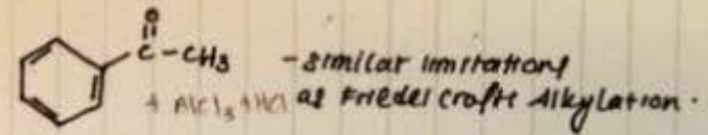
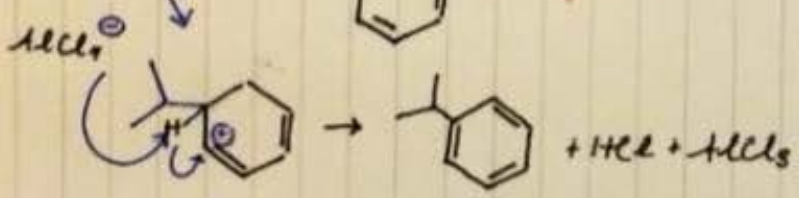
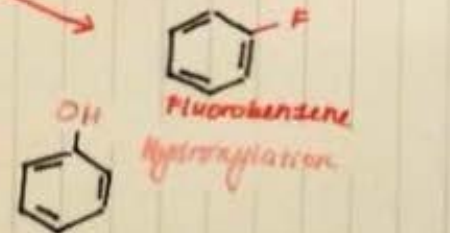
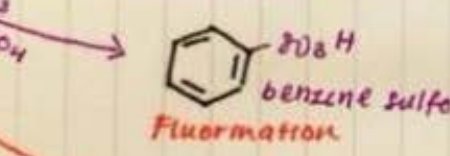
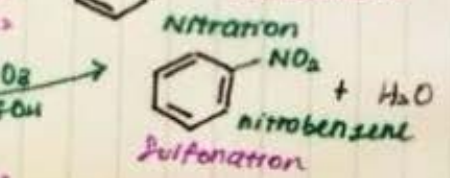
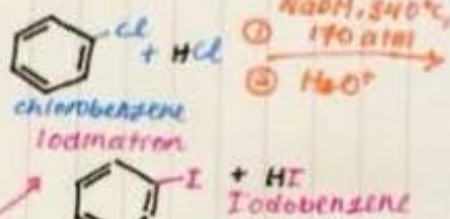
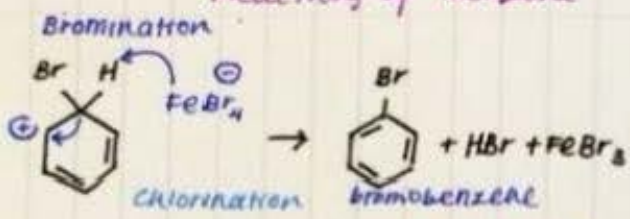
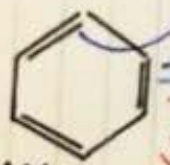
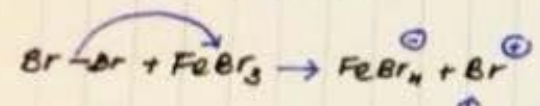


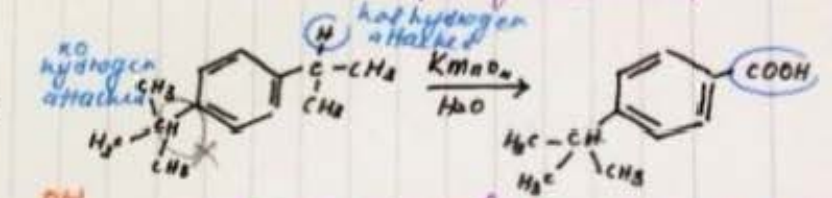


# Reactions of Benzene

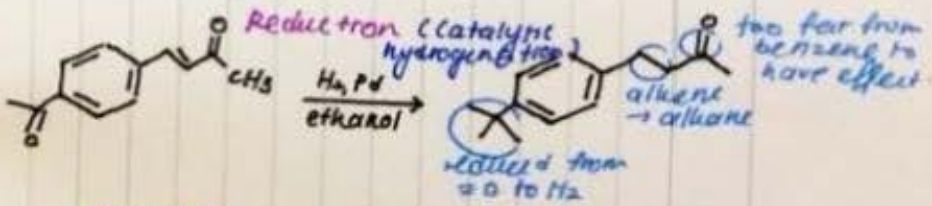
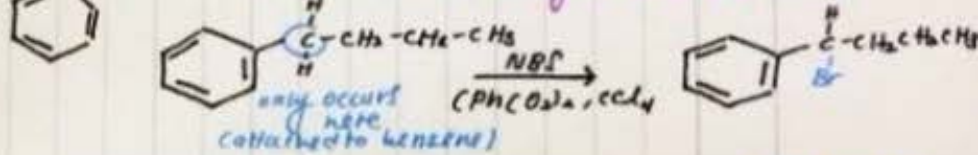
## ① Electrophilic Aromatic Substitution



## Oxidation of Alkyl Benzene

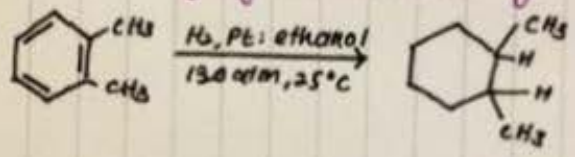


## Bromination of alkylbenzene side chain



- reversible
- Sulfonation = strong acid
- Desulfonation = hot, dilute aq. acid.

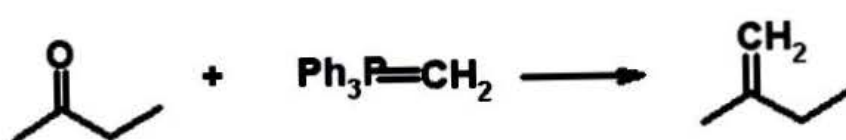
## To hydrogenate aromatic ring



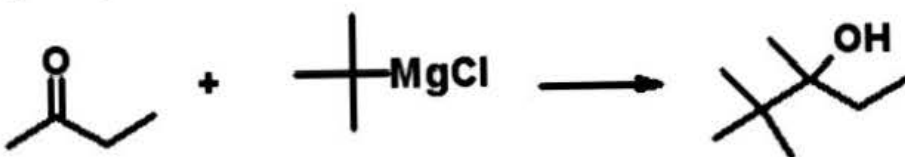
## Limitation

- only alkyl halides (aromatic vinyls too T in energy)
- don't succeed with aromatic substituted with strongly electron-withdrawing eg: carbonyl / basic amino
- difficult to stop after single substitution
- skeletal rearrangement of alkyl carbocation sometimes occur (alkyl halide shift)

