Chapter 1 L 4&5

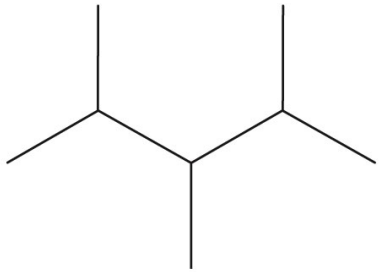
Classification According to Molecular Framework and Functional Groups

Problem Solving

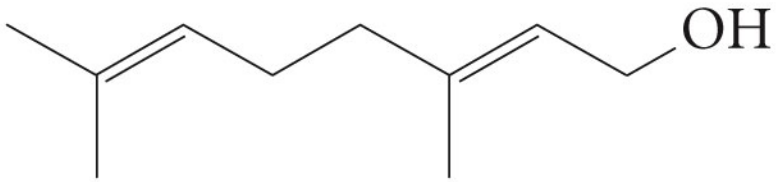
Classification According to Molecular Framework

Acyclic (not cyclic)
These may be branched or not

unbranched chain of
eight carbon atoms



branched chain of
eight carbon atoms



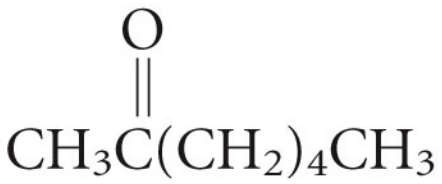
geraniol
(oil of roses)
bp 229–230°C

A branched chain compound used in perfumes

$CH_3(CH_2)_5CH_3$

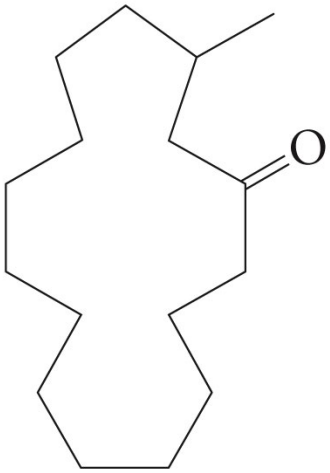
heptane
(petroleum)
bp 98.4°C

A hydrocarbon present in petroleum, used as a standard in testing the octane rating of gasoline



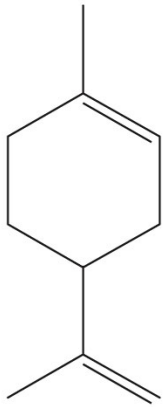
2-heptanone
(oil of cloves)
bp 151.5°C

A colorless liquid with a fruity odor, in part responsible for the "peppery" odor of blue cheese



