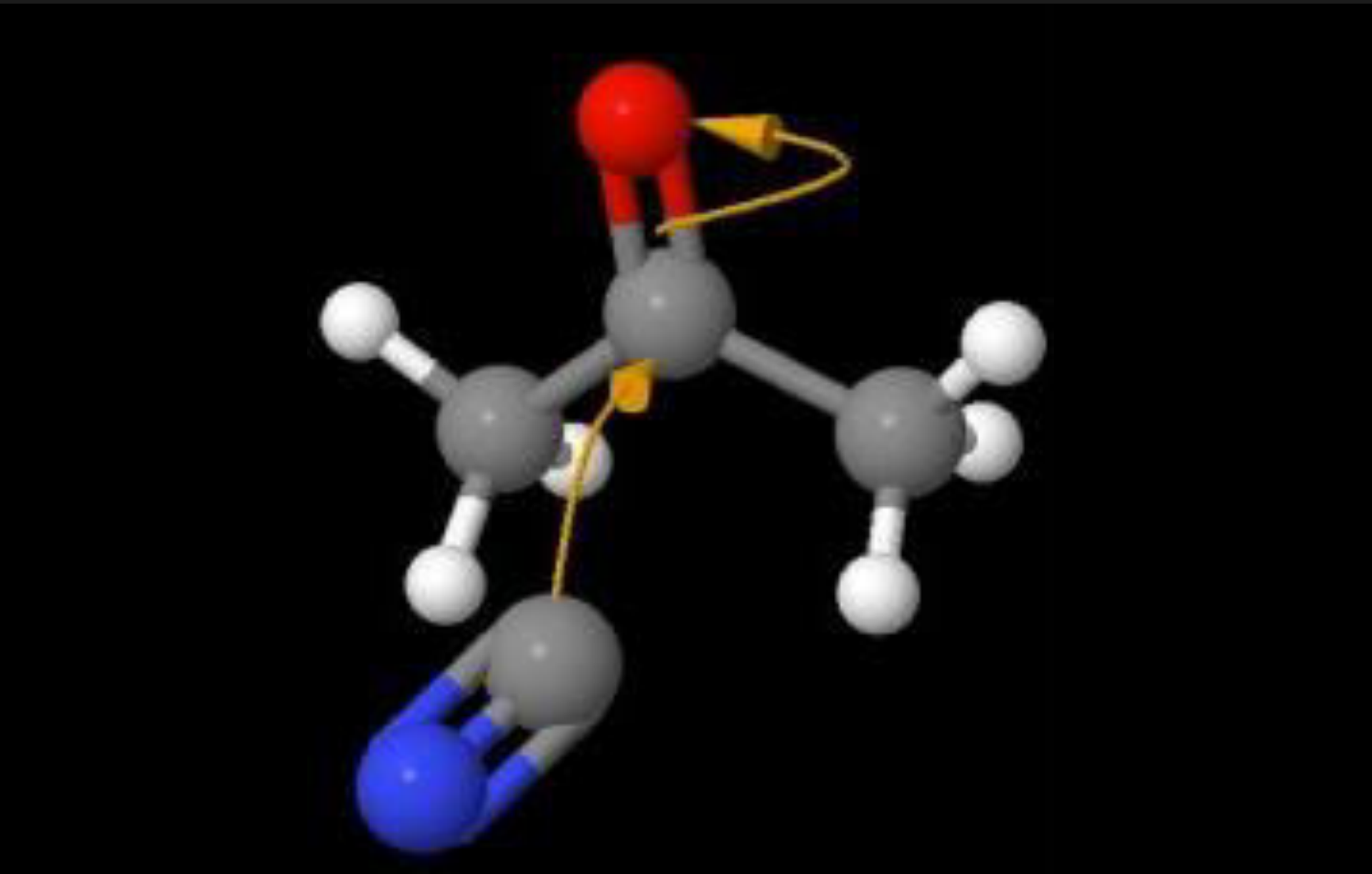
ORGANIC REACTIONS



ORGANIC REACTIONS

5 Types of Reactions

1. Condensation Reactions
2. Addition Reactions
3. Substitution Reactions
4. Elimination Reactions
5. Oxidation Reactions

CONDENSATION REACTIONS

(ETHERS, ESTERS, & AMIDES)

Condensation Reactions

These reactions synthesize new functional group as a result of the release of a water molecule (condensation).

