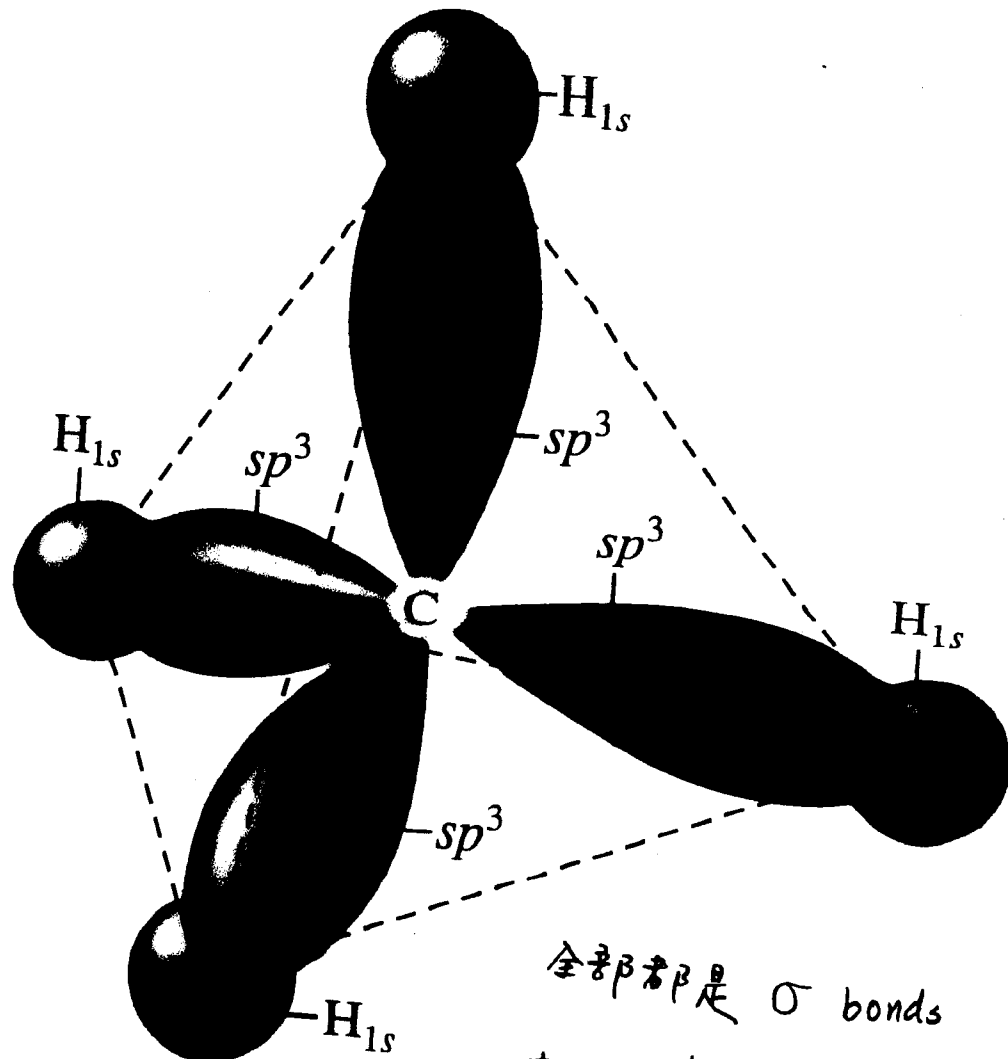
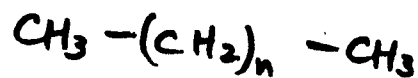


22.1 Alkanes : saturated hydrocarbons
 烷類 飽和 碳氫化合物



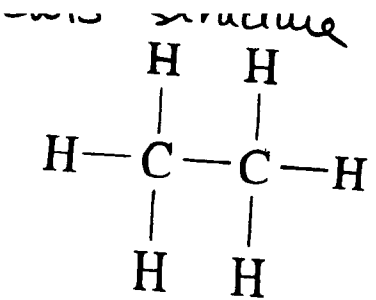
n=1	CH ₄	<u>methane</u>
n=2	C ₂ H ₆	<u>ethane</u>
n=3	C ₃ H ₈	<u>propane</u>
n=4	C ₄ H ₁₀	<u>butane</u>
		<u>Pentane</u>
		<u>hexane</u>
		<u>heptane</u>
		<u>Octane</u>
		<u>nonane</u>
		<u>decane</u>

normal, straight-chain, or unbranched hydrocarbons (直鏈狀) :



全部都是 σ bonds
 由 carbon sp^3
 & hydrogen $1s$

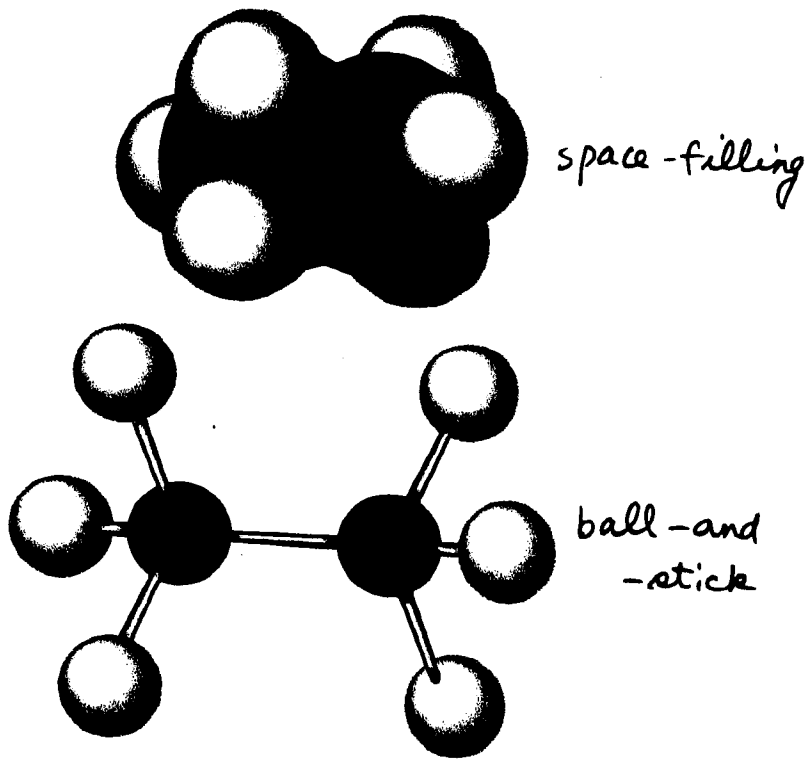
Figure 22.1
 The orbitals in CH₄



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(a)



