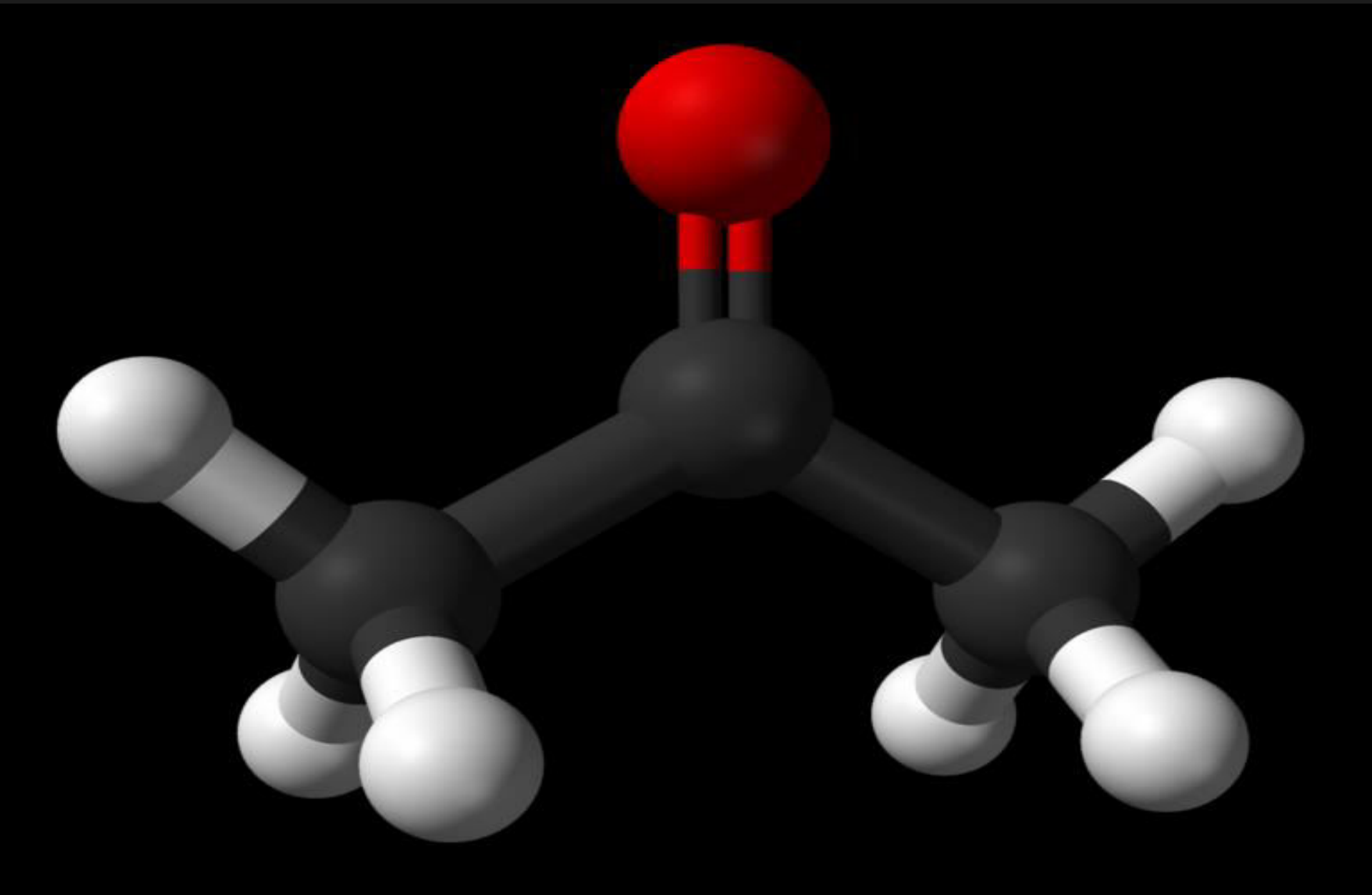
ALCOHOLS, ALDEHYDES, & KETONES



ALCOHOLS, ALDEHYDES, & KETONES

ALCOHOLS

Alcohols (-OH)

IUPAC naming system

A C-chain containing an –OH (alcohol / hydroxyl) functional group will have an –ol ending that replaces the "e" of an –ane, – ene or –yne ending.

