactions*



*The best leaving groups are weakly basic*

*Table 8.8*
*Approximate Relative Reactivity of Leaving Groups*

| Leaving Group | Relative Rate | Conjugate acid of leaving group | $K_a$ of conj. acid |
|---|---|---|---|
| $F^-$ | $10^{-5}$ | HF | $3.5 \times 10^{-4}$ |
| $Cl^-$ | 1 | HCl | $10^7$ |
| $Br^-$ | 10 | HBr | $10^9$ |
| $I^-$ | $10^2$ | HI | $10^{10}$ |
| $H_2O$ | $10^1$ | $H_3O^+$ | 56 |
| $TsO^-$ | $10^5$ | TsOH | 600 |
| $CF_3SO_2O^-$ | $10^8$ | $CF_3SO_2OH$ | $10^6$ |

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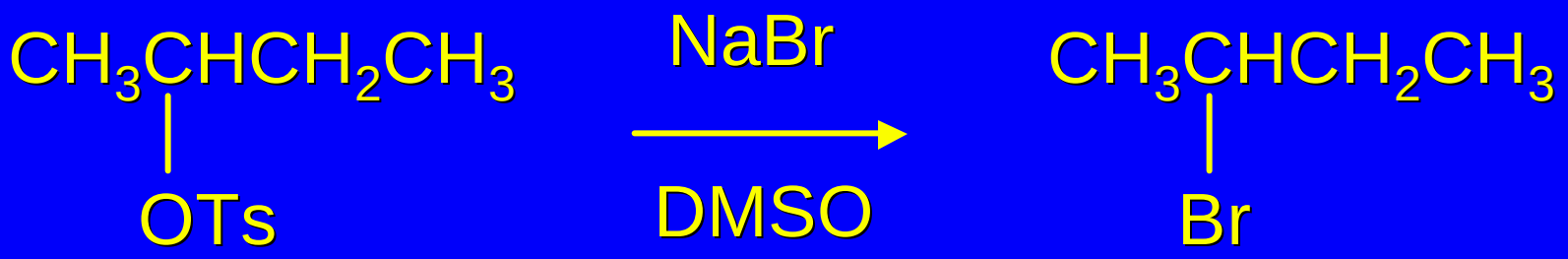
Sulfonate esters are extremely good leaving groups; sulfonate ions are very weak bases.

*Tosylates can be converted to alkyl halides*

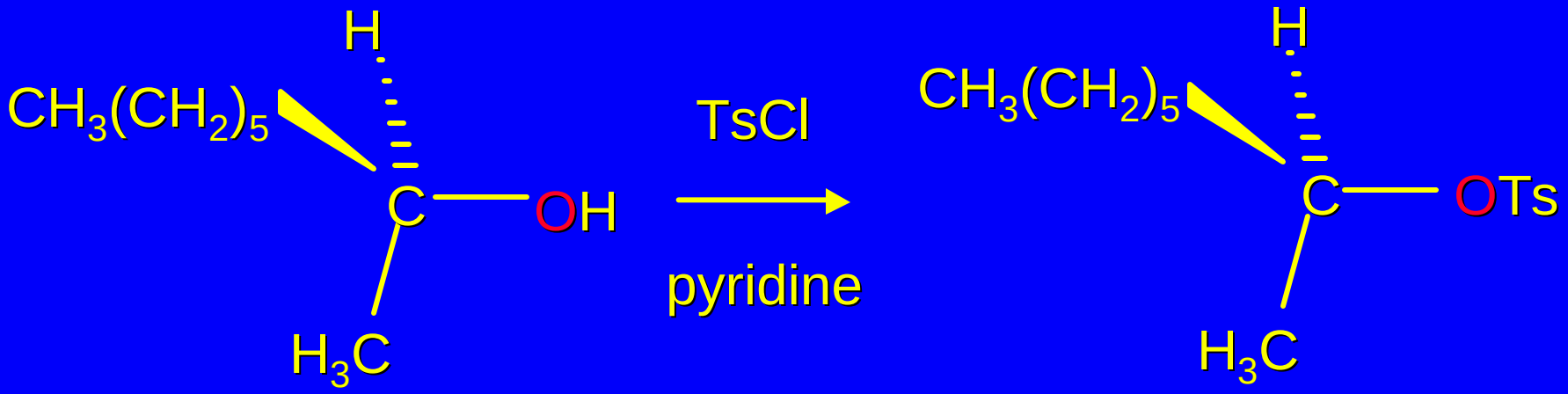



(82%)

Tosylate is a better leaving group than bromide.