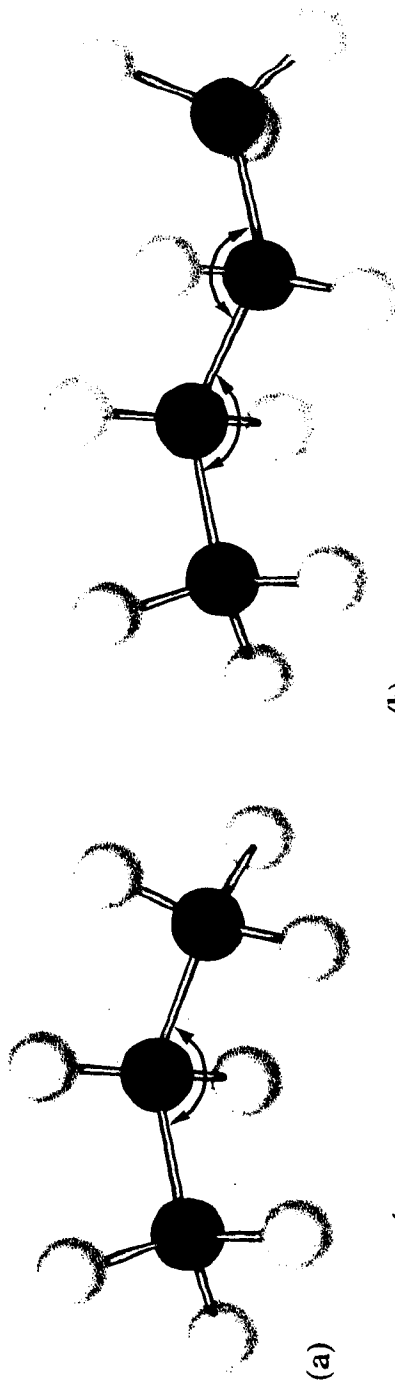
(b)

Figure 22.2
The ethane structure

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力



∴ 每个 C 皆为 sp^3

由其原子键键法

∴ 皆为四面体, $\sim 109.5^\circ$

(b)

(a)

Figure 22.3

The propane and butane structures

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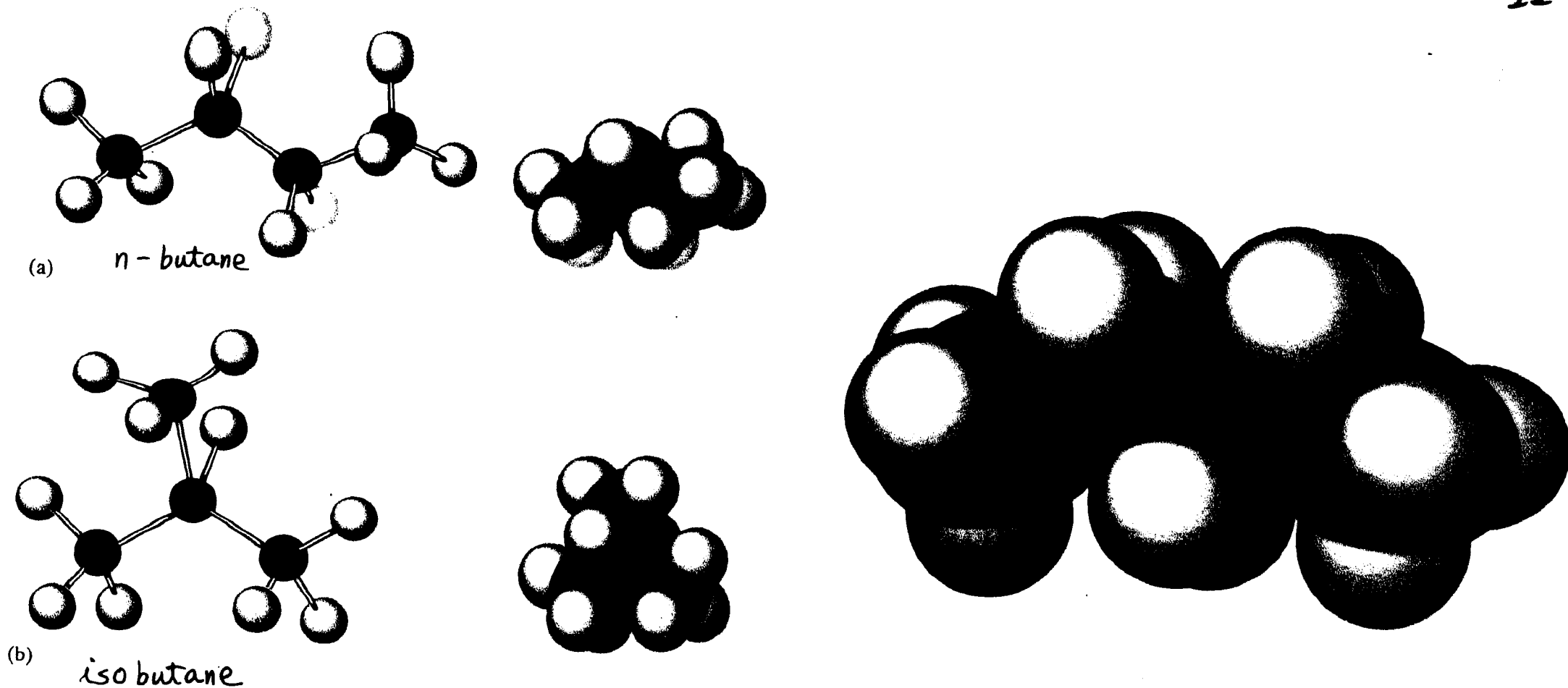


Figure 22.4
The isomers of butane

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Normal pentane

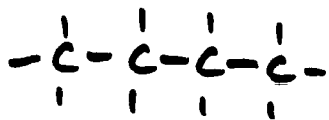
Steven S. Zumdahl, *Chemistry*, © Houghton Mifflin Company. All Rights Reserved.



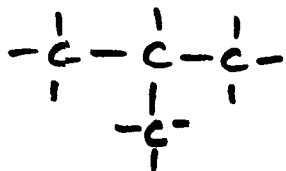
isomerism in alkanes 異構物 22-7

Ex: butane C_4H_{10}

(1) normal butane



(2) isobutane



\therefore 共有 2 structural isomers

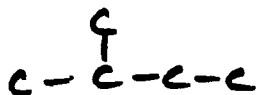
see Fig. 22.4

Ex. 22.1 Draw the isomers of pentane

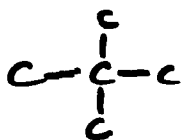
(1) normal pentane



(2) isopentane



(3) neopentane



\therefore 共有 3 structural isomers

Nomenclature (命名法) 22-8

1. For normal, straight-chain hydrocarbo

use meth + ane

eth + ane

Prop + ane

buto + ane

⋮

For branched hydrocarbon, 找最長的

(longest continuous chain of carbon

atoms) C 鏈, give the root name

for the hydrocarbon.