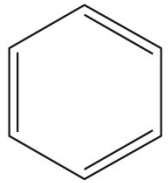
muscone
(musk deer)
bp 327–330°C

A 15-membered ring ketone, used in perfumes



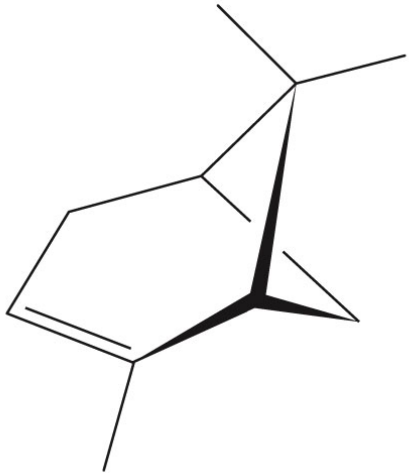
limonene
(citrus fruit oils)
bp 178°C

A ring with two side chains, one of which is branched



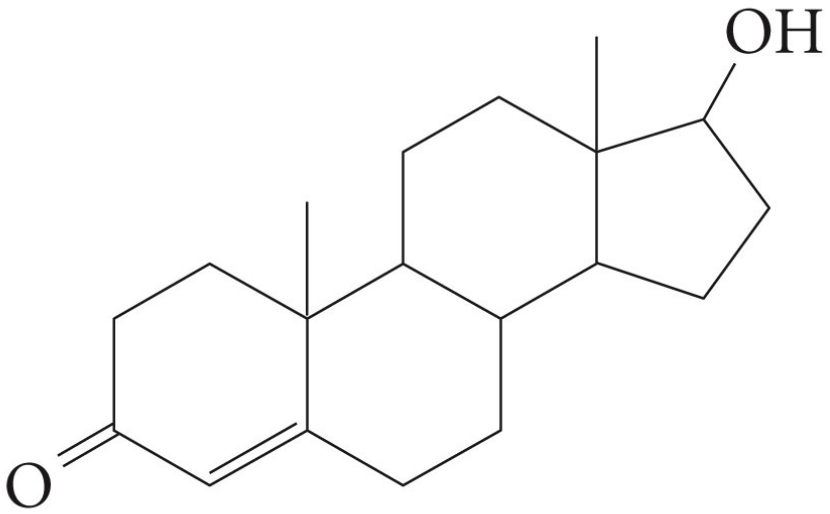
benzene
(petroleum)
mp 5.5°C, bp 80.1°C

A very common ring



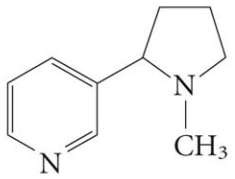
α-pinene
(turpentine)
bp 156.2°C

A bicyclic molecule; one would have to break *two* bonds to make it acyclic



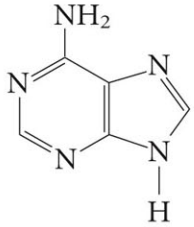
testosterone
(testes)
mp 155°C

A male sex hormone in which several rings of common sizes are *fused* together; that is, they share two adjacent carbon atoms



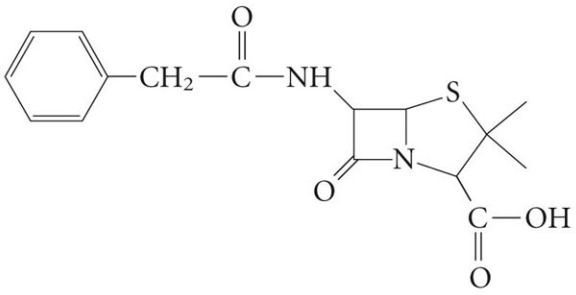
nicotine
bp 246°C

Present in tobacco, nicotine has two heterocyclic rings of different sizes, each containing one nitrogen.



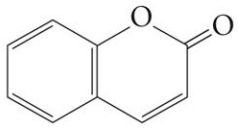
adenine
mp 360–365°C
(decomposes)

One of the four heterocyclic bases of DNA, adenine contains two fused heterocyclic rings, each of which contains two heteroatoms (nitrogen).



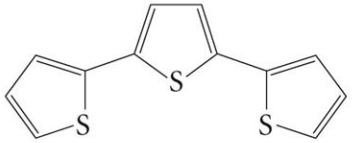
penicillin-G
(amorphous solid)

One of the most widely used antibiotics, penicillin has two heterocyclic rings, the smaller of which is crucial to biological activity.



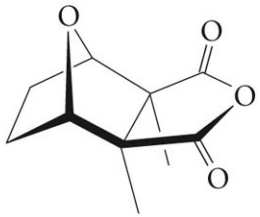
coumarin
mp 71°C

Found in clover and grasses, coumarin produces the pleasant odor of new-mown hay.



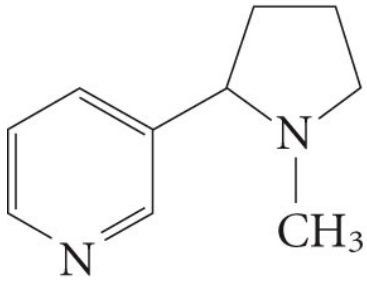
α-terthienyl
mp 92–93°C

This compound, with three linked sulfur-containing rings, is present in certain marigold species.



cantharidin
mp 218°C

This compound, an oxygen heterocycle, is the active principle in cantharis (also known as Spanish fly), a material isolated from certain dried beetles of the species *Cantharis vesicatoria* and incorrectly thought by some to increase sexual desire.



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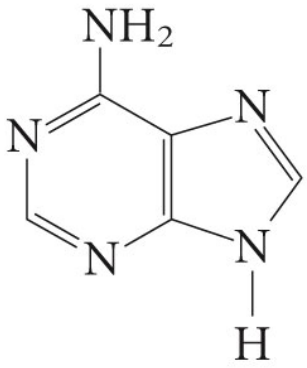

