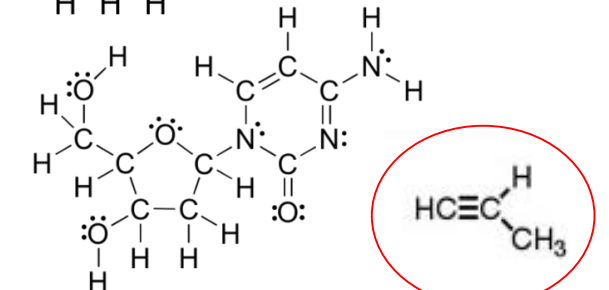
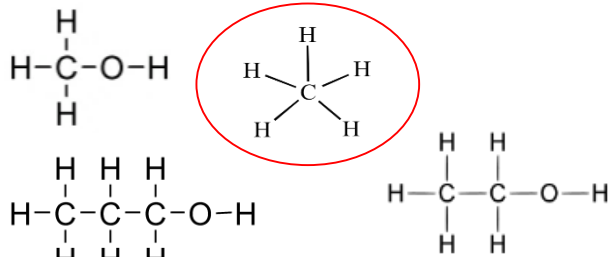


organic chemistry: the study of carbon-based substances

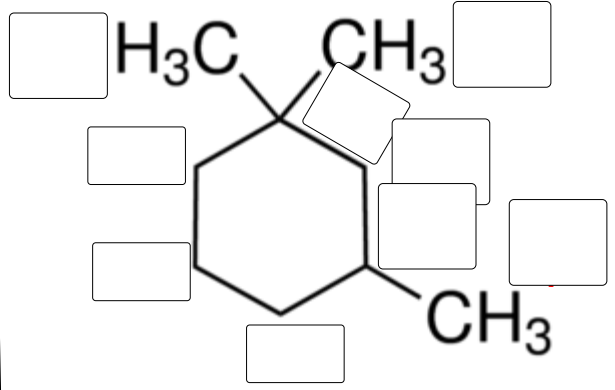
what they are their bonding patterns how to draw them common functional groups reactions

most common elements and number of bonds for each:

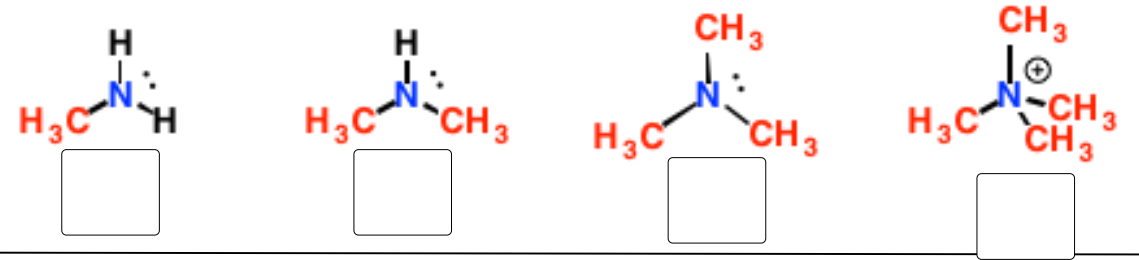
which are unreasonable?



why?



primary secondary, tertiary and quaternary



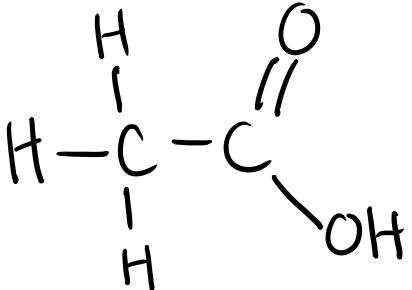
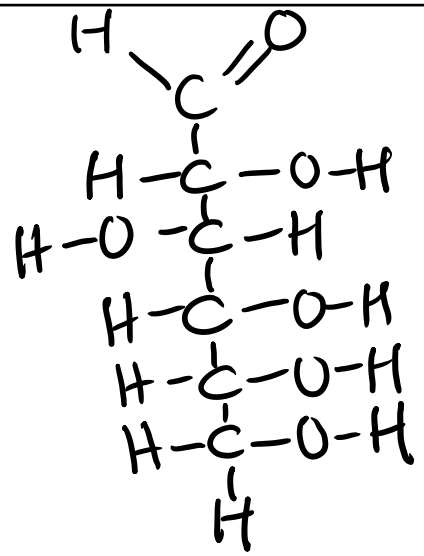
ways to draw them (using ethanol as an example):

structural formula	skeletal formula (H added to show alcohol functional group)	molecular formula	condensed structural formula	structural formula with stereochemistry	molecular model ball and stick	molecular model space filling	actual microscopic image
		$\text{C}_2\text{H}_6\text{O}$	$\text{CH}_3\text{CH}_2\text{OH}$				
				<p>hatch bond moving away</p> <p>wedge bond moving closer</p>			does not exist! (yet)

some common functional groups:

drawing organic substances

fill in the blanks

formula	ethane	ethanoic acid	glucose
empirical			
molecular	C_2H_6		
structural			
condensed structural			