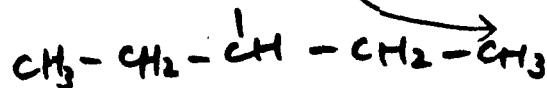
e.g.



最長的 C 鏈

6 个 C.

\therefore 叫 hexane



2. 找 branch 的長度. 如 2 个 C

\therefore 叫 eth 另加 yl

↓

meth

eth + yl

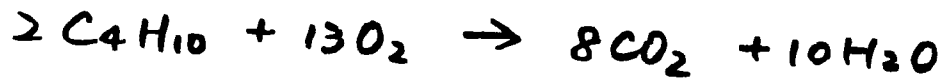
ane

alkanes 不易反應

22-11

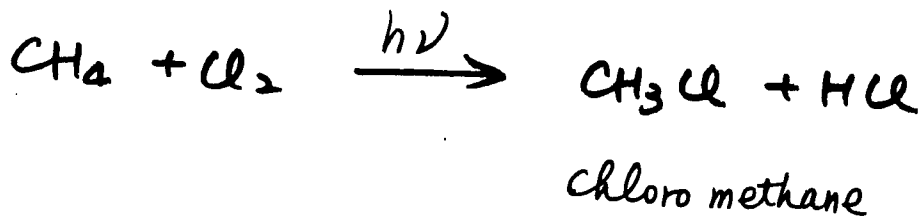
at 25°C. 不和鹼、鹵、氧化劑作用

1) 燃燒反應 (combustion reactions)

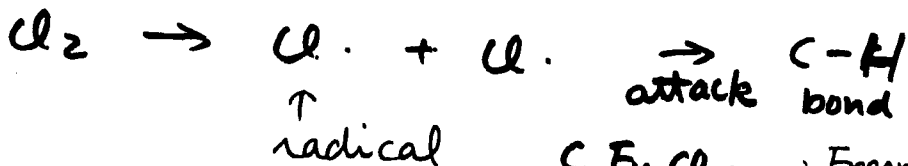


作為 fuel 燃料

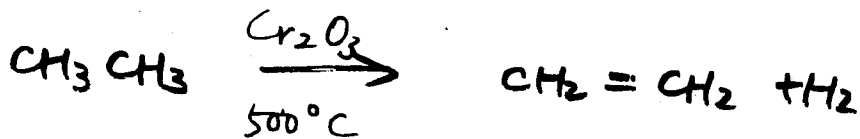
2) substitution reactions:



紫外光 (以 hv 表示) breaks

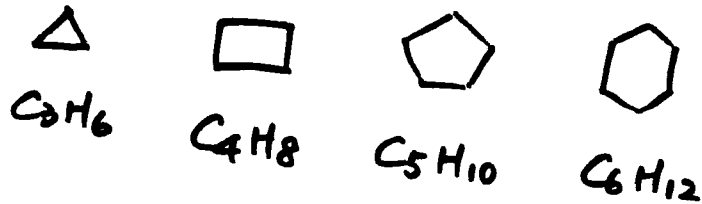
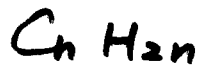


dehydrogenation reactions: CxHxCl4-x: Freons 冷媒

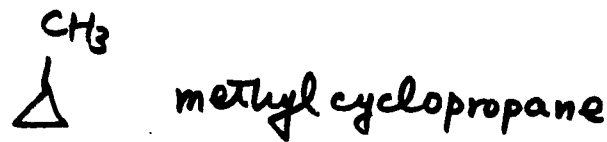


Cyclic Alkanes

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C: sp3
H: 1s
sigma bonds



see Fig. 22.5

C-C bond

應為 sp3-sp3 的 sigma bond

但是 三角 只有 60 degrees. C-C 的 orbital 並非 head to head 的 overlap.

因此 C-C bond 不穩 (quite reactive)

Diagram of cyclobutane 夾角 90 degrees. C-C bond 不穩.

see Fig 22.6

C6H12 (Cyclohexane) 有兩個 conformations

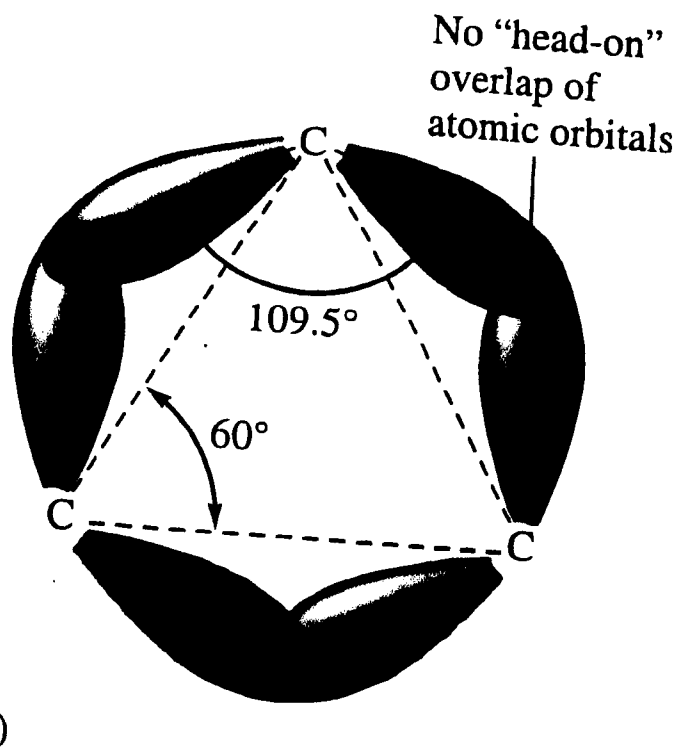
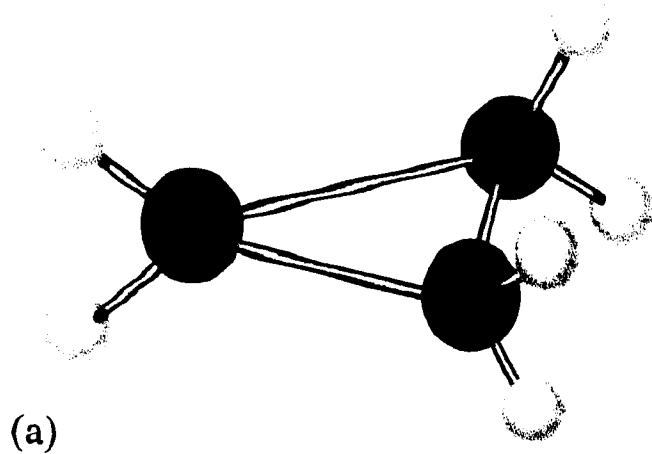


