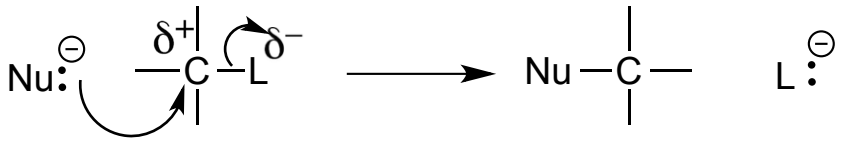
Substitution Reactions

Nucleophilic substitution reaction



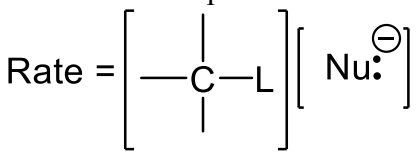
Nucleophile: Substance that seeks a positive centre.

Electrophile: Substance that seeks a negative centre

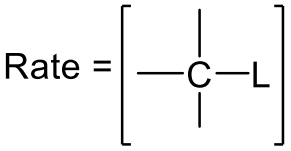
Leaving Group: e^- withdrawing atom or group gives the attached carbon a partial positive charge (electrophilic character).

Substitution Reactions – 2 types: S_N1 and S_N2

S_N2: Biomolecular reaction. Reaction rate depends on concentrations of the two reactants.



S_N1: Unimolecular reaction. Reaction rate depends on just one reactant.



S_N2 reactions:

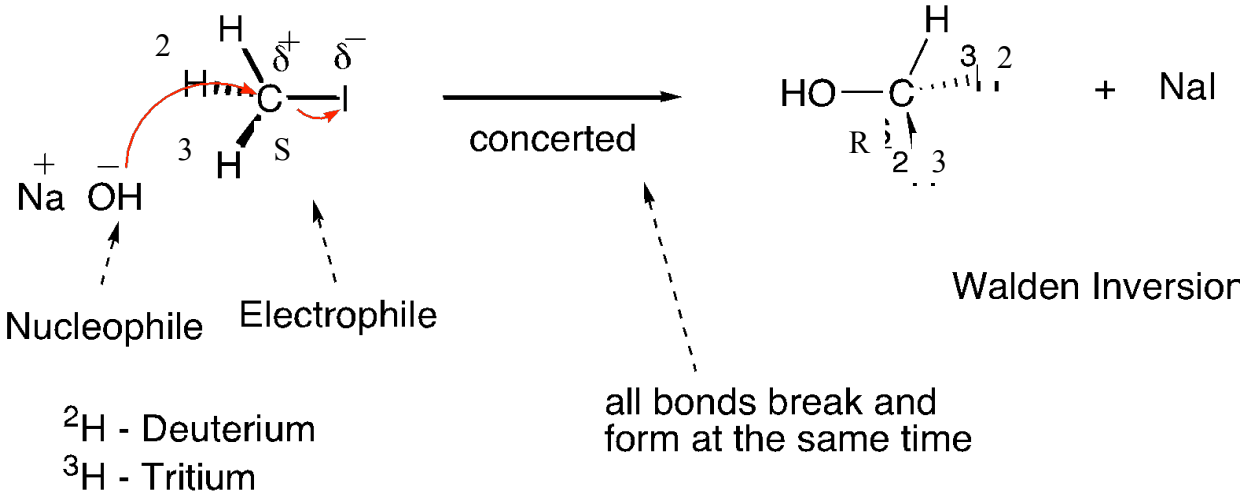
S = Substitution
N = Nucleophilic
2 = Bimolecular reaction (rate of reaction depends on 2 reagents)

- **Stereospecific reaction** – Stereochemistry of the starting material determines the stereochemistry of the product
- Inversion of configuration of the stereogenic centre
- **Concerted reaction** – All bonds break and form at the same time
- Rate depends on two reagent concentration: [Nu] and [SM]
- Favored for primary 1° carbons, OK for 2° carbons, never for 3° carbons or C=C.

