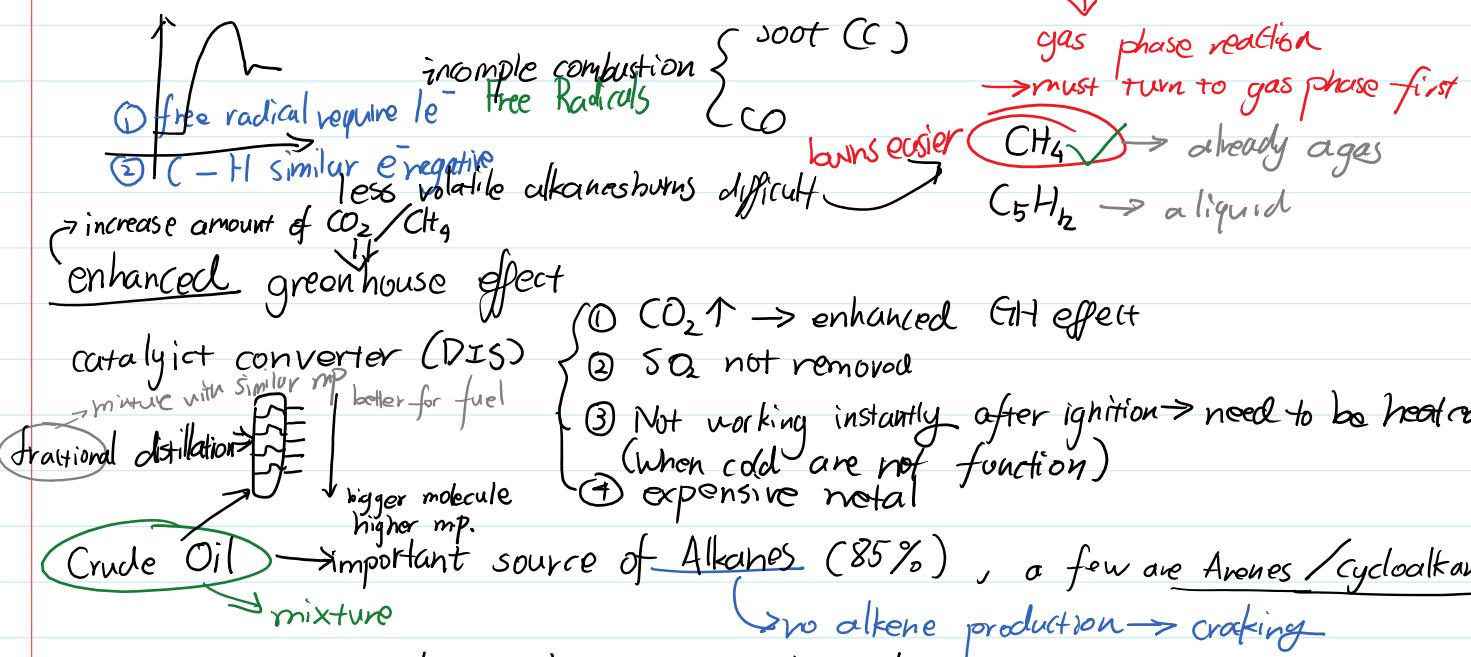
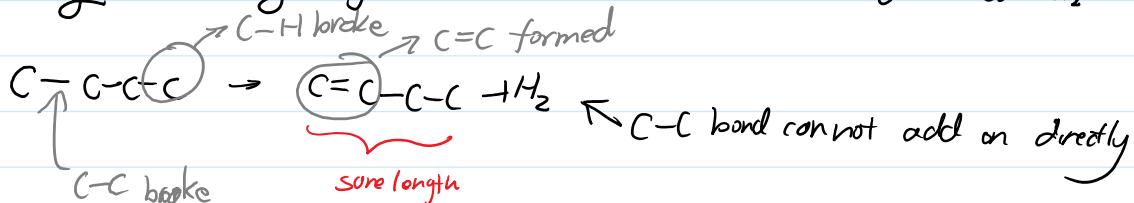


Alkanes are kinetically stable with oxygen but are energetically unstable with respect to their oxidation products. ΔE° for alkanes are high \rightarrow not burning by themselves (rate are slow)



Cracking \rightarrow converting long or chain alkanes into shorter alkenes & alkanes & H_2



① Thermal Cracking

high temp (400-900°C)

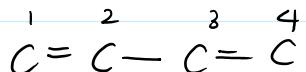
high pressure

② Catalytic Cracking
catalyst (Zeolite)
Low Temp (400°C)

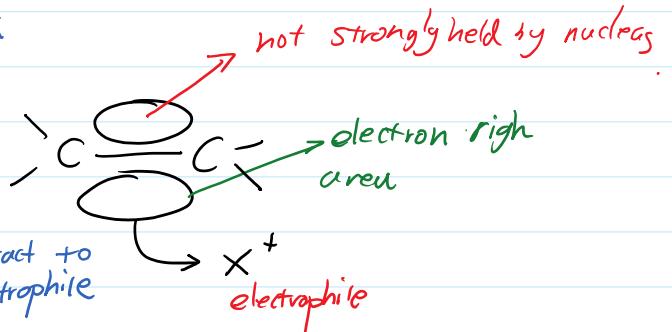
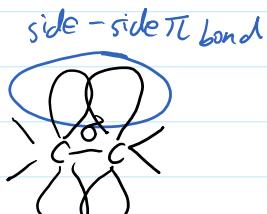
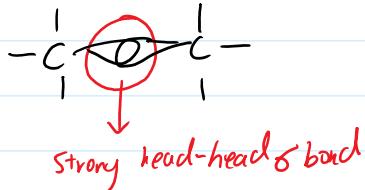
Convert low demand
bigger fraction to high
demand lower fraction
makes alkenes

Alkenes

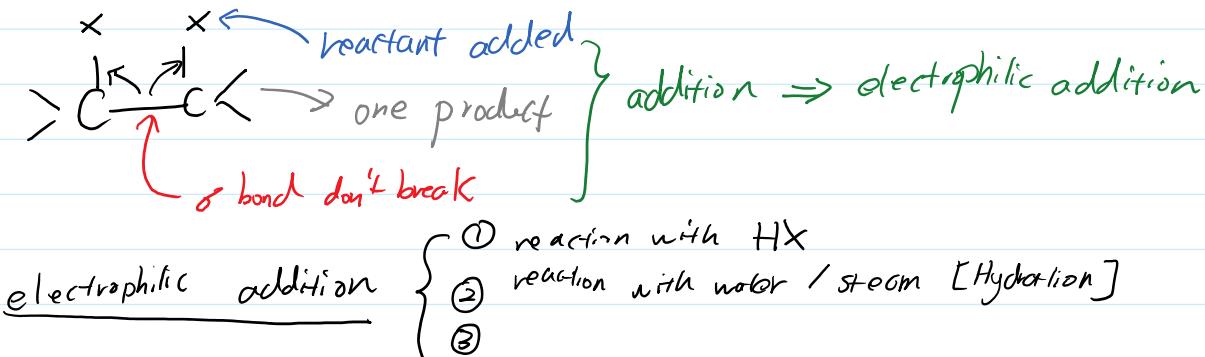
- contain $C=C$, general formula C_nH_{2n}
- made by cracking



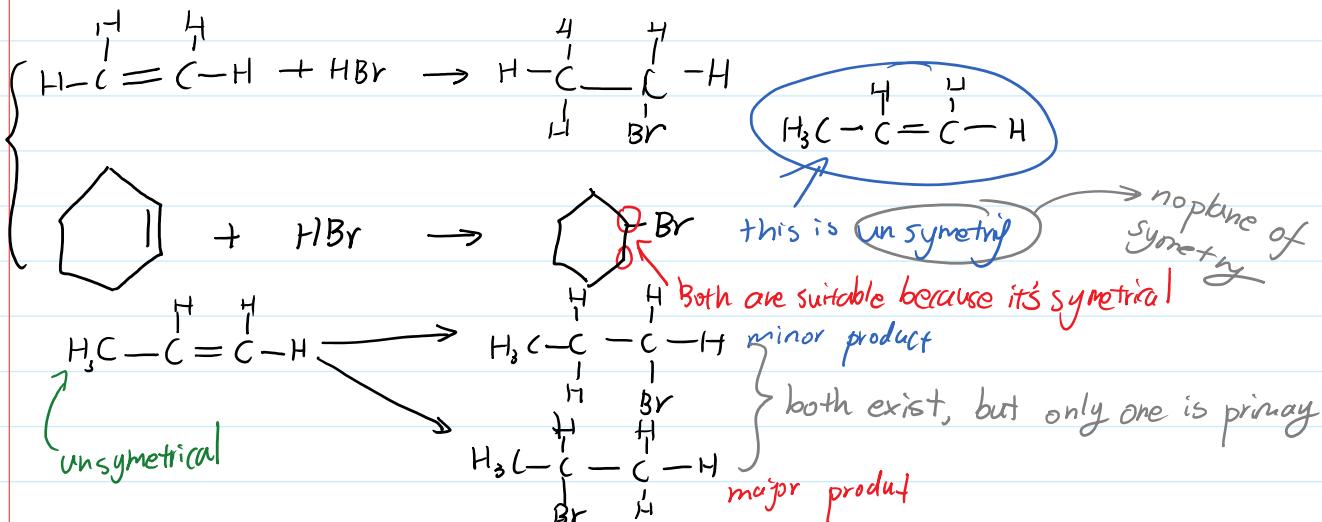
Buta - 1,3 - dieno

Reactivity of alkenes

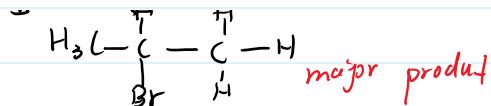
- Unsaturated
- weaker π bond \rightarrow start reaction faster
- attract electrophile at π bond

1. electrophilic addition with HX Reagent: $HBr_{(g)}$ or $HCl_{(g)}$

Product: Halalkanes

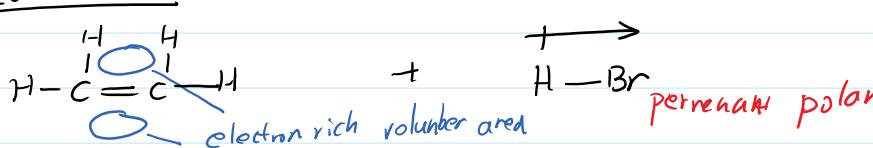


Unsymmetrical

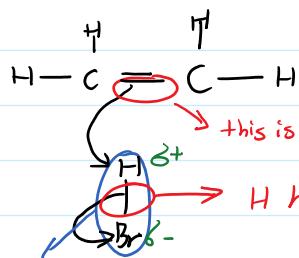


major product

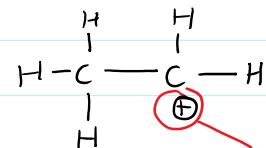
Mechanism



Carbocation

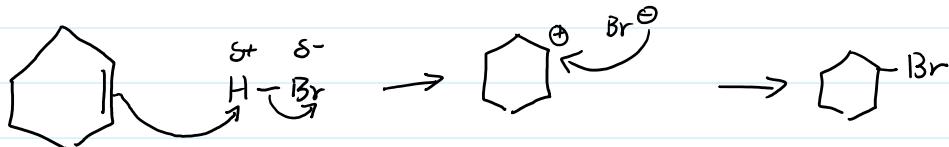
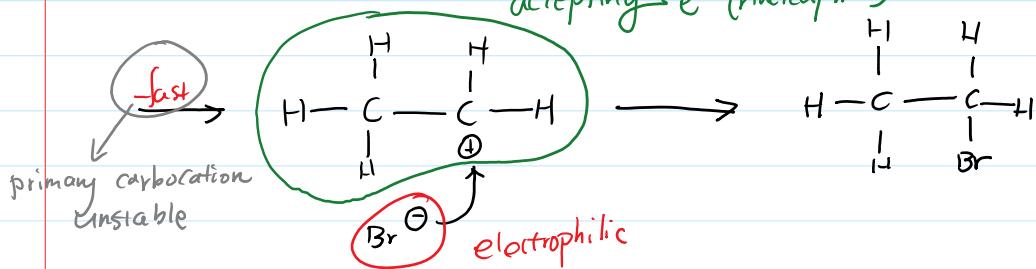


→ this is not the lone pair

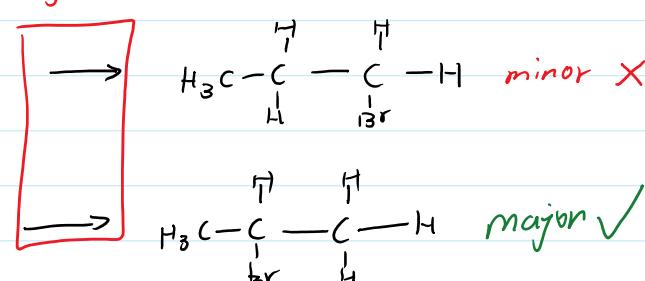
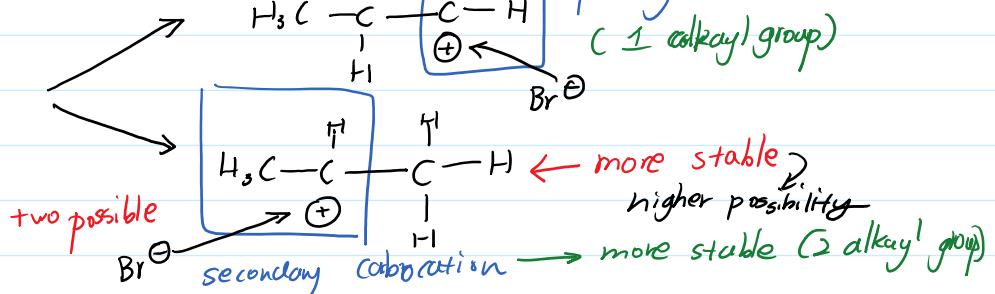
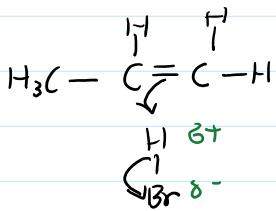


Intermediate loose a share electron form \oplus

electrophilic \rightarrow acceptor of pair of e^- accepting e^- (nucleophilic)



Unsymmetrical ones



more stable intermediate
• more collision rate
• higher possibility

a rule for judging \rightarrow H connect to C with more H

Makromnikoff's rule is the major product \rightarrow because of stability of carbocation

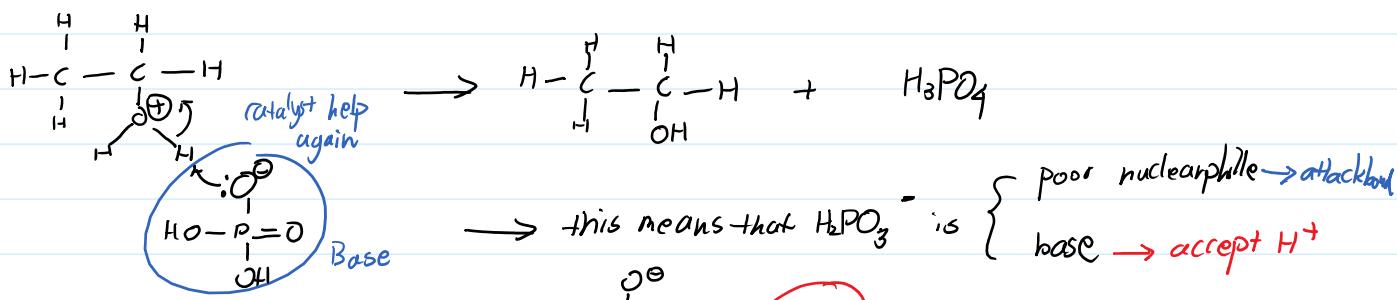
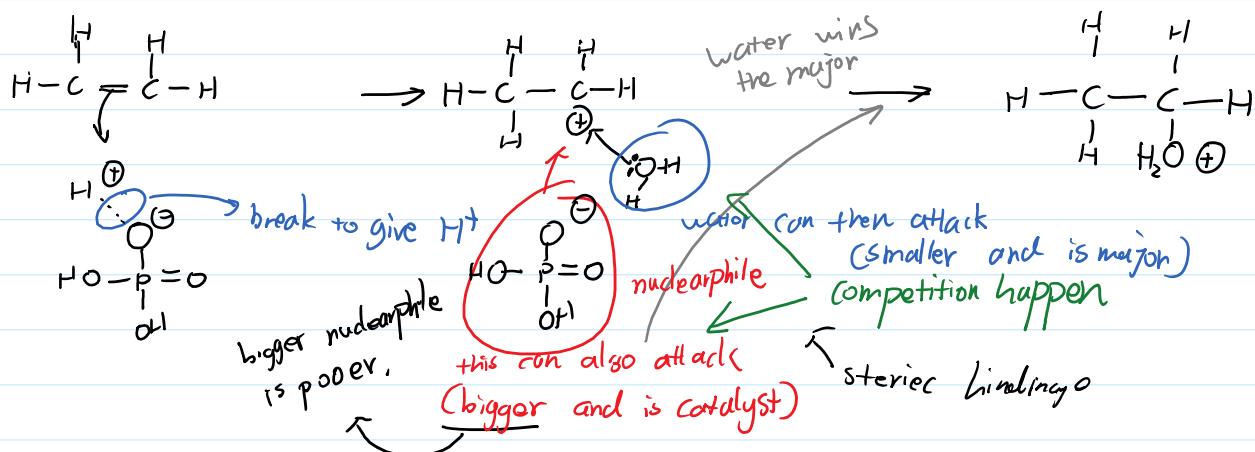
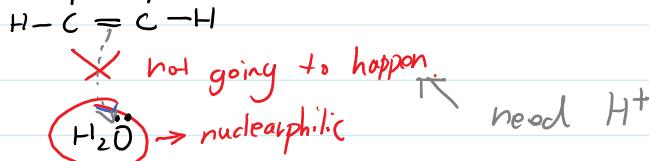
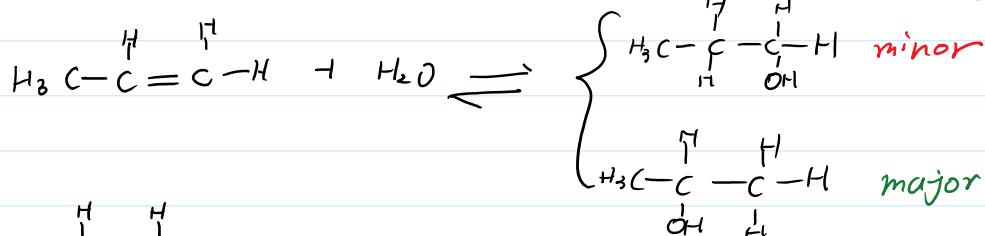
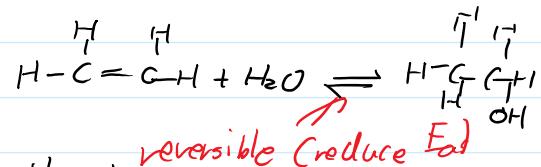
a rule for judging \rightarrow H connect to C with more H
Makromikoff's rule is the major product \rightarrow because of stability of carbocation