Figure 22.5
Cyclopropane structure and bonding
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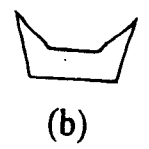
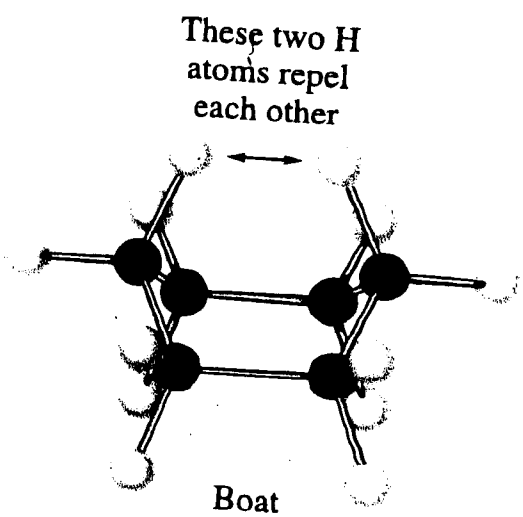
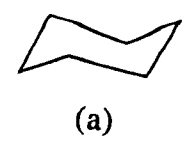
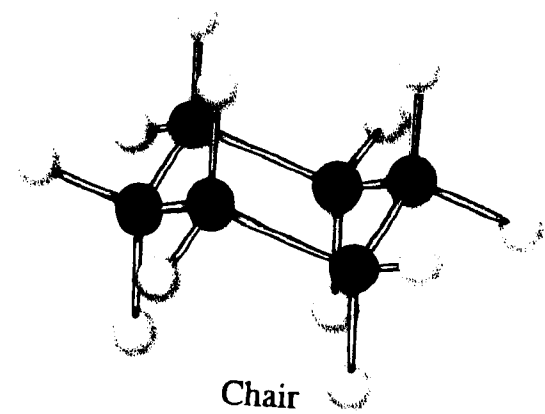
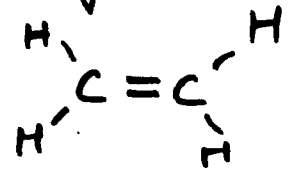


Figure 22.6
The chair and boat forms of cyclohexane
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alkene: $\hat{=}$ C=C double bond

ex. ethylene



C: sp^2 H: $1s$ \rightarrow σ bond

C: sp^2 C: sp^2 \rightarrow σ bond

C: p_z C: p_z \rightarrow π bond } double bond

命名:

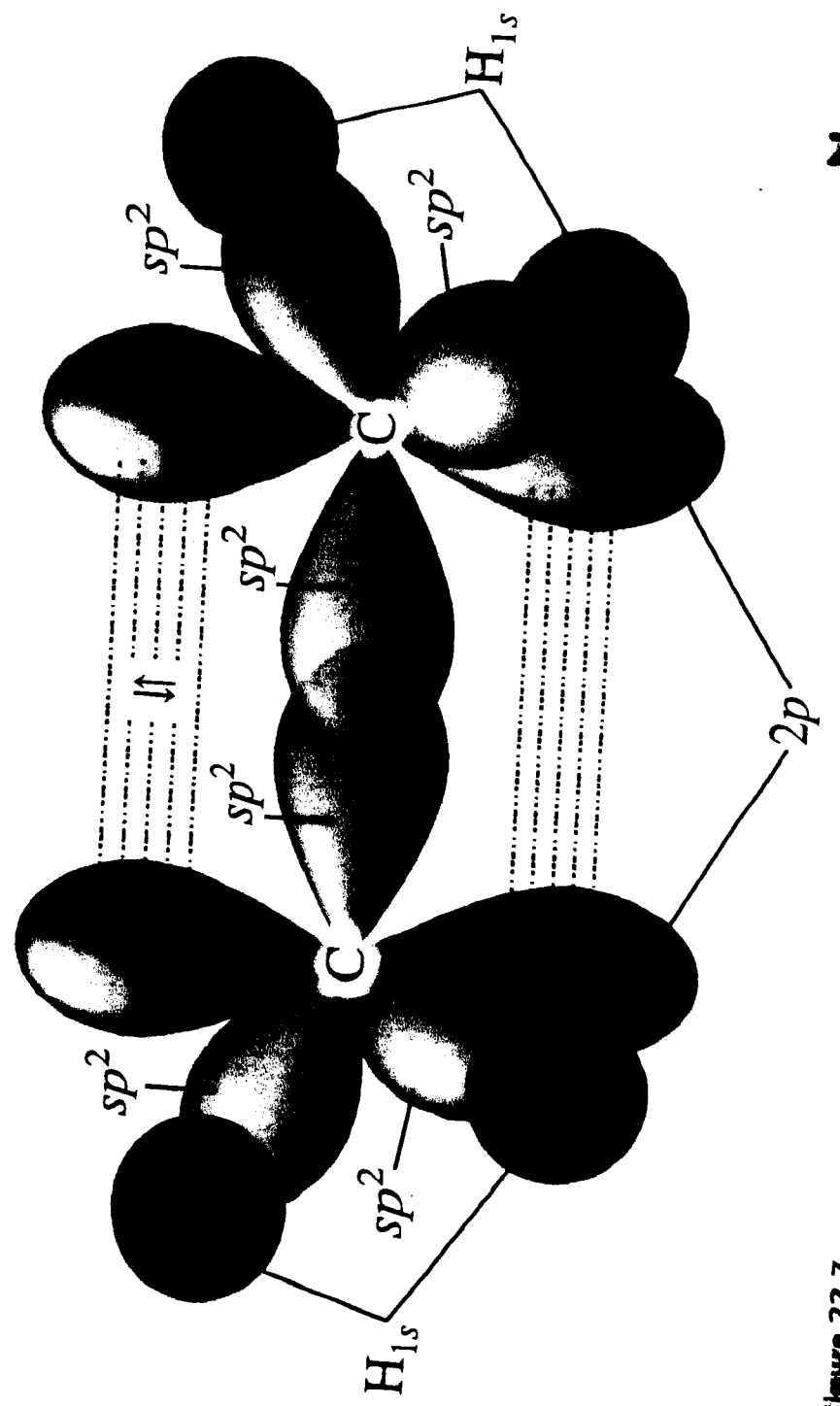


Figure 22.7

The orbitals in C₂H₄

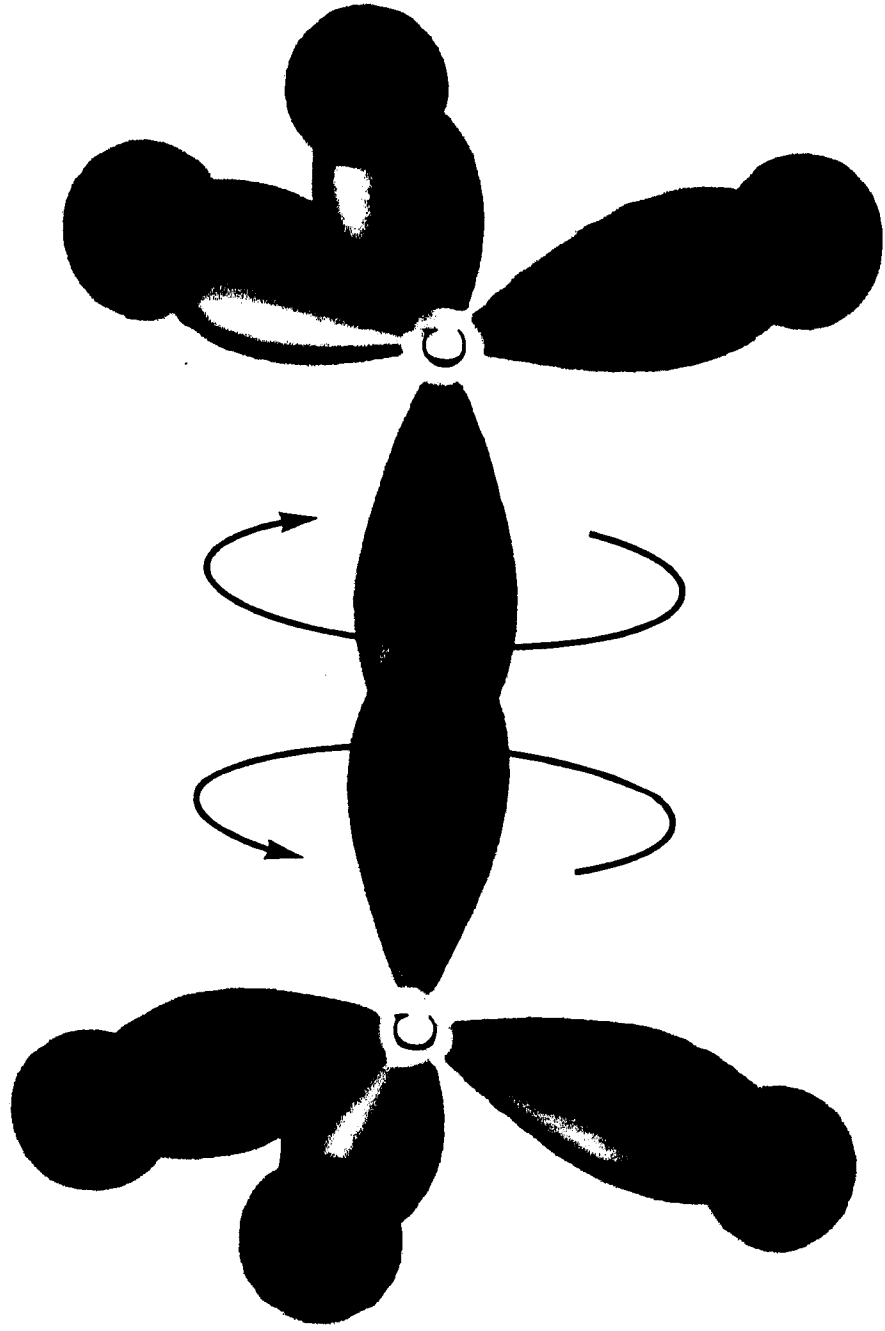


Figure 22.8

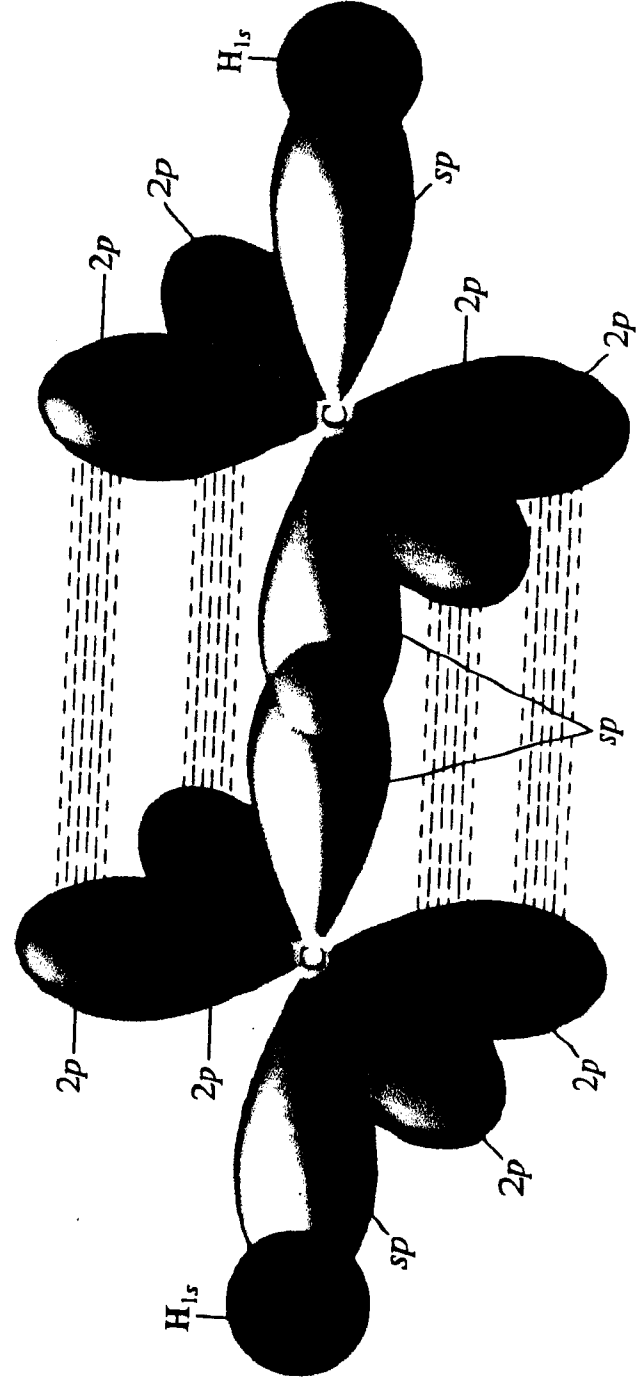
Free rotation for C_2H_6

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$C \equiv C$: 1 σ bond

: 2 π bonds

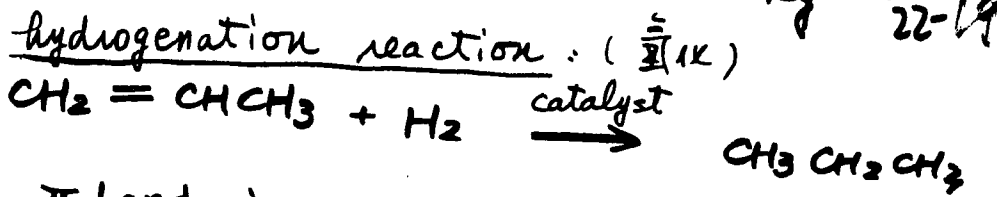
Figure 22.10

The orbitals of C_2H_2

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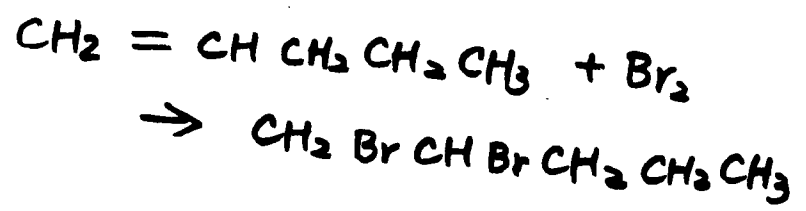


π bond is weaker than C-C σ bond
 ↓
 break 1 π bond (C=C) and 1 σ bond (H-H)
 ↓
 new C-H σ bonds are formed

通常 use Pt, Pd as catalyst to break H_2 (H-H) bond.

人工合成奶油...

halogenation (卤化):



polymerization (高分子化)

§ 22.3 Aromatic Hydrocarbons (芳香族)



C-H : C(sp²) - H(1s) σ bond
 C-C : C(sp²) - C(sp²) σ bond
 C(p_z) - C(p_z) π bond

delocalized molecular orbital π electrons

取代反应

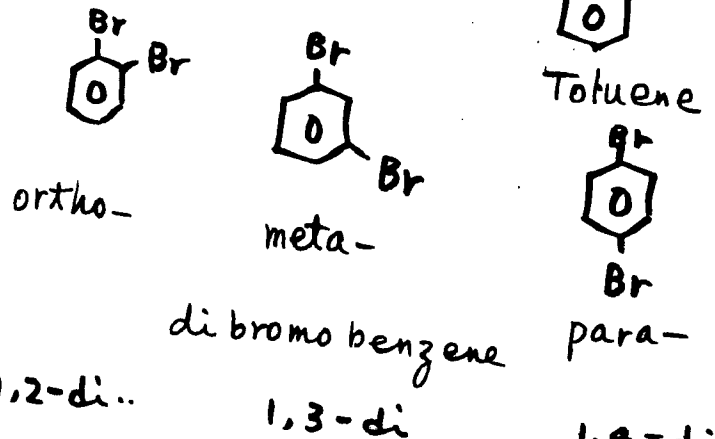
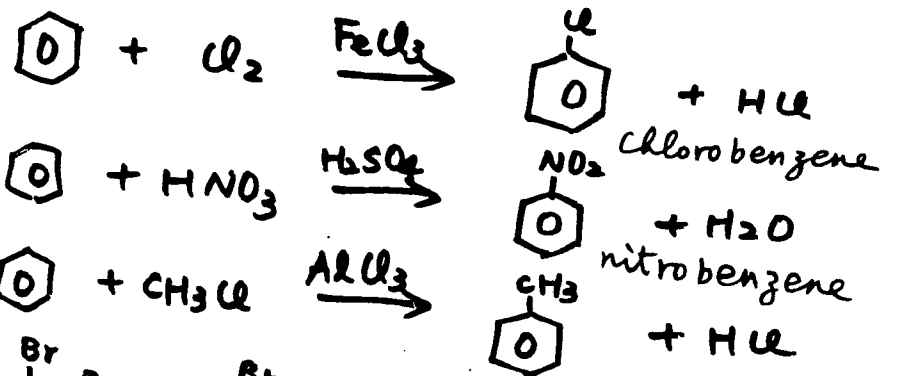


Table 22.5

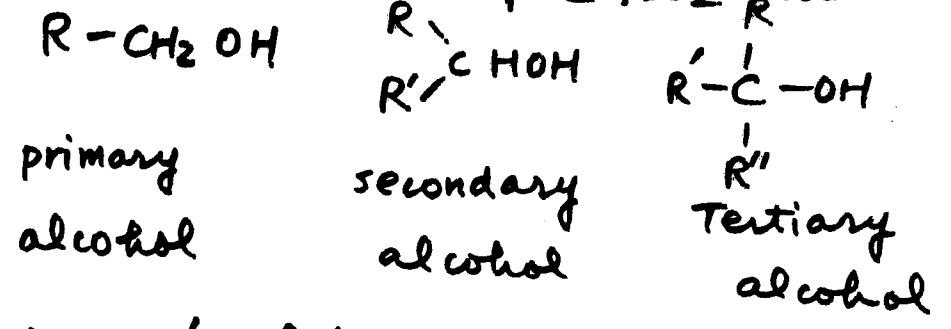
Class	Functional Group	General Formula*	Example