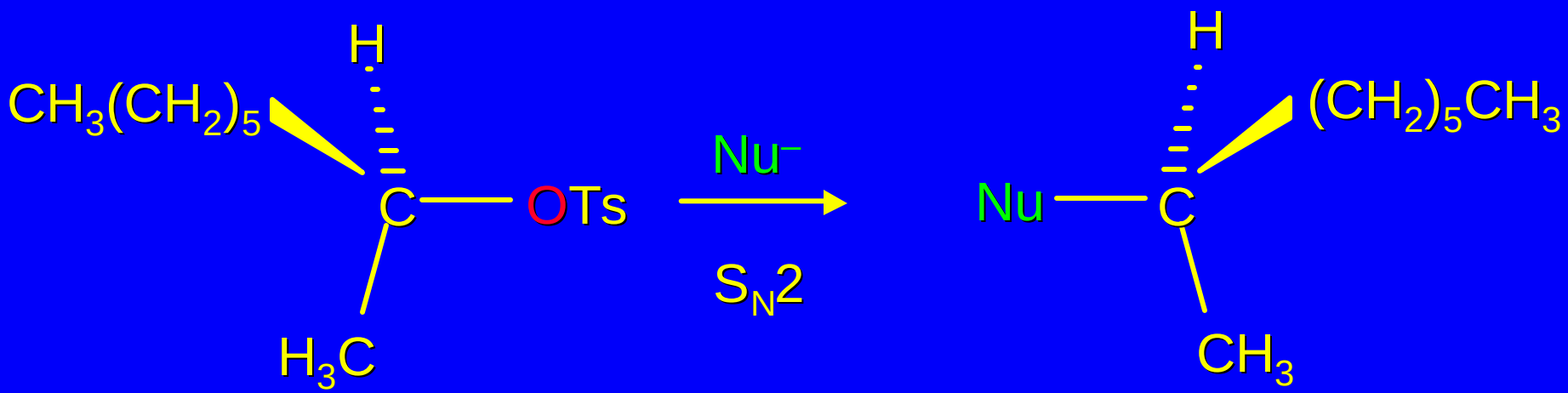
## *Tosylates allow control of stereochemistry*

Preparation of tosylate does not affect any of the bonds to the stereogenic center, so configuration and optical purity of tosylate is the same as the alcohol from which it was formed.



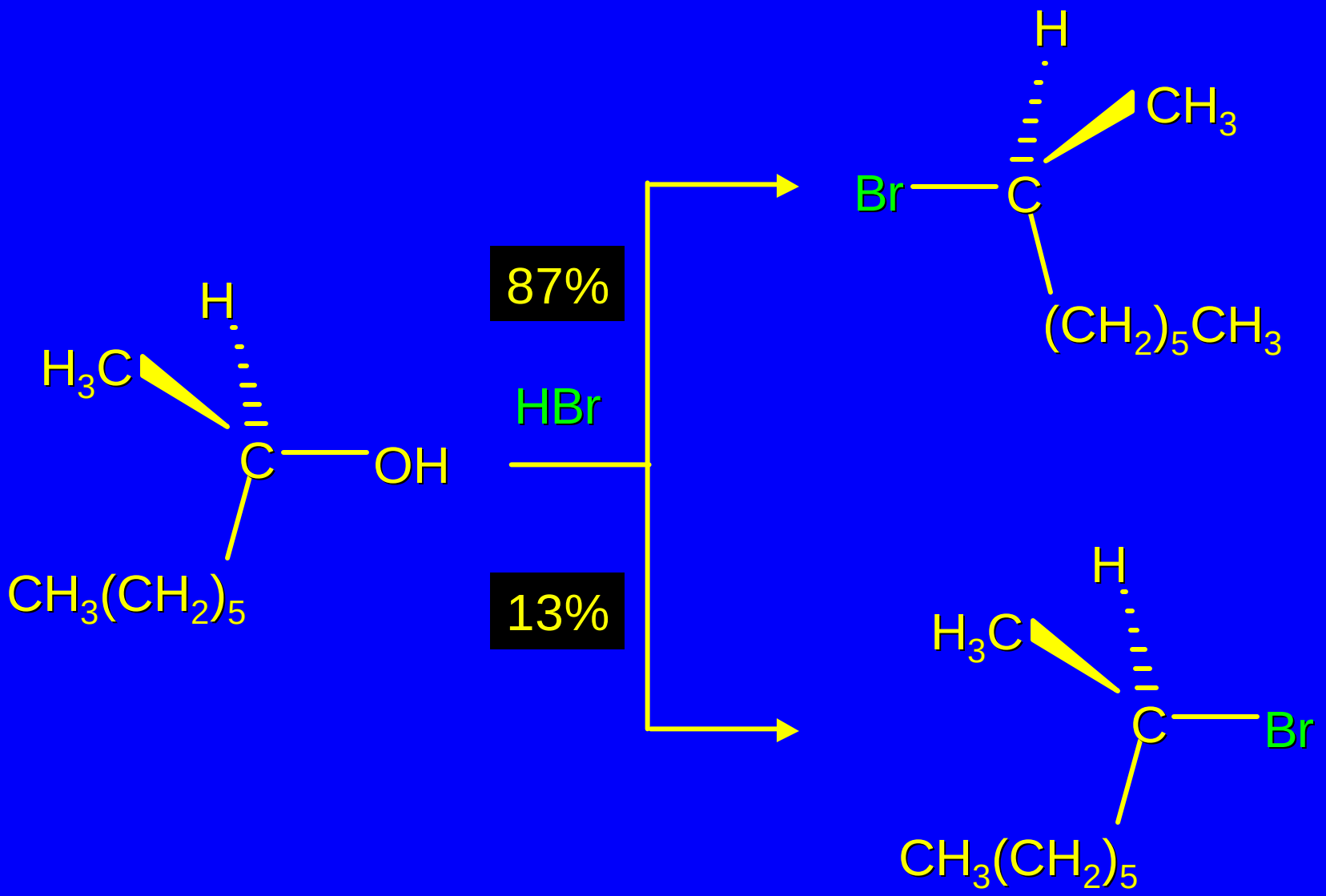
*Tosylates allow control of stereochemistry*