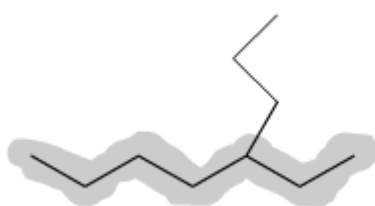
First: Identify the longest chain of carbon atoms

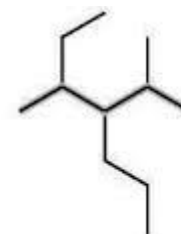
# of C-atoms in longest chain	Stem in IUPAC name
1	
2	
3	
4	
5	

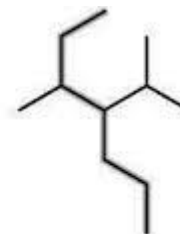
5	pent-
6	
7	
8	
9	

naming organic substances

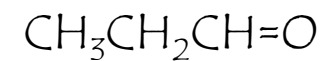
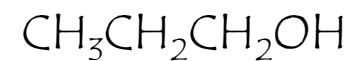
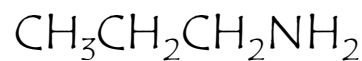
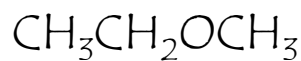
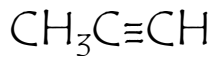
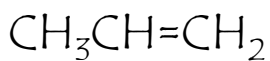
how many?





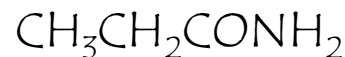


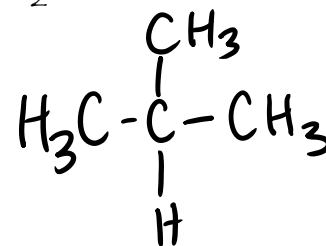
Second: identify the functional group

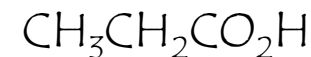




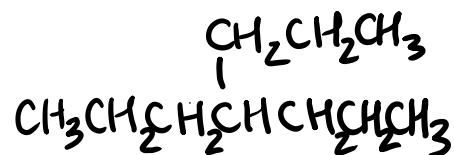


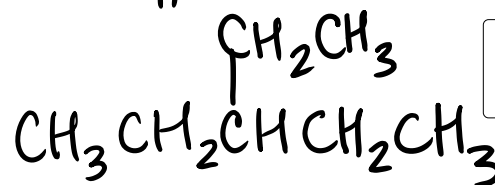






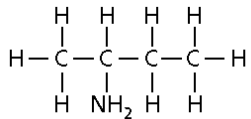
Finally, identify side chains, keeping numbers low:



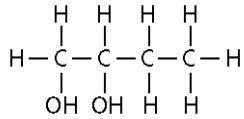


name these!

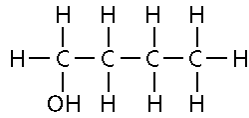
lots of minor rules will become evident by example:



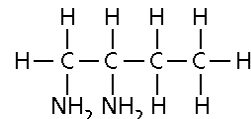
a



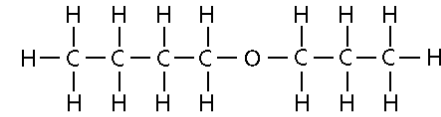
b



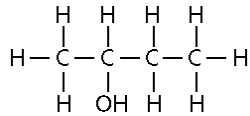
c



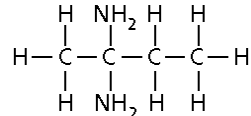
d



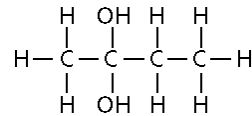
e



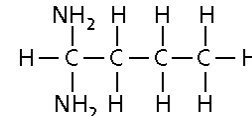
f



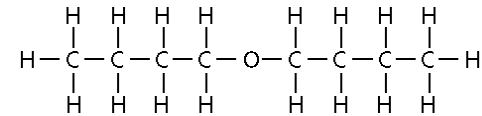
g



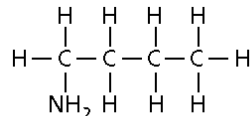
h



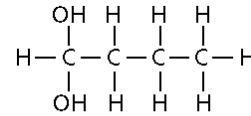
i



j



k



l

- | | | | |
|----|----------------|-----|--------------------|
| 1. | 1-butanol | 7. | butyl propyl ether |
| 2. | 2-butanol | 8. | 1-butylamine |
| 3. | 1,1-butanediol | 9. | 2-butylamine |
| 4. | 2,2-butanediol | 10. | 1,1-butyldiamine |
| 5. | 1,2-butanediol | 11. | 2,2-butyldiamine |
| 6. | dibutyl ether | 12. | 1,2-butyldiamine |

practice some more with [this quiz](#)

organic isomers

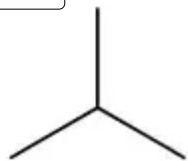
isomers share the same

but have different

structural:

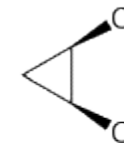


both C_4H_{10}

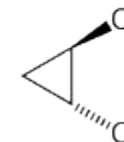


types:

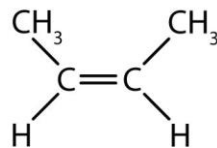
stereo



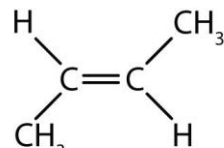
both $C_3H_4Cl_2$



cis/trans and E/Z



cis-2-butene

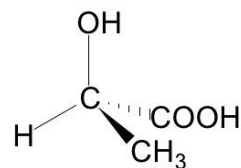


trans-2-butene

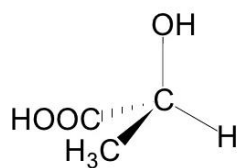
both C_4H_8

optical

typically 4 different substituents on C of different arrangement:



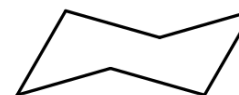
(-) lactic acid
in sour milk



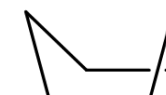
(+) lactic acid
in muscles

both $C_3H_6O_3$

conformational



Chair



Boat

both C_6H_{12}

same physical properties except how they interact with polarized light: catalysts will only react with 1:

alkanes

general formula:

no double bonds: they are

only contain C,H...they are

both C-C bonds and C-H bonds are

which means 2 things:

nucleophile^{δ-} :

electrophile^{δ+} :

a bit about each functional group

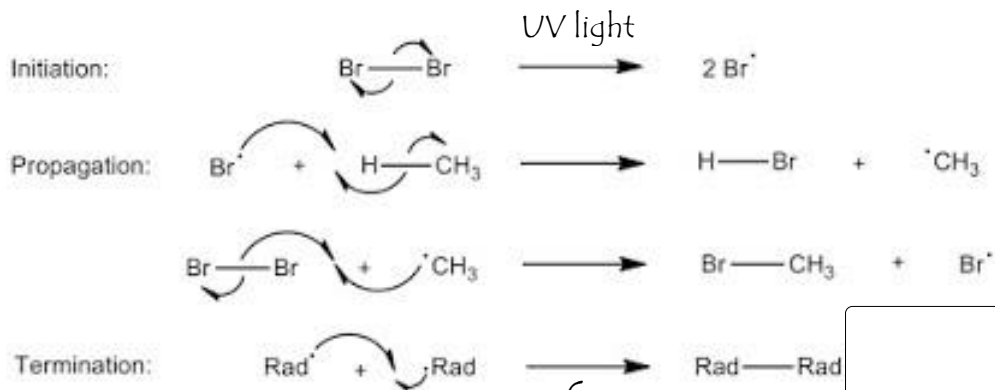
...but they do

let's burn hexane:

combustion may be destroying our planet as CO₂ is responsible for

alkanes may also react with halogens to make

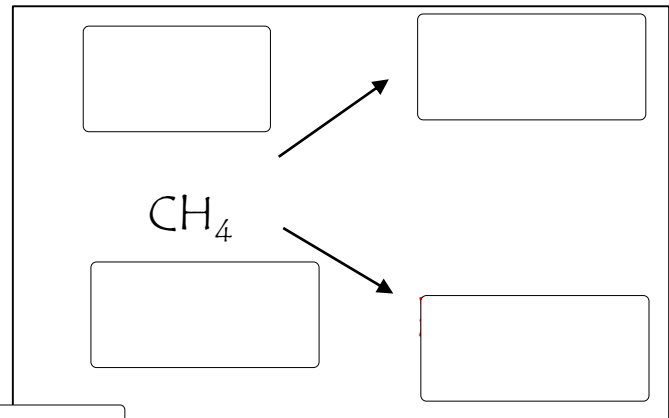
mechanism:



prior to reaction :

after reaction:

note single headed arrows for

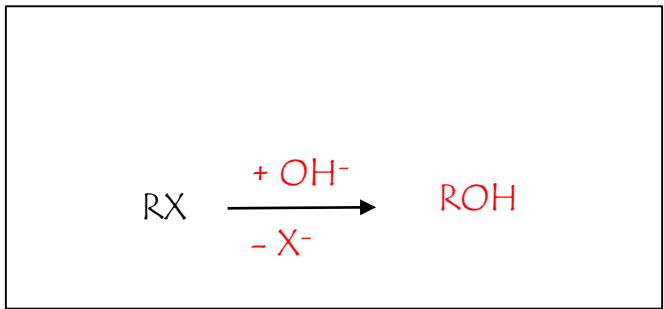


haloalkanes

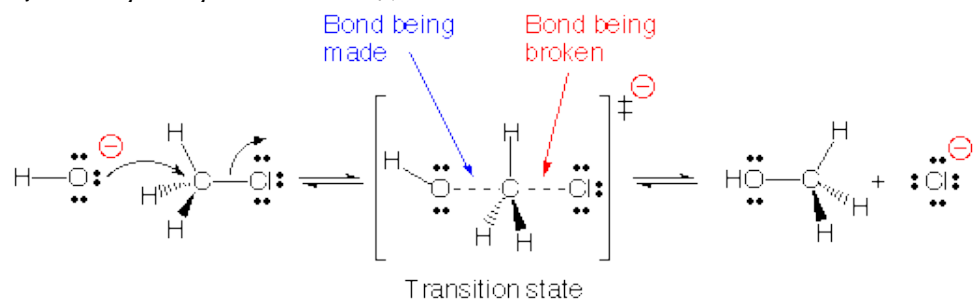
aka

general formula: they are electrophilic at the therefore they are prone to

the mechanism depends on the type of alkyl halide with other minor effects to consider



primary alkyl halides: S_N2



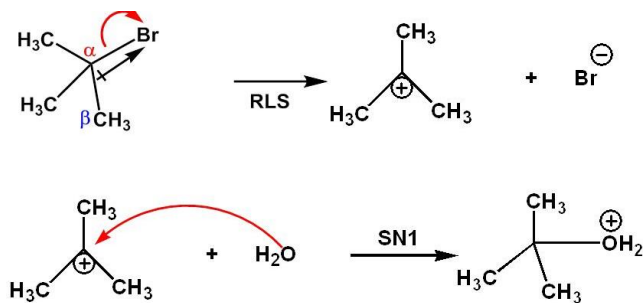
S_N2 notes:

inverts stereocenter

favoured by polar aprotic solvents (polar but can't hydrogen bond)

polarizes intermediate without forming a H-bond

tertiary alkyl halides: S_N1



S_N1 notes:

rate only depends on slow step:
concentration of haloalkane.

steric hindrance and carbocation stability can slow things down...but is still faster than S_N2

polar protic solvents help by stabilizing carbocation

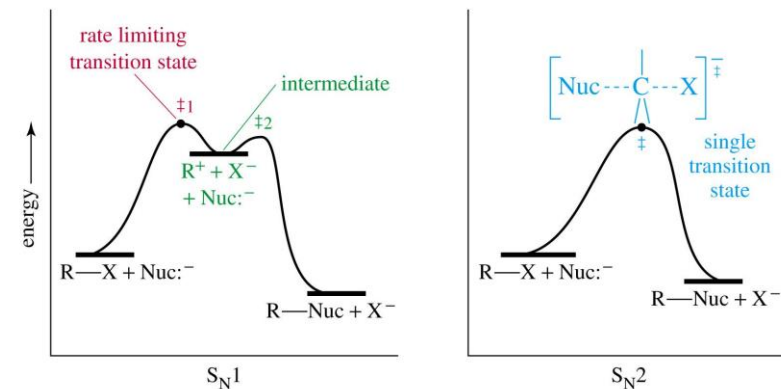
symmetry of carbocation result in racemic mixture sadly

secondary alkyl halides...a bit of each.