2. Reaction with water / steam.

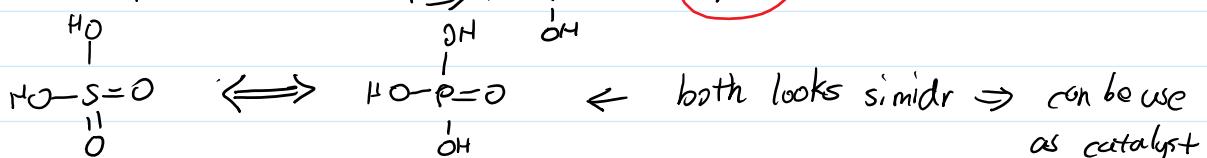
Reagent: H_2O (g)

Condition: H_3PO_4 , catalyst, 300°C , 70 atm.

product: Alcohol



The acid is important in first step $\Rightarrow \text{HO}-\text{P}=\text{O} + \text{H}_3\text{O}^+$ Use this to attack



3. Reaction with Halogens.

Reagent: $\text{Cl}_2 / \text{Br}_2$ [in water (aq) or CCl_4 /Hexane]

not good solvent

discouraged due to toxicity

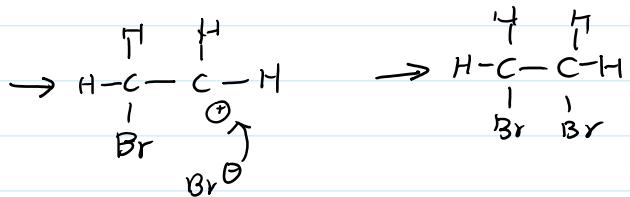
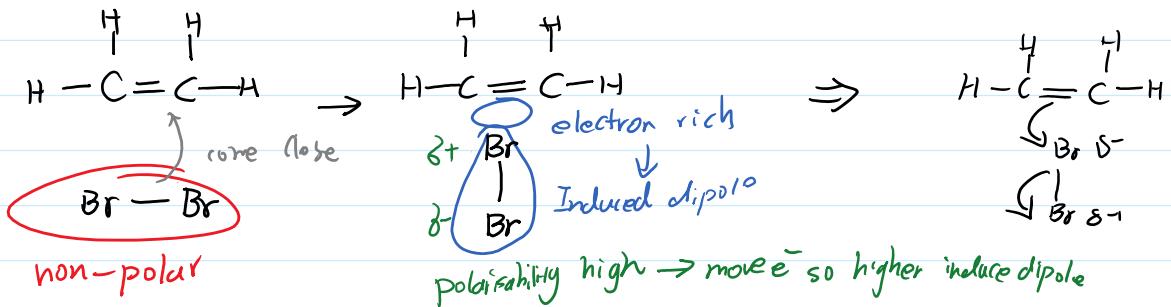
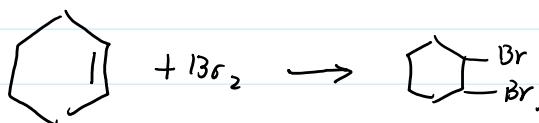
3. Reaction with Halogens.

Reagent: $\text{Cl}_2 / \text{Br}_2$

Condition: -

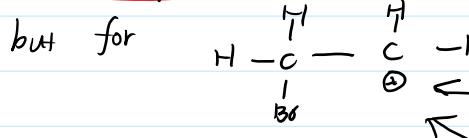
Product: Haloalkane

not very efficient
[in water (aq) or CCl_4 / Hexane]
mostly bromine water
good solvent
orange
Observation: reddish-brown solution
turns colorless



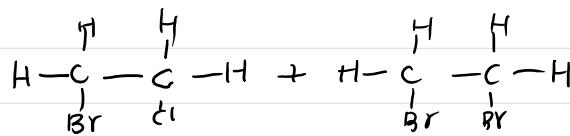
if NaCl contaminated H_2O $\rightarrow \{ \begin{array}{l} \text{Na}^+ \rightarrow \text{not electrophilic. } \times \\ \text{Cl}^- \text{ (no dative covalent bond)} \end{array}$

So electrophilic attack will be normal. \rightarrow first step unaffected



Strong attraction

both can attack. \rightarrow so competition happens



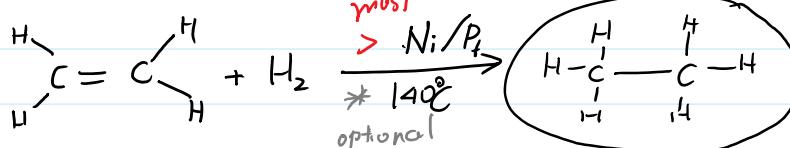
$\text{H}-\text{C}-\text{C}-\text{H}$ depends on
this also could be possible

F^- Cl^- Br^- I^- strongest

Other reactions

1 addition of H^+

not electrophilic

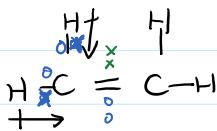


Alkane.

Reduction

\rightarrow use to hardening of vegetable and animal oil to produce margarine



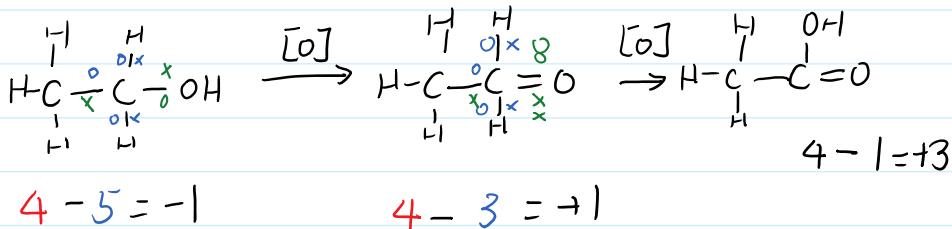
- find oxidation number

Oxidation (increase oxidation number)
Adding C=O bond [O]

$$\boxed{4} - \boxed{6} = -2$$

originally owned

Reduction (decrease oxidation number)
remove C=O bond [H]

Oxidation by KMnO_4

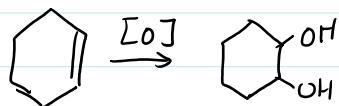
code, dilute acidic manganese (VII) solution

Reagent: $\text{KMnO}_4 / \text{H}^+$ solution

Condition: cold and dilute

Product: Diol (remove from π bond, create 2 C=O bond)[O] agent

- $\text{KMnO}_4 / \text{H}^+$ Purple \rightarrow colorless
 - $\text{CrO}_7^{2-} / \text{H}^+$ Orange \rightarrow green
- Not strong enough to oxidise alkanes



hot, concentrated acidic manganese (VII) solution \rightarrow oxidative cleavage
split, breakdown

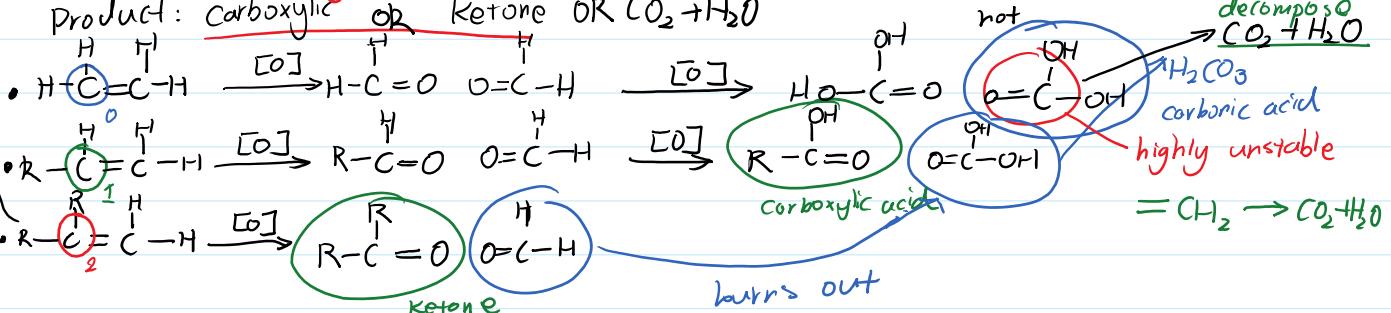
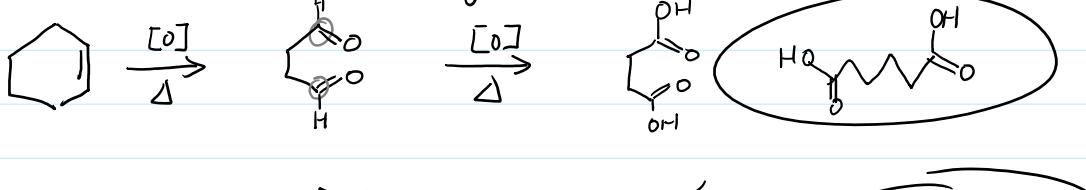
Reagent: $\text{KMnO}_4 / \text{H}^+$ solution Generally

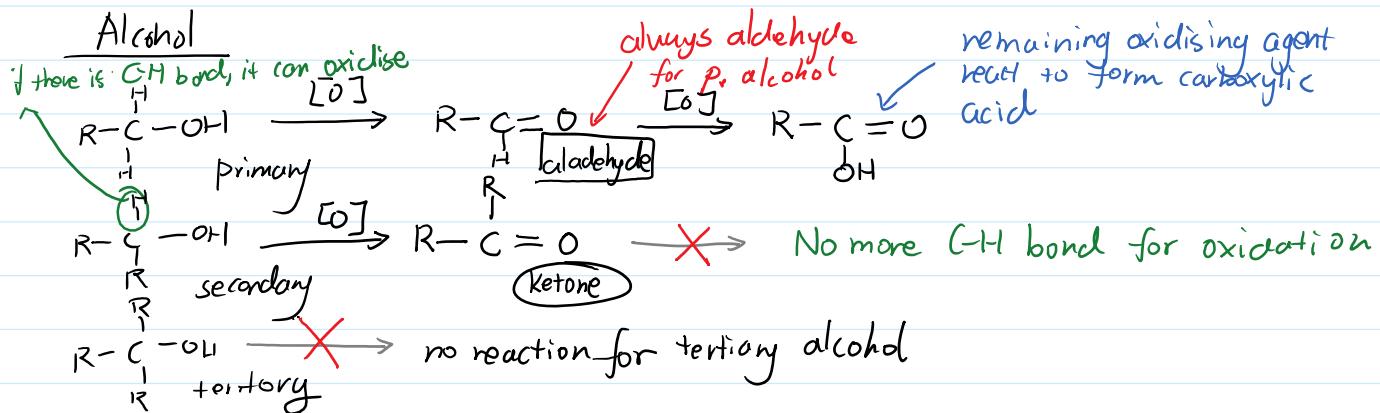
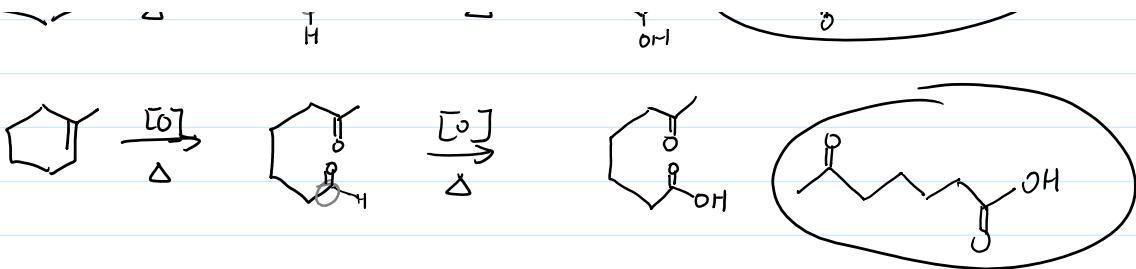
Condition: hot and concentrated

Only two organic product

Product: carboxylic OR ketone $\text{CO}_2 + \text{H}_2\text{O}$ 

(burns out)

 \rightarrow used to make ketone / carboxylic acid, not $\text{CO}_2 + \text{H}_2\text{O}$ 

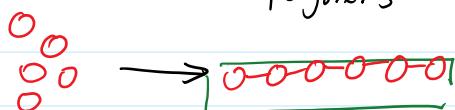


Polymerisation

Alkenes: addition polymerisation

Cond: high temp. / catalyst

Alkenes



Polymer

macromolecule / giant molecule

Monomer \longrightarrow Polymer not having double bond!

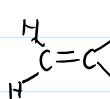
alkene

Poly (alkene)

plastic bag
near continuous

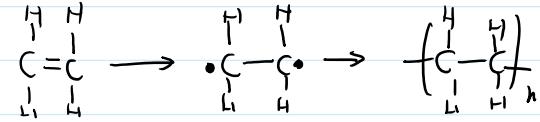
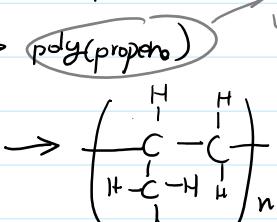
- empirical formulas same
- no molecules lost
- Unsaturated monomer

a. Ethene

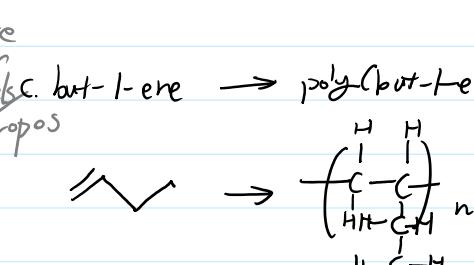
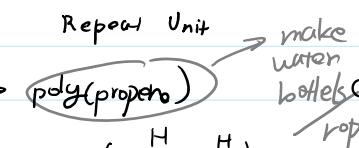
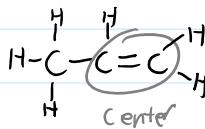


free radicals

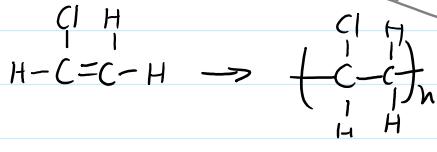
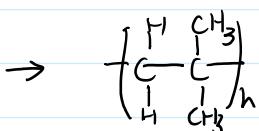
Repeat Unit



b. propeno



c. 2-methylpropane \rightarrow poly(erc.)



water pipes
electrical insulators
PTFE \rightarrow stick pens

Dispose problem

- non-biodegradable \rightarrow buried
- toxic gas (HCl) \rightarrow burned

poly(alkene) \rightarrow alkanes / halokane
unreactive

Polystyrene

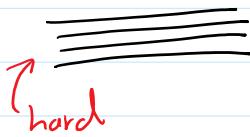
(poly(phenylthene))
- packaging

• ~~thin walled~~ - unreactive

Unreactive

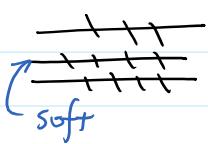
- packaging

HDPE



Less branching
close Packing
stronger VDF
Denser, stronger, harder

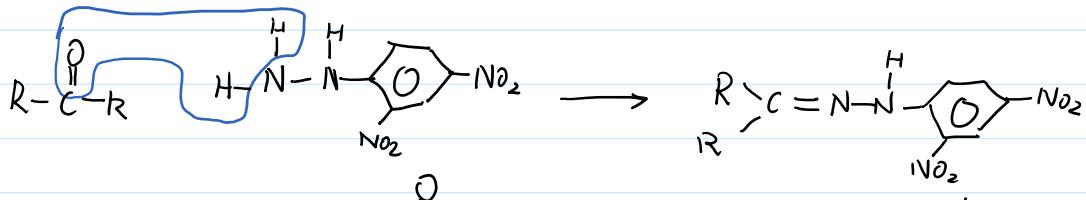
LDPE



softer poly(ethene)

1. Identification of $R-C\overset{\text{O}}{||}R$, (Bridg's test)

→ Orange ppt.
2,4-DNPH



2. aldehyde specific $R-C=H$

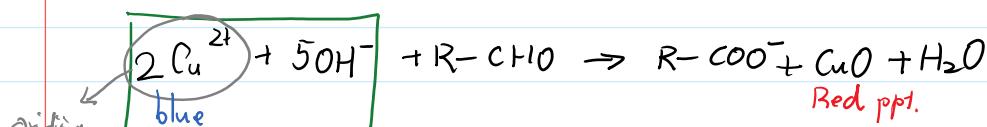
- aldehyde can be further oxidised to alcohol, but Ketone can not
- don't use $KMnO_4/Mg$ because it also oxidised alkanes

a) Firling's solution (A + B)

obs: Red ppt.