Halohydrocarbons	-X (F, Cl, Br, I)	R-X	CH ₃ I Iodomethane (methyl iodide)
Alcohols 西拿	-OH	R-OH	CH ₃ OH Methanol (methyl alcohol)
Ethers 西迷	-O-	R-O-R'	CH ₃ OCH ₃ Dimethyl ether
Aldehydes 西拿	$\begin{array}{c} \text{O} \\ \parallel \\ \text{-C-H} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R-C-H} \end{array}$	CH ₂ O Methanal (formaldehyde)
Ketones 西司	$\begin{array}{c} \text{O} \\ \parallel \\ \text{-C-} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R-C-R}' \end{array}$	CH ₃ COCH ₃ Propanone (dimethyl ketone or acetone)
Carboxylic acids 羧酸	$\begin{array}{c} \text{O} \\ \parallel \\ \text{-C-OH} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R-C-OH} \end{array}$	CH ₃ COOH Ethanoic acid (acetic acid)
Esters 西首	$\begin{array}{c} \text{O} \\ \parallel \\ \text{-C-O-} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R-C-O-R}' \end{array}$	CH ₃ COOCH ₂ CH ₃ Ethyl acetate
Amines 西安	-NH ₂	R-NH ₂	CH ₃ NH ₂ Aminomethane (methylamine)

*R and R' represent hydrocarbon fragments.

