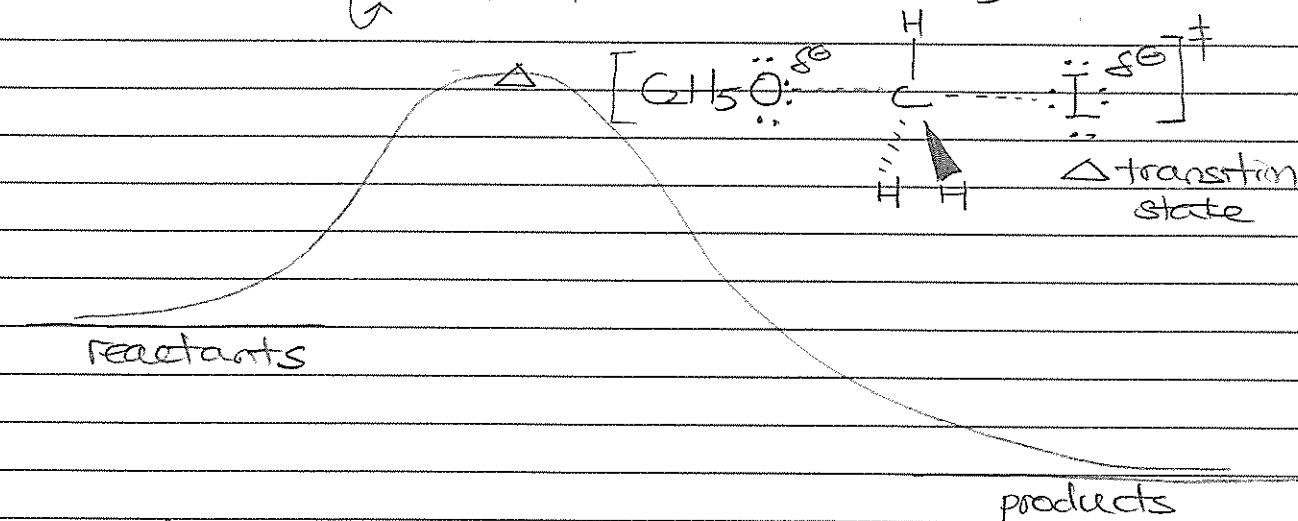
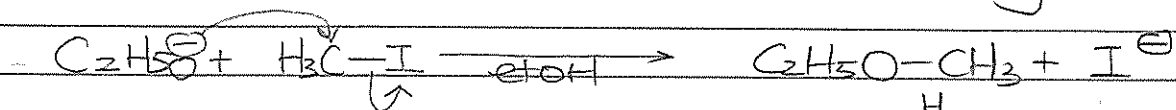


Nov 8 Ch 9 (cont'd)

S_N2 Reaction
 substitution (↑) nucleophilic (↑) 2nd order (↑) bimolecular mechanism in the rate limiting step