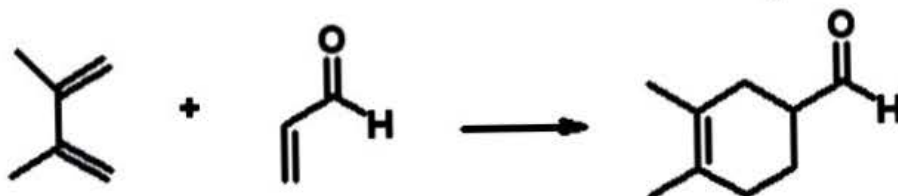
Wittig



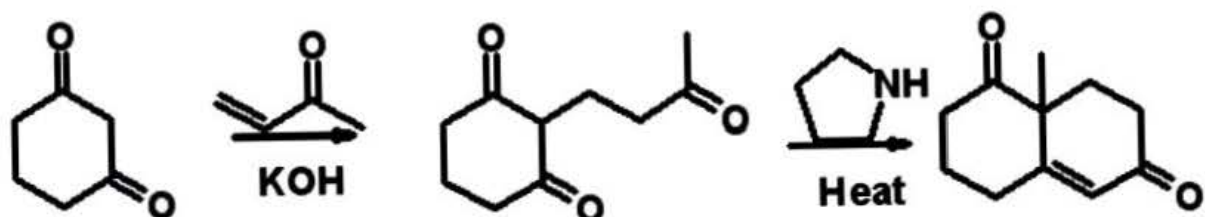
Grignard



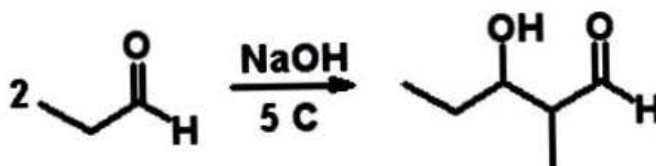
Diels-Alder



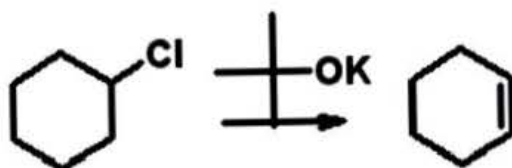
Robinson  
Annulation



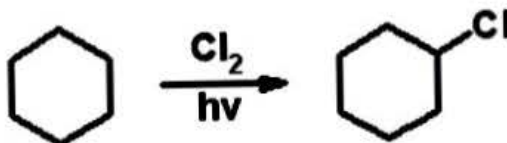
Aldol Reaction



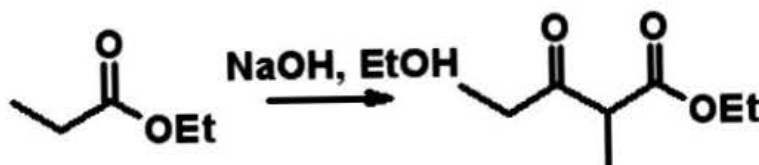
Elimination



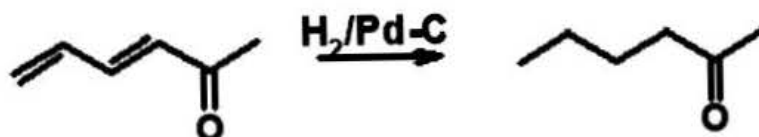
Free Radical  
Halogenation



Claissen



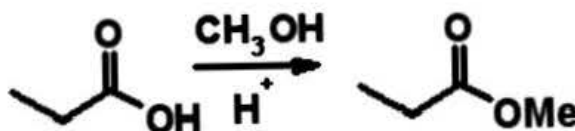
Hydrogenation



Electrophilic  
Aromatic  
Substitution



Fischer  
Esterification

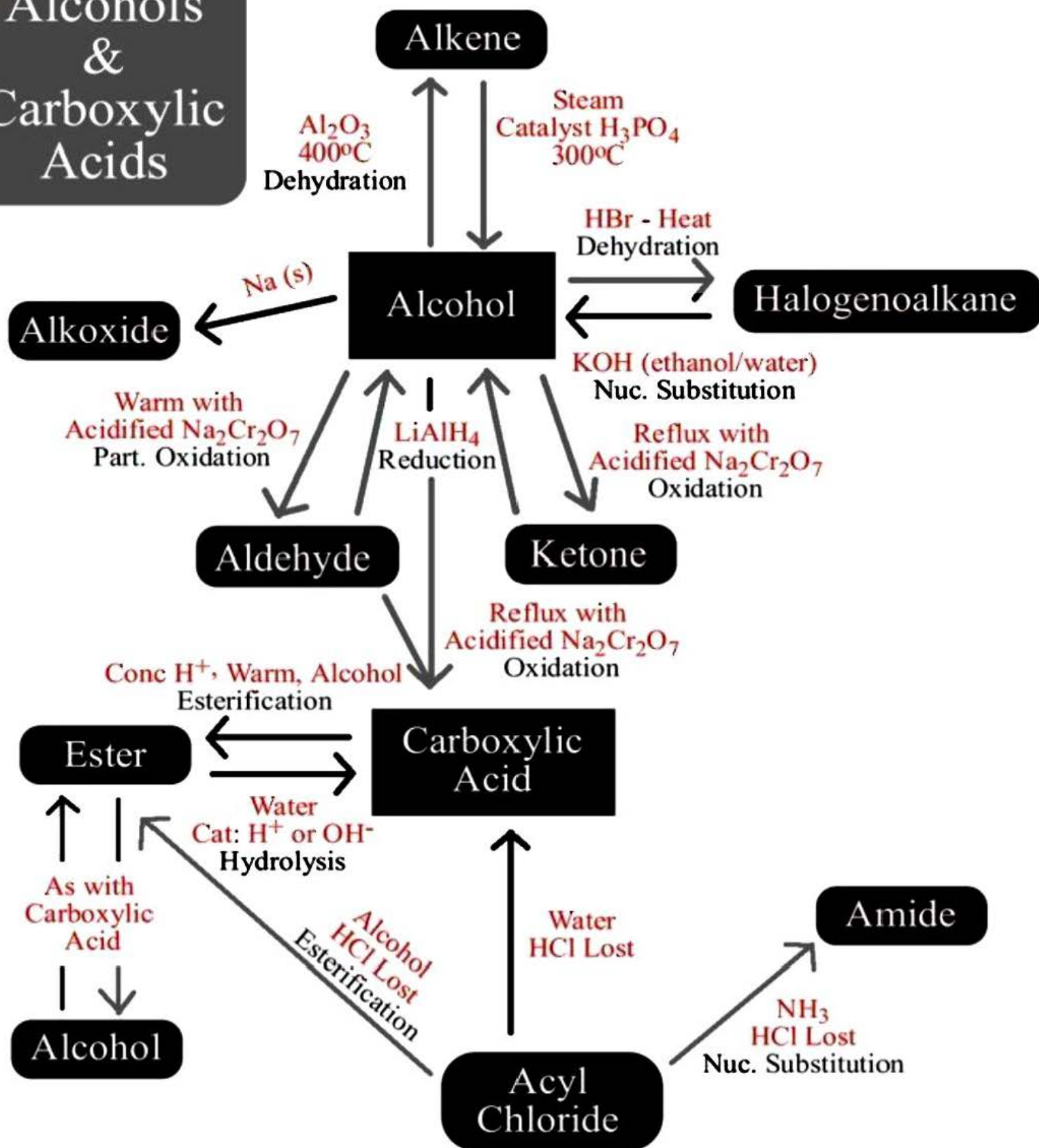


Substitution



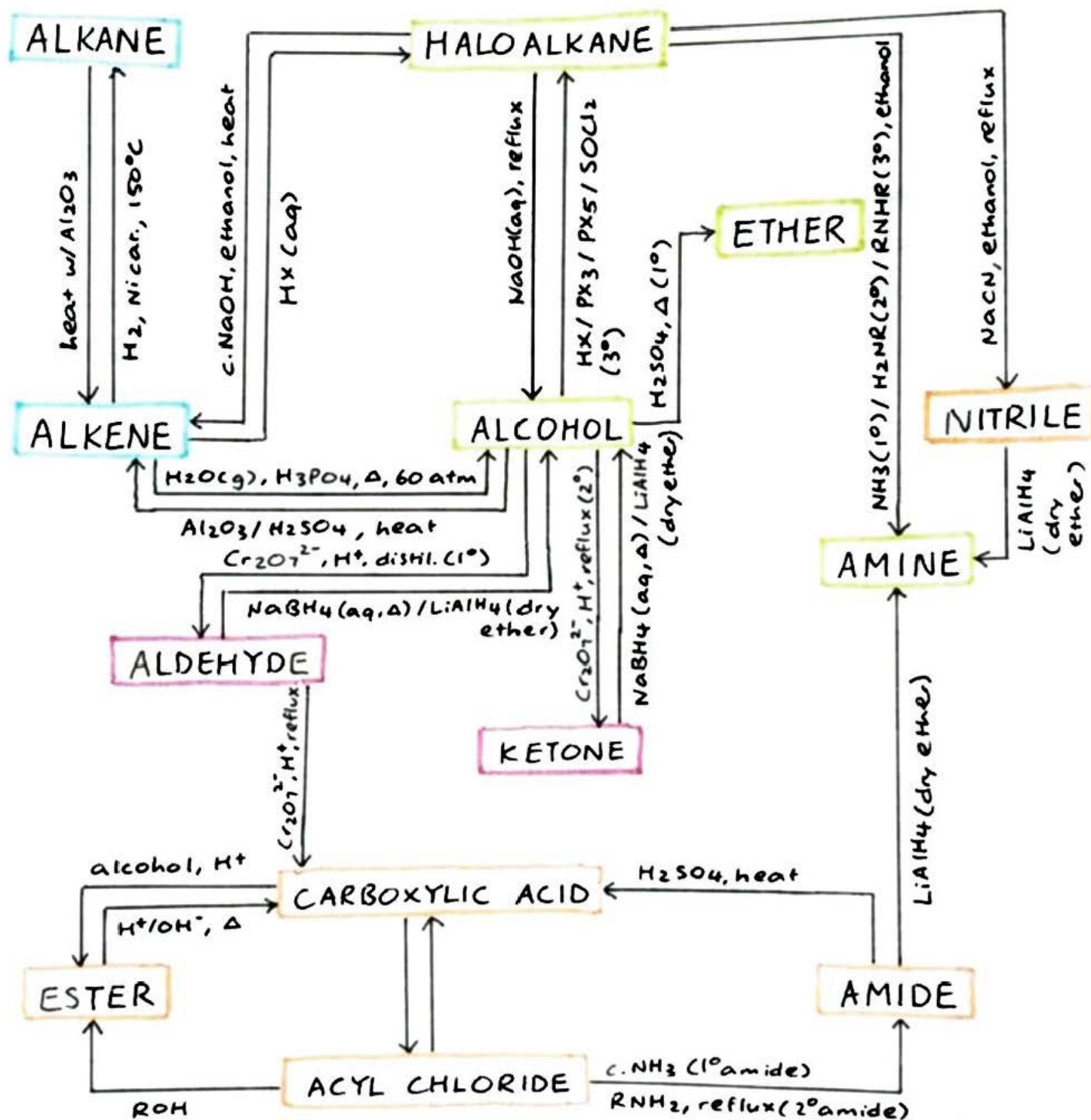


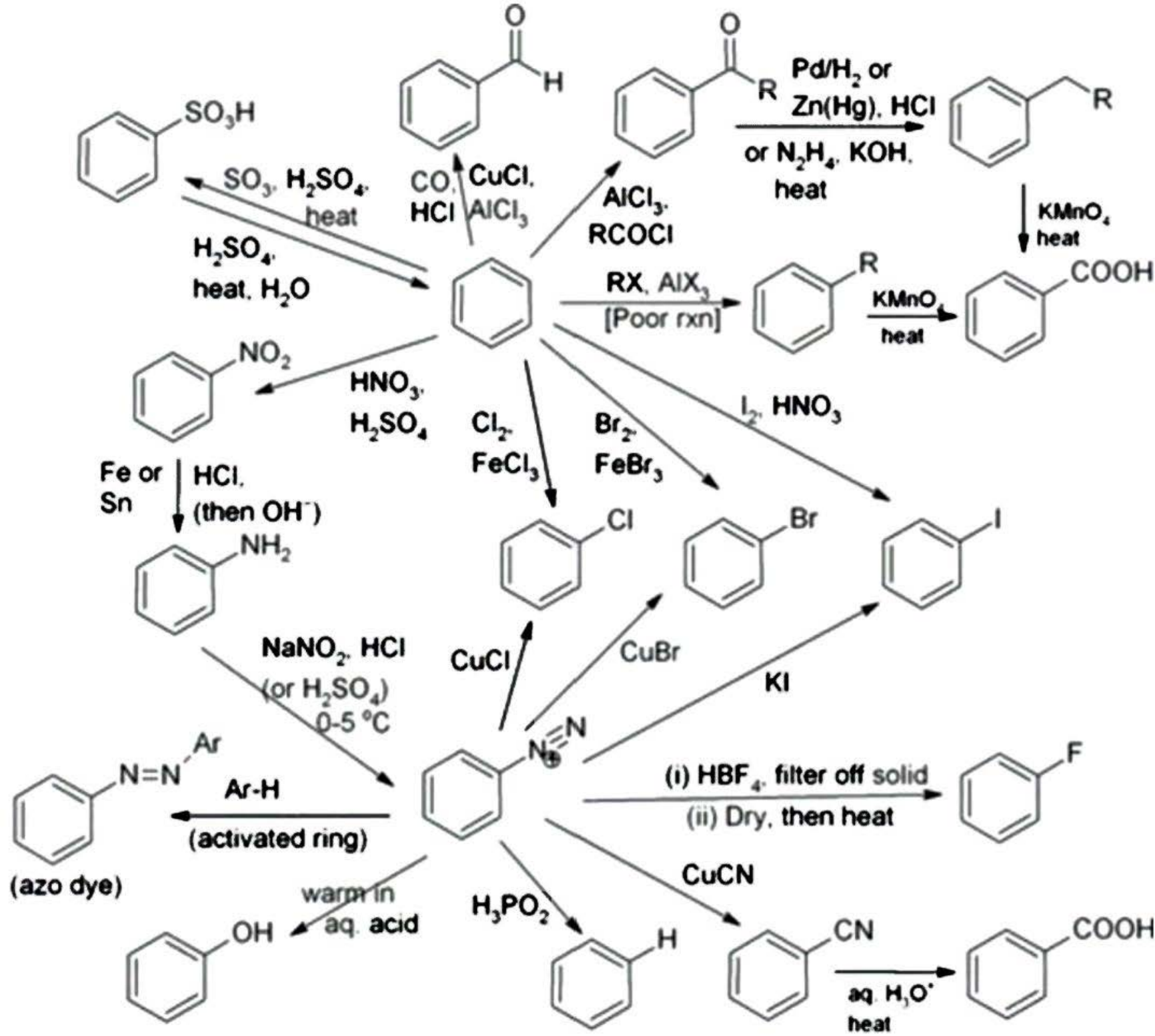
# Alcohols & Carboxylic Acids



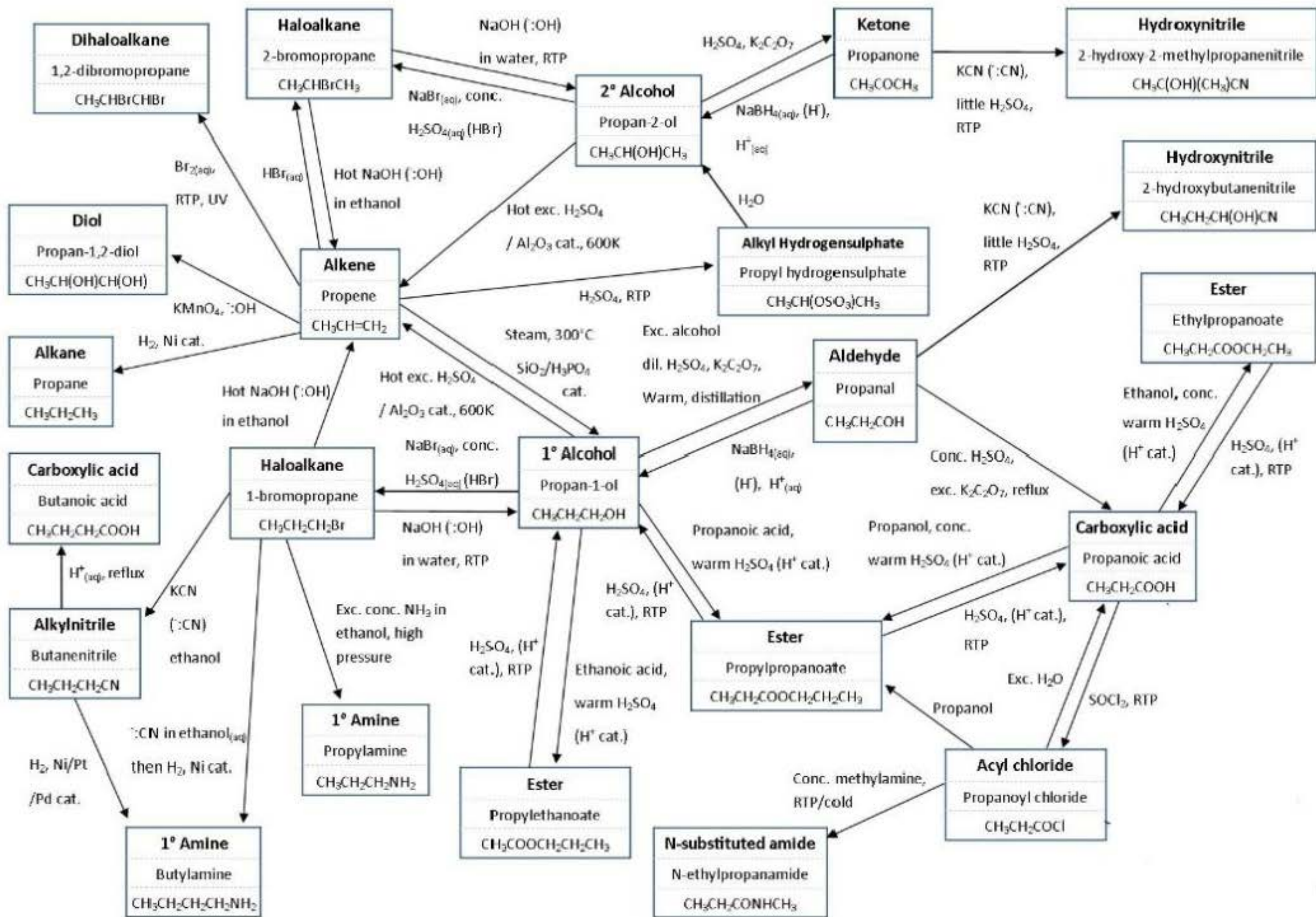