S_N1 versus S_N2 notes

small leaving group make either S_N1 or S_N2 faster: $\text{F} > \text{Cl} > \text{Br} > \text{I}$...but bond strength is weakest for the bigger C-X bond so iodides react fastest, fluorides slowest.

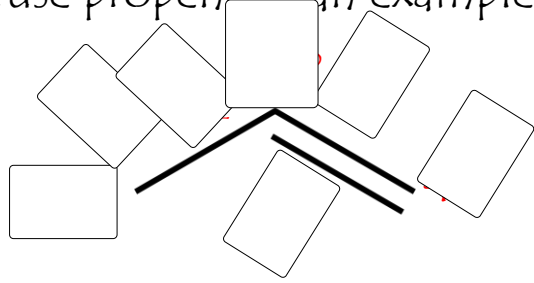
S_N1 and S_N2 energy profiles



alkenes

general formula:

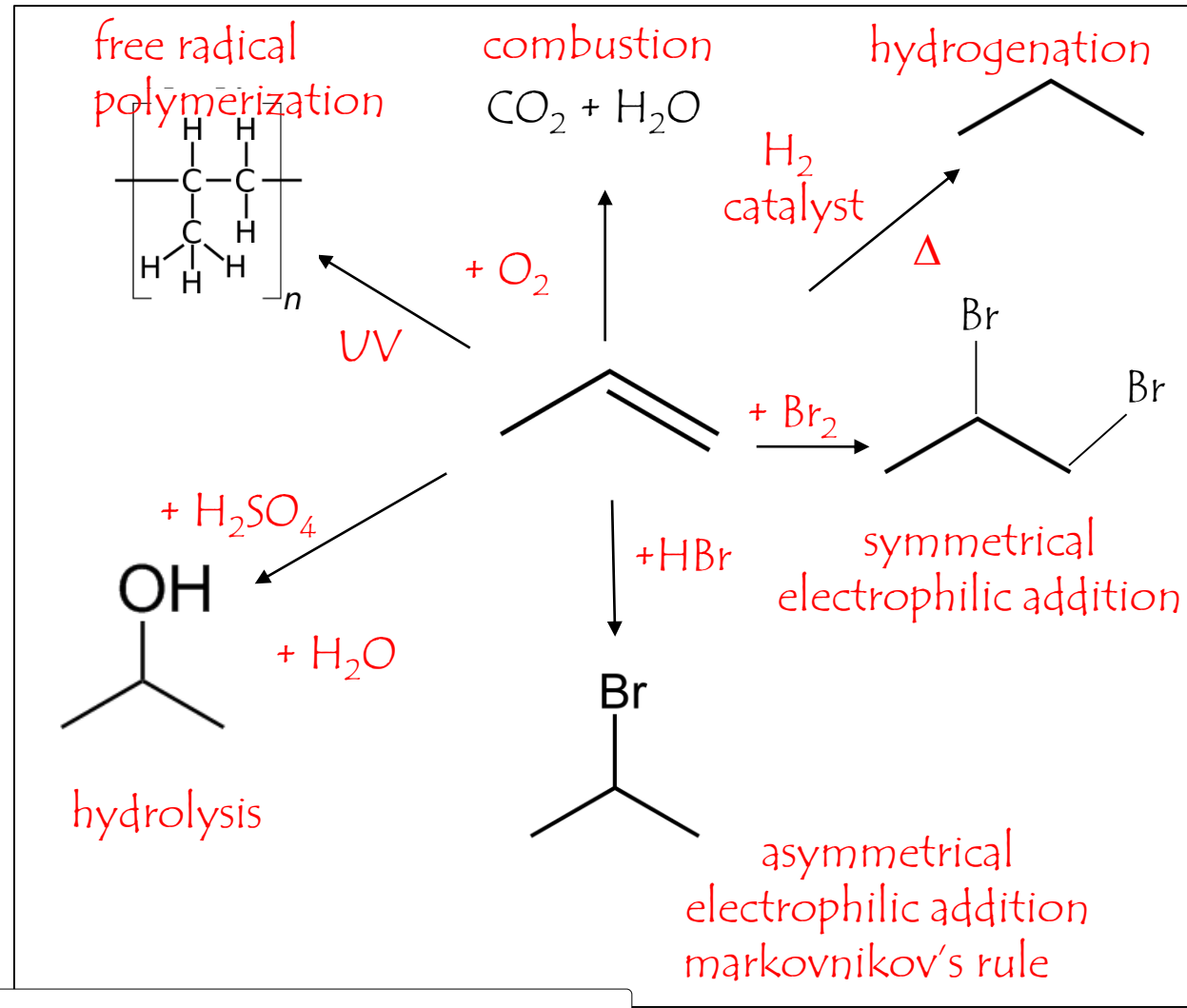
molecular orbitals, hybridization, bond angles...use propene as an example



