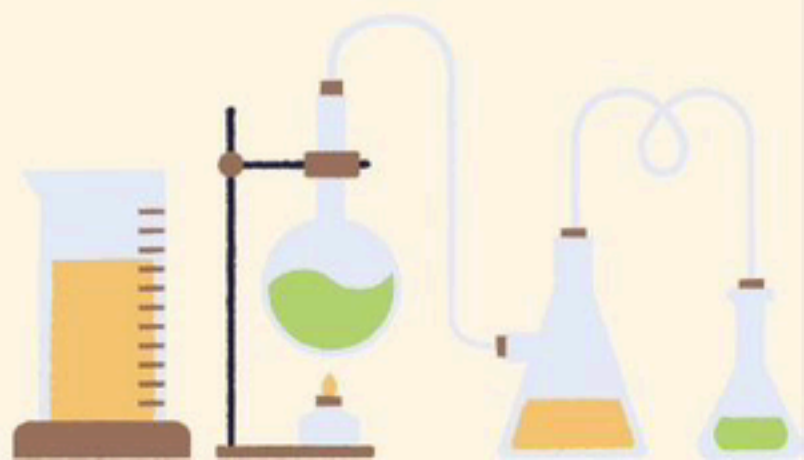


Organic Chemistry

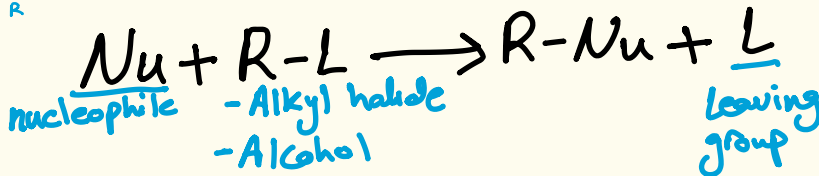
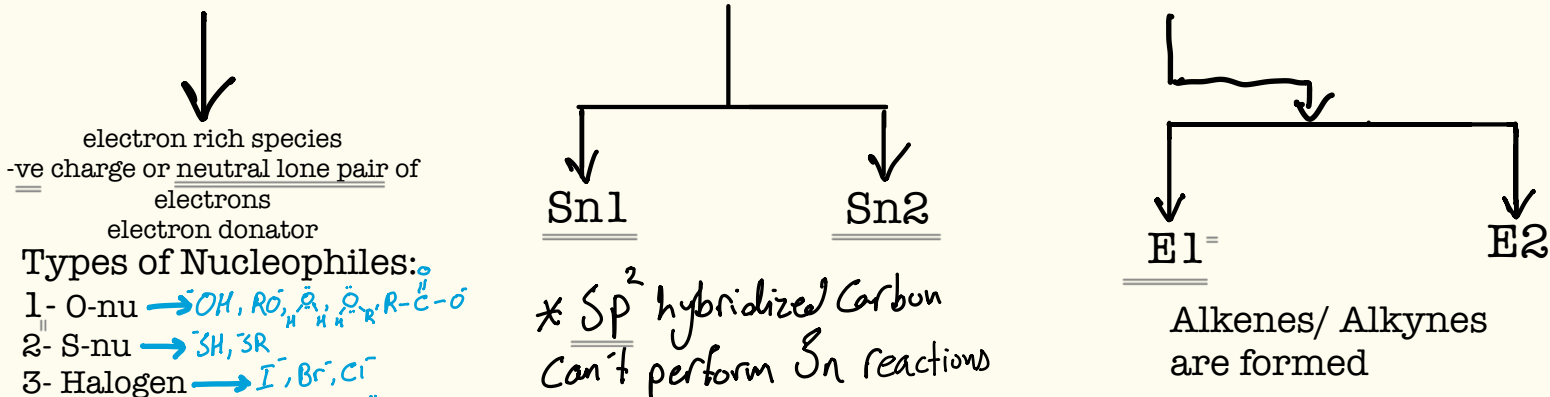
Chapter 6 summary

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Nucleophilic substitution (Sn) and Elimination reactions (E)



Sn2 reactions:

- 1- Bimolecular, rate of reaction depend on the concentration of both the nucleophile and the alkyl halide $R = k [\text{Nu}] [\text{R-X}]$
- 2- Single step so **no intermediate** is formed, 1 transition state is formed
- 3- The nucleophile enters the compound from the back forming 180 degree between the nucleophile and the leaving group, causing inversion of configuration

For example: achiral \rightarrow chiral

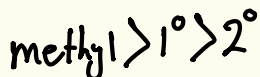
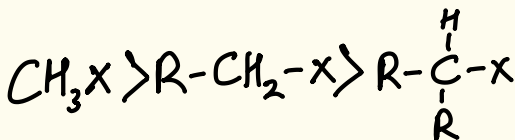
chiral \rightarrow change the configuration

chair conformation \rightarrow convert between axial and equatorial

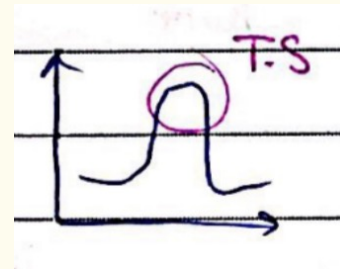
trans \rightarrow cis

4- Prefer Aprotic polar solvents

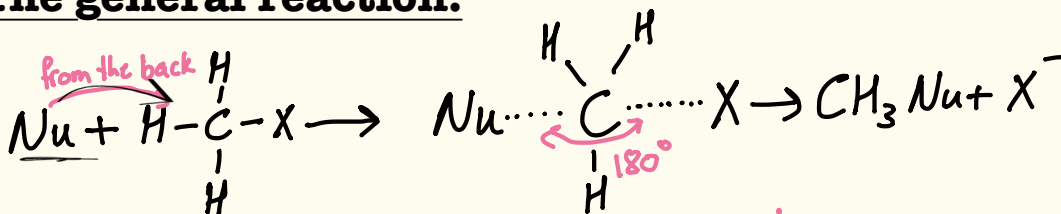
5- Reactivity depending on the classification of alkyl halide due to the steric factor (size):



Note: Tertiary alkyl halides can't perform Sn2 reactions



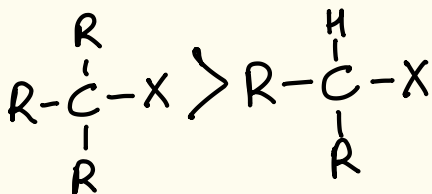
The general reaction:



The transition state

Sn1 reactions:

- 1- Unimolecular, rate of reaction depends on the concentration of alkyl halide $R = k [\text{C-X}]$
- 2- The nucleophilicity strength affect the rate of the reaction
- 3- More than one step: step one: slow, rate determining step
-carbocation intermediate formed
step two: always fast
- 4- Reactivity of the alkyl halide:



$\text{sp}^2, 120^\circ$
triangular planar

Note: methyl and primary alkyl halides can't perform Sn1 reactions, because they form the least stable carbocation, so they won't react
Why does the tertiary alkyl halide perform the fastest reaction?

Because the carbocation of tertiary alkyl halide is tertiary carbocation and it is the **most stable intermediate**, so it's the fastest.

5- If the halide alkyl has a chiral center, S_N1 reaction leads to two products with equal ratios of R and S configurations \rightarrow Forming Racemic mixture (optically inactive)

If the halide alkyl has an achiral center, S_N1 reaction leads to one product

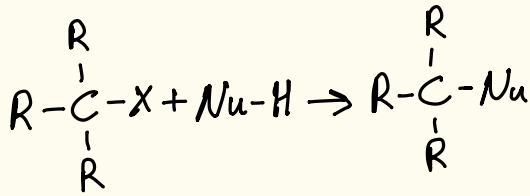
6- Form 2 transition states and an intermediate carbocation

7- Prefer protic polar solvents

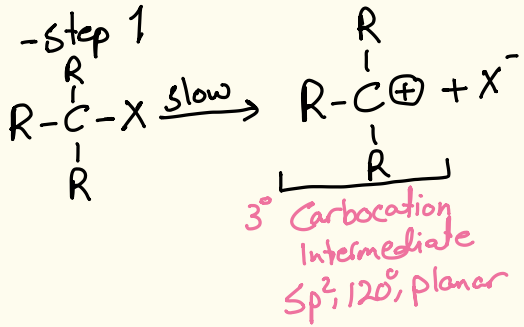
Why:

Half of the nucleophiles will react with the carbocation from the top and the other half will react from below the carbocation, forming two different configurations

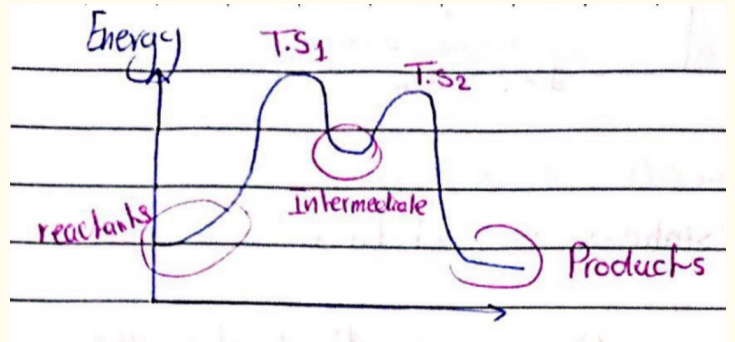
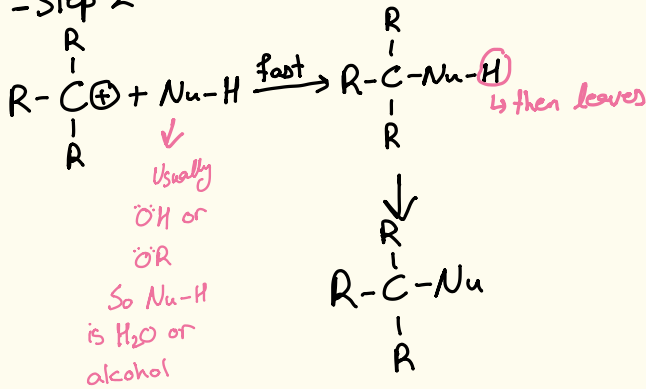
The general reaction:



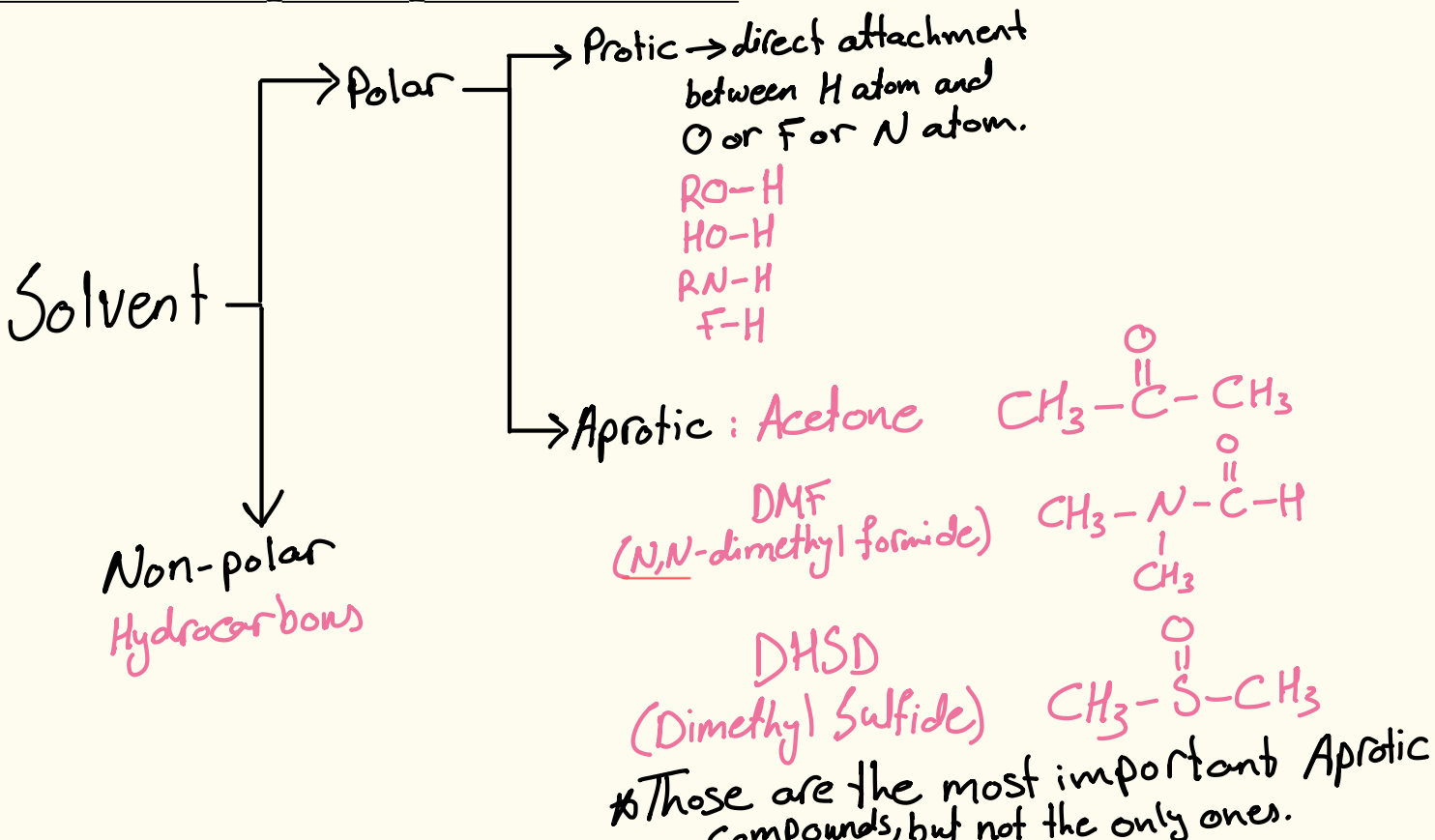
steps: - step 1



- step 2

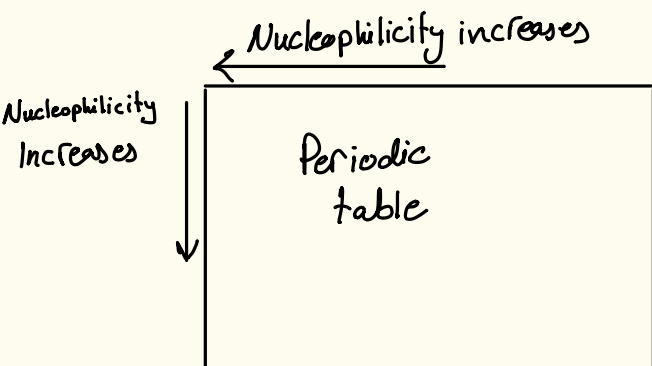


Protic and Aprotic polar Solvents:

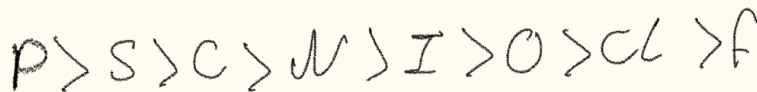


Nucleophilicity strength (important for Sn2 only):

↳ The ability to give electrons



Sn1 reactions' reactivity has nothing to do with the nucleophile and its strength, it's a unimolecular reaction depending on the alkyl halide mainly and only.



* -ve nucleophile is stronger than neutral nucleophile.

Eg. Which one is the strongest nucleophile?

OH⁻/H₂O/S⁻H-/Cl⁻/H₂S

* -ve nucleophiles are stronger

so OH⁻, S⁻H⁻, Cl⁻

* From right to left, nucleophilicity increases.

so OH⁻, S⁻H⁻ > Cl⁻

* From up to down, nucleophilicity increases.

so S⁻H⁻ > OH⁻

so S⁻H⁻ > OH⁻ > Cl⁻ > H₂S > H₂O

E2 reactions:

1-Bimolecular, the rate of the reaction depend on the concentration of the alkyl halide and the nucleophile.