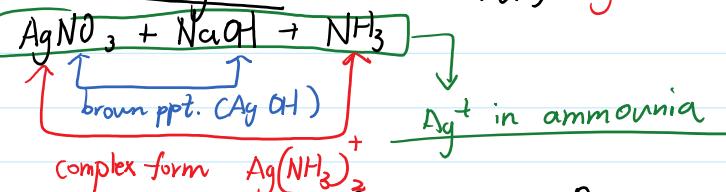


Organic product: $R-COO^-$ base of carboxylic acid

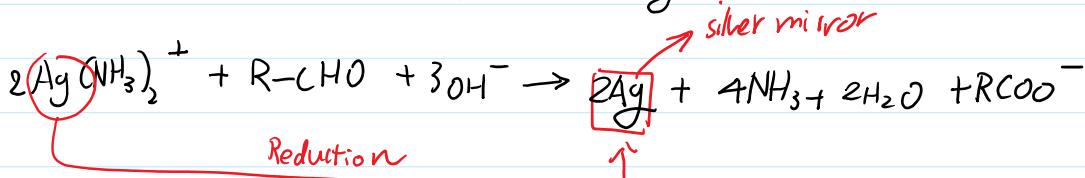


No ppt. because solution B prevent complex form.

b) Tollen's reagent (silver mirror) 4g stuck on the wall

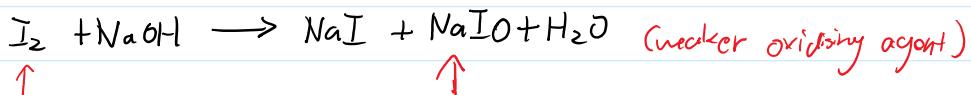


Organic product: $R-C\overset{\text{O}}{||}O^- / R-C\overset{\text{O}}{||}OAg$



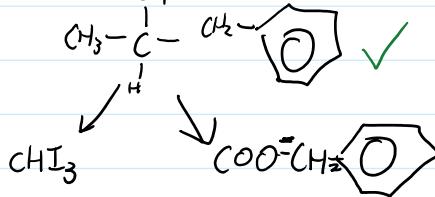
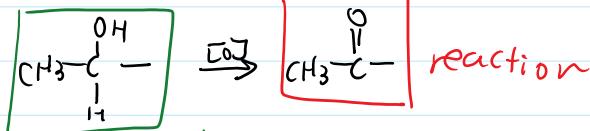
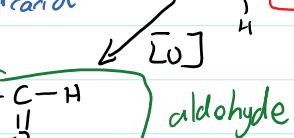
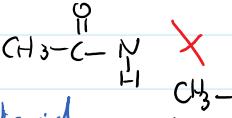
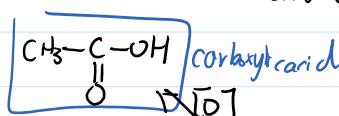
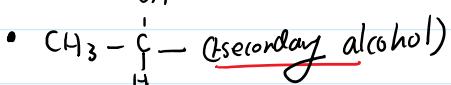
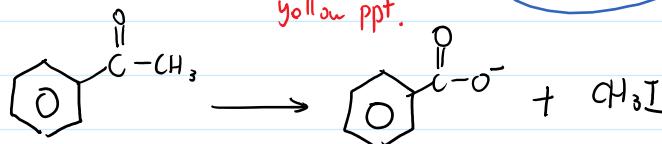
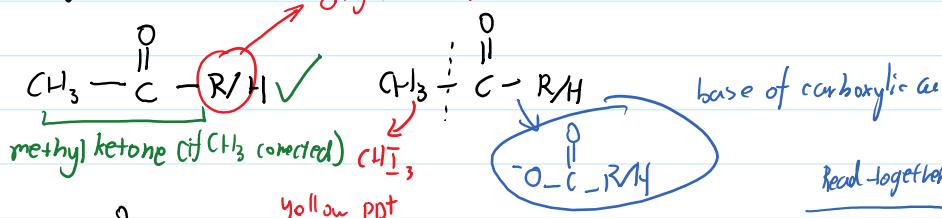
3. Iodoform test (CHI_3)

Reagents: $I_2(aq) + NaOH$ Strong base [alkaline I_2 solution]



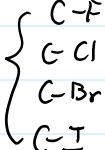
observation: yellow ppt.

Test for: only to C/H!

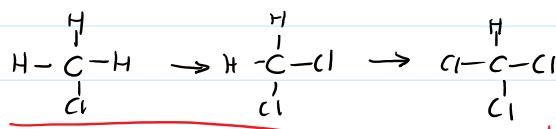
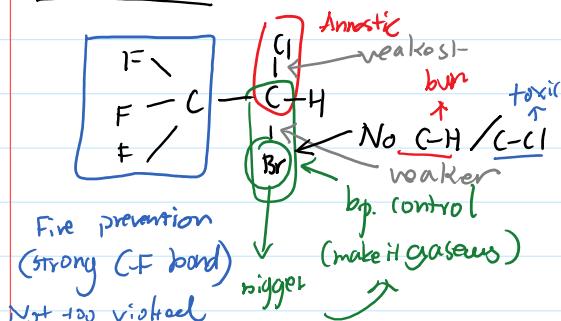


Halogenoalkane

Contain: $C-X$



Halothane \rightarrow anaesthetic used

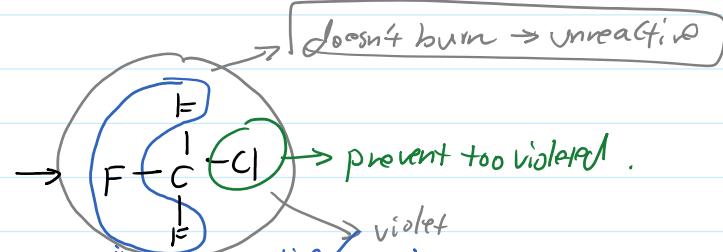
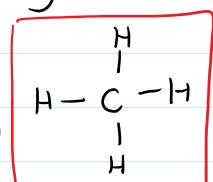


toxic

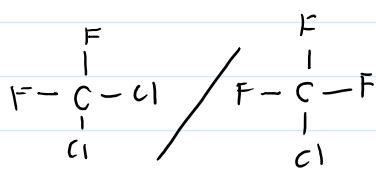
chaotic

CFC (chlorofluorocarbon)

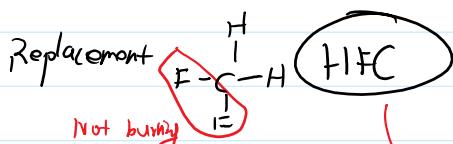
- Refrigerators
- Aerosol propellant
- Solvent
- Fire extinguisher



- fluorine  $\text{H}-\text{C}-\text{F}$ \rightarrow $\text{F}-\text{C}-\text{F}$ - **prevents fluorination**
 - Solvent
 - five extinguishers



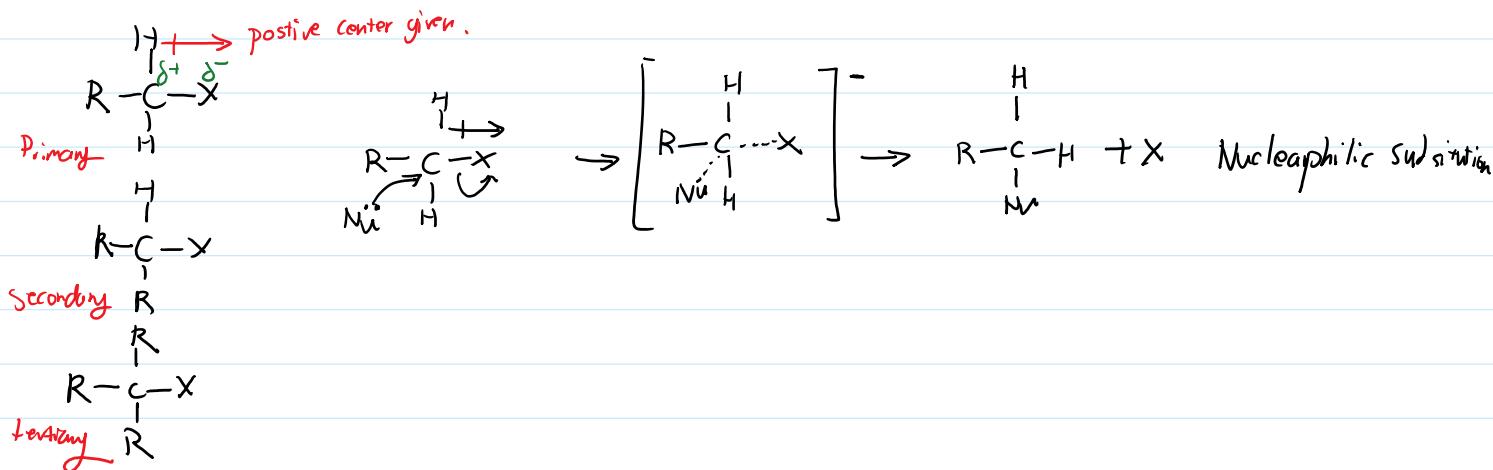
- unreactive → doesn't decompose
- not flammable
- volatile → goes to upper



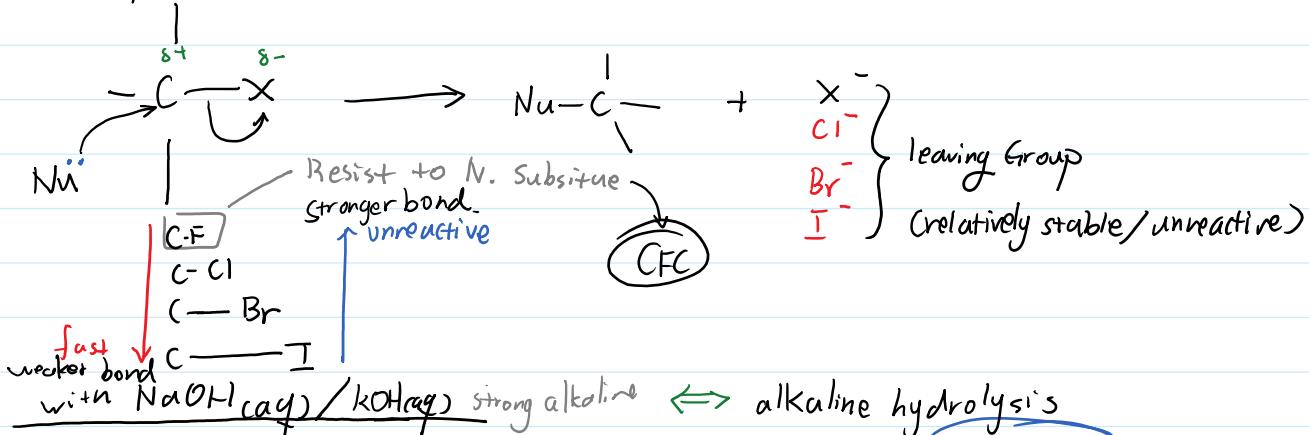
$$\begin{array}{l}
 \dot{O}_1 + O_3 \rightarrow O_2 + \dot{O}Cl \\
 \dot{O}Cl + \dot{O} \rightarrow O_2 + \dot{Cl} \\
 \end{array}
 \quad
 \left. \begin{array}{l}
 O_3 \rightarrow \dot{O} \rightarrow 2O_2 \\
 \dot{Cl} \text{ act as catalyst}
 \end{array} \right\}$$

more problems \Rightarrow green house gas $3000 \times CO_2$

Reactions



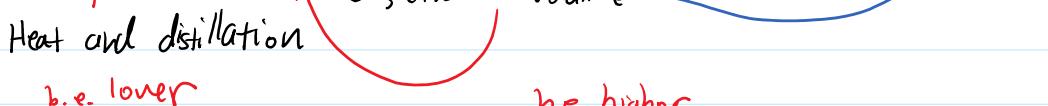
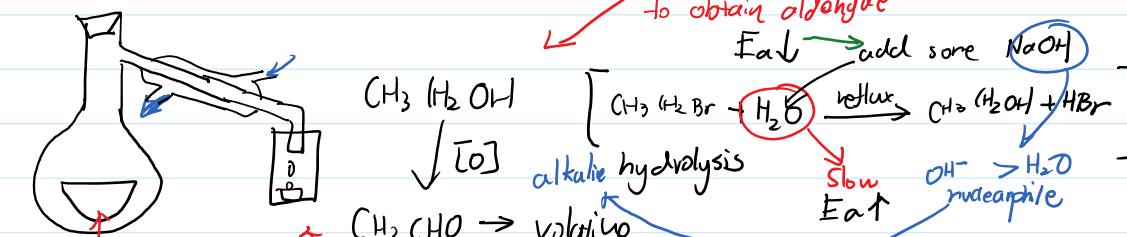
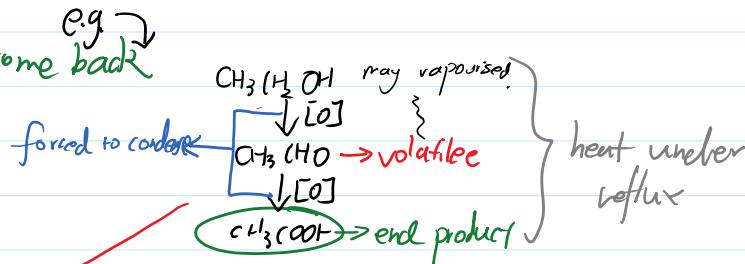
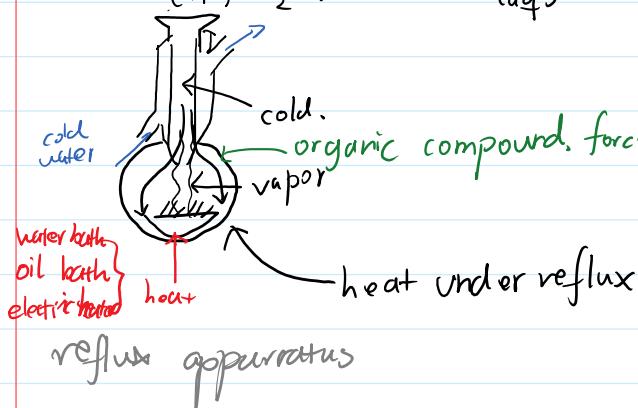
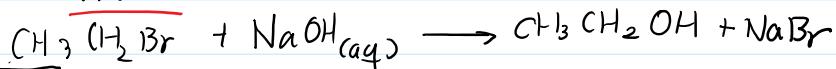
Nucleophilic Substitution



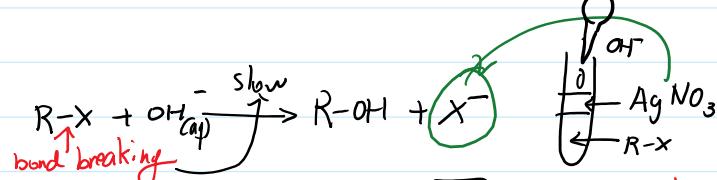
Reagent: $\text{NaOH}_{(\text{aq})}$ or $\text{KOH}_{(\text{aq})}$ $\longrightarrow \text{OH}^{-}_{(\text{aq})}$ Nucleophile

Condition: aqueous, heat under reflux

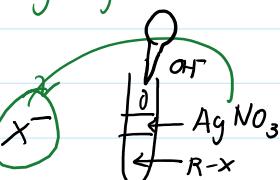
Product: Alcohol

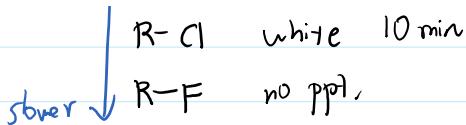


	R-I	R-Br	R-Cl	R-F
faster	yellow	cream	white	no ppt.
	immediately	2 min	10 min	



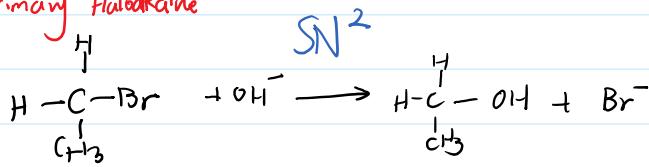
stop warm \square wait ppt.