# ORGANIC CHEMISTRY

## >> ORGANIC REACTIONS MAP

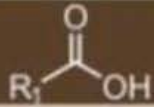
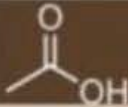
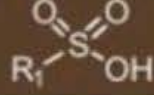
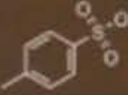
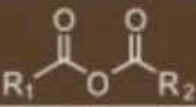
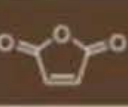
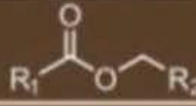
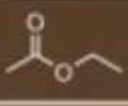
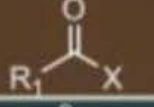
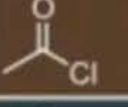
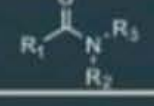
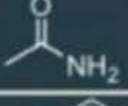
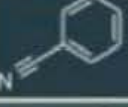
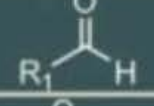
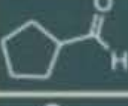
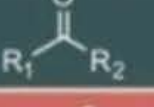
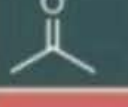










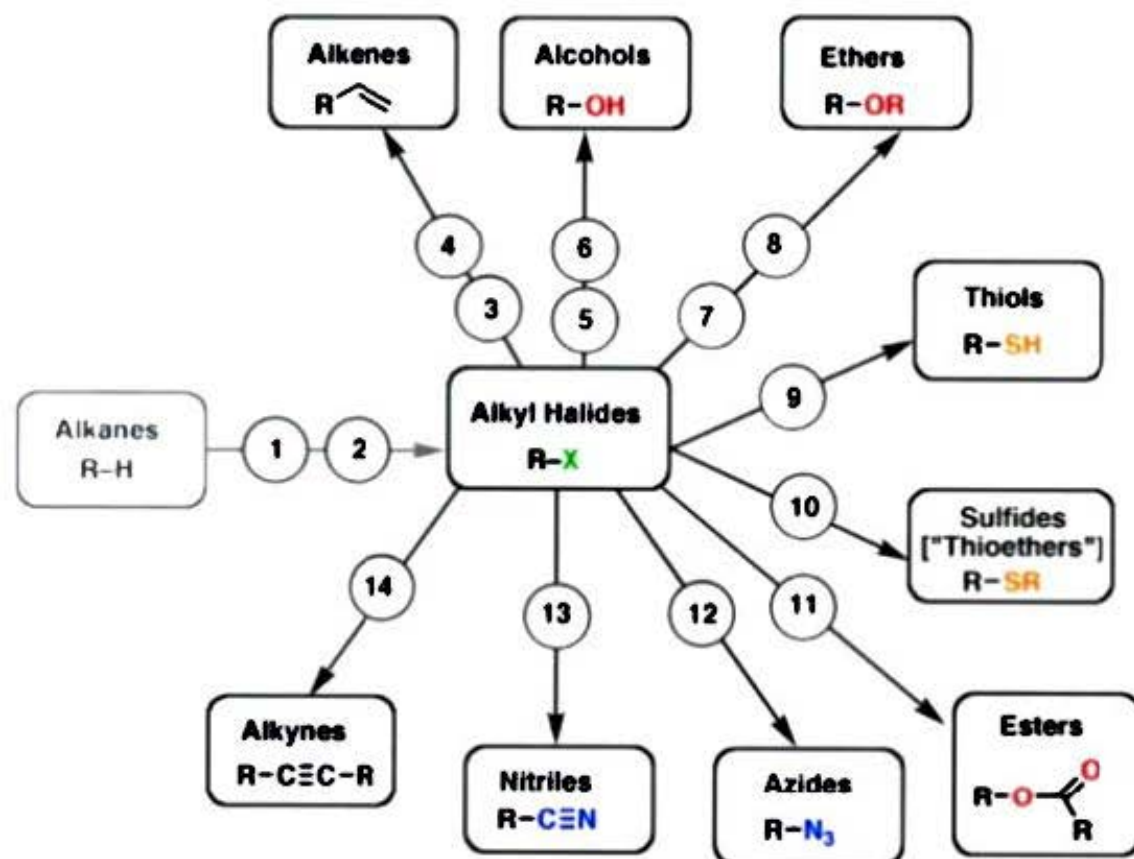


# Organic chemistry functional groups

Name	Formula	Prefix	Suffix	Example	Notes
Carboxylic acid		*	-oic acid	 Ethanoic acid	Common are acetic acid (vinegar) and butyric acid (human vomit)
Sulphonic acid		*	- sulfonic acid	 Toluene sulphonic acid	Used in batteries and dye production.
Anhydride		*	-anhydride	 Maleic anhydride	Used in production of polymers
Ester		*	R <sub>1</sub> -...-R <sub>2</sub> oate	 Ethyl acetate	Often good smell and flavor
Acid halide		Haloformyl-	-R <sub>1</sub> oyl halide	 Acetyl chloride	Usually lachrymatory
Amide		Amido-	-amide	 Ethanamide	Distinctive feature of proteins (hair, spider silk, enzymes)
Nitriles	$R-C\equiv N$	Cyano-	-nitrile	 Benzonitrile	Found in a lot of fruits and nuts, as well as application in medicine
Aldehyde		Oxo-	-al	 cyclopentanecarbaldehyde	Production of resins and plastics. Ingredients of flavours and perfumes.
Ketone		Oxo-	-one	 Propanone	Solvents, precursor for polymers, pharmaceuticals.
Alcohol	$R-OH$	Hydroxy-	-ol	$CH_3OH$ Methanol	Favorite way to spend Friday evening.
Thiol	$R-SH$	Mercapto-	-thiol	 Methanethiol	Cysteine, many cofactors
Amine		Amino-	-amine	 Methanamine	Amino acids, dyes, drugs
Alkene	$R_1=CH-R_2$	*	*	$H_2C=CH_2$ Ethene	Plastic manufacture, fuel
Alkyne	$R_1\equiv C-R_2$	*	*	$HC\equiv CH$ Ethyne	Pharmaceuticals, some plants
Alkane	$R_1-CH_2-R_2$	*	*	$H_3C-CH_3$ Ethane	Heating and cooking purposes
Ether	$R_1-O-R_2$	[group] oxy-	*	 Methoxyethane	Solvents, anesthetics