CONDENSATION REACTIONS

involve 3 molecules…

a) Ethers

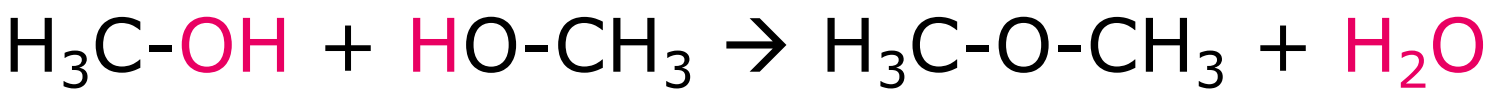
b) Esters

c) Amides

ETHERS

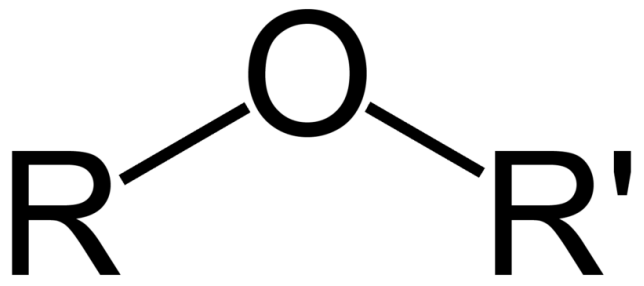
a) Ethers

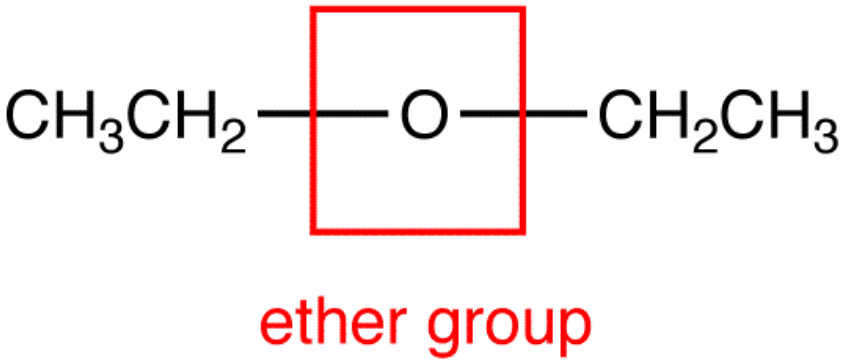
When two hydroxyl groups react, an ether group (C-O-C) bond is produced and water is released.

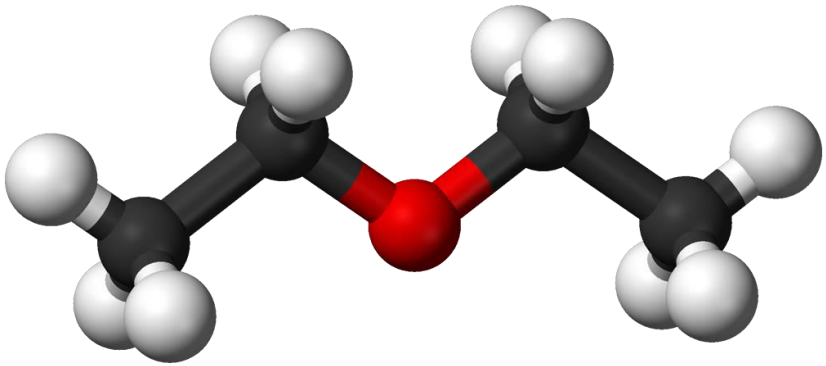


ETHERS

Structure of Ethers:







ETHERS

IUPAC naming system

i. The root of the chemical is the longer C-chain

ii. The shorter C-chain and oxygen comprise the ether side chain and is given the ending "oxy"

iii. The location of the ether group is numbered when necessary

ETHERS

Example #1

What is the IUPAC name for the compound CH_3-O-C_2H_5?

methoxyethane

ETHERS

Common naming system

This system uses the name "ether" as the root and the alkyl names as prefixes.