Mechanism N. sub \rightleftharpoons SN

primary Haloalkane



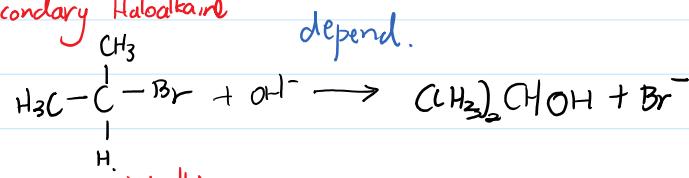
* 1 step mechanism

* spontaneous loss of X^- and gain of OH^-

* transition state

* No carbocation form (too unstable to form)

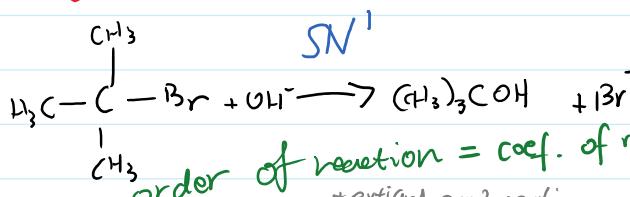
secondary Haloalkane



blury because both exists

- SN^1 (steric hindrance)
- SN^2 (secondary carbocation)

tertiary Haloalkane

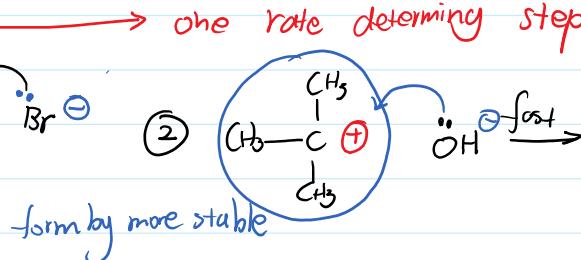
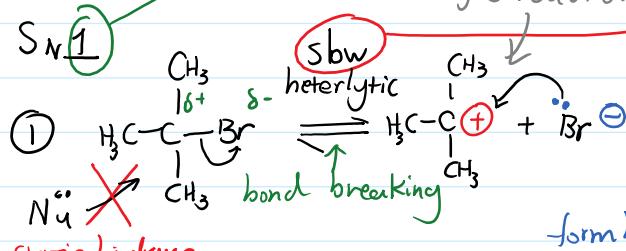


* 2 step mechanism

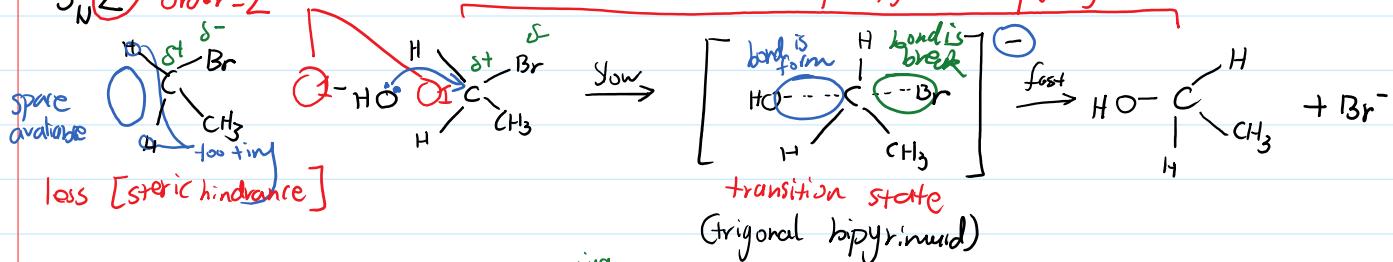
* No intermediate

amount of molecules depends on this step

change of rate
Only at that step



$\text{S}_{\text{N}}2$ Order = 2

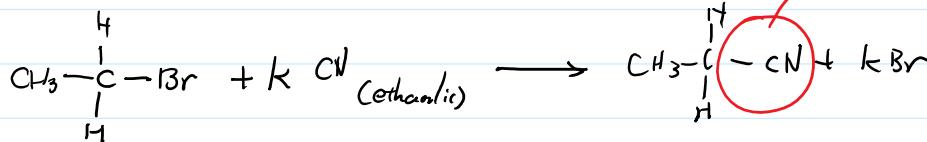


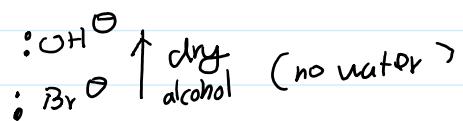
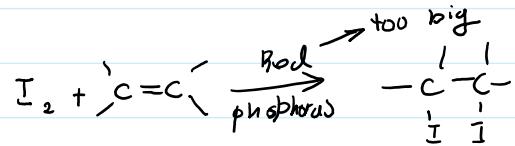
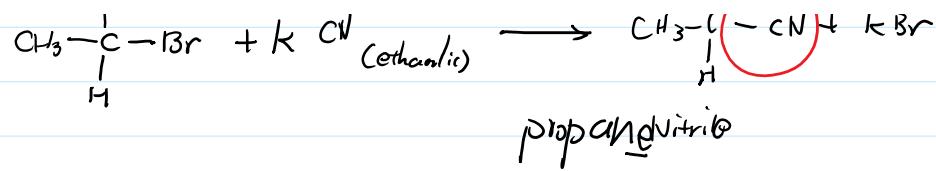
Reaction with Cyanide ions

Reagent KCN / NaCN (ethanolic) $\xrightarrow{\text{H}_2\text{O}}$ form alkaine

Condition: In ethanol + reflux

Product: Nitrile.

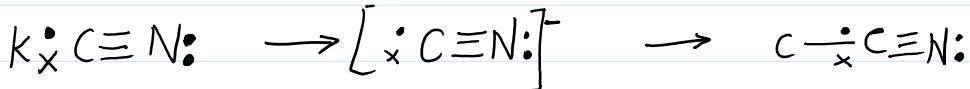




Mechanism is the same with OH^-

could be $\text{S}_{\text{N}}1$ or $\text{S}_{\text{N}}2$.

Important because can use to increase length of carbon chain



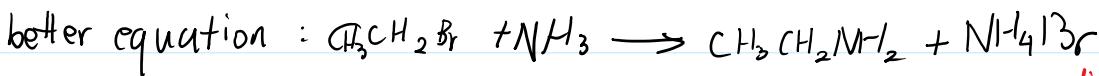
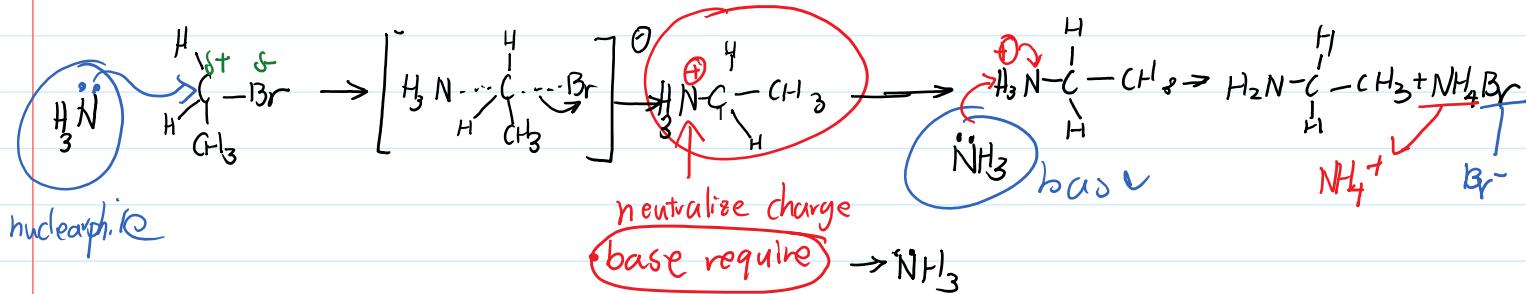
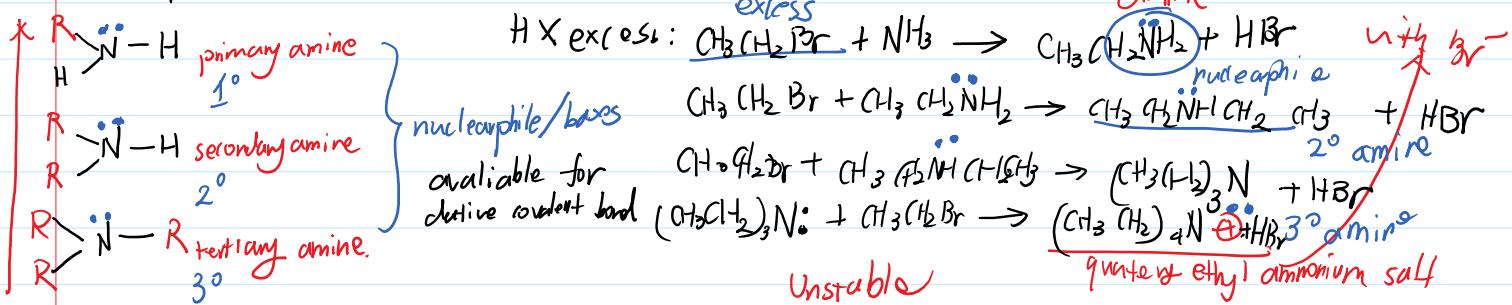
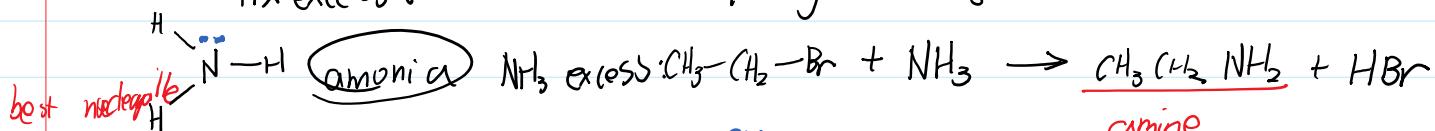
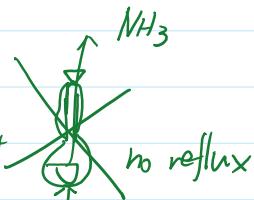
Reaction with Ammonia

Reagent: NH_3 (ethanoic / alcoholic) heat required, but ammonia goes out

Condition: in ethanol, heat in a closed tube

Product: NH_3 excess: 1° amine produce pure

HX excess: 2° or 3° amine or 4° ethyl ammonium salt

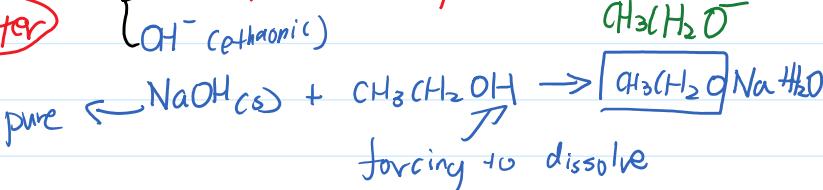
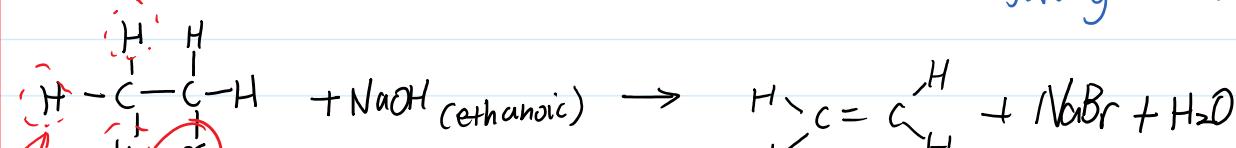


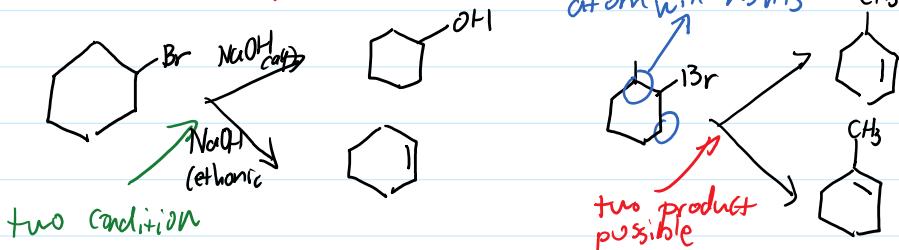
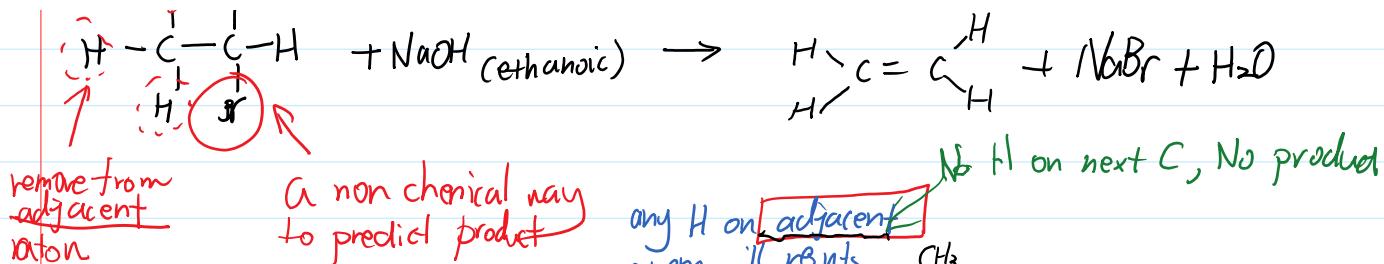
Elimination with Alkaline

Reagent: NaOH (ethanoic) OH^- aq = nucleophile ion dipole

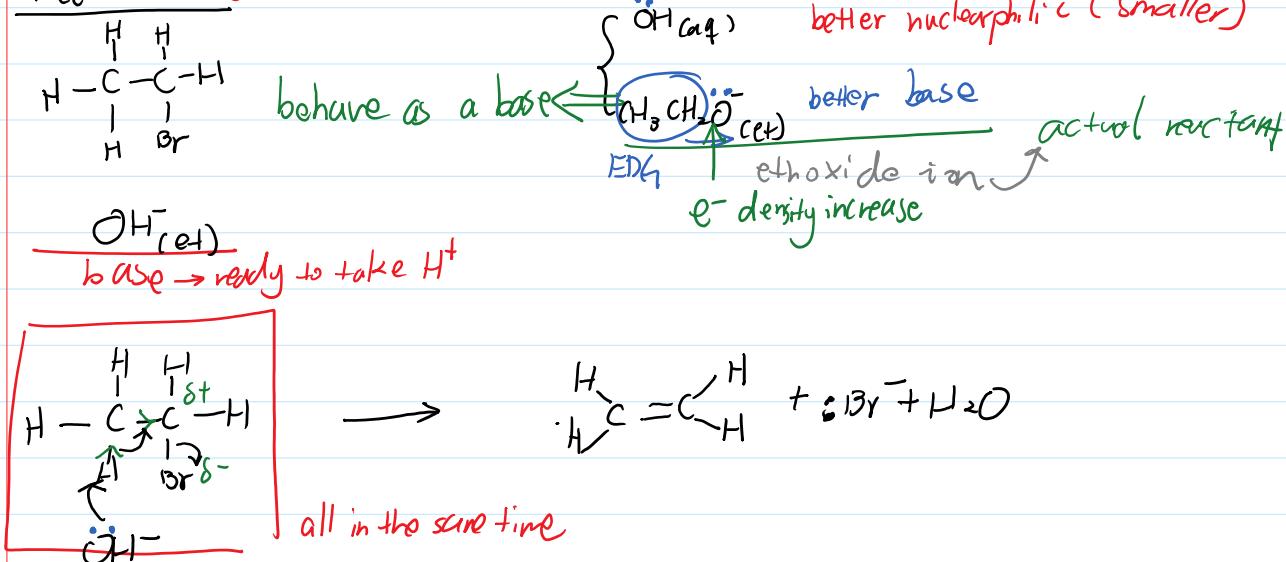
Condition: in Ethanol and reflux

Product:





Mechanism (x)

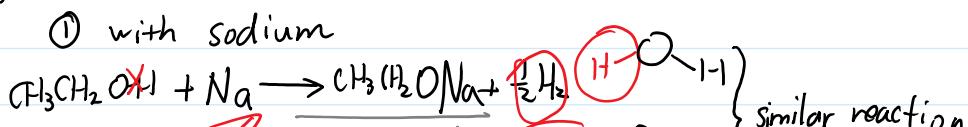
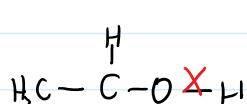


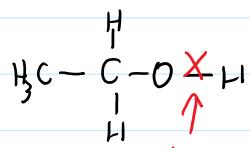
Alcohols

$-\text{OH} \rightarrow$ compounds containing an $-\text{OH}$ (hydroxyl group)
 $\text{C}_n\text{H}_{2n+2}\text{O} / \text{C}_n\text{H}_{2n+1}\text{OH}^-$
 1° alcohol / 2° alcohol / 3° alcohol
 \rightarrow form $-\text{OH}$ bond — lower alcohols [1, 2, 3] are completely soluble
 as $[\text{H} \cdots \text{H}] \Rightarrow$ length increase, long non-polar chain repel
 Solubility decrease