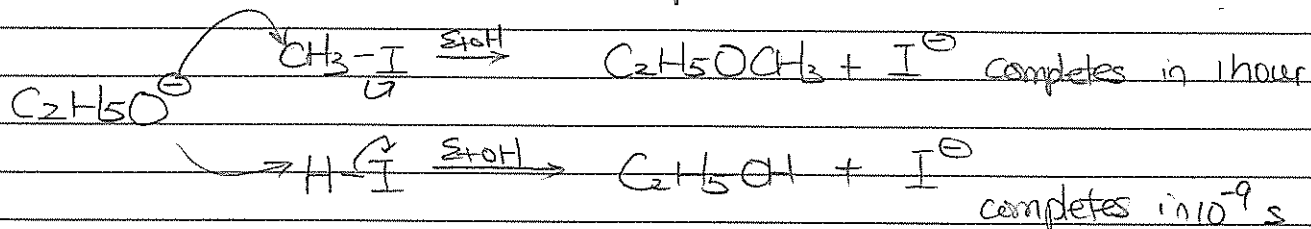
① reaction order
 rate law

$$rate = k [CH_3I] [C_2H_5O^-]$$

second order reaction that is 1st order in $[CH_3I]$ and $[C_2H_5O^-]$

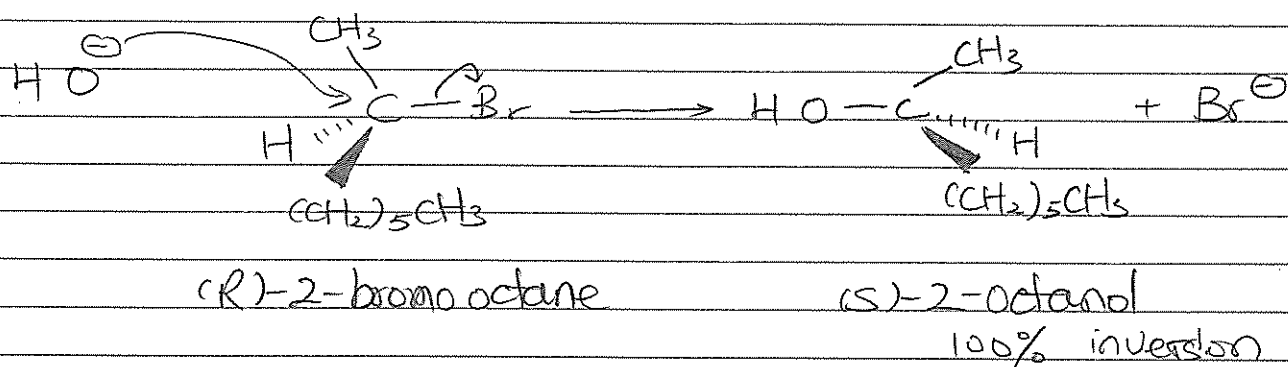
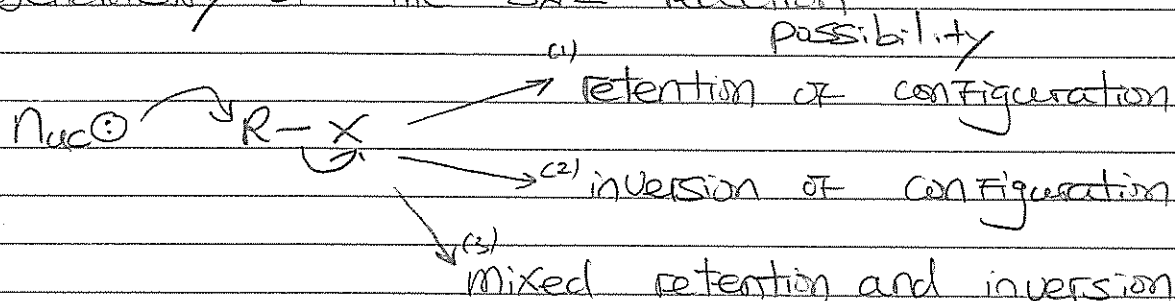
i.e. rate law indicates that one eq. of each reactant involves in the rate-limiting step

— The absolute reaction rate of the substitution rxn is much slower than a comparable acid/base rxn

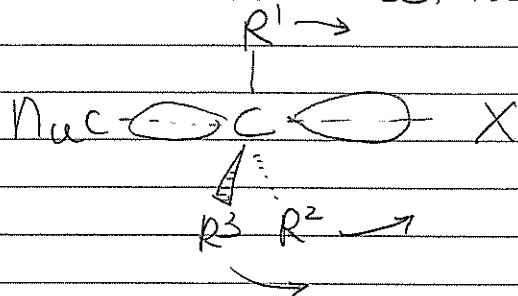


why is this?

② Stereochemistry of the S_N2 reaction

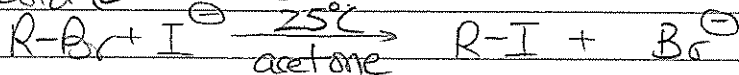


Mechanism: Backside Substitution



③ Effect of alkyl halide structure on the S_N2 reaction

Substitution on both α - and β -carbons retards the reaction



R	Relative rate	
CH_3-	145	steric effect ↓ decrease
CH_3CH_2-	1.0	
$(\text{CH}_3)_2\text{CH}-$	0.0078	
$(\text{CH}_3)_3\text{C}-$	5×10^{-3}	

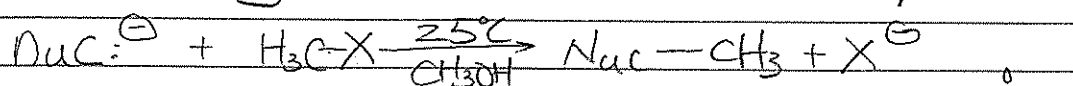
④ Nucleophilicity in the S_N2 reaction

<1> In a series of nucleophiles in which the nucleophilic atoms are from the same period of the periodic table, there is a rough correlation of nucleophilicity w/ basicity

<2> In a series of nucleophiles in which the nucleophilic atoms are from the same group (different periods), the less basic nucleophiles are more nucleophilic

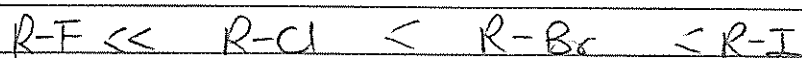
- The strongest Brønsted bases are the best H-bond acceptor (in protic solvents)

- The stronger the H-bond to solvent, the greater is the rate-retarding effect on nucleophilicity



X^{\ominus}	pK_a of conjugate acid	k ($\text{M}^{-1}\text{s}^{-1}$) MeOH / DMF ($\text{CH}_3\text{N}^{\oplus}\text{R}_2$)
I^{\ominus}	-10	3.4×10^{-3} / 4.0×10^{-1}
Br^{\ominus}	-8	8.0×10^{-5} / 1.3
Cl^{\ominus}	-6	3.0×10^{-6} / 25
F^{\ominus}	3.2	5.0×10^{-8} / 3

⑤ Leaving Group Effects in the S_N2 Reaction



- The best leaving groups in the S_N2 reaction are those that give the weakest base as product.

- On a laboratory scale, R-Br are often used, representing the best compromise between cost and reactivity.