CH_3-O-C_2H_5 ethylmethyl ether

C_2H_5-O-C_2H_5 diethyl ether

ETHERS

Example #2

Write a balanced equation to show the formation of an ether from propan-1-ol only. Name the ether formed.

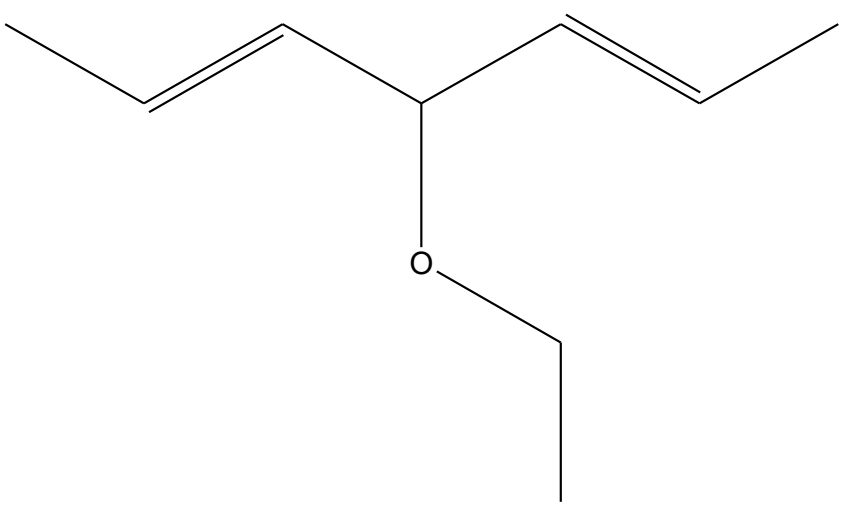
1-propoxypropane

$$CH_3CH_2CH_2OH + CH_3CH_2CH_2OH \xrightarrow{H_2SO_4} CH_3CH_2CH_2OCH_2CH_2CH_3 + H_2O$$

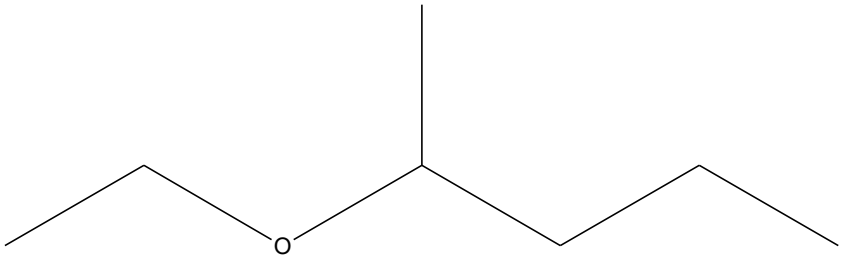
ETHERS

Example #3

Name the following ethers:



(2*E*,5*E*)-4-ethoxyhepta-2,5-diene



2-ethoxypentane

ETHERS

Properties of Ethers

Ethers have _____ boiling points than their hydrocarbon counterparts, but _____ boiling points than their alcohol counterparts.

Ethers are usually effective solvents.