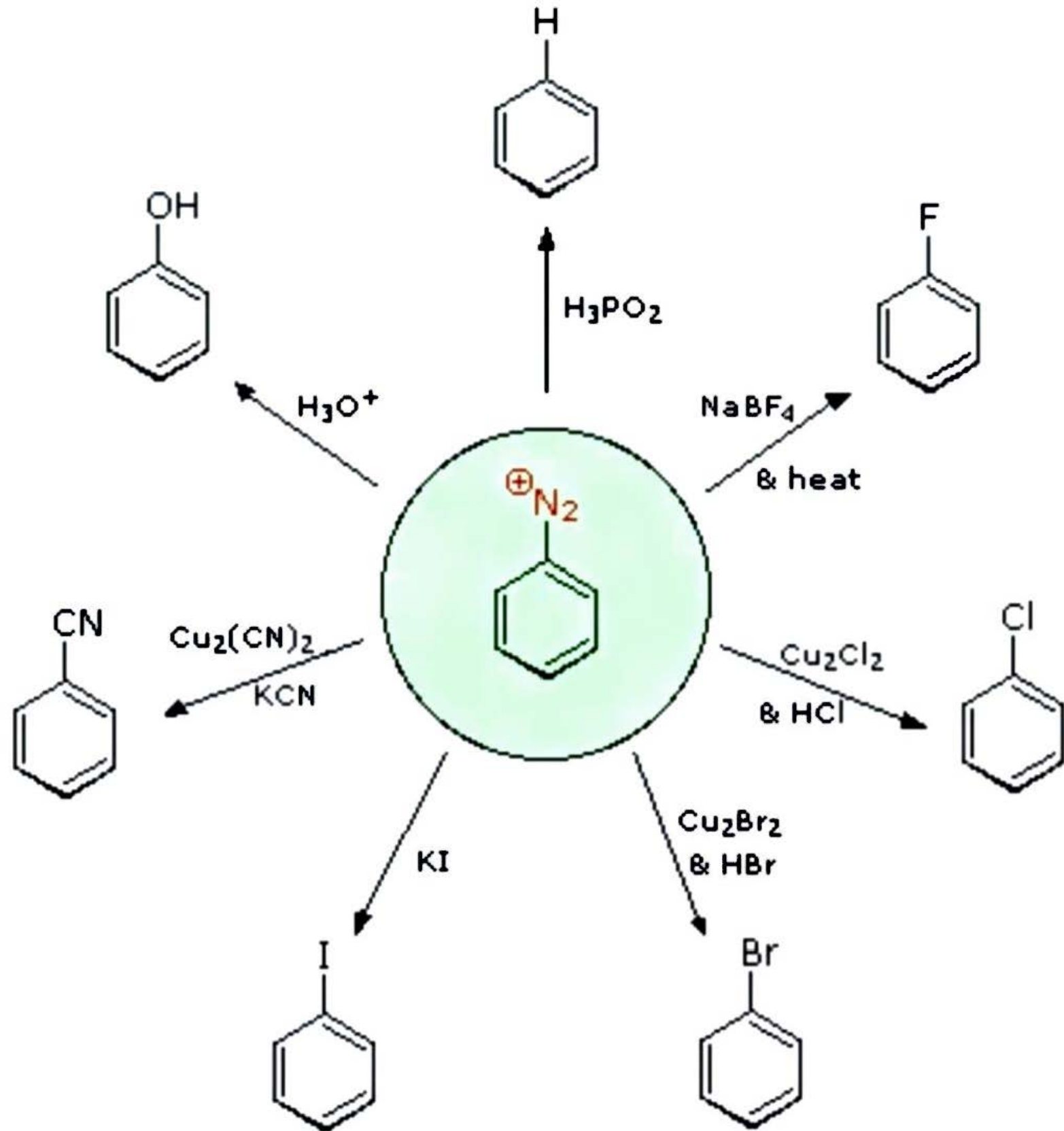


# Reaction Map: Reactions of Alkanes & Alkyl Halides



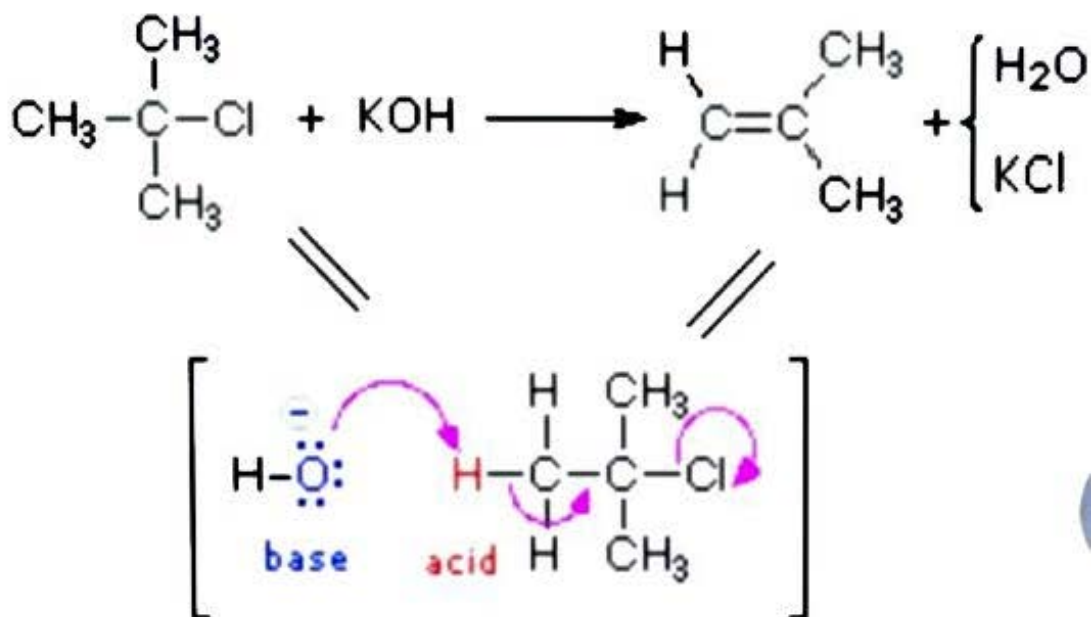
Reaction	Name	Typical Conditions	Notes [1°, 2° and 3° refers to primary, secondary, tertiary]
1	Free radical chlorination	Cl <sub>2</sub> , hν	Not highly selective
2	Free radical bromination	Br <sub>2</sub> , hν	Highly selective for tertiary C-H
3	Elimination [E2]	RO <sup>⊖</sup> /ROH	Best for 2° and 3°, <i>anti</i> stereochemistry
4	Elimination [E1]	polar solvent, heat	Competes with S <sub>N</sub> 1
5	Alcohol Formation [S <sub>N</sub> 2]	OH <sup>⊖</sup> / H <sub>2</sub> O	Best for 1° alkyl halides; 2° can compete w/ E2
6	Alcohol Formation [S <sub>N</sub> 1] "Solvolysis"	H <sub>2</sub> O	Best for 3° alkyl halides; rearr possible w/ 2°
7	Ether Formation [S <sub>N</sub> 2] ["Williamson Ether Synthesis"]	RO <sup>⊖</sup> /ROH	Best for 1° alkyl halides; 2° can compete w/ E2
8	Ether Formation [S <sub>N</sub> 1] "Solvolysis"	ROH	Best for 3° alkyl halides; rearr possible w/ 2°
9	Thiol formation [S <sub>N</sub> 2]	SH <sup>⊖</sup>	S <sub>N</sub> 2; best for 1° alkyl halides, 2° OK
10	Sulfide formation [S <sub>N</sub> 2]	SR <sup>⊖</sup>	S <sub>N</sub> 2; best for 1° alkyl halides, 2° OK
11	Ester formation [S <sub>N</sub> 2]	RCO <sub>2</sub> <sup>⊖</sup>	S <sub>N</sub> 2; best for 1° alkyl halides, 2° OK
12	Azide formation [S <sub>N</sub> 2]	N <sub>3</sub> <sup>⊖</sup>	S <sub>N</sub> 2; best for 1° alkyl halides, 2° OK
13	Nitrile formation [S <sub>N</sub> 2]	CN <sup>⊖</sup>	S <sub>N</sub> 2; best for 1° alkyl halides, 2° OK
14	Alkyne formation [S <sub>N</sub> 2]	R-C≡C <sup>⊖</sup>	Best for 1° alkyl halides; 2° can compete w/ E2

