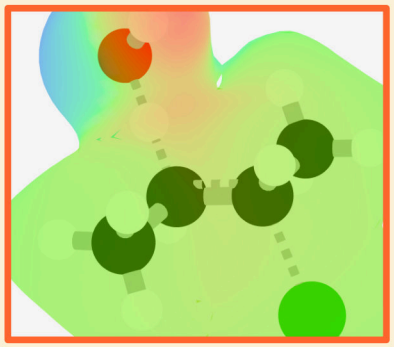
HIGHLIGHTS

- Characteristics of:
  - S_N1
  - S_N2
  - E1
  - E2



Tabulating the main characteristics of the four common substitution and elimination mechanisms (S_N1, S_N2, E1 & E2). This table should help you identify which mechanisms could be operating with any particular reaction. But, remember, there is invariably more than one reaction operating (wouldn't it be nice if you got a 100% yield each time?) in any given reaction, and that these are just guidelines to help undergraduates. They are not rules, and many factors influence which mechanism is operating (and there are more mechanisms than the ones described here).

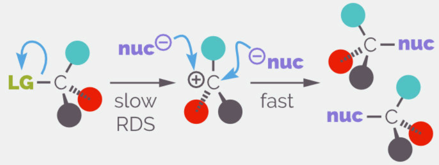
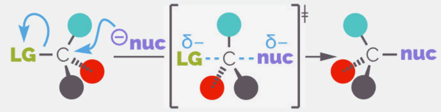
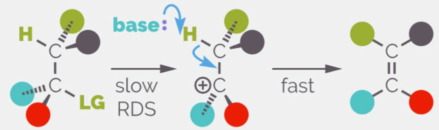
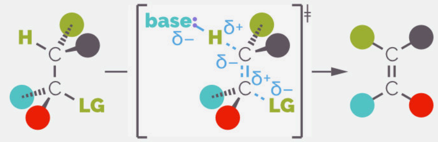
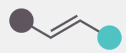
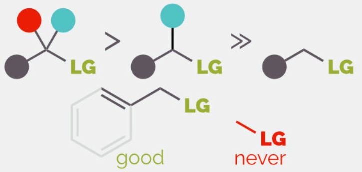
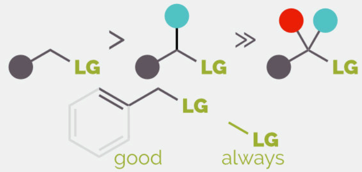
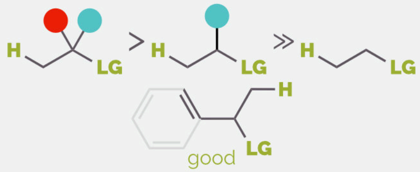
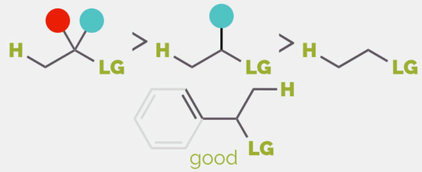
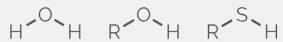
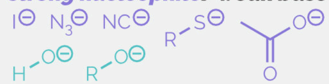
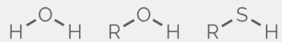
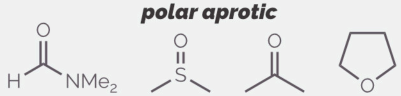
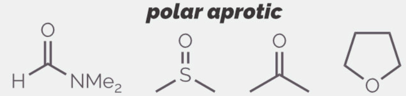
CHEMISTRY CLASSICS

SUBSTITUTION & ELIMINATION

A SUMMARY OF FOUR MECHANISMS

SN1/SN2/E1/E2: A Quick Summary

Making Molecules www.makingmolecules.com

FACTOR	MECHANISM: SN1	SN2	E1	E2
mechanism				
rate equation	rate = k[**R–LG**]	rate = k[**R–LG**][**nuc**]	rate = k[**R–LG**]	rate = k[**R–LG**][**base**]
summary	***stepwise reaction:*** ***step 1*** - formation of carbocation (RDS) ***step 2*** - **nucleophile** attacks carbon	***concerted reaction:*** **nucleophile** attacks carbon & swaps with **leaving group** (backside attack)	***stepwise reaction:*** ***step 1*** - formation of carbocation (RDS) ***step 2*** - **base** removes proton favors more substituted alkene	***concerted reaction:*** antiperiplanar conformation allows **base** to remove proton & kick out **leaving group**
stereochemistry	 ***Racemization*** - but tight-ion pairs mean there can be more inversion	 ***inversion*** through backside attack	 ***stereoselective*** - favors *trans* or *E* alkene	 ***stereospecific***, or if choice of H, favors *E*
substrate **R–LG**				
leaving group **R–LG**	***LG = weak base*** (pK_aH is low) TsO^-, MsO^-, I^-, Br^-, Cl^-, H_2O *etc* solvent plays important role	***LG = weak base*** (pK_aH is low) TsO^-, MsO^-, I^-, Br^-, Cl^-, H_2O *etc* solvent plays important role	***LG = weak base*** (pK_aH is low) TsO^-, MsO^-, I^-, Br^-, Cl^-, H_2O *etc* solvent plays important role	***LG = weak base*** (pK_aH is low) TsO^-, MsO^-, I^-, Br^-, Cl^-, H_2O *etc* solvent plays important role
reactant **nuc** or **base**	***weak nucleophile*** - not important to rate ***weak base*** - not important to rate 	***strong nucleophile/weak base*** 	***weak nucleophile*** - not important to rate ***weak base*** - not important to rate 	***strong (bulky) base or nucleophile*** 
solvent	***polar protic*** 	***polar aprotic*** 	***polar protic*** 	***polar aprotic*** 
temperature			***↑ increased temp. favors elimination***	***↑ increased temp. favors elimination***
NOTES	***stability*** of carbocation is important ***rearrangement*** can be problematic	***leaving group*** α-to a carbonyl enhances rate of reaction	***rearrangement*** can be problematic ***regioselectivity*** more substituted (Zaitsev) alkene favored ***stereoselective*** bulky groups are *trans*	***small base*** favors more substituted alkene ***bulky base*** can lead to Hofmann alkene ***stereoselective*** if choice of hydrogen ***stereospecific*** if only one proton