ESTERS

b) Esters

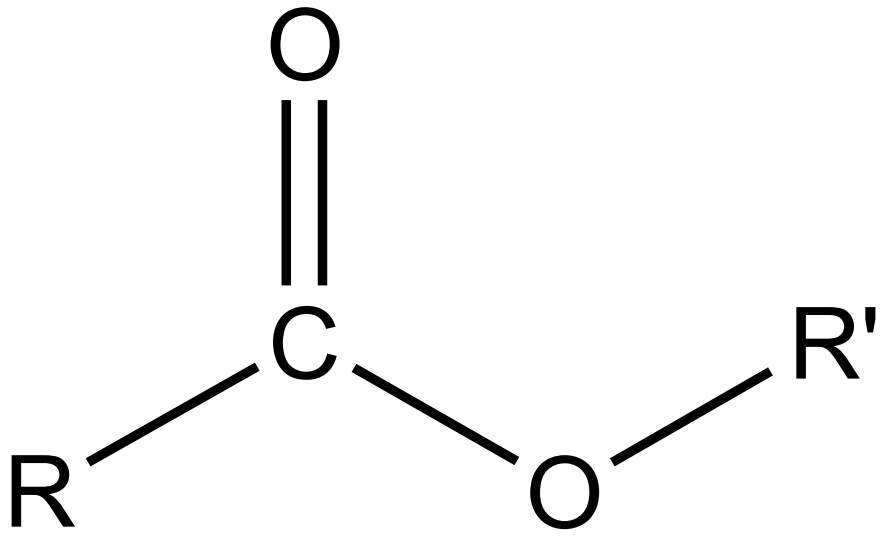
Esters (RCOOR') are formed through the condensation reaction between a hydroxyl group and a carboxylic acid group.

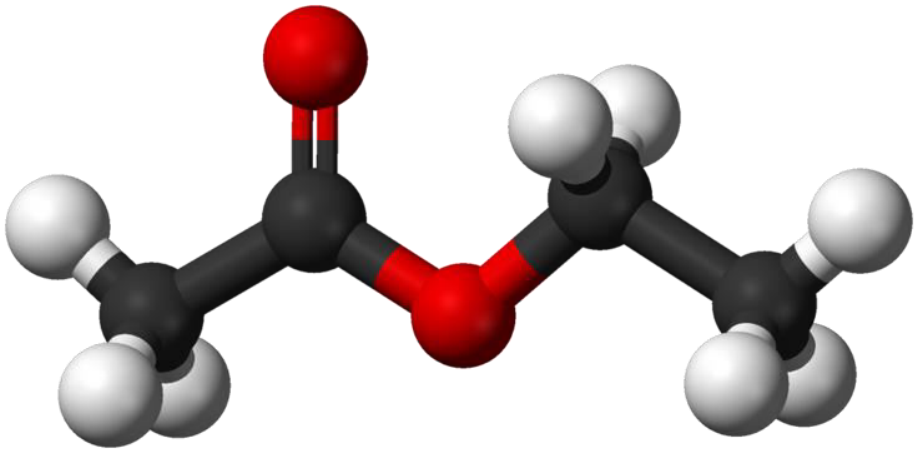
$$CH_3\text{-}OH + HOOCH_3 \xrightarrow[\text{Heat}]{\text{Conc. } H_2SO_4} CH_3\text{-}OOCH_3 + H_2O$$

This condensation reaction is also known as an esterification reaction.

ESTERS

Structure of Esters:





ESTERS

IUPAC naming system

i. The alcohol becomes the alkyl group.

ii. The carboxylic acid is the root, but the "-oic acid" is changed to "-oate".

ESTERS

Example #4

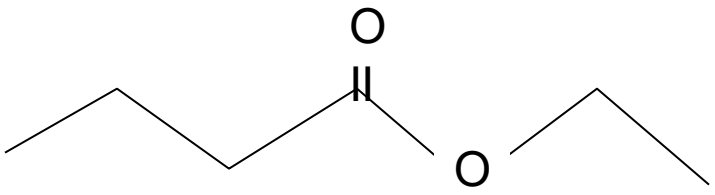
Name the reactants and identify and name the products of the reaction.