in  
polar  
aprotic  
solvent

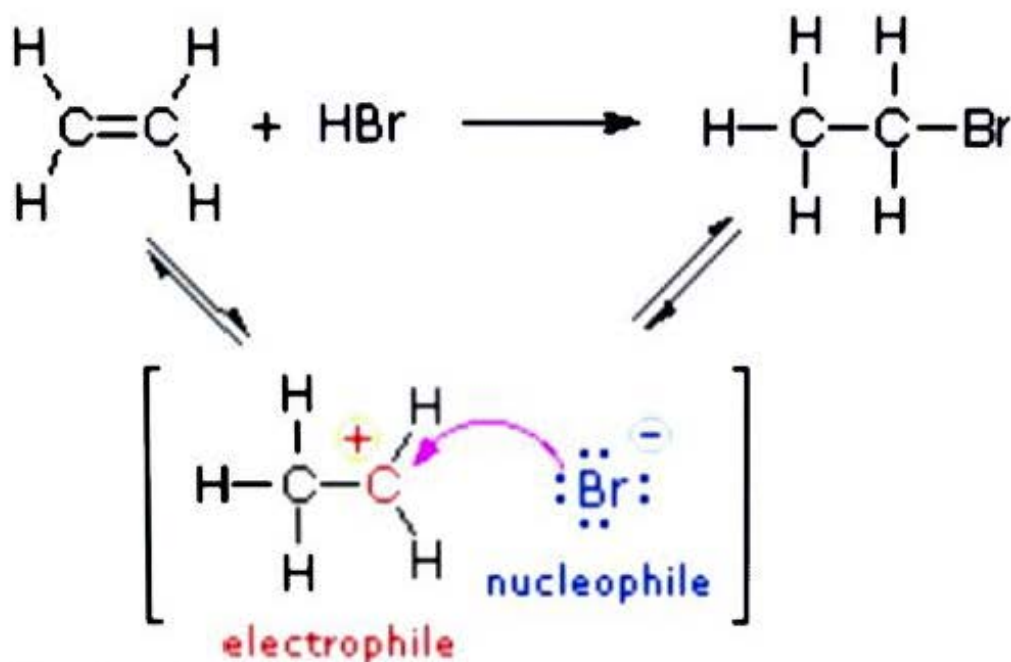




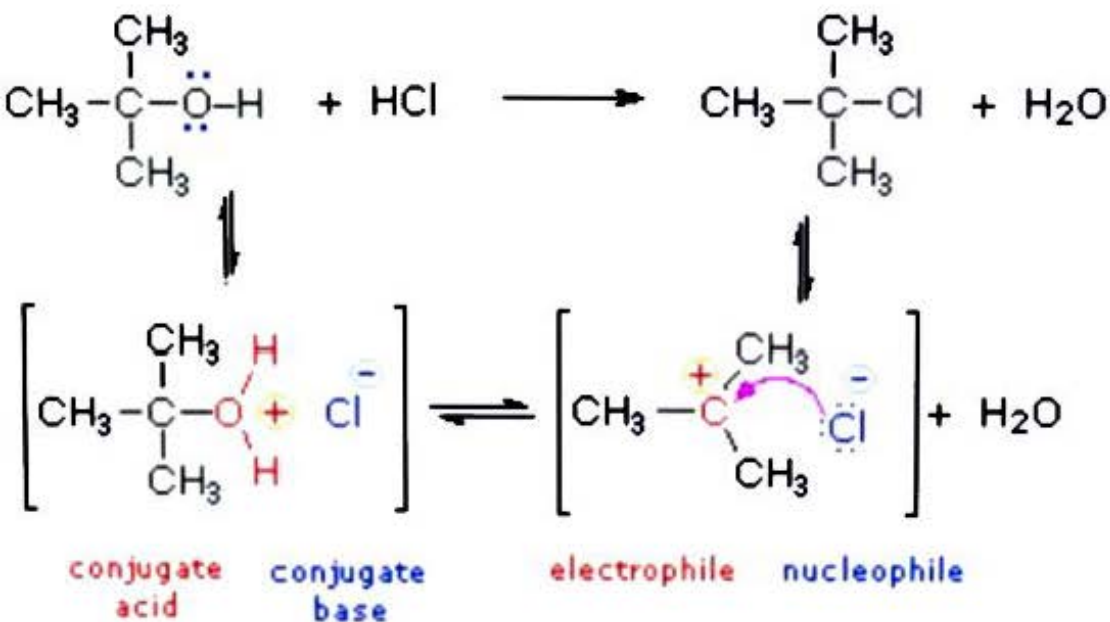
## elimination



## addition



## substitution



Activating groups,  
electron donating, nucleus  
more nucleophilic.


