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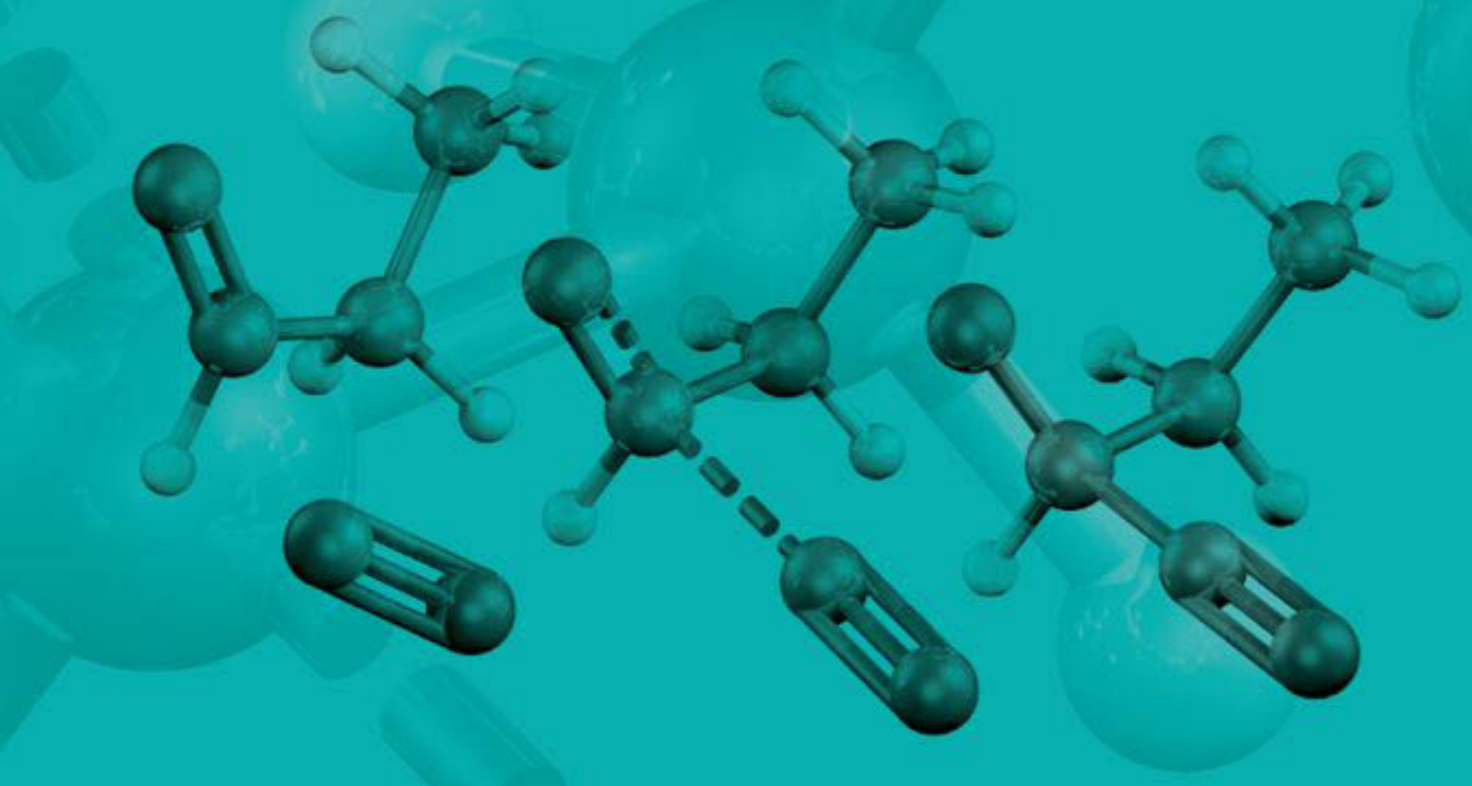
Solutions manual to accompany

ORGANIC CHEMISTRY

SECOND EDITION



Jonathan Clayden and Stuart Warren

Solutions manual to accompany

Organic Chemistry

Second Edition

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Suggested solutions for Chapter 2

2

PROBLEM 1

Draw good diagrams of saturated hydrocarbons with seven carbon atoms having (a) linear, (b) branched, and (c) cyclic structures. Draw molecules based on each framework having both ketone and carboxylic acid functional groups in the same molecule.

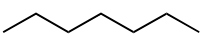
Purpose of the problem

To get you drawing simple structures realistically and to steer you away from rules and names towards more creative and helpful ways of representing molecules.