$CH_3CH_2CH_2COOH + CH_3CH_2OH$

butanoic acid ethanol

$$\xrightarrow[\text{Heat}]{\text{Conc. } H_2SO_4} CH_3CH_2CH_2COOCH_2CH_3 + H_2O$$

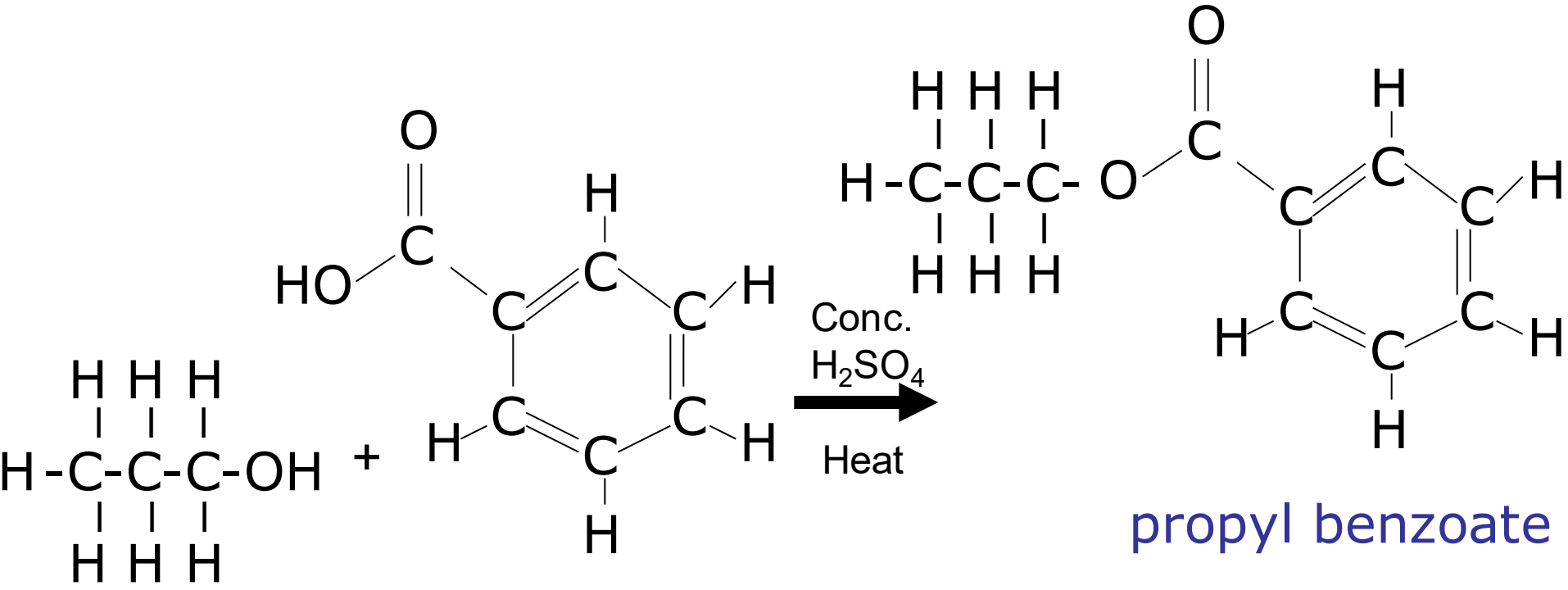
ethyl butanoate



ESTERS

Example #5

Draw the structural diagram and write the IUPAC name for the ester formed in the reaction between propan-1-ol and benzoic acid.

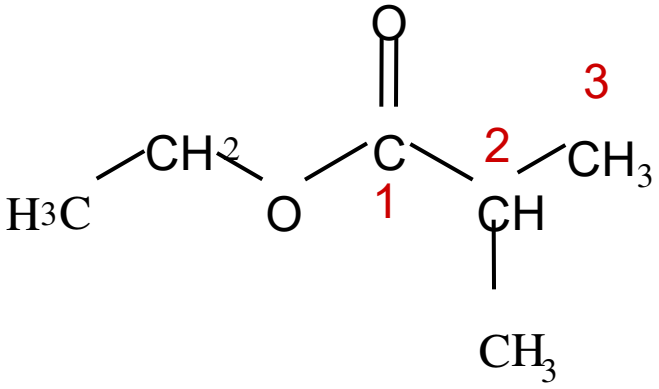


propyl benzoate

ESTERS

Example #6

It there are side chains attached to the carboxylic acid part, then the side chain names are attached to the 'oate' part of the ester name