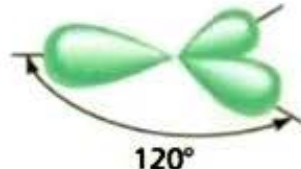
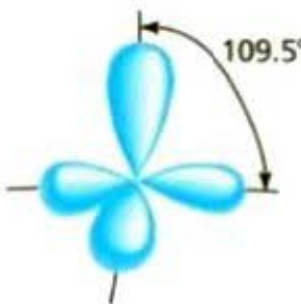
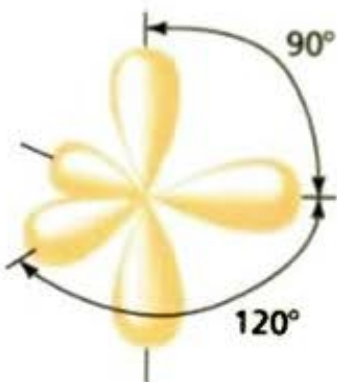
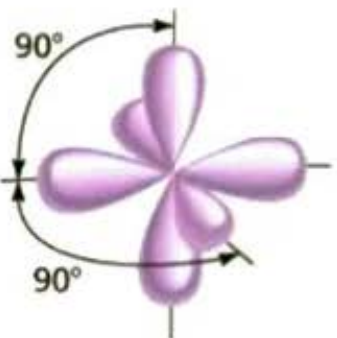
Deactivating groups  
 $e^-$  withdrawing,  
nucleus less nucleophilic.

nucleus less nucleophilic	Very strong	$-O^-$	} +I, +M	O, P directing
	Strong	$-NR_2$		
		$-NHR$		
		$-NH_2$		
		$-OH$		
		$-OR$		
	Moderately strong	$-HNCOR$	} -I < +M.	
		$-OCOR$		
		$-C_6H_5$		
	Weak	$-CH_3$	} +I < +M	
		$-C_2H_5$		} +I
		$-F \sim (H)$	} -I > +M.	
		$-Cl, Br, I^*$		
		$-CH_2-Cl$		
		$-CH=CH-COOH$		
$-CH=CH-NO_2$				
$-CONH_2$		} -I, -M		
$-COR$				
$-CHO$				
$-SO_3H$				
$-CN$				
Strong	$-NO_2$		m directing.	
Very strong	$-^+NH_3$	-I		



TABLE 10.4

Important Hybrid Orbitals and Their Shapes

Pure Atomic Orbitals of the Central Atom	Hybridization of the Central Atom	Number of Hybrid Orbitals	Shape of Hybrid Orbitals	Examples
$s, p$	$sp$	2	 Linear	$\text{BeCl}_2$
$s, p, p$	$sp^2$	3	 Trigonal planar	$\text{BF}_3$
$s, p, p, p$	$sp^3$	4	 Tetrahedral	$\text{CH}_4, \text{NH}_4^+$
$s, p, p, p, d$	$sp^3d$	5	 Trigonal bipyramidal	$\text{PCl}_5$
$s, p, p, p, d, d$	$sp^3d^2$	6	 Octahedral	$\text{SF}_6$

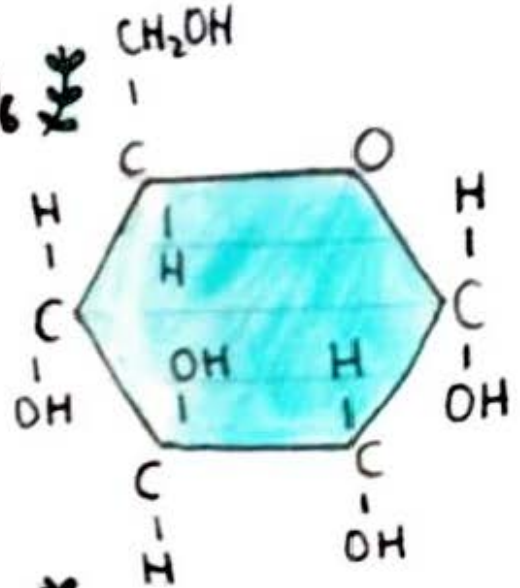
# CARBOHYDRATES

## Classification

### 1 MONOSACCHARIDES $\text{C}_6\text{H}_{12}\text{O}_6$

examples

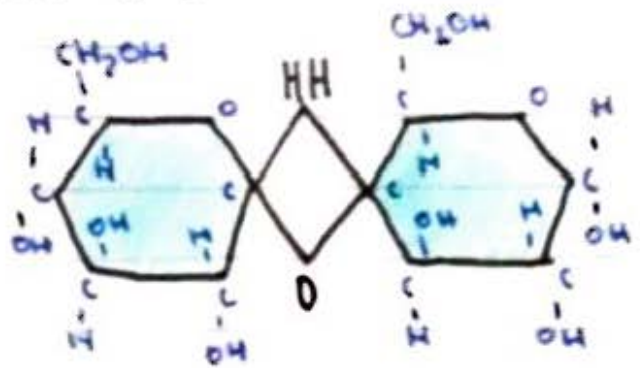
- glucose  $\rightarrow$  fruit 🍎
- fructose  $\rightarrow$  honey 🍯
- galactose  $\rightarrow$  digested milk 🥛



### 2 DISACCHARIDES $\text{C}_{12}\text{H}_{22}\text{O}_{11}$

examples

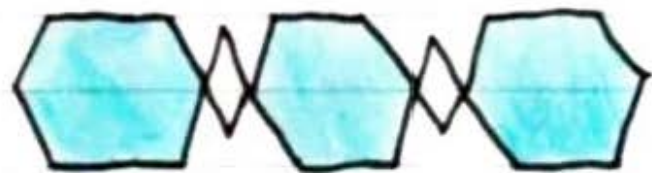
- sucrose  $\rightarrow$  table sugar
- lactose  $\rightarrow$  milk
- galactose  $\rightarrow$  barley



### 3 POLYSACCHARIDES $(\text{C}_6\text{H}_{10}\text{O}_5)_n$

examples

- starch  $\rightarrow$  potatoes
- cellulose  $\rightarrow$  fruit and veg
- pectin  $\rightarrow$  wholegrain cereals
- glycogen  $\rightarrow$  stored animal starch



$\approx$  3 or more linked  $\approx$