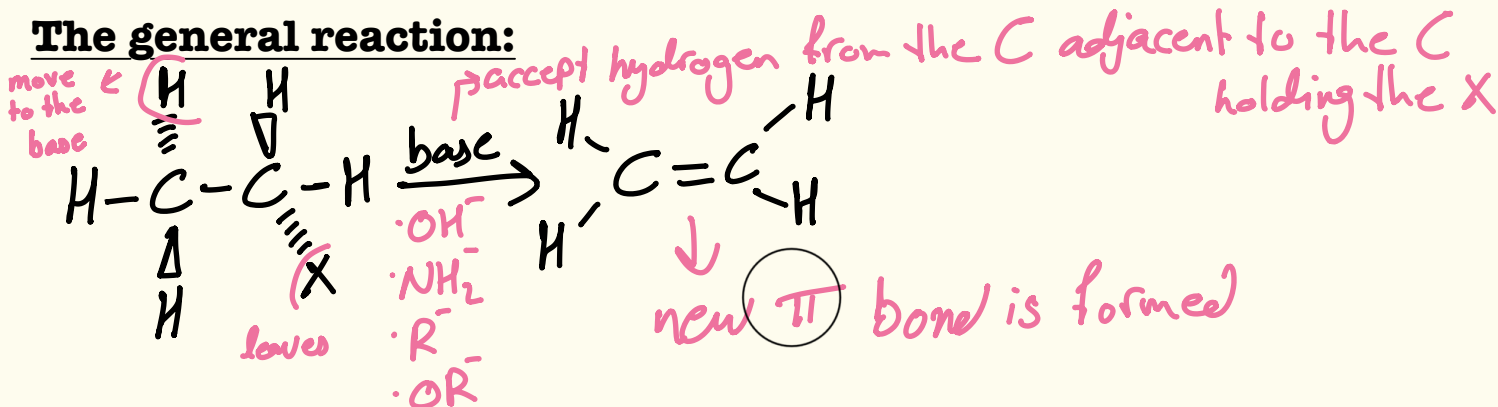
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2- Single step, so **no intermediate** is formed.

3- The removed H and halogen to perform the Alkene should be arranged in an anti arrangement (anti periplanar)...

-The position of the removed H should be the same as the removed halogen (both from the back, front)

The general reaction:



E1 reactions:

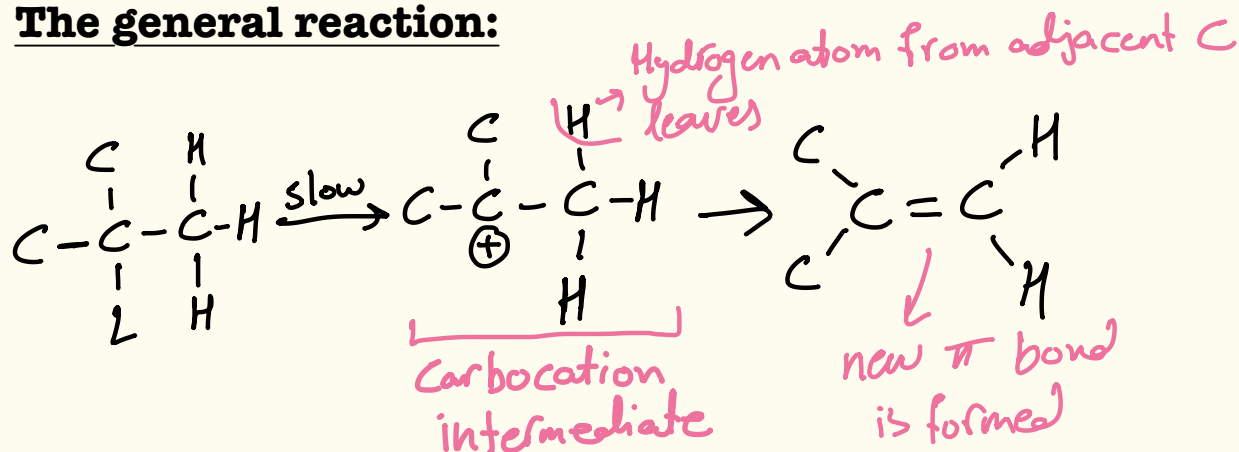
1- Unimolecular, the rate of the reaction depends on the concentration of the substrate (usually alcohol) only.

2- More than one step: -step one: slow

-carbocation intermediate is formed

-step two: fast, No Nu present in the reaction/
solvent

The general reaction:



Alkyl Halide

Note: E1 usually used in alcohols, no usage in halide alkyl