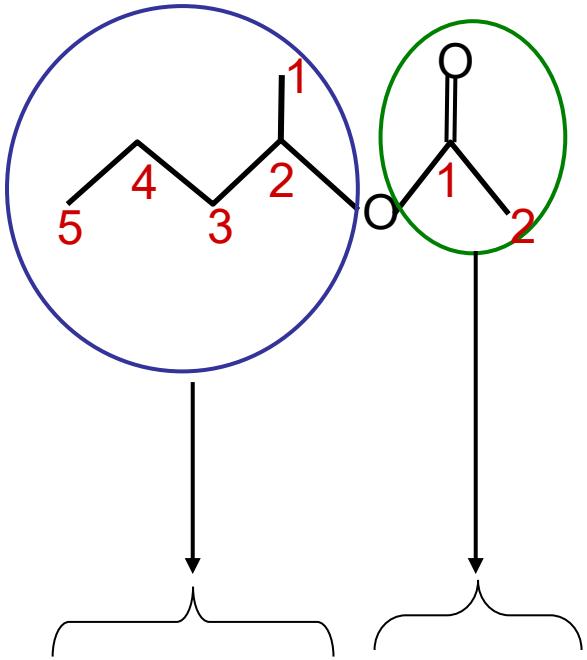
ethyl 2-methylpropanoate

ESTERS

Example #8

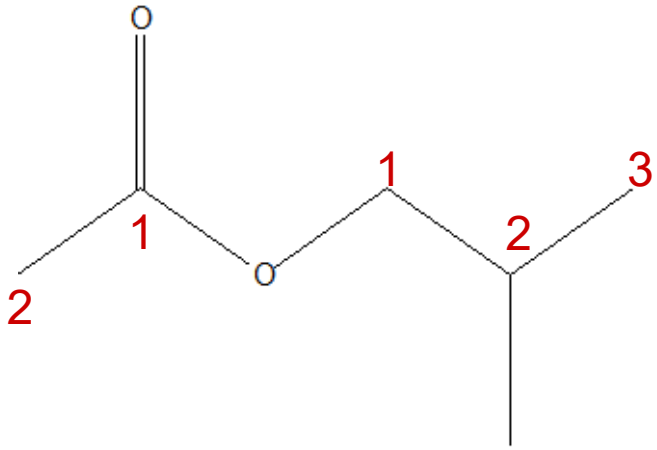
Name the following molecules:

a)



pentan-2-yl ethanoate

b)



2-methylpropyl ethanoate

ESTERS

Properties of Esters

Many aromatic fruits and flowers are due to the natural production of esters. They are also synthetically produced for foods (tastes) and perfumes (odours).

Esters have a _____ boiling point than their carboxylic acid counterpoints.