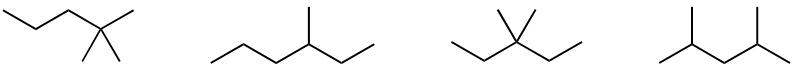
Suggested solution

There is only one linear hydrocarbon but there are many branched and cyclic options. We offer some possibilities, but you may have thought of others.

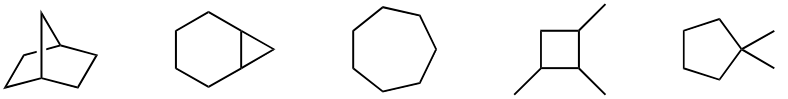
linear saturated hydrocarbon (*n*-heptane)



some branched hydrocarbons

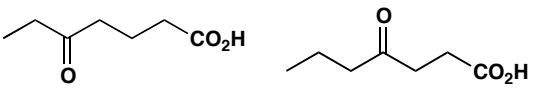


some cyclic hydrocarbons

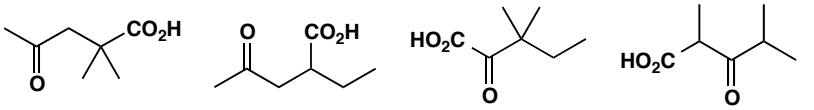


We give you a few examples of keto-carboxylic acids based on these structures. A ketone has to have a carbonyl group not at the end of a chain; a carboxylic acid functional group by contrast *has* to be at the end of a chain. You will notice that no carboxylic acid based on the first three cyclic structures is possible without adding another carbon atom.

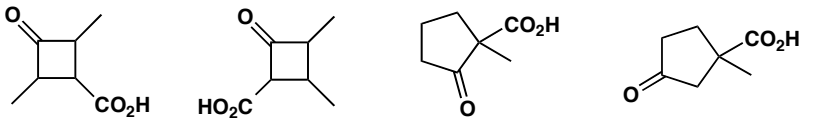
linear molecules containing ketone and carboxylic acid



some branched keto-acids

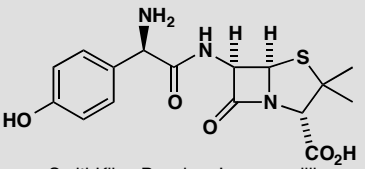


some cyclic keto-acids

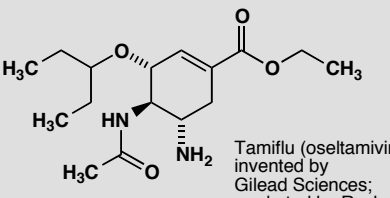


PROBLEM 2

Draw for yourself the structures of amoxicillin and Tamiflu shown on page 10 of the textbook. Identify on your diagrams the functional groups present in each molecule and the ring sizes. Study the carbon framework: is there a single carbon chain or more than one? Are they linear, branched, or cyclic?



SmithKline Beecham's amoxycillin
β-lactam antibiotic
for treatment of bacterial infections



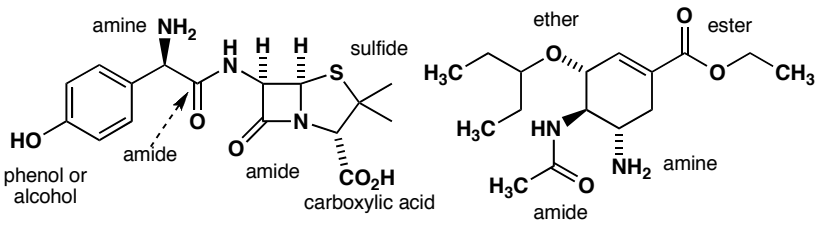
Tamiflu (oseltamivir):
invented by
Gilead Sciences;
marketed by Roche

Purpose of the problem

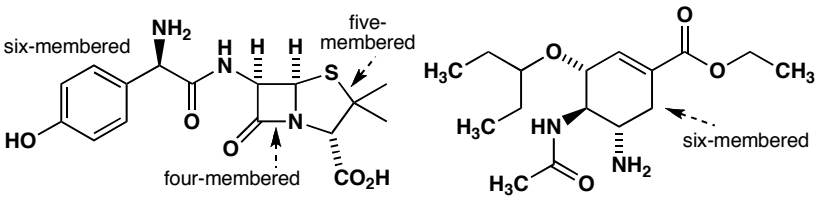
To persuade you that functional groups are easy to identify even in complicated structures: an ester is an ester no matter what company it keeps and it can be helpful to look at the nature of the carbon framework too.