\rightarrow It can dissolve both polar and non-polar reaction

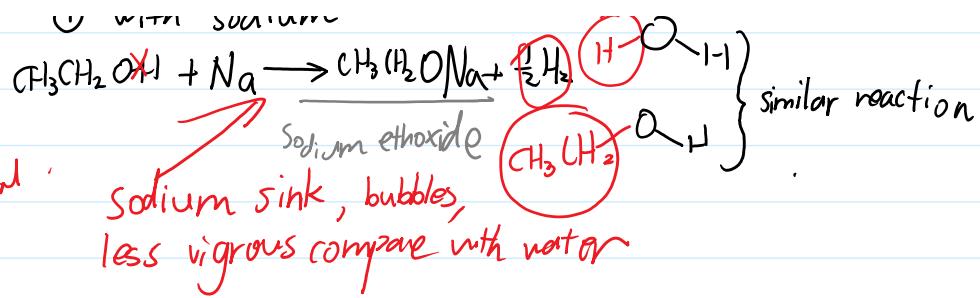
Reactions involving cleavage of $\text{O}-\text{H}$ bond





cleavage of OH bond

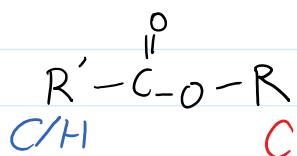
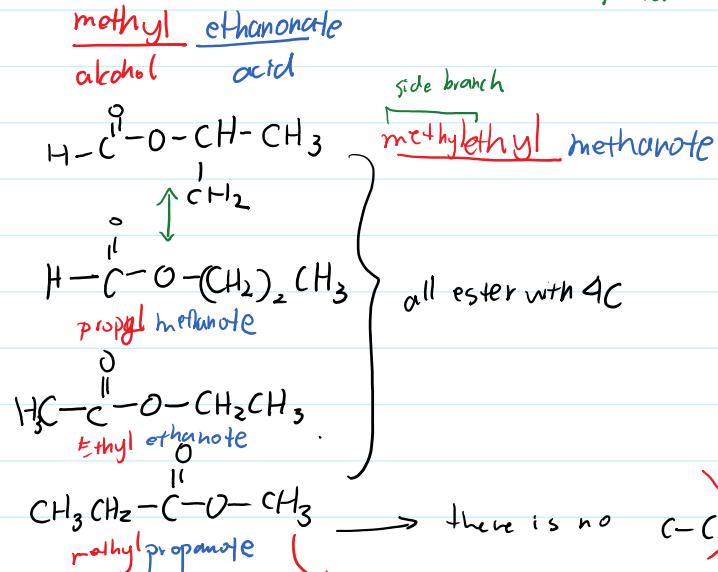
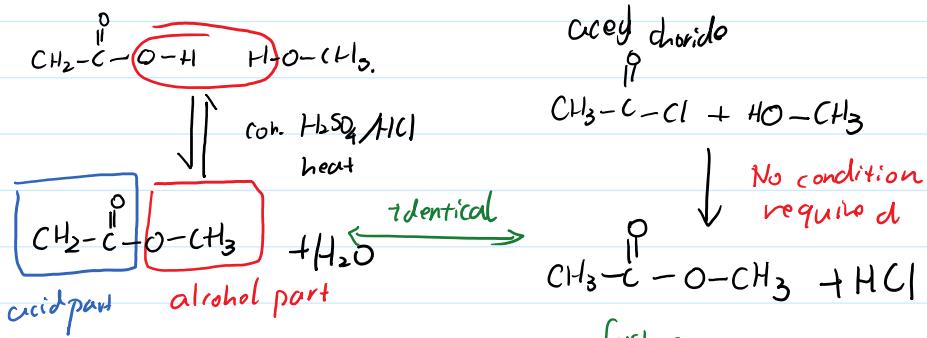
Redox reaction



② Esterification

carboxylic + alcohol \rightarrow ester + water (condensation)

condition: heat + few drops of catalyst $\left\{ \begin{array}{l} \text{H}_2\text{SO}_4 \\ \text{HCl} \end{array} \right.$



Condensation → [Nucleophilic addition and elimination]

Reactions involving cleavage of C-O bond

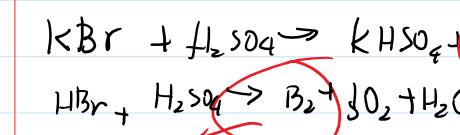
Reaction with halide ions

Nucleophilic Substitution

Reagent: $\text{KX} (\text{KBr}_{(s)})$ con. H_2S

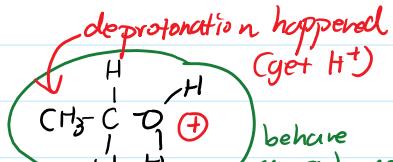
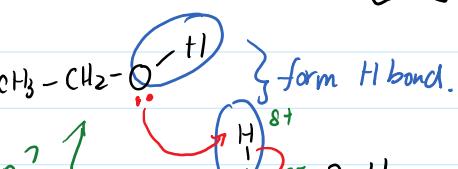
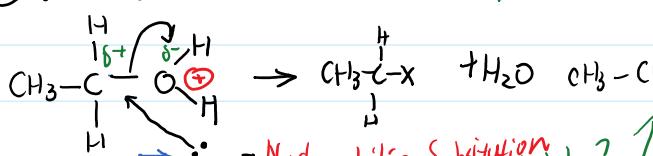
Condition: reflux

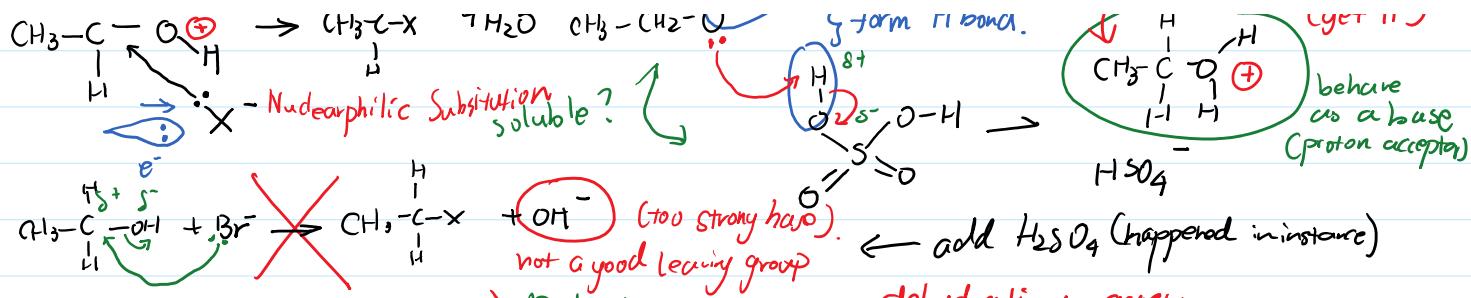
Product: Haloalkane (bromo alkane)



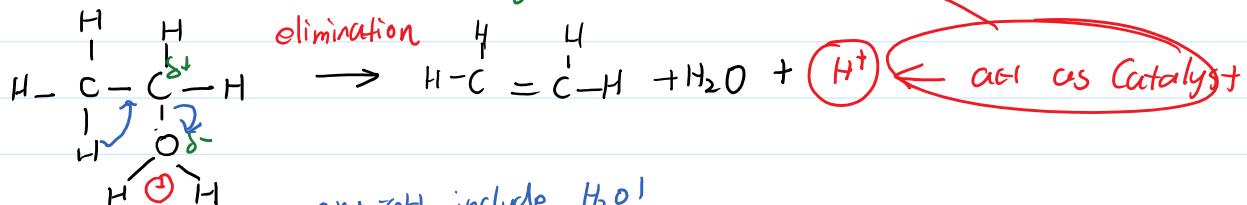
not enough conc. of nucleophile $\xrightarrow{\text{no } \text{H}_2\text{SO}_4}$ Lodging
 (i) X^- (Kor., NaCl, KI, etc.) Deprotonation

① if X^- (Ker., NaCl, KI, etc.) Deprotonation





② If no X^- (no nucleophilic) Dehydration



Substitutions

a) $\text{PCl}_5 \rightarrow \text{[}-\text{OH} \rightarrow \text{[}-\text{Cl}]$
Reagent: PCl_5
Condition: nothing

Product:



b) with P_2I_3 / mixture of red phosphorus and Iodine

Reagent: P_2I_3
Condition: Reflux

Product: Iodidealkane

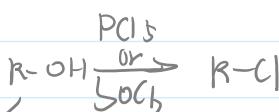
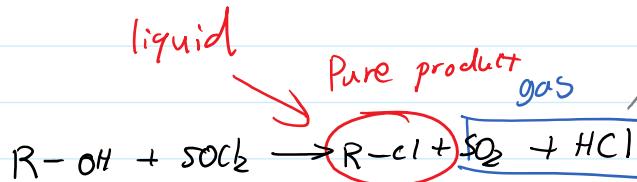


c) SOCl_2

Reagent: SOCl_2

Condition: nothing

Product



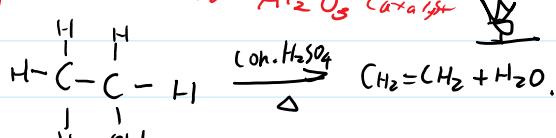
Carbohydrates

1. Dehydration of alcohol to alkene

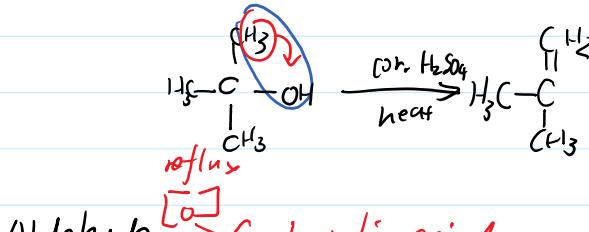
Reagent: $\text{Conc. H}_2\text{SO}_4$

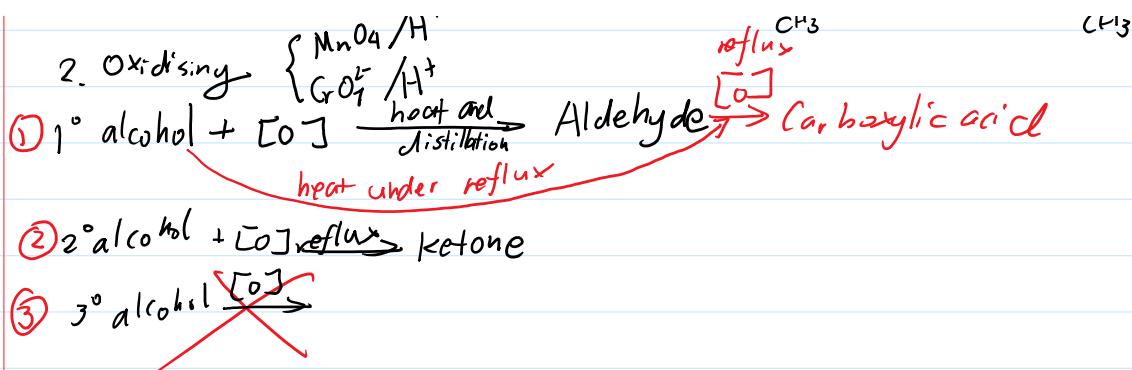
Con. heat to 170°C

Product: alkene



2. Oxidising $\left\{ \begin{array}{l} \text{MnO}_4^- / \text{H}^+ \\ \text{CrO}_4^{2-} / \text{H}^+ \end{array} \right.$



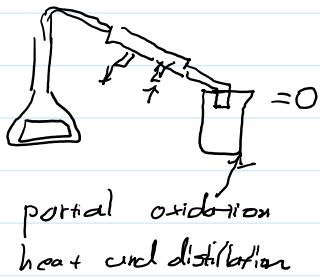


Alcohol

Oxidation:

- Heat under reflux
- Heat and distillation

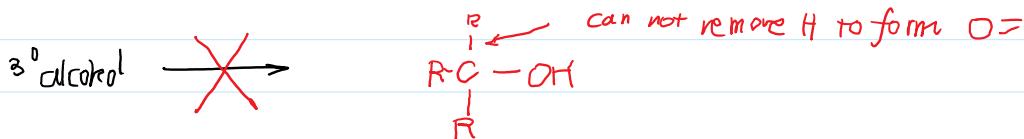
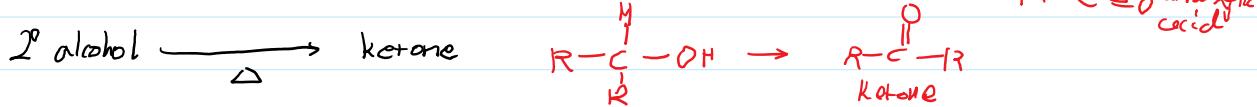
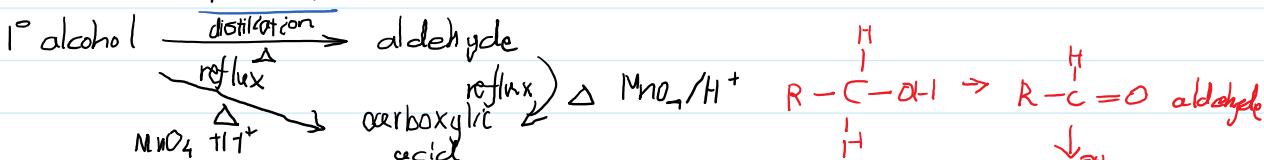
complete Oxidation



Observation:

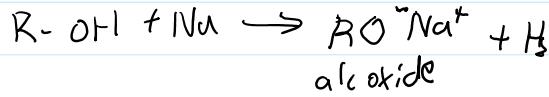
- $K_2Cr_2O_7$: orange \rightarrow green
- $KMnO_4$: purple \rightarrow colorless

H_2/MnO_4 (condition) { reagent apparatus condition}



Unless stronger $[O]$ and breaks into CO_2 in 'Ultimate' oxidation (burning)

Application:



- fuel
- solvent

Carbonyl

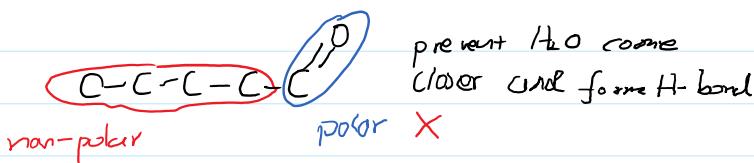
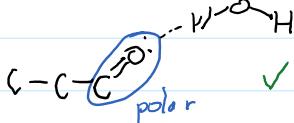
carbonyl = aldehydes + Ketone or middle

general formula: $\text{C}_n\text{H}_{2n}\text{O}$

physical properties

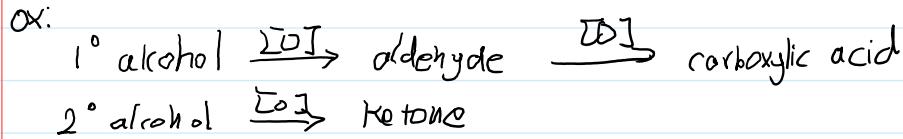
most of them are liquid (except methanol is gas)

methanol / ethanol / propanol can dissolve in water



Reactions

1. Redox:



RE:

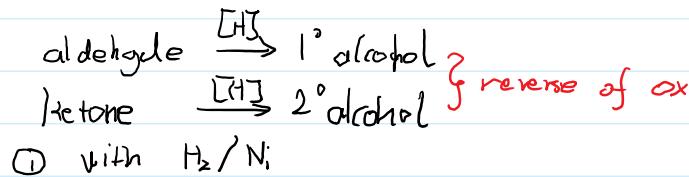
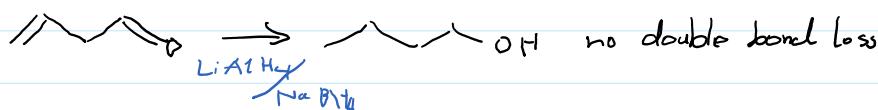
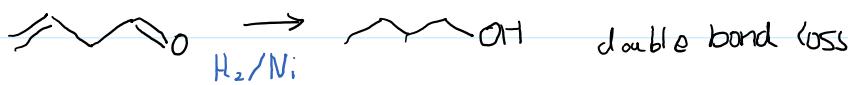
reducing agent:

- H_2/Ni
- $NaBH_4$ [specific to aldehyde & ketone]
sodium boron hydride
- $LiAlH_4$ [very strong, even reduces carboxylic acid/ester]

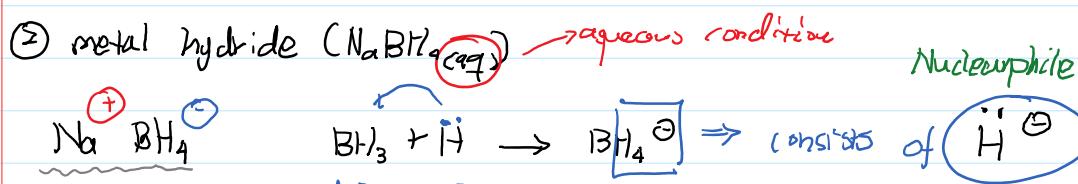
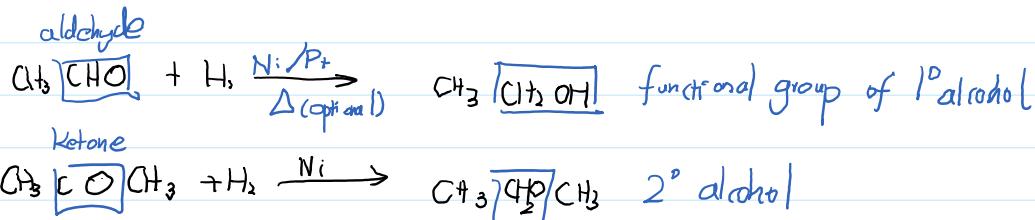
Strength

H_2/Ni (hot)
H_2/Ni (cold)
$LiAlH_4$
$NaBH_4$

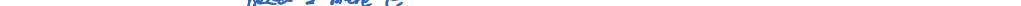
$C=C$ ✓
 $\} \text{Nb } C=L \times$



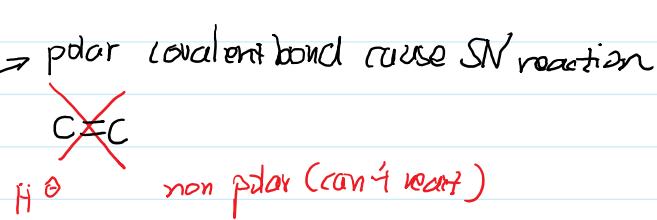
① with H_2/Ni :