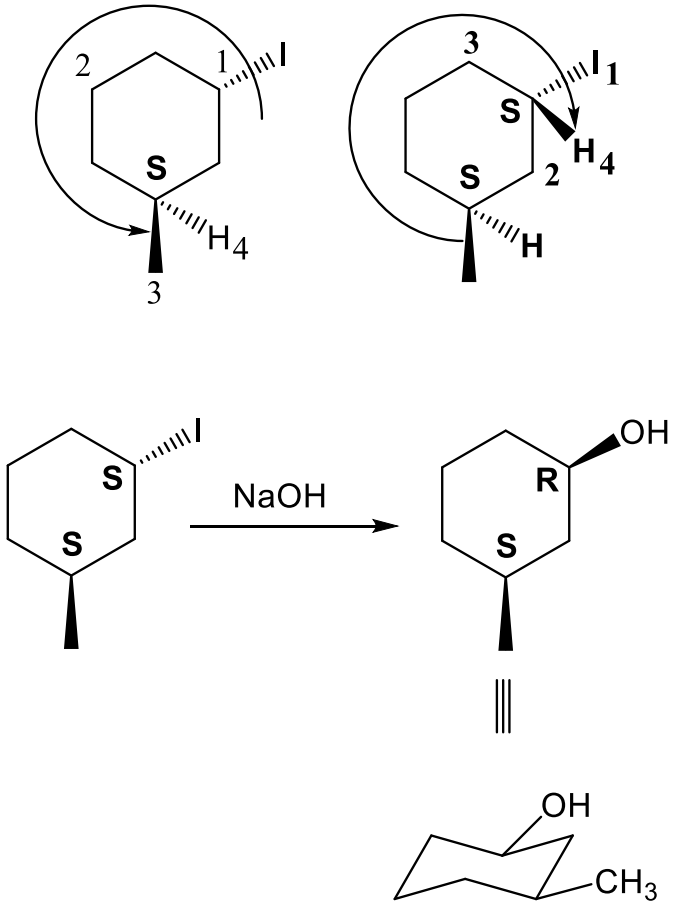
Example 1:

$$NaOH + CH_3I \longrightarrow CH_3OH + NaI$$

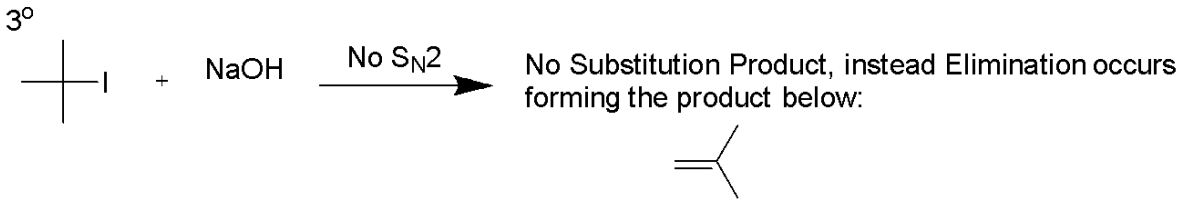
Mechanism:



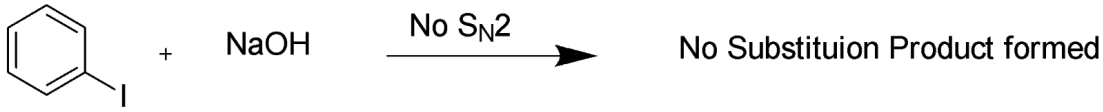
Example 2:



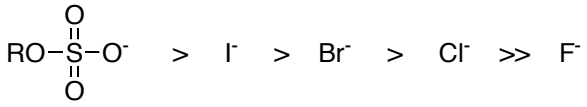
Example 3: 2-Iodo-2-methylpropane / *tert*-butyl iodide



Example 4: Iodobenzene - S_N2 reactions never occur at double bonds



Excellent to Good Leaving Groups



very good poor

The order of halide leaving group ability is due to solvation and size. Solvent helps anion departure.

Solvents

- Polar aprotic (no OH) solvents are best
  - e.g. Dimethyl formamide (DMF), dimethyl Sulfoxide (DMSO), acetonitrile (CH_3CN).
- However it will still work with R-OH and H_2O.