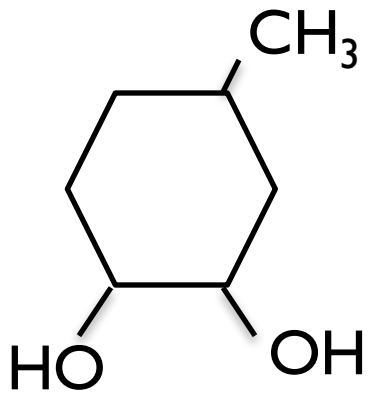
CH_3OH	methanol
CH_3CH_2OH	ethanol
$CH_3CH_2CH_2OH$	propan-1-ol

ALCOHOLS

Example #1

a) $CH_3CHOHCH_3$ propan-2-ol or isopropanol

b) $CH_2=CHCH_2CH_2OH$ but-3-en-1-ol

c) 

4-methylcyclohexane-1,2-diol

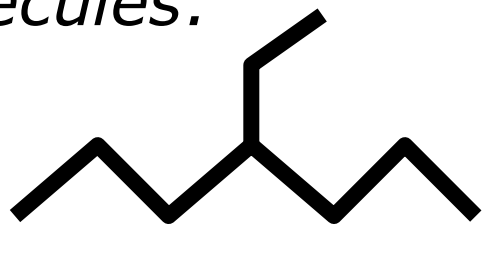
Note that the e is reinstated when there are multiple alcohol groups

ALCOHOLS

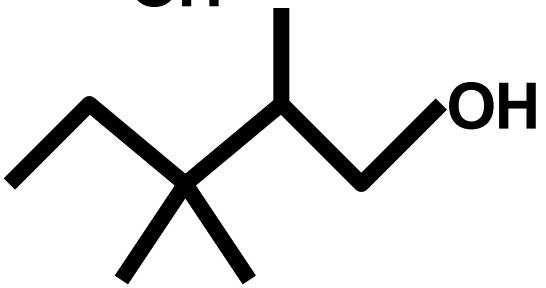
Example #2

Draw the following molecules:

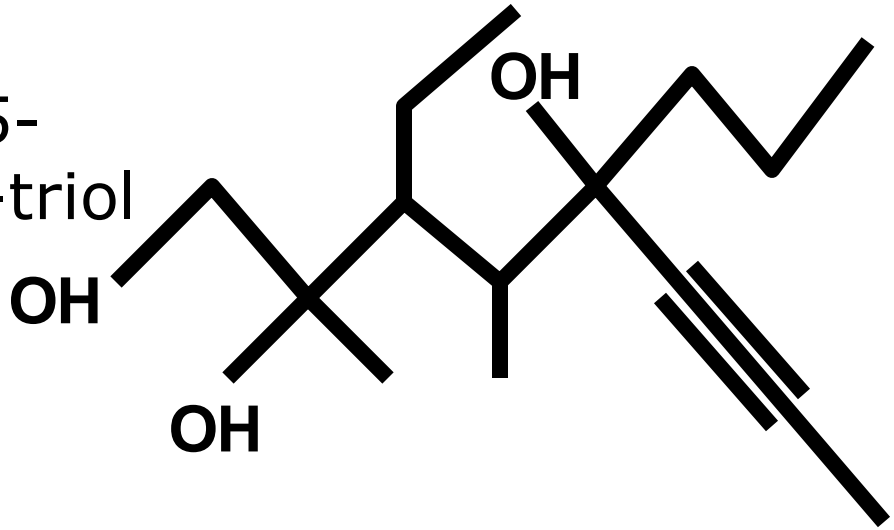
a) 3-ethylhexan-1-ol



b) 2,3,3-trimethylpentan-1-ol



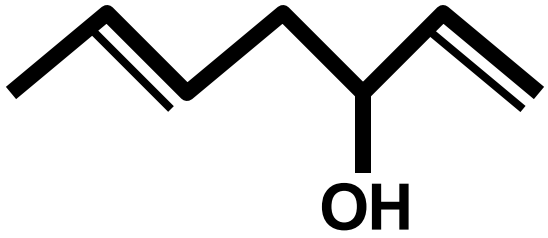
c) 3-ethyl-2,4-dimethyl-5-propyloct-6-yne-1,2,5-triol