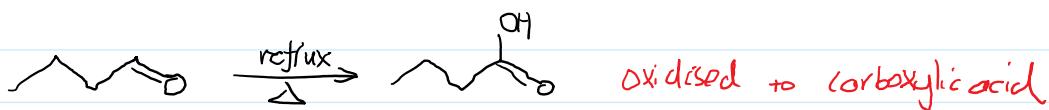
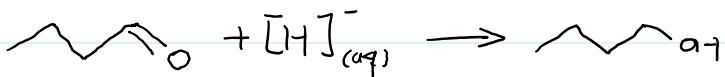
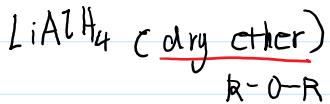


selective reducing agent for carbonyl

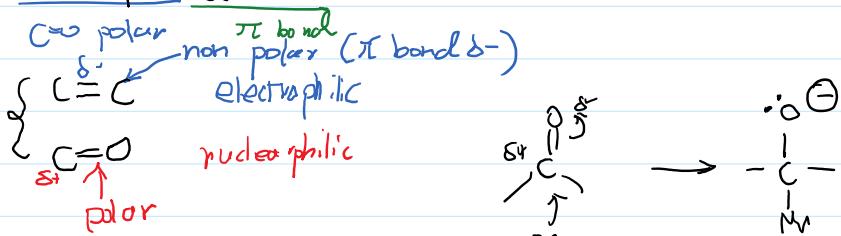


need 2 more e^-





2. Nuclearophilic addition



addition of HCN highly poisonous
 to add one C more

reagent: HCN reagent this is a weaker nucleophile, therefore not attacking H^{\oplus}

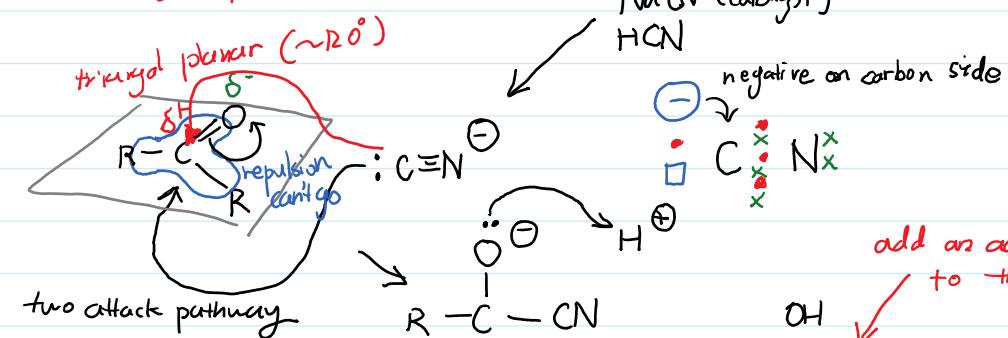
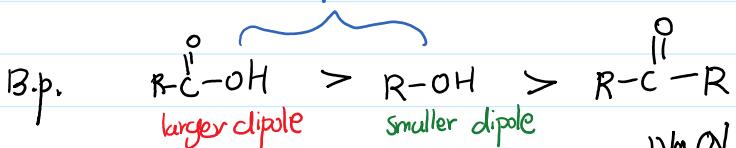
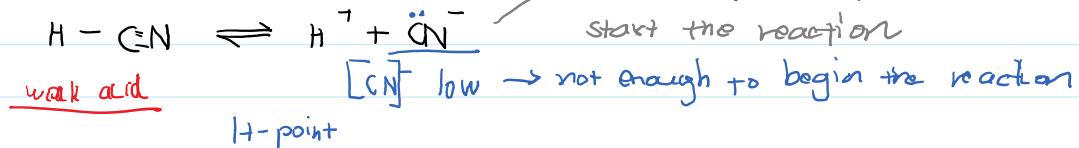
condition: NaCN or KCN or NaOH or KOH (catch all H^{\oplus})

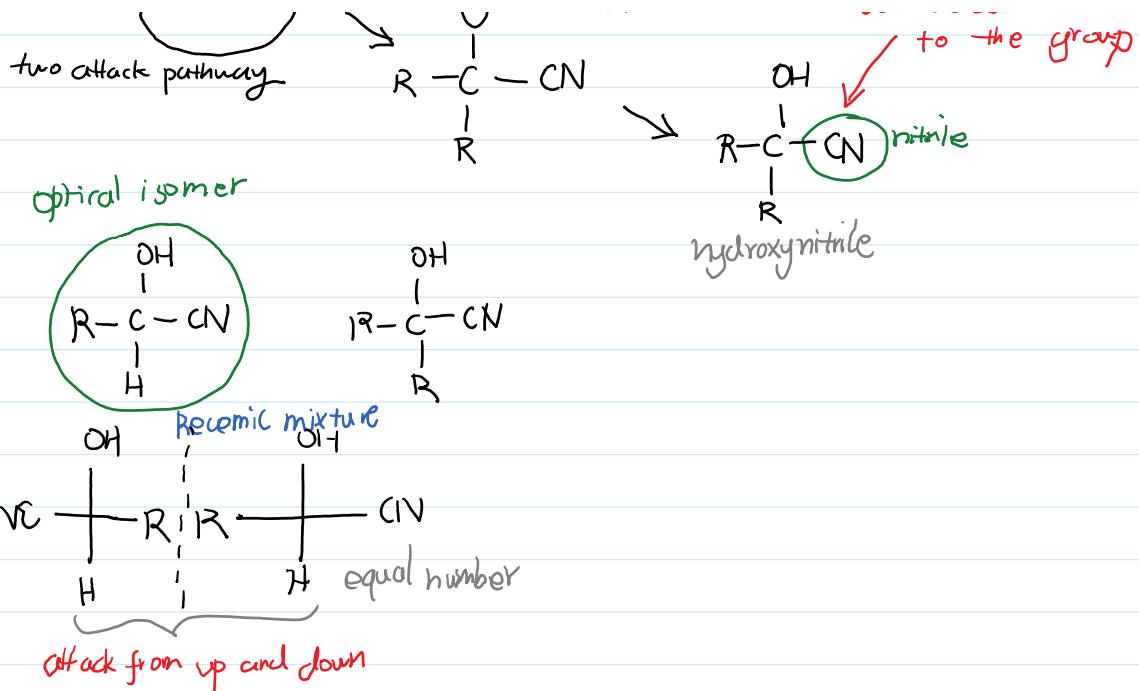
product:

ionic \rightarrow complete ionized

KCN & NaCN need to

start the reaction



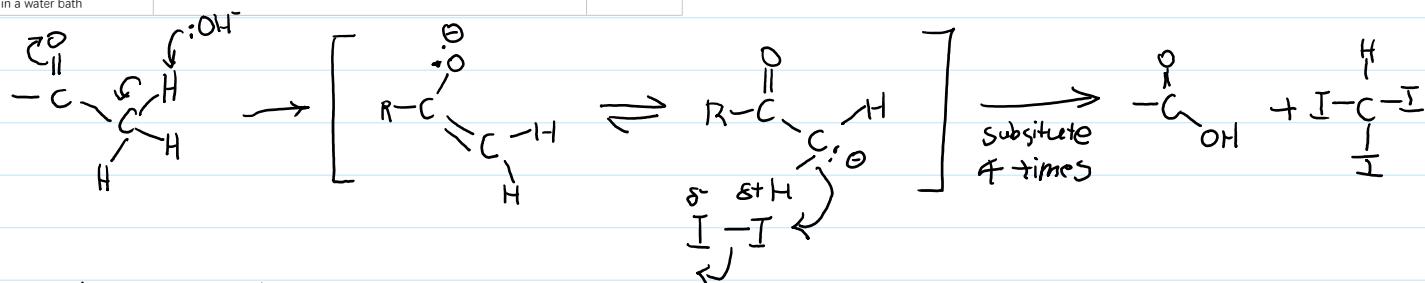
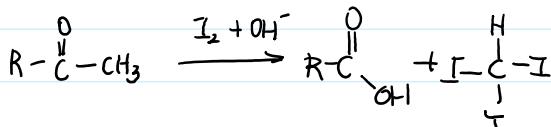


Tests

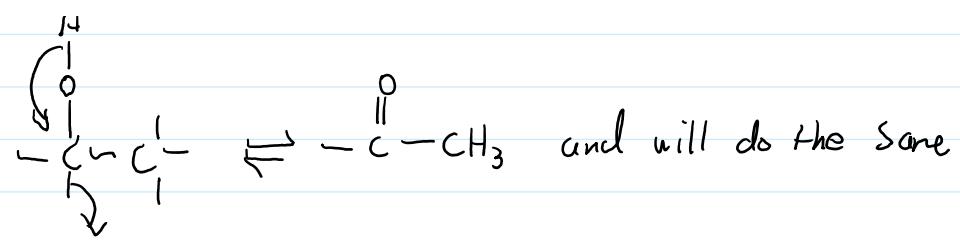
cannot be oxidised

Test	Aldehyde(-al)RCH=O	Ketone(-one) RCR=O
2,4-DNPH(Brady's Reagent) To 5 drops of a carbonyl compound, add 2 or 3 drops of Brady's reagent. Waiting Time: Roughly few minute	Orange ppt. Notice: this experiment has the distinguish effect for the aldehyde and ketone only!	Orange ppt.
Tollens's Reagent Add one drop of sodium hydroxide solution to 1 cm ³ of silver nitrate solution in a test tube. Add aqueous ammonia dropwise until the precipitate dissolves. Add 5 drops of a carbonyl compound and warm in a water bath if necessary Waiting Time: Roughly 10-15 minute /Benedict/Sandels	Silver mirror formed Notice: 1. if you do not dissolve the Ag(OH) previously by drop by drop ammonia, the test will be useless 2. the overall effect is silver mirror, but you will be expected from black to brown (because of Ag+ reappear) to silver. MS usually thinks they are ok.	No reaction Carbonyl act as reducing agent → oxidised to carboxylic acid
Fehling's Reagent Mix equal amounts of Fehling's solution and add 5 drops of carbonyl compound. Warm the mixture gently in a water bath Waiting Time: Roughly few minute	Turn to red/orange color Notice: it is the same color as you will see in Benedict's solution. Refer to Biology Manual if you don't get it	Remains blue
Acidified Potassium manganate To 5 drops of a carbonyl compound, add 10 drops of sulfuric acid and 5 drops of potassium manganate(VII) and warm in a water bath Waiting Time: Roughly few minute	Decolorized Notice: this also works for alkene and alcohol, so do not assume it must be aldehyde	No effect

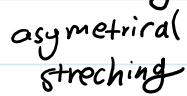
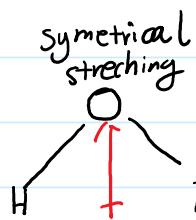
Test	With CH ₃ CO-	Without CH ₃ CO-
Iodine and aqueous sodium hydroxide (Iodoform Test) To 5 drops of a carbonyl compound, add 10 drops of 4 mol dm ⁻³ NaOH(aq). Then add 5 drops of aqueous iodine and warm in a water bath	Yellow ppt. formed Notice: this sometimes doesn't get very accurate, but if the yellow or cream color appear, you should write the yellow ppt. formed on it	No reaction



alcohol (ethanol) can do it



IR absorbance is caused by dipole

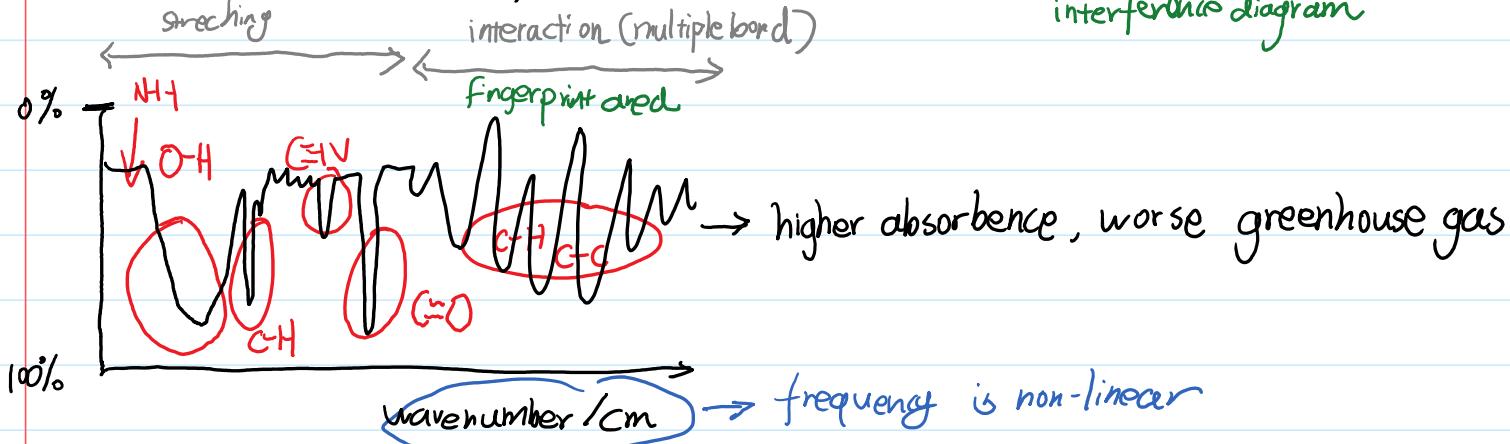
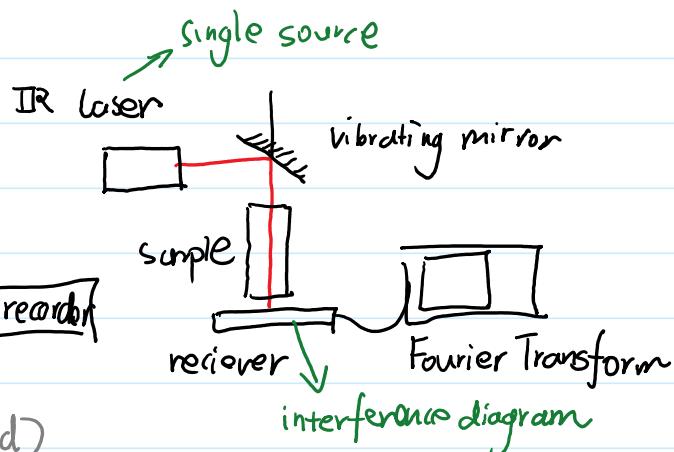
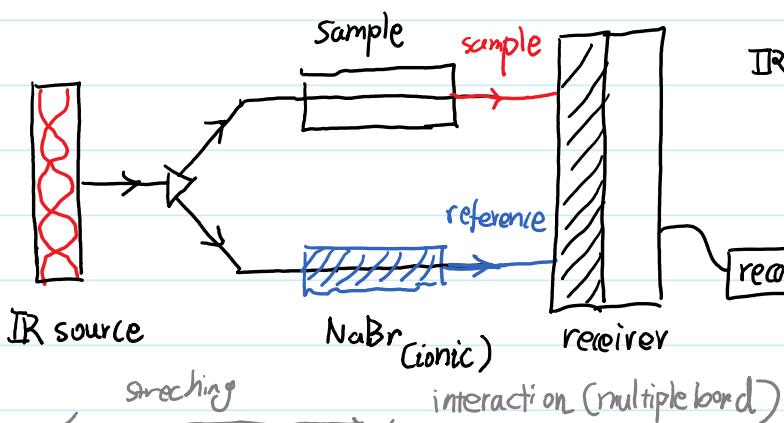
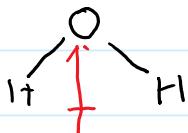


spring model of the bond

bending

- higher strength, higher f

- larger mass, lower f



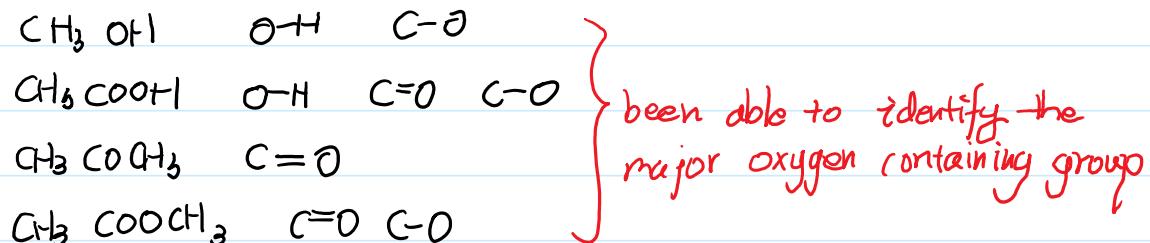
we don't have test otherwise for:



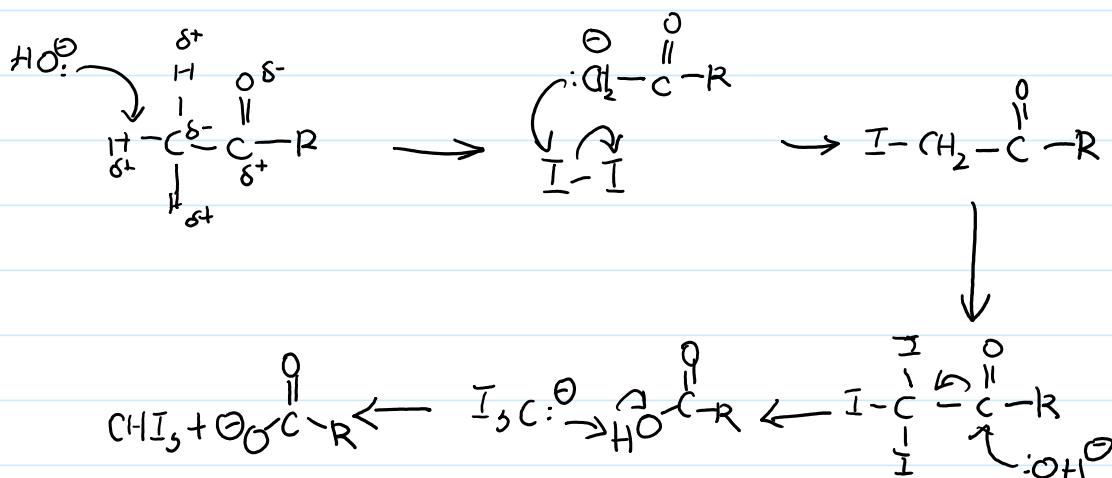
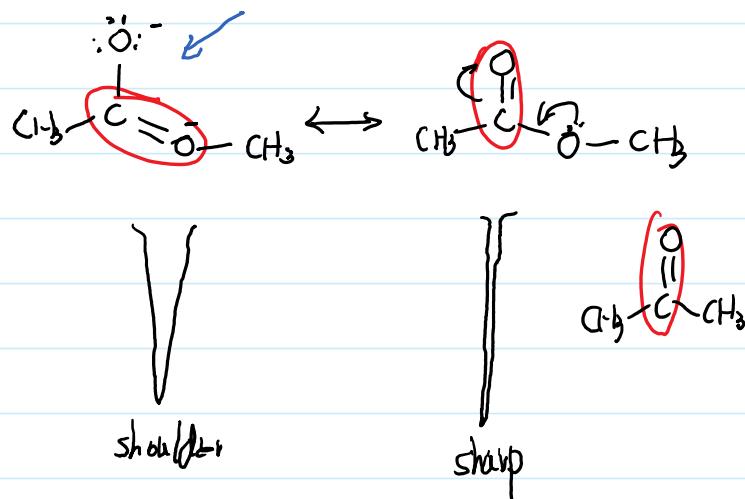
→ It's not specific

do a test for nitrogen group and check the nitrogen

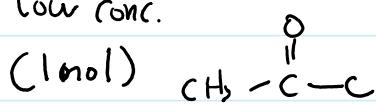
→ do *altest* for nitrogen group and check the nitrogen