AMIDES

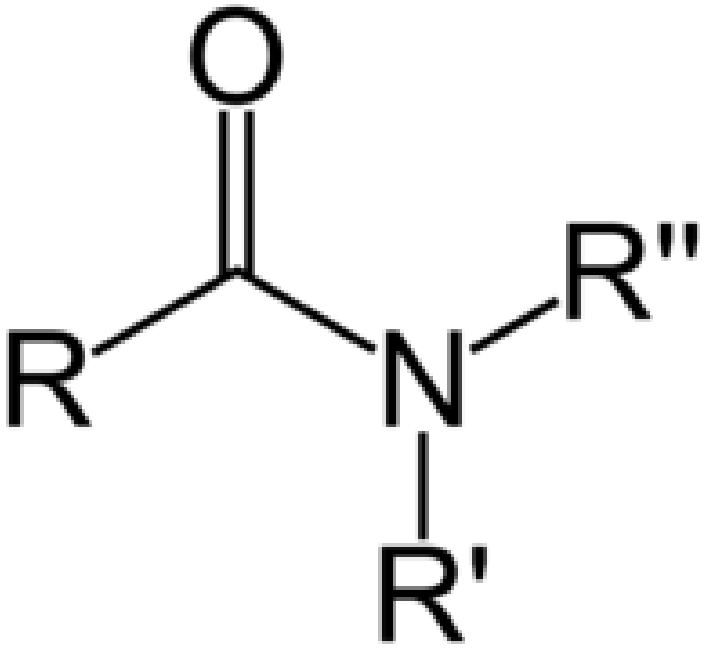
c) Amides

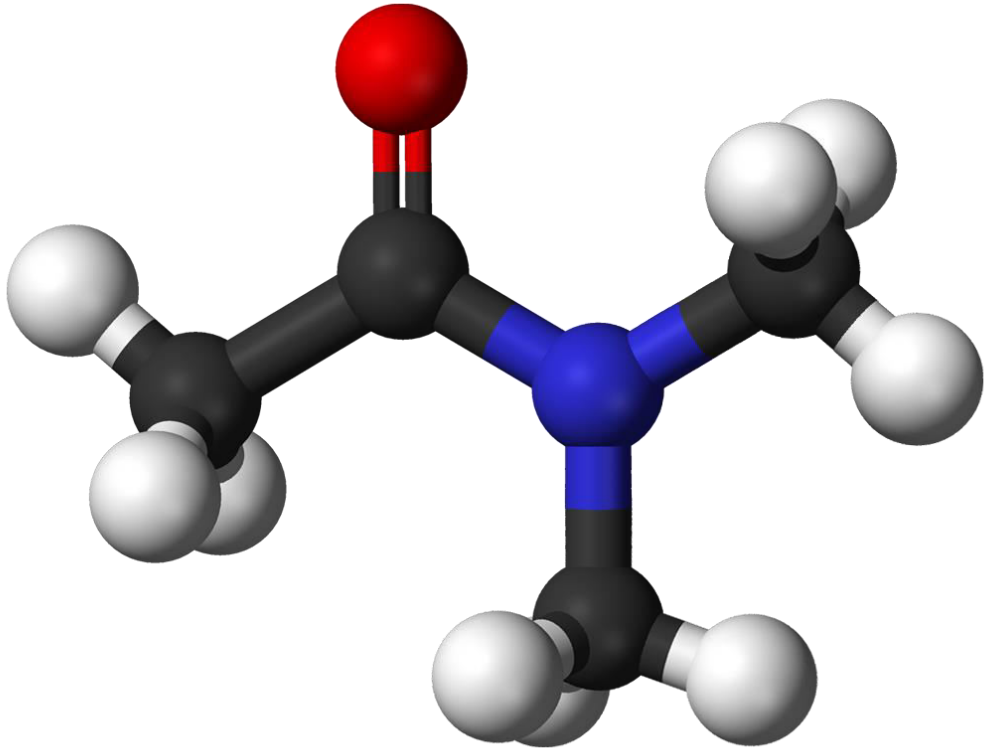
Amides (RCONHR') are produced due to the condensation between a carboxylic acid and an amine / ammonia.

$$HCOOH + H\text{-}NH_2 \rightarrow HCONH_2 + H_2O$$

AMIDES

Structure of Amides





AMIDES

IUPAC naming system

i. The amine becomes the alkyl group.

ii. The carboxylic acid is the root, but the "-oic acid" is changed to "-amide".

AMIDES

Example #9

Name the reactants and identify and name the products of the reaction.