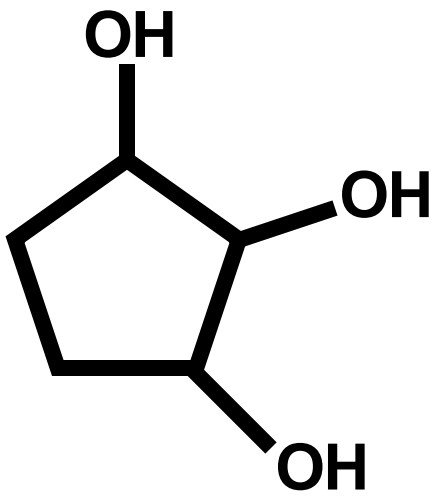
ALCOHOLS

Example #2

d) (5*E*)-hepta-1,5-dien-3-ol



e) cyclopentane-1,2,3-triol



Alcohol Nomenclature

Common naming system

Although the IUPAC system is preferred, many compounds are still referred by their "common" names.

methanol	methyl alcohol
ethanol	ethyl alcohol
isopropanol	isopropyl alcohol

ALCOHOLS

Properties of Alcohols

Alcohols typically have higher boiling points than their hydrocarbon counterparts. Why?

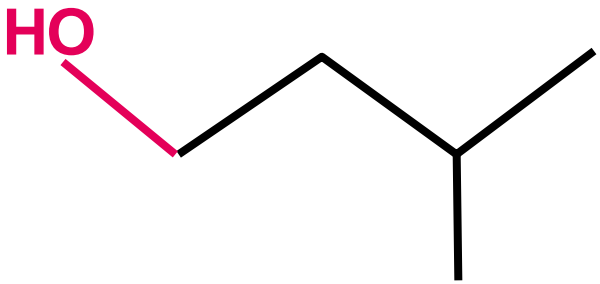
Alcohols have hydroxyl groups (OH) which can form hydrogen bonds with one another. Hydrogen bonds are stronger than the London dispersion forces that form between their hydrocarbon counterparts. Thus more energy is required to break these stronger intermolecular bonds.

The shorter the carbon chain of an alcohol, the more water soluble the compound. Why?

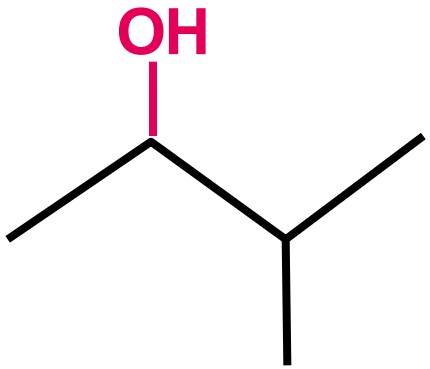
Water bonds to other water molecules via hydrogen bonds. They would preferentially form hydrogen bonds with each other over weaker Van der Waals forces with long carbon chains.

ALCOHOLS

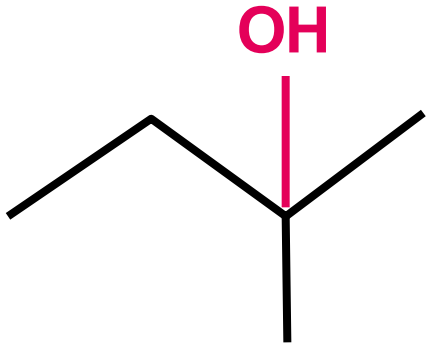
Primary, secondary, and tertiary alcohols



primary alcohol



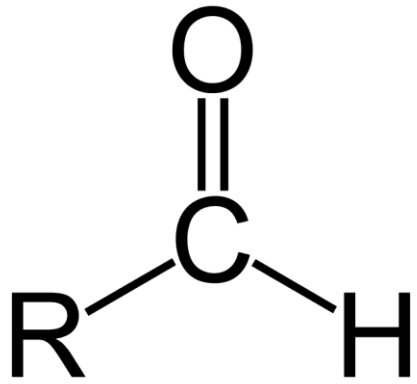
secondary alcohol



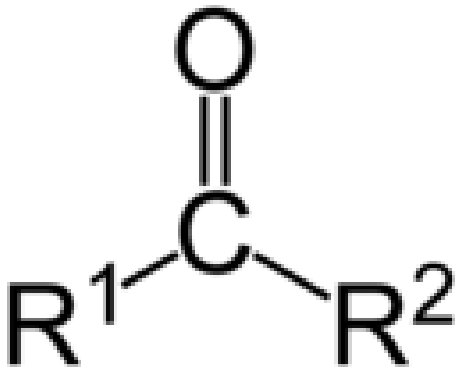
tertiary alcohol

Aldehydes and Ketones

Both of these groups contain a C=O (carbonyl group). The location of this group determines whether a compound is an aldehyde or a ketone.



aldehyde



ketone

ALDEHYDES

Aldehyde Nomenclature

The aldehyde group must be included in the main C-chain to be named and labeled as carbon #1.