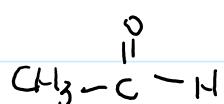
more when energy added



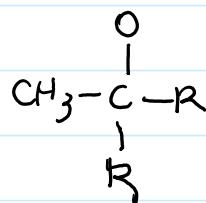
low conc.



high conc.
(6 mol)

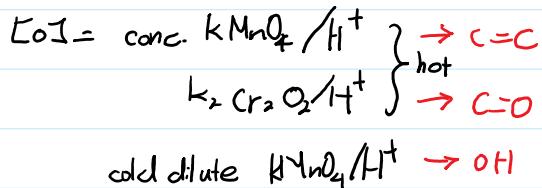
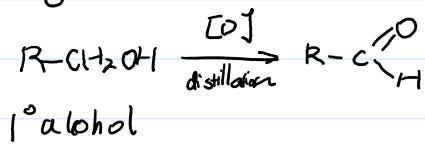


$$\text{CH}_3\text{CH}_2\text{OH}$$

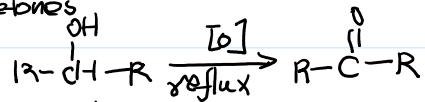


Synthesis

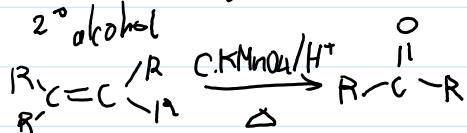
aldehydes



ketones



2° alcohol

Oxidation

aldehydes



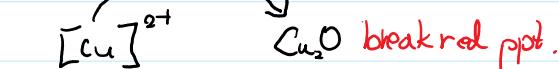
ketones

Toln's

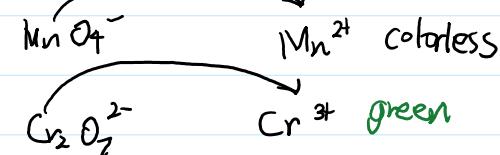


silver mirror

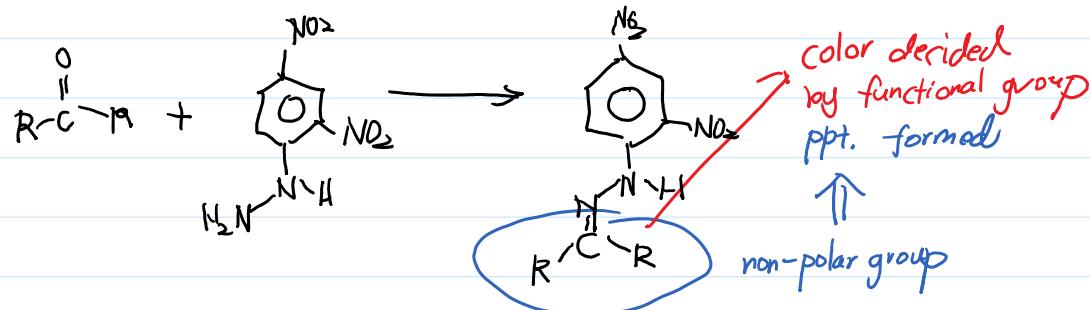
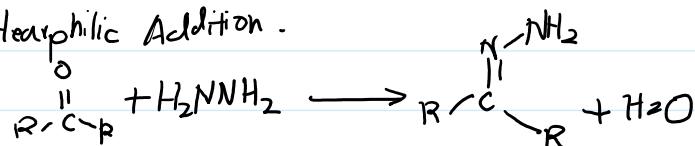
Ferling's



break red ppt.

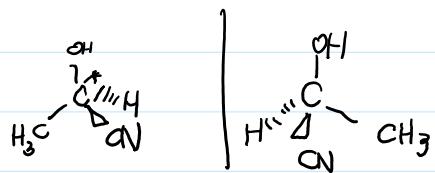
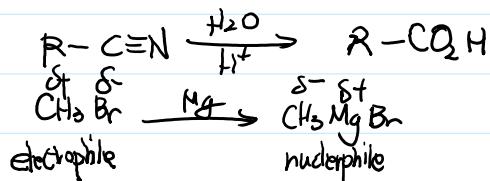
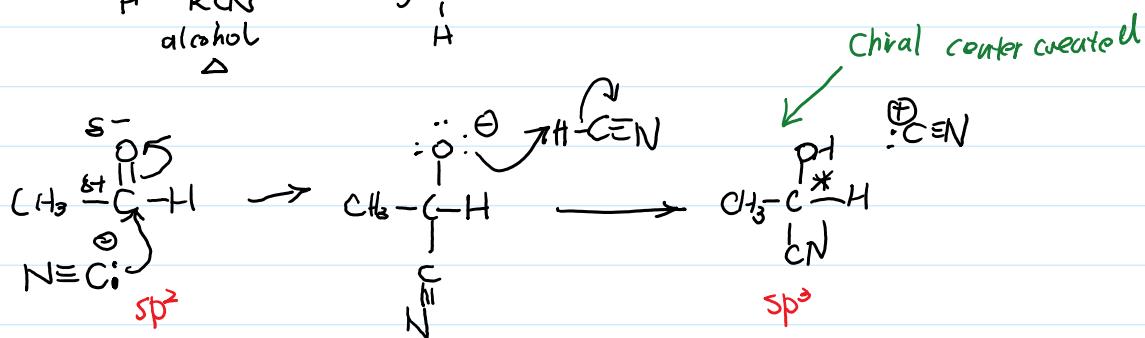
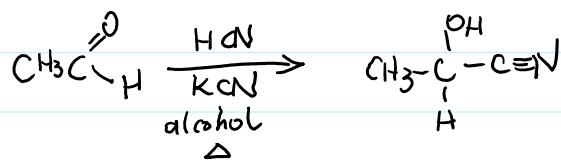


Nucleophilic Addition.

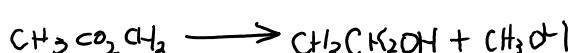
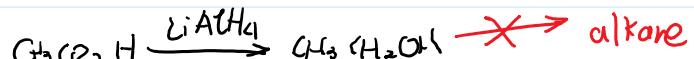
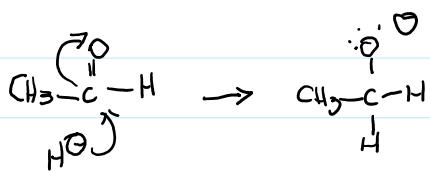
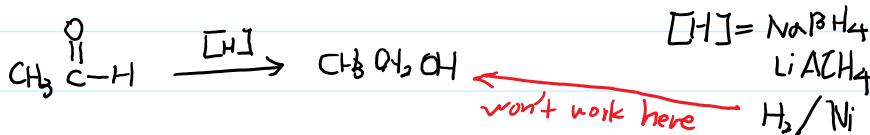


Nucleophilic Addition

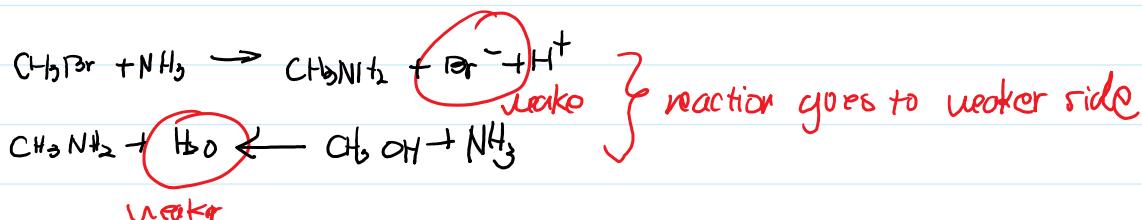
Nucleophilic Addition

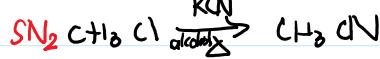
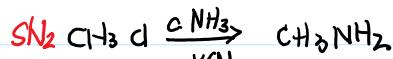
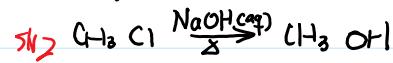
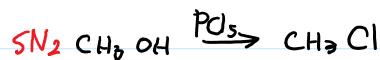


Reduction



can not react with $\text{C}=\text{C}$ bond (N. addition)





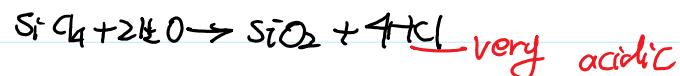
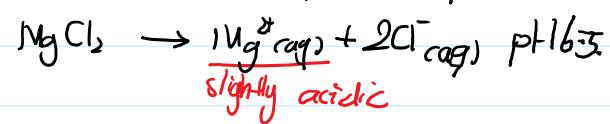
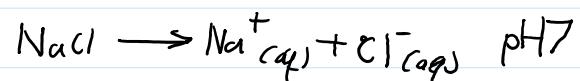
electrophilic add.



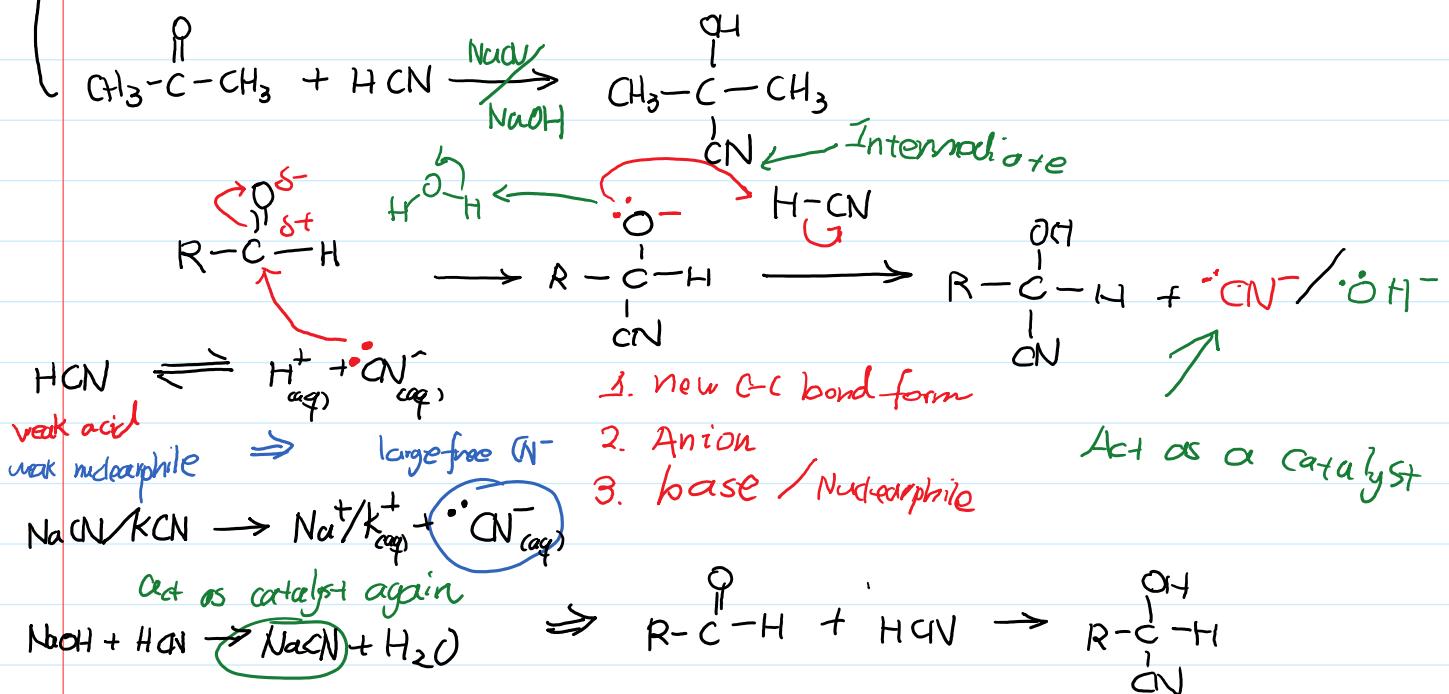
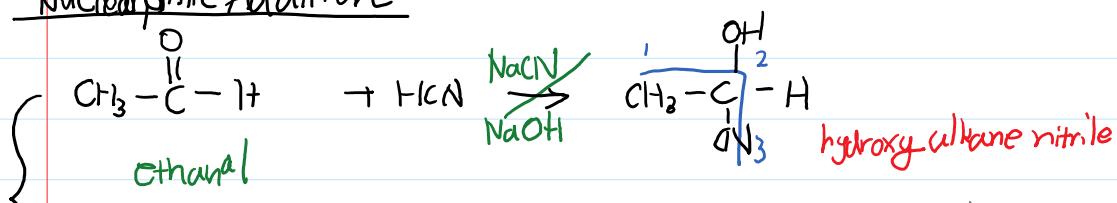
nucleophilic add.



SN.

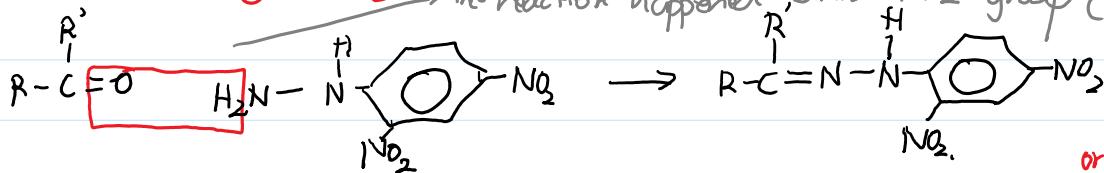


Nucleophilic Addition



2,4-DNPH [Any Carbonyl]

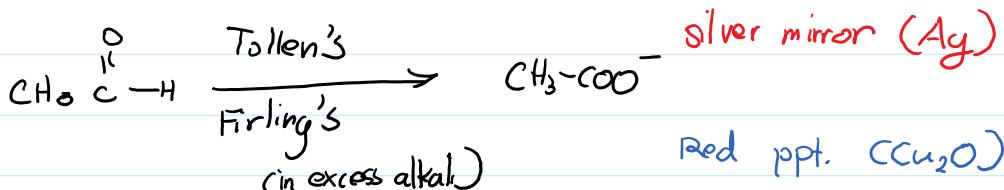
→ the reaction happened with $\text{R}-\text{NH}_2$ group (condensation)



orange ppt.