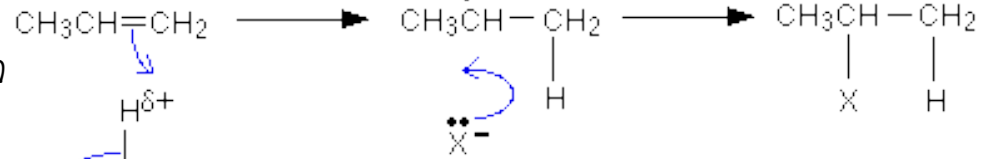
only contain C,H...they are

they are weakly nucleophilic at the

lot's of reactions!



mechanism of electrophilic addition



more stable carbocation formed due to

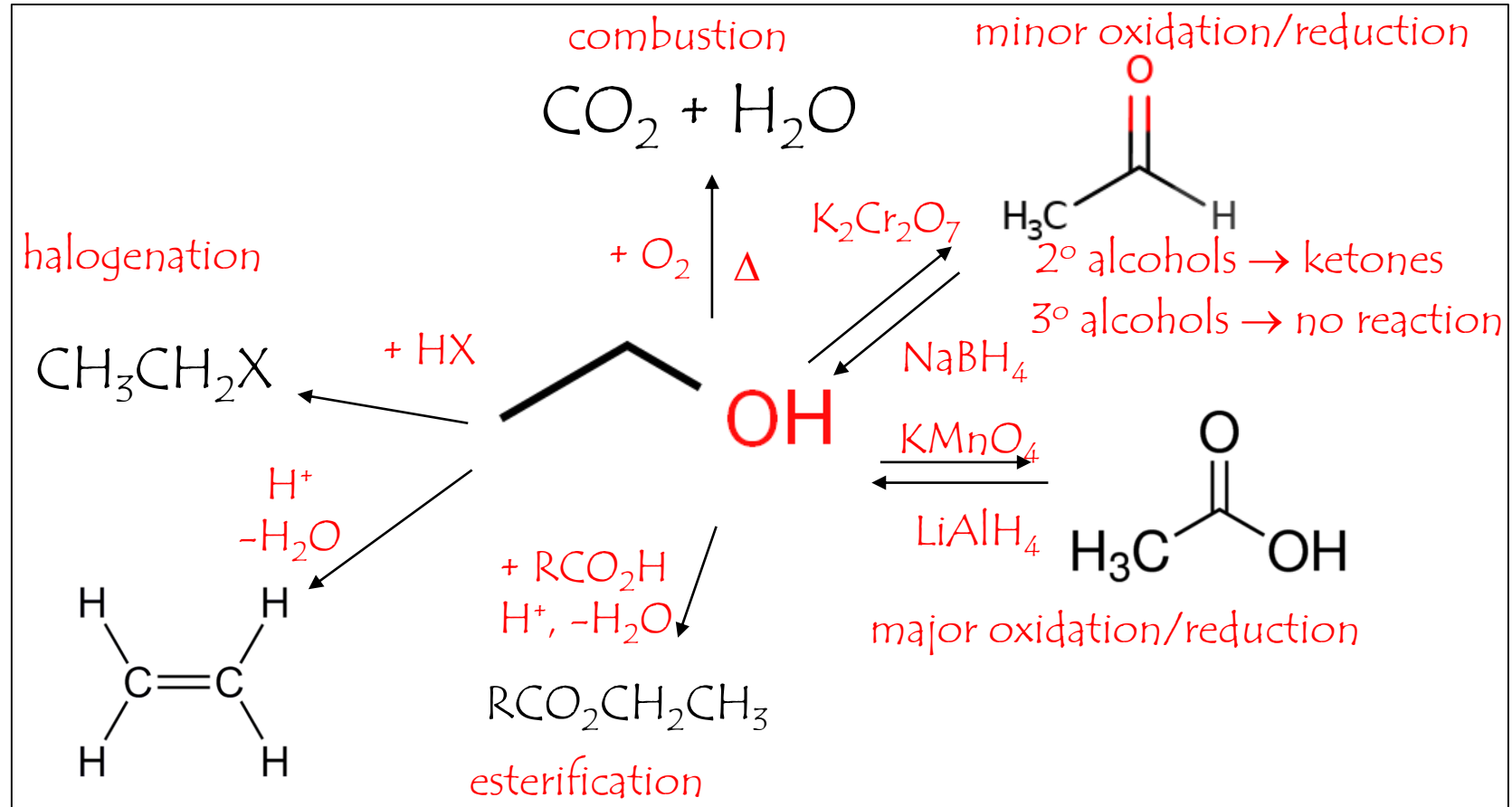
alcohols

general formula:

they are strongly nucleophilic at the

they can be primary, secondary or tertiary:

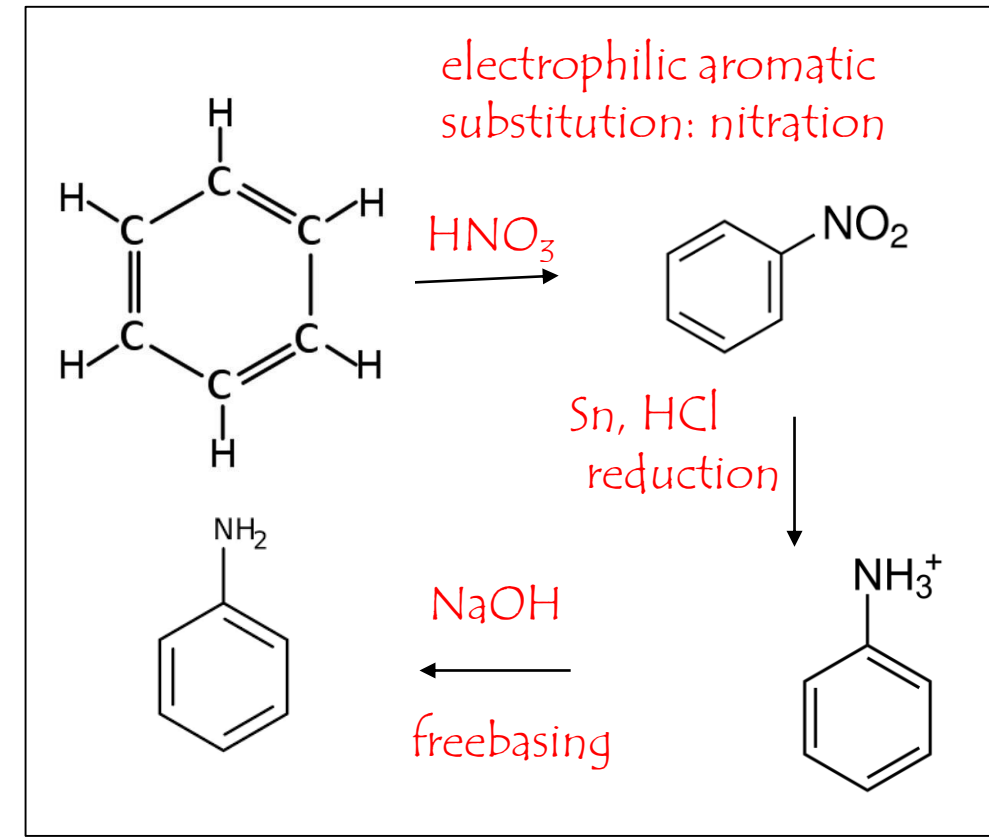
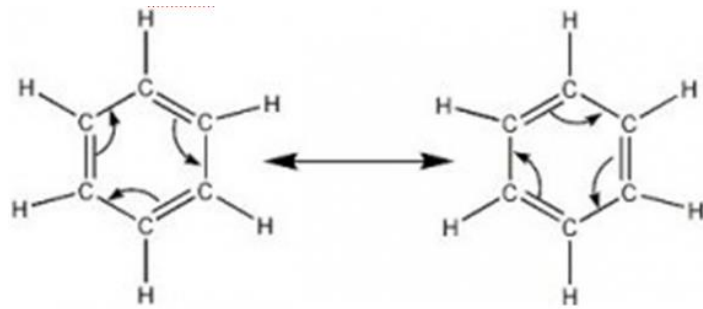
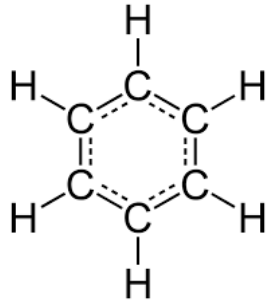
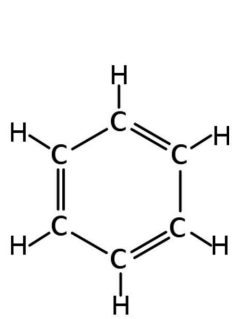
we have a special enzyme for one of them



benzene

an example of an

characterized by



misleading since all bond lengths identical (1.5)