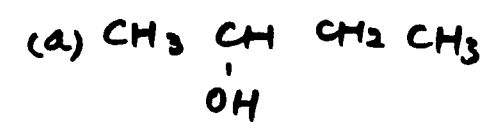
22-2

alcohols (西拿)

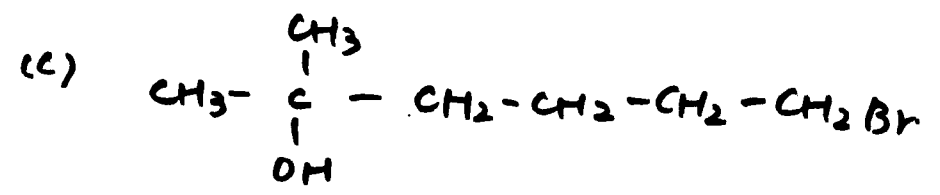
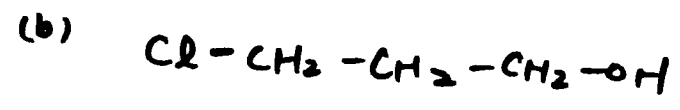
命名: 由 alkane 去掉 e. 加上 -ol



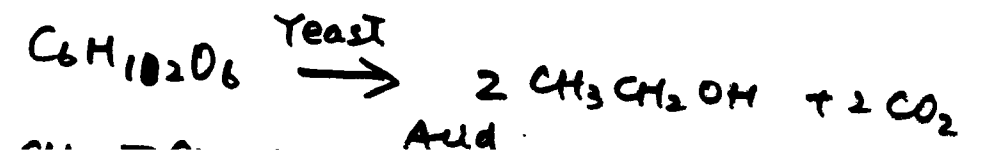
e.g. 22.6 命名



butanol
↓
2-butanol

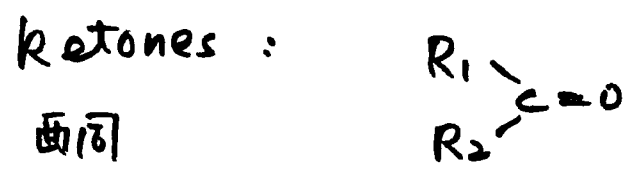
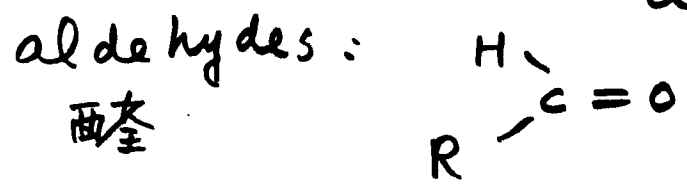
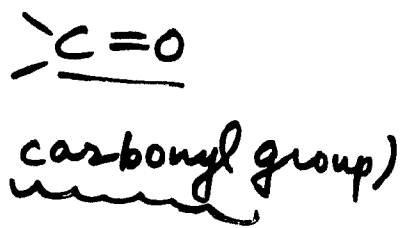


methanol 合成

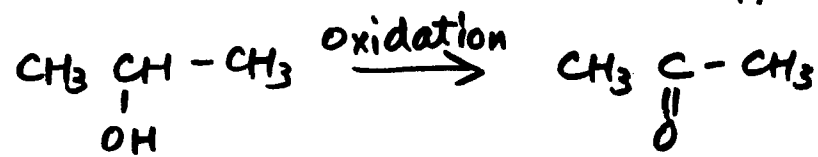
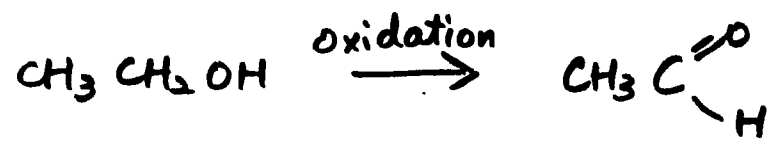


