Part I

# SUBSTITUTION REACTION ($SN_1$)

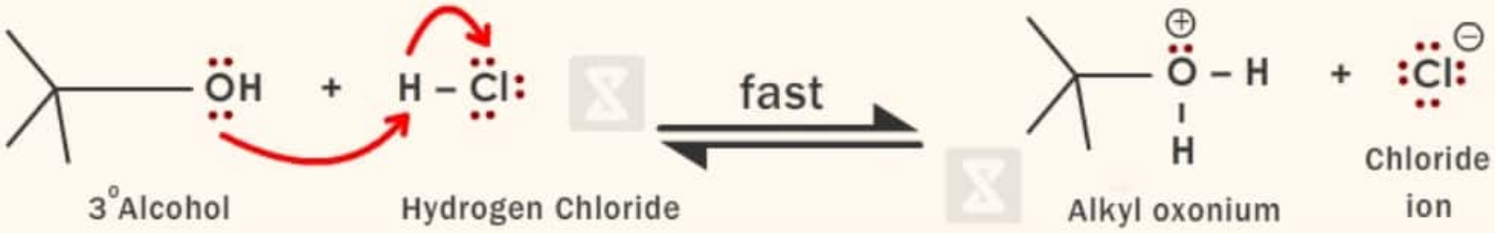
Black cat waits for the brown cat to leave and then takes the pod. Similarly in $SN_1$ reaction one nucleophile waits for other nucleophile to move from substrate.

## WHAT IS $SN_1$ REACTION ?

$SN_1$ indicates the unimolecular nucleophilic substitution reaction in organic chemistry. Their rate determining step of the mechanism depends on the decomposition of a single molecular species. So that, the rate of a $SN_1$ reaction can be expressed as rate = K [R-LG]. Furthermore, $SN_1$ is a multi-step reaction, which forms an intermediate and several transition states during the reaction. This intermediate is a more stable carbocation and the reactivity of the molecule depends on the R- group.

## $SN_1$ MECHANISM (R – OH ⟶ R – X)

### PROTON TRANSFER




### DISSOCIATION OF WATER


**RATE - DETERMINING STEP**

- Unimolecular
- Nucleophilic reaction
- "$SN_1$" mechanism

### CAPTURE OF CARBOCATION


| | |
|---|---|
| Protic solvent | ✓ |
| 3° or 2° carbon | ✓ |
| 1° carbon | ✗ |

# SUBSTITUTION REACTION ($SN_2$)

Part II

Black cat forces the brown cat out from the pod. Similarly in $SN_2$, strong nucleophile kicks out the weaker nucleophile.

## WHAT IS $SN_2$ REACTION?

$SN_2$ indicates the bimolecular nucleophilic substitution reaction in organic chemistry. In this mechanism, separation of leaving group and formation of new bond happen synchronously. Therefore, two molecular species are involve in the rate determining step and this leads to the term bimolecular nucleophilic substitution reaction or $SN_2$. The rate of the $SN_2$ reaction can be expressed as rate = K [R-LG] [Nu−]. In inorganic chemistry, this reaction is also called associative substitution or interchange mechanism.

## $SN_2$ MECHANISM (R – OH ⟶ R – X)

### PROTONATE ALCOHOL


1° Alcohol | Hydrogen Bromide | Alkyl oxonium | Bromide

### NUCLEOPHILE (HALIDE) SEPERATES WATER


Alkyl oxonium | Bromide | Alkyl Bromide | Water

Here, nucleophile attacks from the opposite direction of the leaving group. Thus, $SN_2$ reaction always leads to an inversion of stereochemistry. This reaction works best with methyl and primary halides because bulky alkyl groups block the backside attack of the nucleophile. In addition, the stability of the leaving group as an anion and the strength of its bond to the carbon atom both affect the rate of reaction.