i. $CH_3COOH + NH_3 \rightarrow CH_3CONH_2 + H_2O$

ethanoic acid — ammonia — ethanamide — water

ii. $CH_3CH_2CH_2COOH + CH_3NH_2 \rightarrow$

butanoic acid — methanamine

$CH_3CH_2CH_2CONHCH_3 + H_2O$

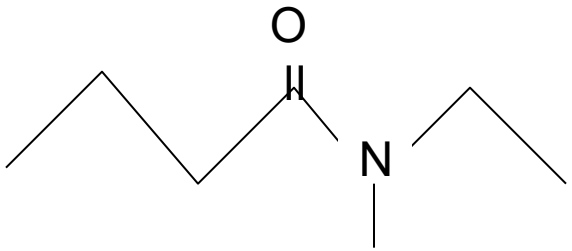
N-methylbutanamide — water

AMIDES

Example #10

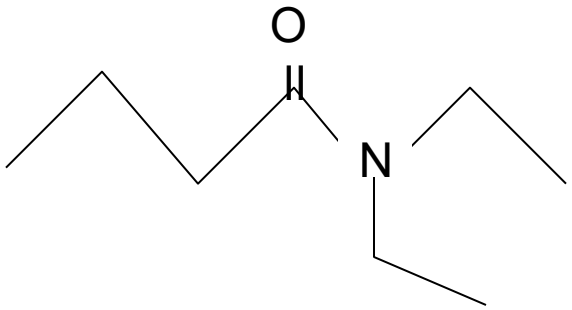
Redraw and name (IUPAC) the following amides.

i. $CH_3CH_2CH_2CON(CH_3)CH_2CH_3$



N-ethyl-*N*-methylbutanamide

ii. $CH_3CH_2CH_2CON(CH_2CH_3)_2$



N,*N*-diethylbutanamide

AMIDES

Properties of Amides

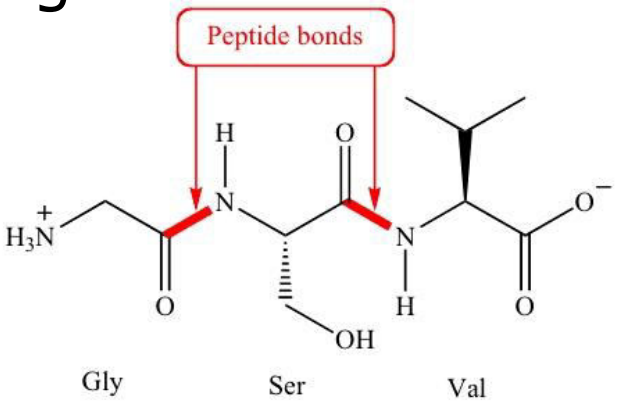
Amides, just like amines, are generally weak bases.

Generally, amides have low boiling points and are not very soluble in water.

AMIDES

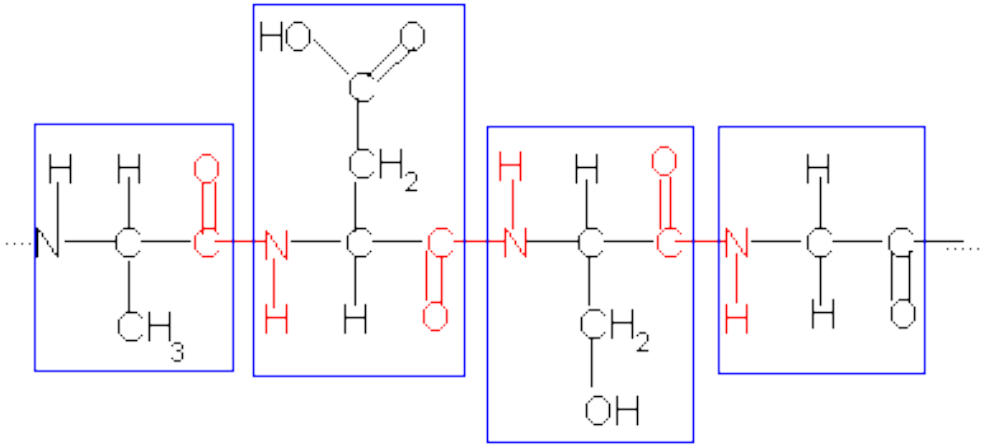
Properties of Amides

- Contain the peptide or amide linkage as their functional group



- Structurally similar to esters

- Amide linkage is very significant in biological systems as the forming and breaking of these bonds give specificity to proteins



HYDROLYSIS

A hydrolysis reaction is the "reverse" of condensation.

A water molecule is used to separate a product formed from a condensation reaction.

$$H_3C\text{-}O\text{-}CH_3 + H_2O \xrightarrow{NaOH} H_3C\text{-}OH + HO\text{-}CH_3$$