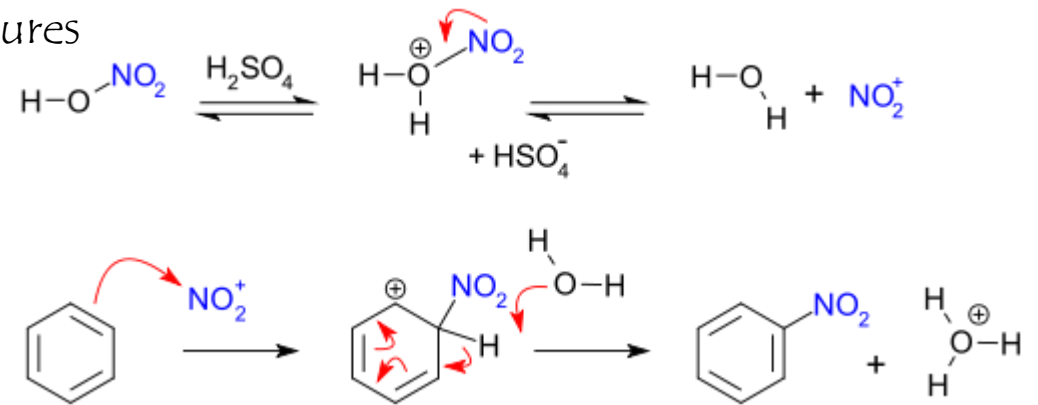
one better way to draw it:

but chemists prefer to say it is halfway between two resonance structures

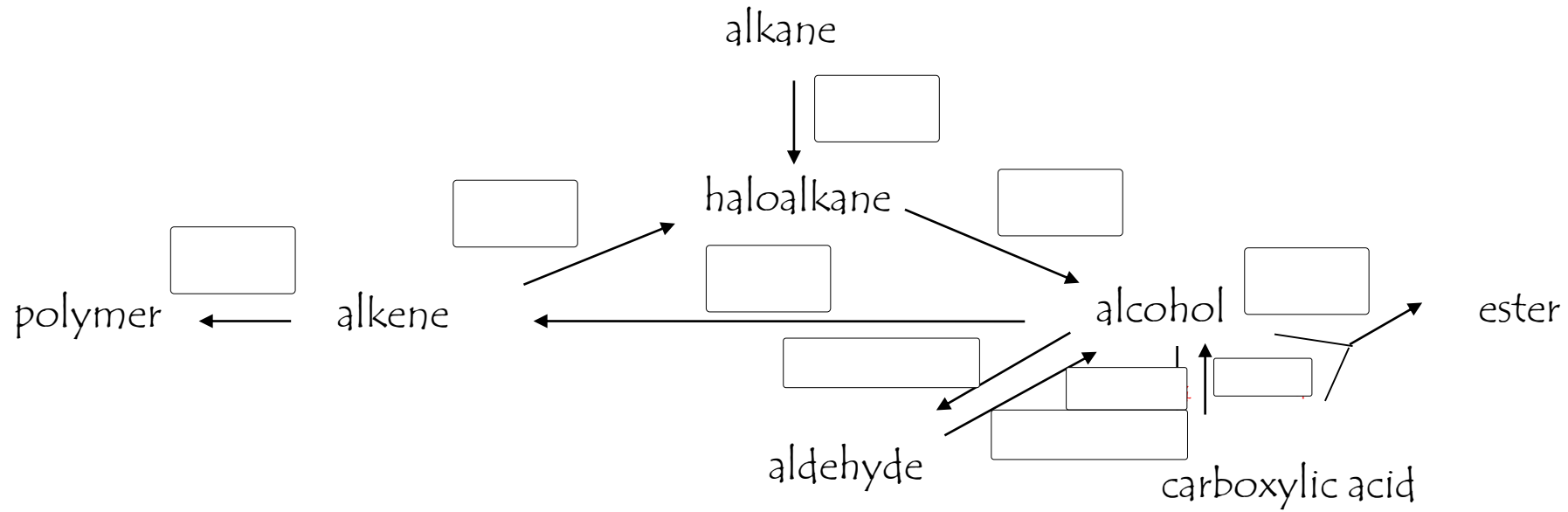
mechanism:

they are strongly nucleophilic at the

typical reaction



retrosynthetic analysis



starting with only ethanol ($\text{CH}_3\text{CH}_2\text{OH}$), synthesize ethyl acetate ($\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3$)