Suggested solution

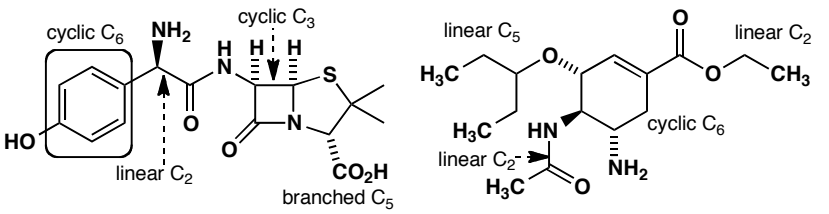
The functional groups shouldn't have given you any problem except perhaps for the sulfide (or thioether) and the phenol (or alcohol). You should have seen that both molecules have an amide as well as an amine.



The ring sizes are easy and we hope you noticed that one bond between the four- and the five-membered ring in the penicillin is shared by both rings.

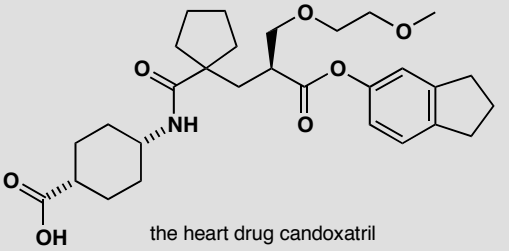


The carbon chains are quite varied in length and style and are broken up by N, O, and S atoms.

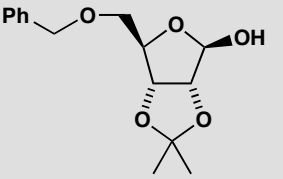


PROBLEM 3

Identify the functional groups in these two molecules



the heart drug candoxatril



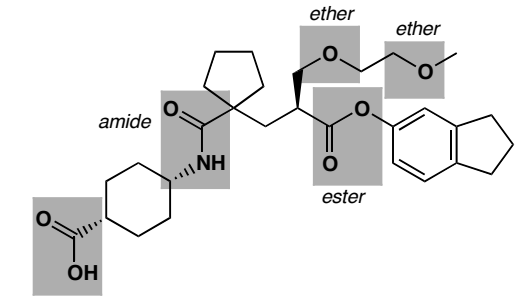
a derivative of the sugar ribose

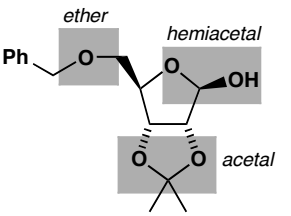
Purpose of the problem

Identifying functional groups is not just a sterile exercise in classification: spotting the difference between an ester, an ether, an acetal and a hemiacetal is the first stage in understanding their chemistry.

Suggested solution

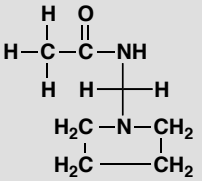
The functional groups are marked on the structures below. Particularly important is to identify an acetal and a hemiacetal, in which both 'ether-like' oxygens are bonded to a single carbon, as a single functional group.

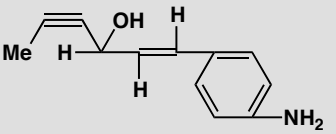




PROBLEM 4

What is wrong with these structures? Suggest better ways to represent these molecules



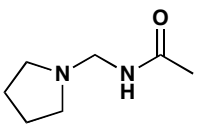


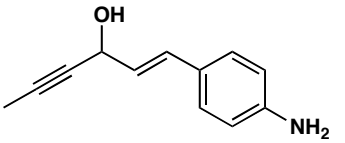
Purpose of the problem

To shock you with two dreadful structures and to try to convince you that well drawn realistic structures are more attractive to the eye as well as easier to understand and quicker to draw.

Suggested solution

The bond angles are grotesque with square planar saturated carbon atoms, bent alkynes with 120° bonds, linear alkenes with bonds at 90° or 180°, bonds coming off a benzene ring at the wrong angles and so on. If properly drawn, the left hand structure will be clearer without the hydrogen atoms. Here are better structures for each compound but you can think of many other possibilities.





PROBLEM 5

Draw structures for the compounds named systematically here. In each case suggest alternative names that might convey the structure more clearly if you were speaking to someone rather than writing.

(a) 1,4-di-(1,1-dimethylethyl)benzene

(b) 1-(prop-2-enyloxy)prop-2-ene

(c) cyclohexa-1,3,5-triene

Purpose of the problem

To help you appreciate the limitations of systematic names, the usefulness of part structures and, in the case of (c), to amuse.