<u>IUPAC naming system</u>

The "e" of –ane, –ene, or –yne will be replaced with an "–al" ending.

ALDEHYDES

Other Nomenclature Prefixes

# of carbons	IUPAC	Common System
1	meth-	form-
2	eth-	acet-
3	prop-	proprion-
4	but-	butyr-

Aldehyde Nomenclature

Common naming system

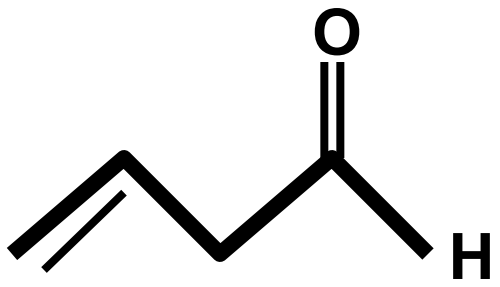
methanal	formaldehyde
ethanal	acetaldehyde
propanal	proprionaldehyde
butanal	butyraldehyde

ALDEHYDES

Example #3

Redraw and name the following compound:

$CH_2=CHCH_2CHO$

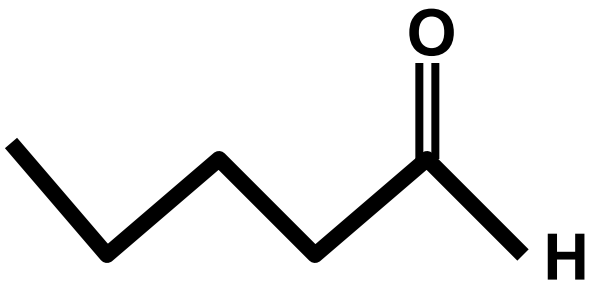


but-3-enal

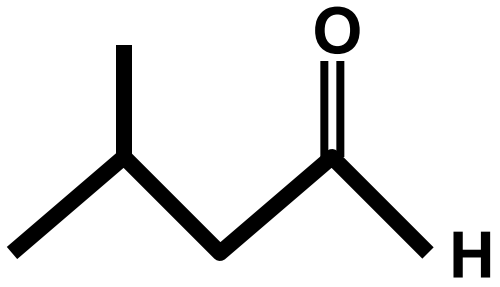
ALDEHYDES

Example #4

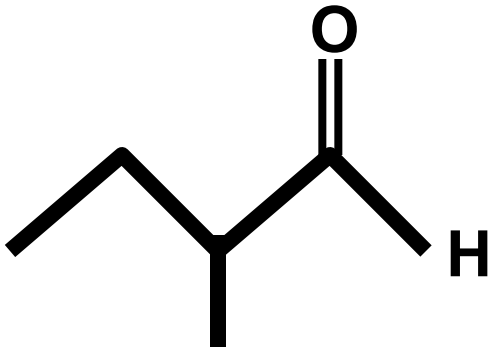
Draw and name all aldehydes with the formula $C_5H_{10}O$.



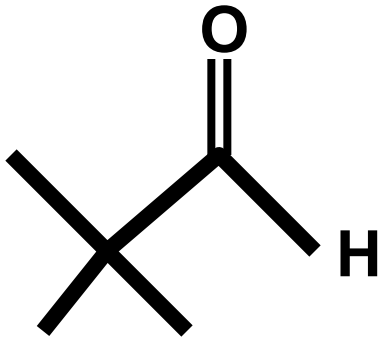
pentanal



3-methylbutanal



2-methylbutanal



2,2-dimethylpropanal

KETONES

Ketone Nomenclature

A compound is a ketone when the carbonyl group is not found on the end of a carbon chain. When naming, the main chain must contain this group.

IUPAC naming system

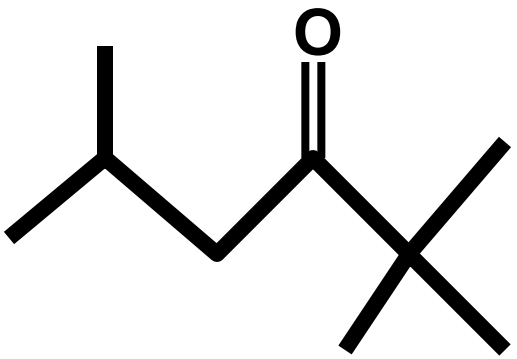
The "e" of the –ane, –ene or –yne ending will be replaced with an "–one" ending.