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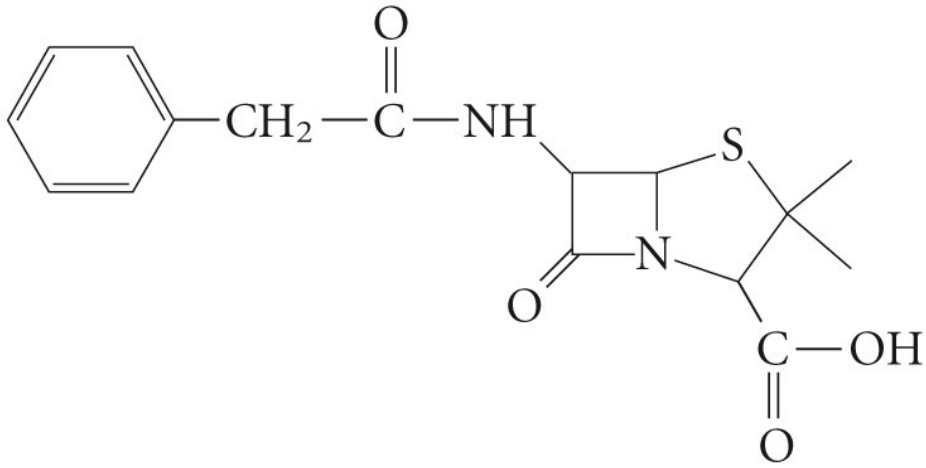

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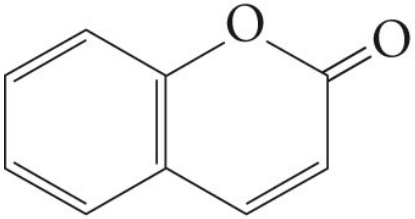

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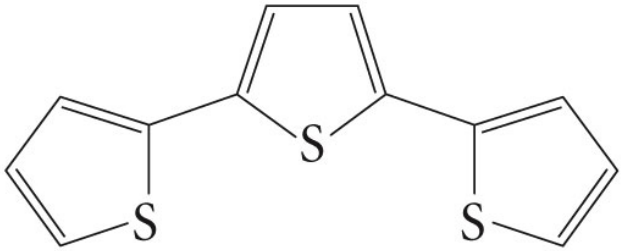

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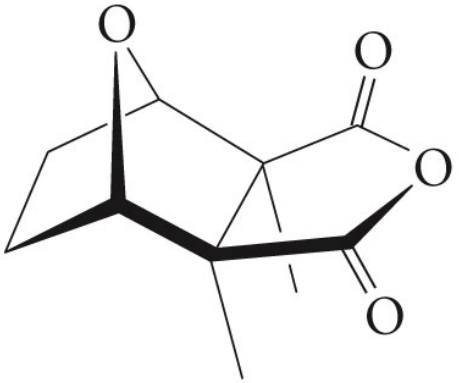

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Classification by Functional Groups

Table 1.6 The Main Functional Groups

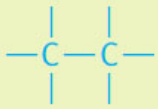
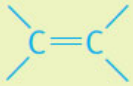
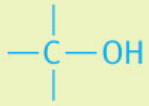
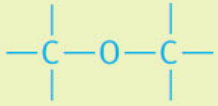
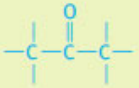
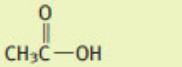
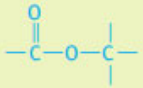
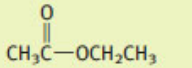
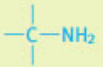
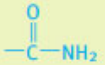
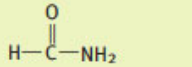
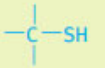
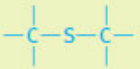
	Structure	Class of compound	Specific example	Common name of the specific example
A. Functional groups that are a part of the molecular framework		alkane	$CH_3—CH_3$	ethane, a component of natural gas
		alkene	$CH_2=CH_2$	ethylene, used to make polyethylene
		alkyne	$HC\equiv CH$	acetylene, used in welding
		arene		benzene, raw material for polystyrene and phenol
B. Functional groups containing oxygen				
1. With carbon–oxygen single bonds		alcohol	CH_3CH_2OH	ethyl alcohol, found in beer, wines, and liquors
		ether	$CH_3CH_2OCH_2CH_3$	diethyl ether, once a common anesthetic