Orange Crystal \leftarrow heat

1. identify carbonyl (ketone/aldehyde)
 2. condensation (addition and elimination)
 3. measure m.p. } → identify the original carbonyl
specific }

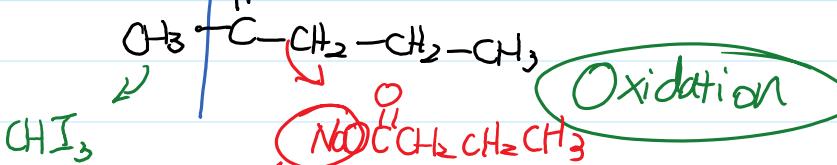


Iodiform (I_2 / NaOH brnq) \rightarrow alkaline Iodine solution

1. $\text{CH}_3 - \overset{\text{O}}{\underset{||}{\text{C}}} - (\text{methyl ketone}) \quad \}$

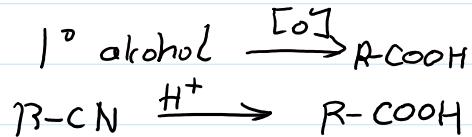
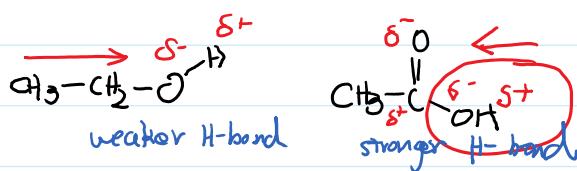
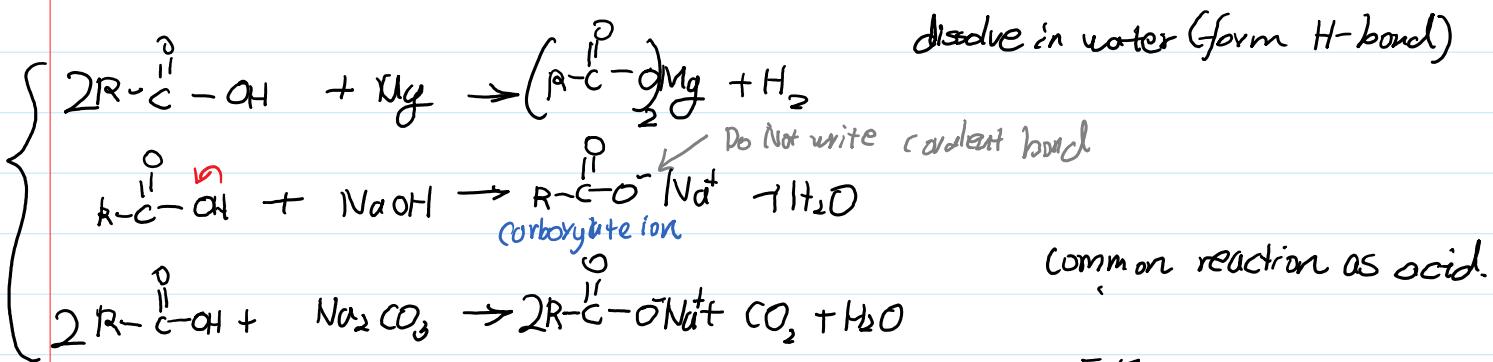
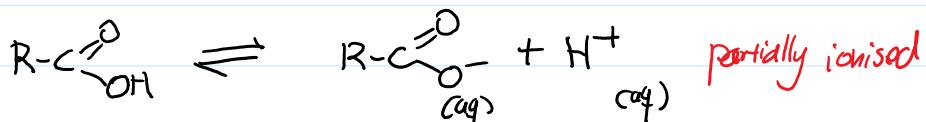
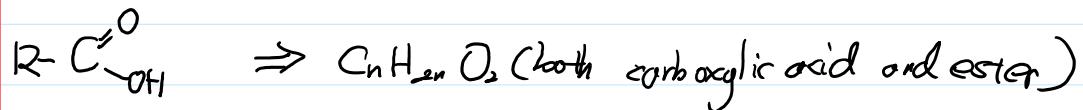
1. $\text{CH}_3-\overset{\text{O}}{\underset{\text{OH}}{\text{C}}}-$ (methyl ketone)
2. $\text{CH}_3-\overset{\text{O}}{\underset{\text{Mg}}{\text{C}}}-$ $\xrightarrow{[\text{O}^-]}$ $\text{CH}_3-\overset{\text{O}}{\underset{\text{C}}{\text{C}}}-$
3. $\text{CH}_3-\overset{\text{O}}{\underset{\text{C}}{\text{C}}}-\text{H}$
4. $\text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_3-\overset{\text{O}}{\underset{\text{C}}{\text{C}}}-$

yellow ppt. (CHI_3) + sodium salt of carboxyl acid

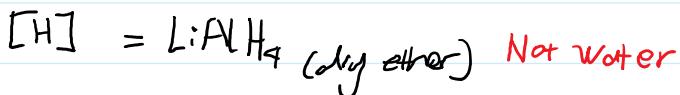


add NaO to original group.

Carboxylic Acid



Reduction of carboxylic acid.



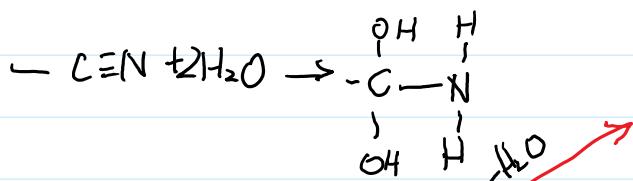
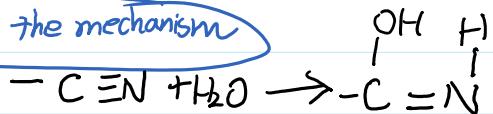
Hydrolysis of Nitrite

acid hydrolysis of nitrile

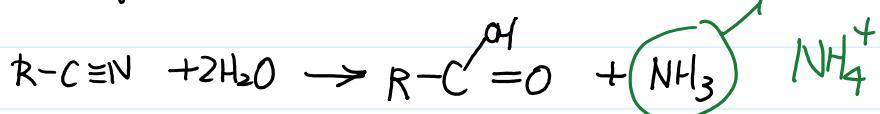
Reagent: $\text{H}^+ \text{cay}$)

condition: heat

Not the mechanism



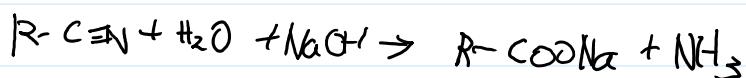
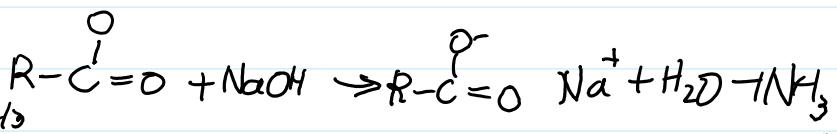
Overall Equation



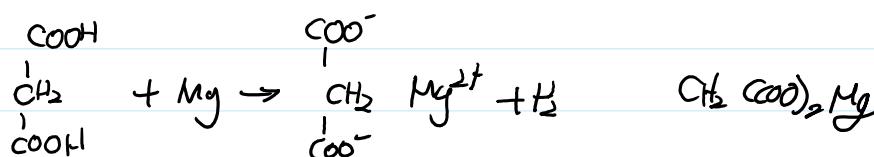
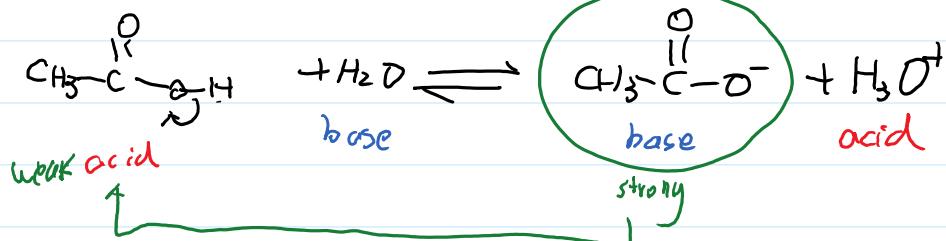
alkali hydrolysis of Nitrile

Condition $\text{NaOH}/\text{bit}^- + \text{heat}$

Product: Salt of carboxylic acid, titrable

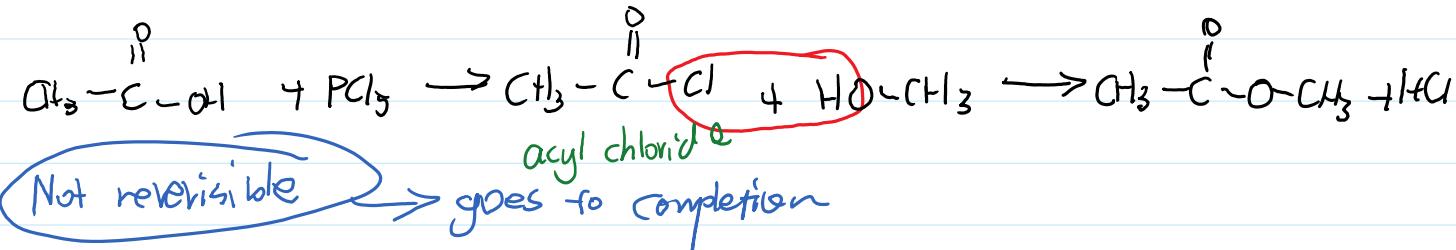
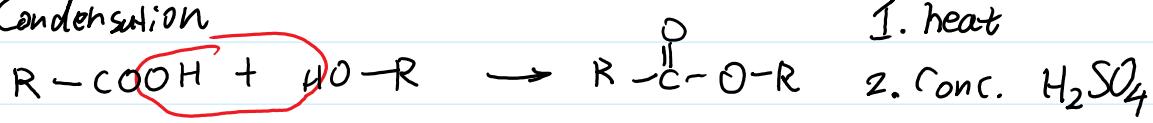


Carboxylic acid

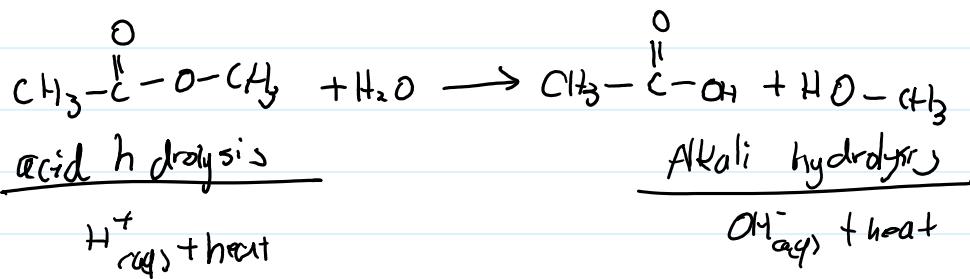




Condensation



Hydrolysis



Products: carboxylic acid + alcohol

COO^-
 \downarrow *oxidation*

Products: $\text{Carbonyl} \text{C} + \text{alcohol}$
esters \rightarrow anti-foul flavours / solvent / perfume oil (insoluble oily liquid)

Wrong Question Review

2017年6月17日 23:19

Moles and Equations

Saturday, August 26, 2017 7:06 PM

Syllabus Content

Atoms, molecules and stoichiometry	Learning Outcomes
1. Relative masses of atoms and molecules	a) define and use the terms <i>relative atomic, isotopic, molecular and formula masses</i> , based on the ^{12}C scale
2. The mole and the Avogadro constant	a) define and use the term <i>mole</i> in terms of the Avogadro constant
3. The determination of relative atomic masses, A	a) analyses mass spectra in terms of isotopic abundances (knowledge of the working of the mass spectrometer is not required) b) calculate the relative atomic mass of an element given the relative abundances of its isotopes, or its mass spectrum
4. The calculation of empirical and molecular formulae	a) define and use the terms <i>empirical</i> and <i>molecular formula</i> b) calculate empirical and molecular formulae, using combustion data or composition by mass
5. Reacting masses and volumes (of solutions and gases)	a) write and construct balanced equations b) perform calculations, including use of the mole concept, involving: (i) reacting masses (from formulae and equations) (ii) volumes of gases (e.g. in the burning of hydrocarbons) (iii) volumes and concentrations of solutions When performing calculations, candidates' answers should reflect the number of significant figures given or asked for in the question. When rounding up or down, candidates should ensure that significant figures are neither lost unnecessarily nor used beyond what is justified (see also Practical Assessment, Paper 3, Display of calculation and reasoning on page 52) c) deduce stoichiometric relationships from calculations such as those in 1.5(b)

Revision Note

- Calculating the chemistry
- Relative atomic mass and relative molecular mass

Atomic Structure

2017年6月18日 23:21

Syllabus Content

Atomic structure	Learning Outcomes
1. Particles in the atom	<p>a) identify and describe protons, neutrons and electrons in terms of their relative charges and relative masses</p> <p>b) deduce the behavior of beams of protons, neutrons and electrons in electric fields</p> <p>c) describe the distribution of mass and charge within an atom</p> <p>d) deduce the numbers of protons, neutrons and electrons present in both atoms and ions given proton and nucleon numbers and charge</p>
2. The nucleus of the atom	<p>a) describe the contribution of protons and neutrons to atomic nuclei in terms of proton number and nucleon number</p> <p>b) distinguish between isotopes on the basis of different numbers of neutrons present</p> <p>c) recognize and use the symbolism X_A for isotopes, where X is the nucleon number and Y is the proton number</p>
3. Electrons: energy levels, atomic orbitals, ionisation energy, electron affinity	<p>a) describe the number and relative energies of the s, p and d orbitals for the principal quantum numbers 1, 2 and 3 and also the 4s and 4p orbitals</p> <p>b) describe and sketch the shapes of s and p orbitals</p> <p>c) state the electronic configuration of atoms and ions given the proton number and charge, using the convention $1s \cdot 2s \cdot 2p^6$, etc.</p> <p>(i) explain and use the term ionization energy</p> <p>(ii) explain the factors influencing the ionization energies of elements</p> <p>(iii) explain the trends in ionization energies across a Period and down a Group of the Periodic Table (see also Section 9.1)</p> <p>d) deduce the electronic configurations of elements from successive ionization energy data</p> <p>e) interpret successive ionization energy data of an element in terms of the position of that element within the Periodic Table</p> <p>f) explain and use the term electron affinity</p>

Revision Note

- Subatomic Particles and their properties
 - The relative charge and relative mass of protons and neutrons
 - Relative Mass
 - Relative Charge
 - Electrons(e^-)
 - Electrons is the first sub atomic particles discovered by the scientist. It was produced as the cathodic ray, which the electrons comes out of the metal in the vacuum tube between two electrode if voltages are applied. This effect was first

overrevved in 19th century, and J.J. Thomason confirmed this is a subatomic particles after measuring the mass charge ratio of it and confirm that its mass is 1/1800 compare with the lightest atom

- The electron will deflect towards the positive charge

- Protons(p^+)

- Protons is one of the subatomic that has positive charged. It was discovered in 1917 by Rutherford when he described that the nucleus for hydrogen appear in all other atom's nucleus

- Neutrons(n)

-

- Calculating the nucleons

- The Atomic Structure History

- Electrons determine the chemical property

- Energy levels

- Atomic orbitals

- Ionization energy

- Electron affinity/electronegativity

Chemical Bonding

2017年6月18日 23:22

Syllabus Content

Chemical Bonding	Learning Outcomes
1. Ionic bonding	a) describe ionic bonding, as in sodium chloride, magnesium oxide and calcium fluoride, including the use of 'dot-and-cross' diagrams
2. Covalent bonding and co-ordinate (dative covalent) bonding including shapes of simple molecules	a) describe, including the use of 'dot-and-cross' diagrams: (i) covalent bonding, in molecules such as hydrogen, oxygen, chlorine, hydrogen chloride, carbon dioxide, methane, ethene (ii) co-ordinate (dative covalent) bonding, such as in the formation of the ammonium ion and in the Al_2Cl_6^- molecule b) describe covalent bonding in terms of orbital overlap, giving π and σ bonds, including the concept of hybridization to form sp , sp^2 and sp^3 orbitals (see also Section 14.3) c) explain the shapes of, and bond angles in, molecules by using the qualitative model of electron-pair repulsion (including lone pairs), using as simple examples: BF_3 (trigonal), CO_2 (linear), CH_4 (tetrahedral), NH_3 (pyramidal), H_2O (non-linear), SF_6 (octahedral), PF_5 (trigonal bipyramidal) d) predict the shapes of, and bond angles in, molecules and ions analogous to those specified in 3.2(b) (see also Section 14.3)
3. Intermolecular forces, electronegativity and bond properties	a) describe hydrogen bonding, using ammonia and water as simple examples of molecules containing $\text{N}-\text{H}$ and $\text{O}-\text{H}$ groups b) understand, in simple terms, the concept of electronegativity and apply it to explain the properties of molecules such as bond polarity (see also Section 3.3(c)), the dipole moments of molecules (3.3(d)) and the behavior of oxides with water (9.2(c)) c) explain the terms <i>bond energy</i> , <i>bond length</i> and <i>bond polarity</i> and use them to compare the reactivities of covalent bonds (see also Section 5.1(b)(ii)) d) describe intermolecular forces (van der Waals' forces), based on permanent and induced dipoles, as in, for example, $\text{CHCl}_3(\text{l})$; $\text{Br}_2(\text{l})$ and the liquid Group 18 elements
4. Metallic bonding	a) describe metallic bonding in terms of a lattice of positive ions surrounded by delocalised electrons
5. Bonding and physical properties	a) describe, interpret and predict the effect of different types of bonding (ionic bonding, covalent bonding, hydrogen bonding, other intermolecular interactions, metallic bonding) on the physical properties of substances b) deduce the type of bonding present from given information c) show understanding of chemical reactions in terms of energy transfers associated with the breaking and making of chemical bonds

Revision Notes

- Ionic bonding
- Covalent bond
- Intermolecular Forces(IMF)
- Metallic bonding
- Bonding and physical properties

States of Matter

2017年6月18日 23:22

Syllabus Content

States of Matter	Learning Outcomes
1. The gaseous state: ideal and real gases and $pV = nRT$	<ul style="list-style-type: none">a) state the basic assumptions of the kinetic theory as applied to an ideal gasb) explain qualitatively in terms of intermolecular forces and molecular size:<ul style="list-style-type: none">(i) the conditions necessary for a gas to approach ideal behaviour(ii) the limitations of ideality at very high pressures and very low temperaturesc) state and use the general gas equation $pV = nRT$ in calculations, including the determination of Mr
2. The liquid state	<ul style="list-style-type: none">a) describe, using a kinetic-molecular model, the liquid state, melting, vaporisation, vapour pressure
3. The solid state: lattice structures	<ul style="list-style-type: none">a) describe, in simple terms, the lattice structure of a crystalline solid which is:<ul style="list-style-type: none">(i) ionic, as in sodium chloride, magnesium oxide(ii) simple molecular, as in iodine and the fullerene allotropes of carbon (C_{60} and nanotubes only)(iii) giant molecular, as in silicon(IV) oxide and the graphite, diamond and graphene allotropes of carbon(iv) hydrogen-bonded, as in ice(v) metallic, as in copperb) discuss the finite nature of materials as a resource and the importance of recycling processesc) outline the importance of hydrogen bonding to the physical properties of substances, including ice and water (for example, boiling and melting points, viscosity and surface tension)d) suggest from quoted physical data the type of structure and bonding present in a substance

Revision Note

Enthalpy Change

2017年6月18日 23:22

Redox Reaction

2017年6月18日 23:22

Equilibrium

2017年6月18日 23:22

Rates of Reactions

2017年6月18日 23:22

Periodicity

2017年6月18日 23:23

Group 2

2017年6月18日

23:23

Group 17

2017年6月18日 23:23

Nitrogen and Sulfur

2017年6月18日 23:23