alkanes 去掉 e 加 2 one

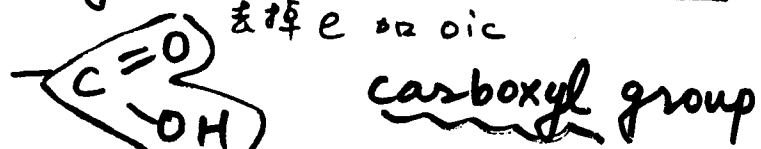
aldehydes
ketones } contain



oxidation of alcohols

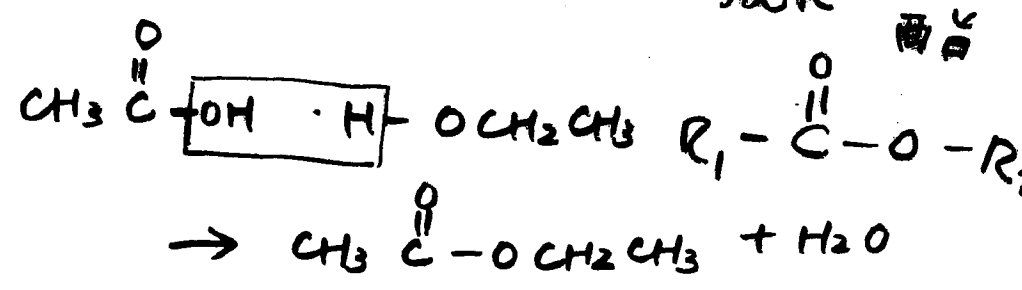


carboxylic acids and esters

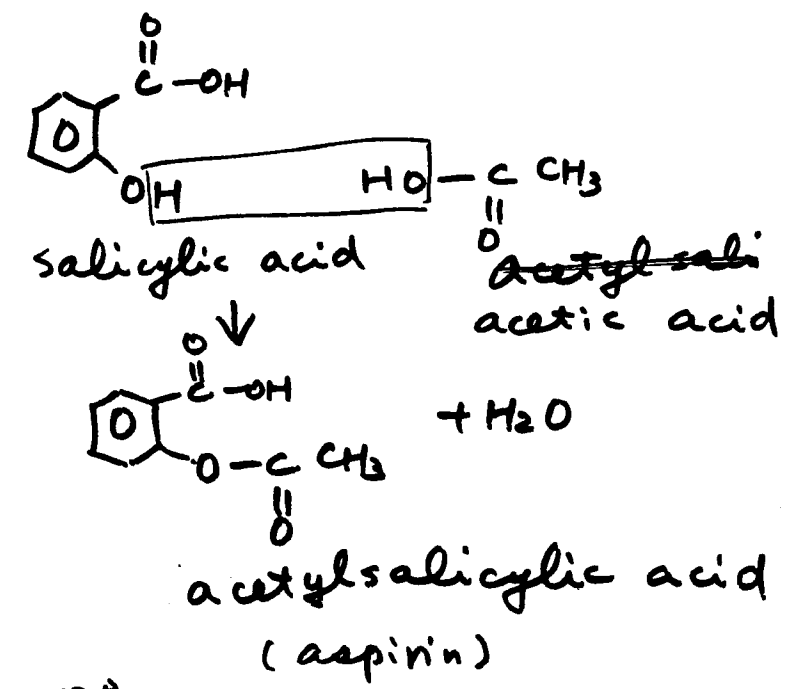


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carboxylic acid + alcohol \rightarrow ester
脱水 酯化



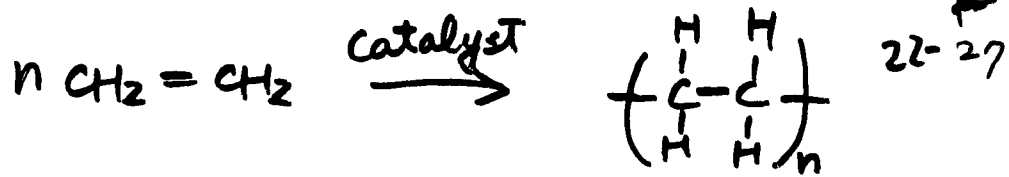
Aspirin



Amines: 胺

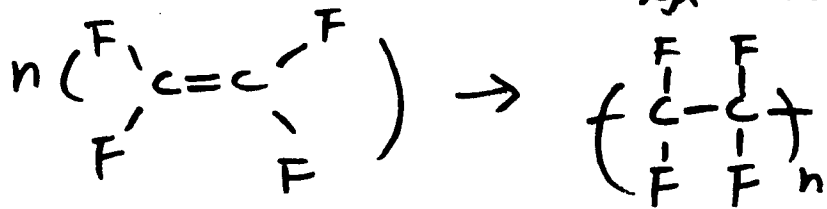
derivatives of ammonia





polyethylene

聚乙烯



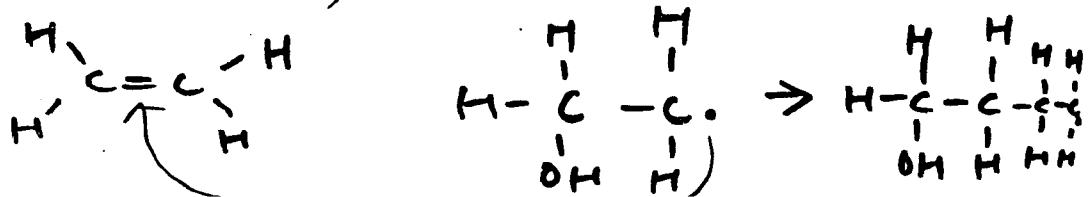
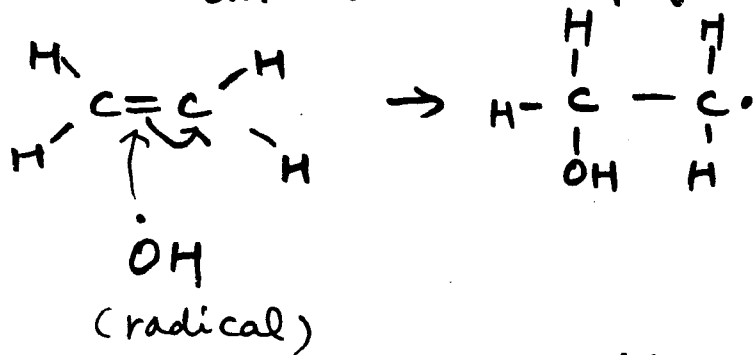
tetrafluoroethylene

Teflon

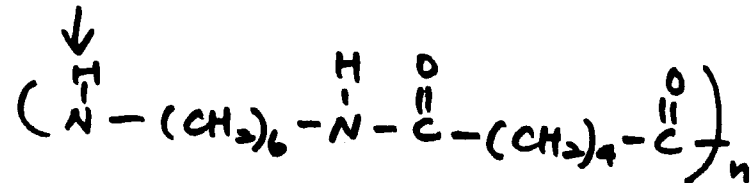
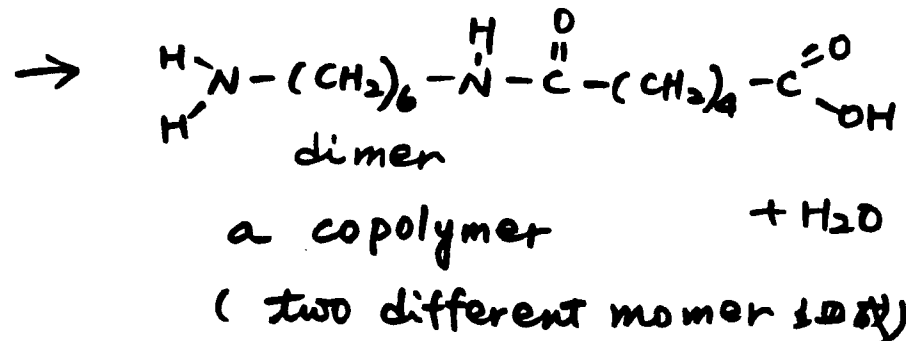
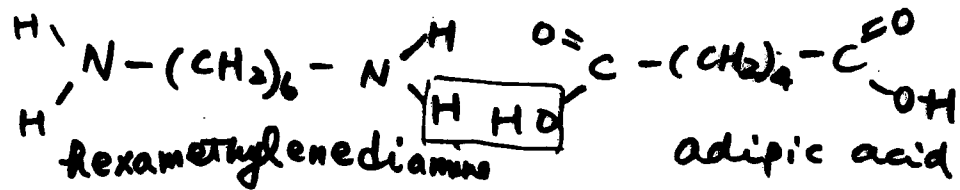
see Table 22.8 (page 1084)

for other polyethylene-type polymers

Mechanism: (addition polymerization)



Condensation polymerization (缩聚反应)
 134 to: ① nylon.



② Dacron (polyester) + 涤纶 = 聚酯