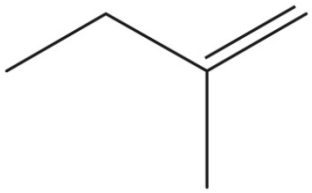
Table 1.6 — continued

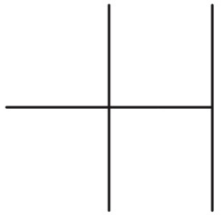
	Structure	Class of compound	Specific example	Common name of the specific example
*2. With carbon–oxygen double bonds**		aldehyde	$CH_2{=}O$	formaldehyde, used to preserve biological specimens
		ketone		acetone, a solvent for varnish and rubber cement
3. With single and double carbon–oxygen bonds		carboxylic acid		acetic acid, a component of vinegar
		ester		ethyl acetate, a solvent for nail polish and model airplane glue
*C. Functional groups containing nitrogen***		primary amine	$CH_3CH_2NH_2$	ethylamine, smells like ammonia
		nitrile	$CH_2{=}CH{-}C{\equiv}N$	acrylonitrile, raw material for making Orlon
D. Functional group with oxygen and nitrogen		primary amide		formamide, a softener for paper
E. Functional group with halogen		alkyl or aryl halide	CH_3Cl	methyl chloride, refrigerant and local anesthetic
F. Functional groups containing sulfur†		thiol (also called mercaptan)	CH_3SH	methanethiol, has the odor of rotten cabbage
		thioether (also called sulfide)	$(CH_2{=}CHCH_2)_2S$	diallyl sulfide, has the odor of garlic

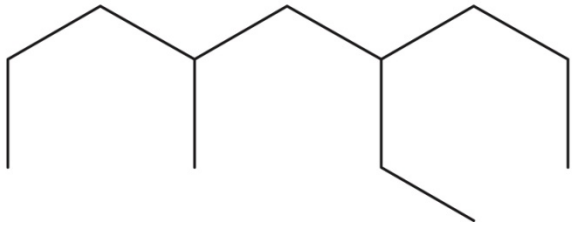
*The  group, present in several functional groups, is called a **carbonyl group**. The  group of acids is called a **carboxyl group** (a contraction of *carb*onyl and hydr*oxyl*).

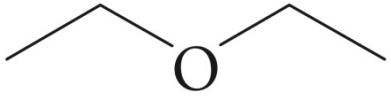
The $-NH_2$ group is called an **amino group.

†Thiols and thioethers are the sulfur analogs of alcohols and ethers.





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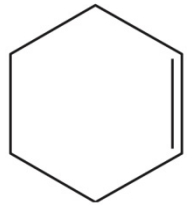

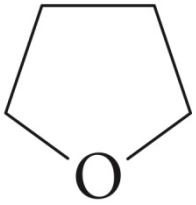
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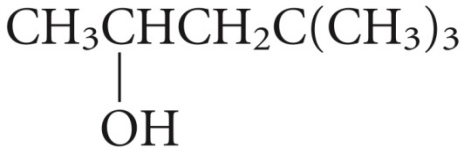
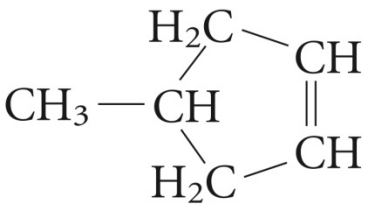
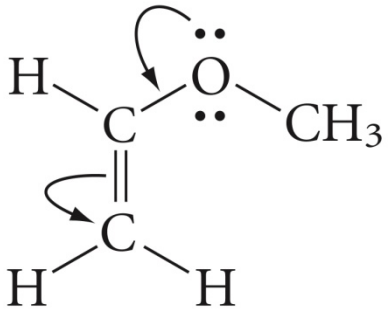
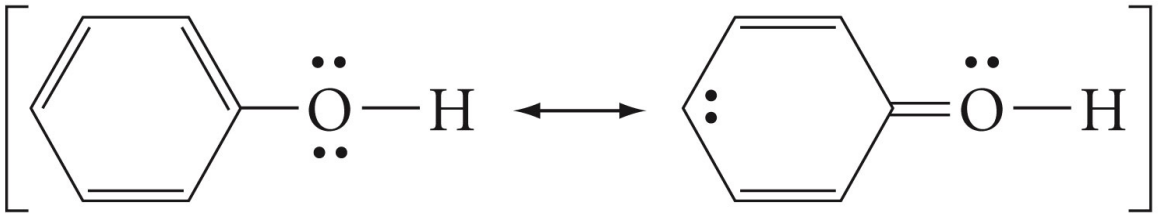
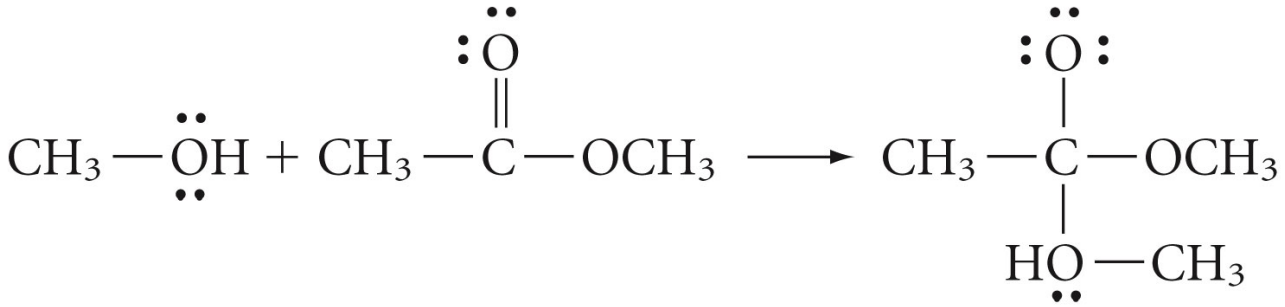
Write the line-segment formulas for the following compounds