Having a tosylate of known optical purity and absolute configuration then allows the preparation of other compounds of known configuration by $S_N2$ processes.



# 8.15
# Looking Back:
# Reactions of Alcohols
# with
# Hydrogen Halides

*Secondary alcohols react with hydrogen halides with net inversion of configuration*



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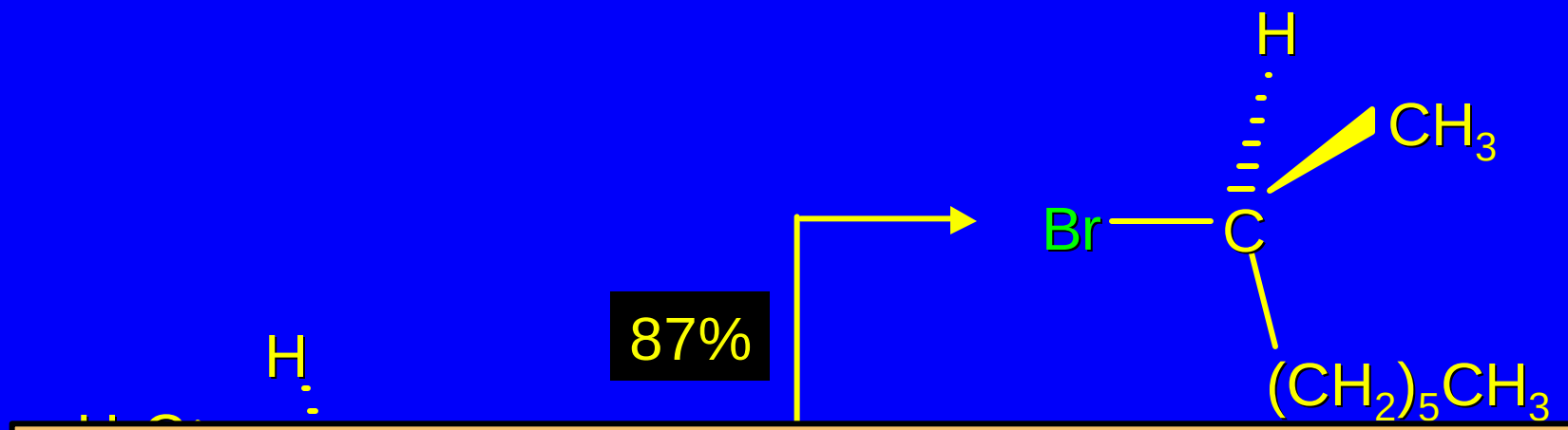
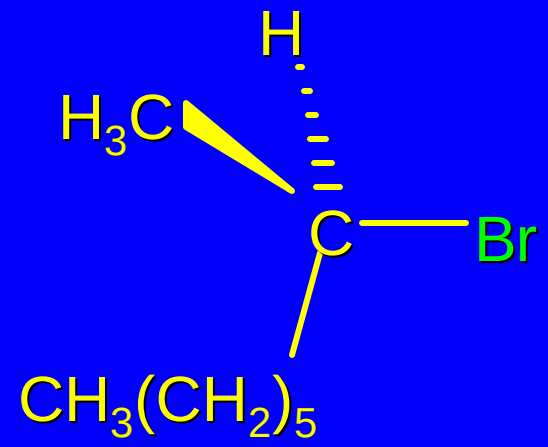
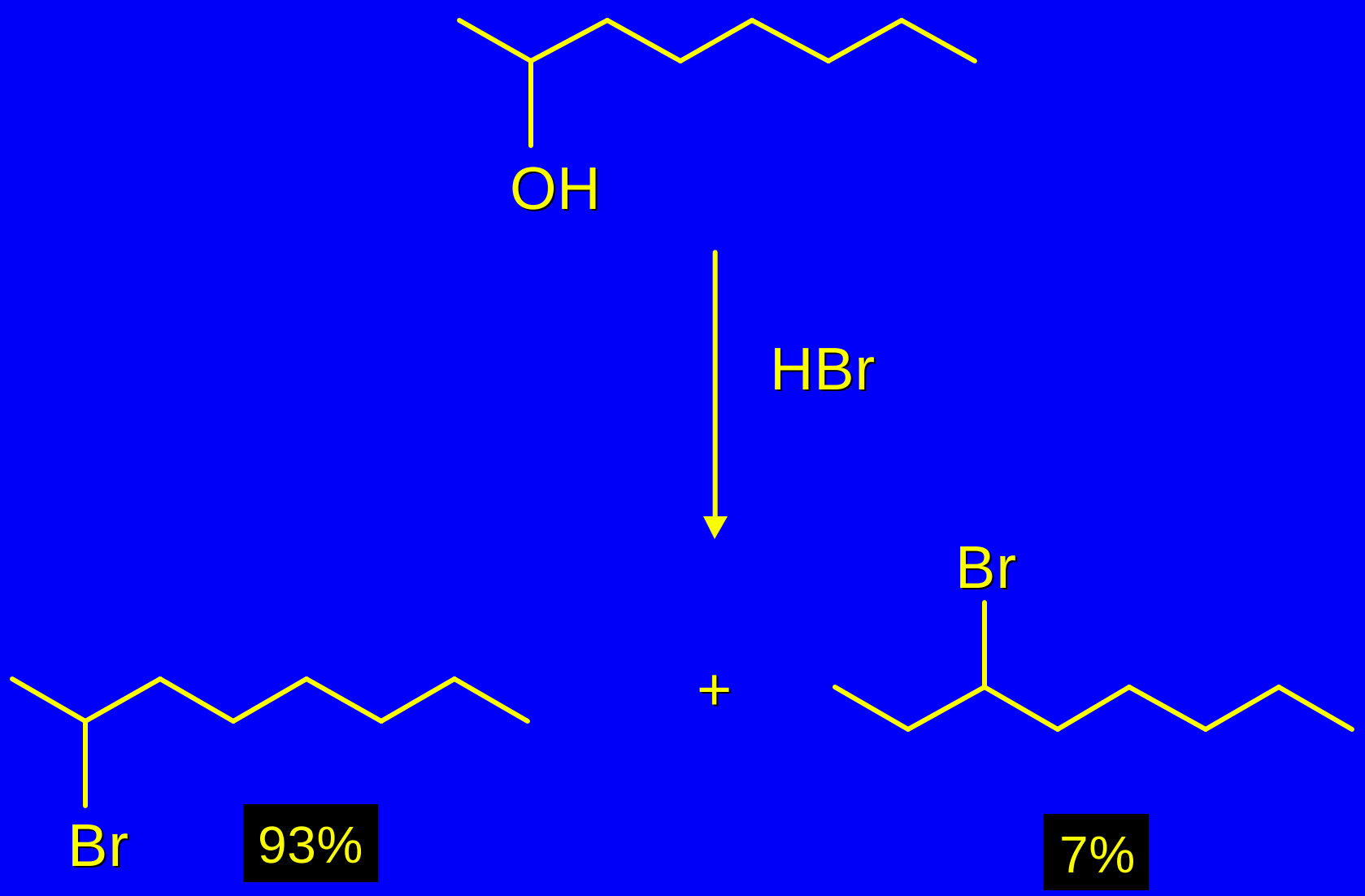



Most reasonable mechanism is $S_N1$ with front side of carbocation shielded by leaving group



*Rearrangements can occur in the reaction of alcohols with hydrogen halides*



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