KETONES

Example #5

Redraw and name the following compound:

$(CH_3)_2CHCH_2COC(CH_3)_3$



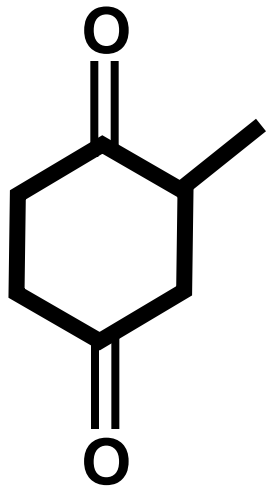
2,2,5-trimethylhexan-3-one

KETONES

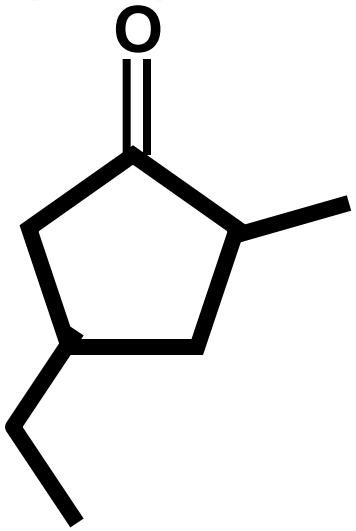
Example #6

Draw the following compounds:

a) 2-methylcyclohexane-1,4-dione



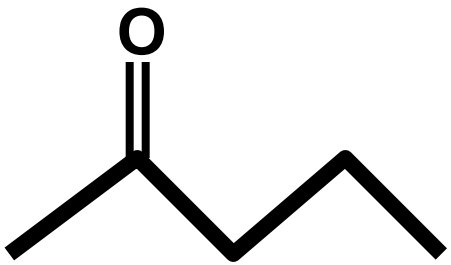
b) 4-ethyl-2-methylcyclopentanone



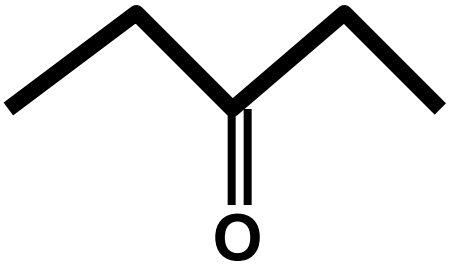
KETONES

Example #6

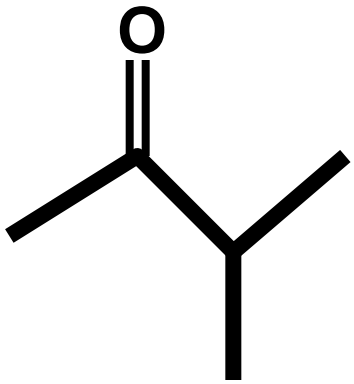
c) all ketones with the formula $C_5H_{10}O$



pentan-2-one



pentan-3-one

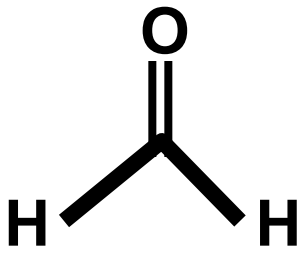


3-methylbutan-2-one

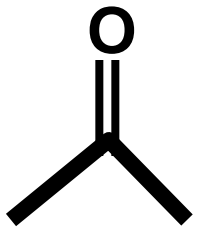
KETONES

Example #7

a) What is the chemical structure of the smallest aldehyde?



b) What is the chemical structure of the smallest ketone?



KETONES

Properties of Aldehydes and Ketones

Aldehydes and ketones have lower boiling points than their corresponding alcohols. Why?

They do not have OH groups so they do not participate in hydrogen-bonding. They can form weaker dipole-dipole interactions.

How do these compounds compare in water solubility compared to alcohols and to hydrocarbon chains?

They are less soluble because they do not form hydrogen bonds with water.

PRACTICE

- Alcohols: Page 34 # 1, 2
- Ethers: Page 38 # 1, 2
- Alcohols, Ethers & Thiols: Page 39 #1, 2, 3
- Aldehydes & Ketones: Page 41 # 1, 2 & 1, 2; Page 46 #1
- Carboxylic Acids: Page 48 # 1, 2
- Esters: Page 50 # 1, 2
- Carboxylic Acids & Esters: Page 55 # 1, 2, 5
- Amines: Page 58 # 1, 2
- Amides: Page 60 #1, 2
- Amines & Amides: Page 62 #1, 2, 3
- Worksheets!