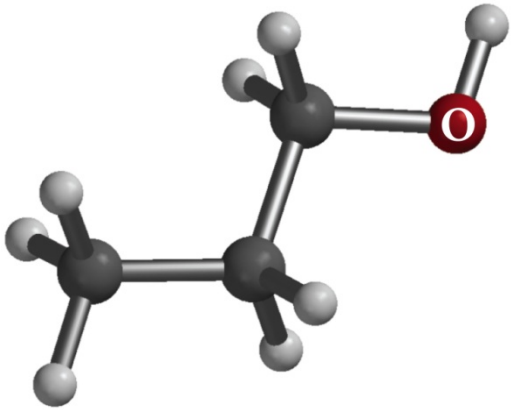








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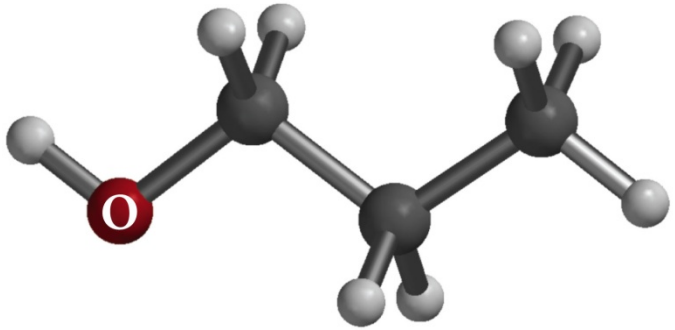
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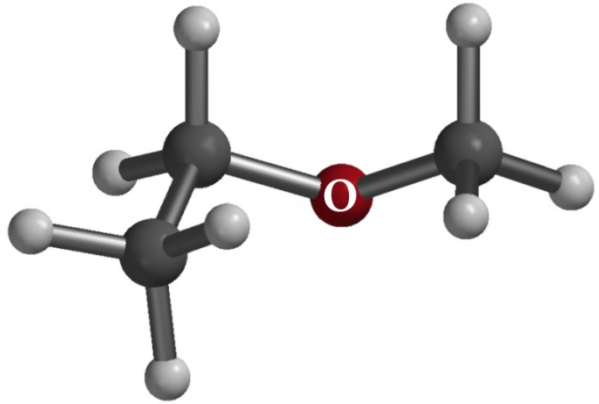
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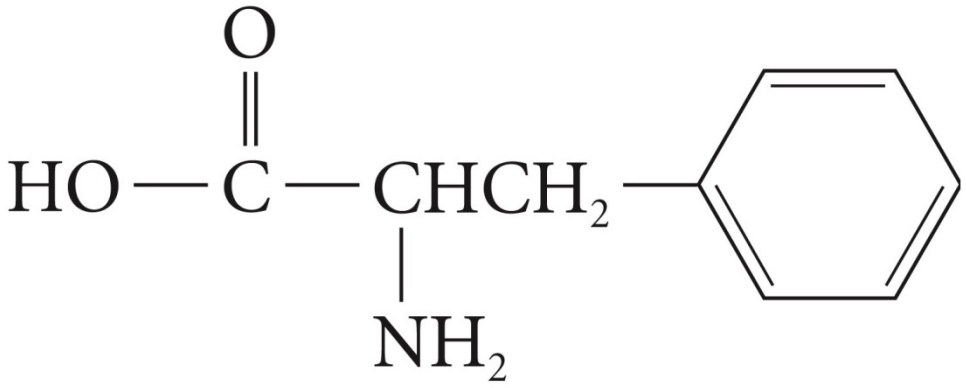

In the structure of phenylalanine above

What are the functional groups present

Show all the unshared electron pairs

What is the molecular formula?

Draw any possible structural isomer and show its functional groups