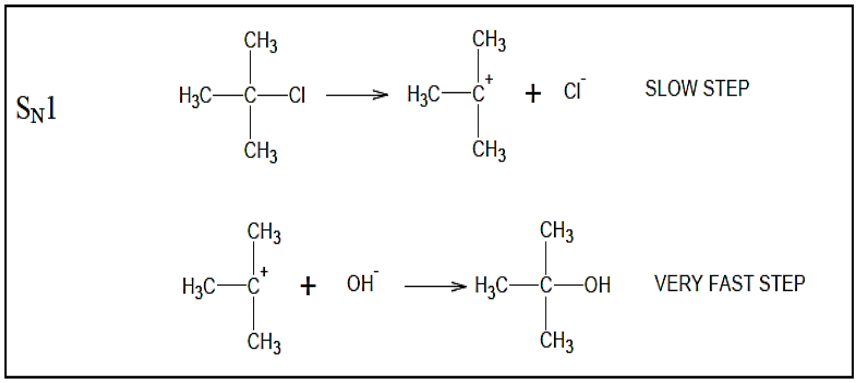
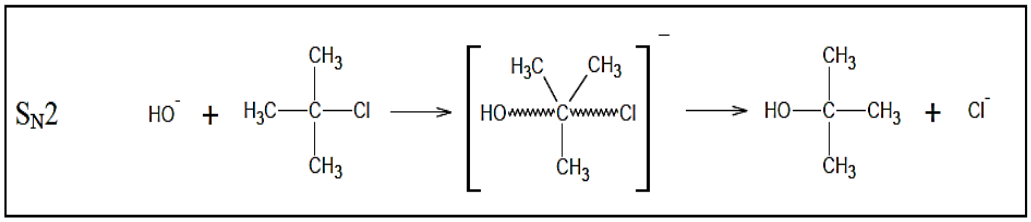
http://www.chemtopics.com/aplab/mechanism.pdf

The Mechanism of a Substitution Reaction

The two proposed nucleophilic substitution mechanisms are represented below, using t-butyl chloride as the substrate and hydroxide as the nucleophile [note: only one of these is actually correct for *t*-butyl chloride]:





The first mechanism is known as **S_N1** (substitution, nucleophilic, unimolecular) because only one molecule is involved in the first step--the *rate determining step*. Reactions occurring by this mechanism should exhibit first-order kinetics, i.e., the rate law should have the form "rate = k[substrate]^1". Because the nucleophile is not involved until after the slow step its concentration will have no effect on the rate.

The alternate mechanism is called **S_N2** (substitution, nucleophilic, bimolecular) because two molecules are involved in the rate determining (and only) step. Such reactions exhibit overall second-order kinetics. The rate is proportional to *both* the concentration of the substrate *and* the concentration of the nucleophile. Reactions like this will have a rate law in the form "rate = k[substrate]^1[nucleophile]^1".

In principle it is therefore relatively simple to distinguish between these mechanisms by experiment. If changing the concentration of nucleophile has no effect on the rate of a reaction then it must be S_N1. If there is an effect the reaction must be S_N2.