

Substitution and Elimination Reactions Comparative Chart

Reaction	Structure of RX	Reactivity of Nu:	Conc. Of Nu:	Solvent	Stereochemistry
SN2	1>2>3 Only this reaction and E2 will most likely react with a primary RX	Strong nucleophile favors reaction	High concentration of nucleophile favors reaction	Aprotic polar solvent favors a SN2 reaction if <i>either</i> of the reactants is charged ex: DMF DMSO Acetone	inversion of configuration
E2	3>2>1 Major product is more substituted alkene unless *the base is large *the alkyl halide is an alkyl fluoride *the alkyl halide contains one or more double bonds	Strong Base favors reaction	High concentration of base favors reaction	Aprotic polar solvent favors a E2 reaction if <i>either</i> of the reactants is charged ex: DMF DMSO Acetone	If the reactant has 2 H bonded to the carbon from which a H is to be removed, both E and Z result. The conformers that has the bulkiest groups on opposite sides will be the major product. Anti and syn elimination– if it is cyclohexane, it has to be axial (anti)
SN1	3>2>1 Forms a carbocation	Not effected by strength of nucleophile but a weak nucleophile favors it by not favoring a SN2 reaction	Not effected but low concentration disfavors a SN2 reaction	Protic polar favors a SN1 reaction if the reactant is not charged. Ex: H2O, CH3OH, etc.	Racemization (with some inversion because of ion pairing)
E1	3>2>1 Forms a carbocation	Weak base favors E1 reaction by disfavoring E2 reaction	Not effected but a low concentration of base favors E1 by disfavoring a E2 reaction	Protic polar favors a E1 reaction if the reactant is not charged. Ex: H2O, CH3OH, etc.	Bulkiest groups on opposite sides

SN Versus E

Methyl halide	Primary halide	Secondary halide	Tertiary halide
SN2 reaction most favored No Elimination reactions!	SN2 when the main reaction is with good nucleophiles/weak bases such as I ⁻ and CH ₃ CO ₂ ⁻ E2 if you use strong bulky bases such as t-butoxide steric effects	SN2 if the main reaction is with weak base or Nu: where Pka of <u>conjugate acid is 11 or less</u> ex: I ⁻ or CH ₃ CO ₂ ⁻ E2 if the main reaction is with a strong base or Nu: where Pka of <u>conjugate acid is 11 or greater</u> , high temperatures and bulky bases increas elimination SN1/E1 are common in reactions with weak Nu: in polar protic solvents like water, high temps favor E1	E2 if Main reaction is with strong bases like OH ⁻ and RO ⁻ SN1/E1 if main reaction is with a poor Nu: High temperatures favor E1 out of the two.