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ABSTRACT

This booklet is one of a set of eight designed to be used in a self-paced introductory chemistry course in conjunction with specified textbooks and computer-assisted instruction (CAI) modules. Each topic is introduced with a textbook reading assignment and additional readings are provided in the booklet. Also included are self-tests (and answers), CAI module assignments, and suggested breakpoints for student-teacher consultations. Supplementary learning materials, including filmstrips, are also suggested. Each booklet contains specific cognitive objectives to be met by completion. This booklet covers basic organic chemistry, including hydrocarbons, functional groups, and cyclic and heterocyclic compounds. (MH)

ILS CHEM PAC No. 7

CARBON

by

William Torop

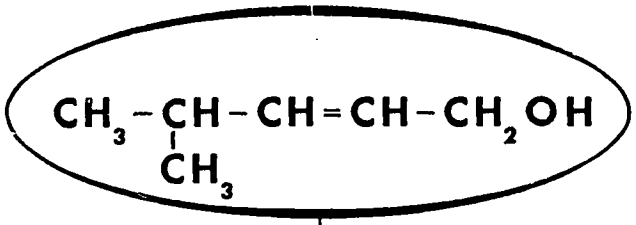
West Chester State College
West Chester, Pennsylvania

Student No. & Name .....

Date Started .....

Date Completed .....

Rules of the I.U.P.A.C. System of Nomenclature Applied



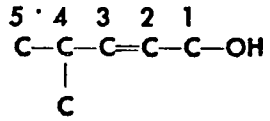
4 – methyl – 2 – pentene – 1 – ol

Rules → *Application*

a) Use the longest continuous chain of carbon atoms (containing the functional groups) as the basis for the name, and name the compound as a derivative of this parent hydrocarbon. → **pent —** (five carbon atoms in the longest chain)

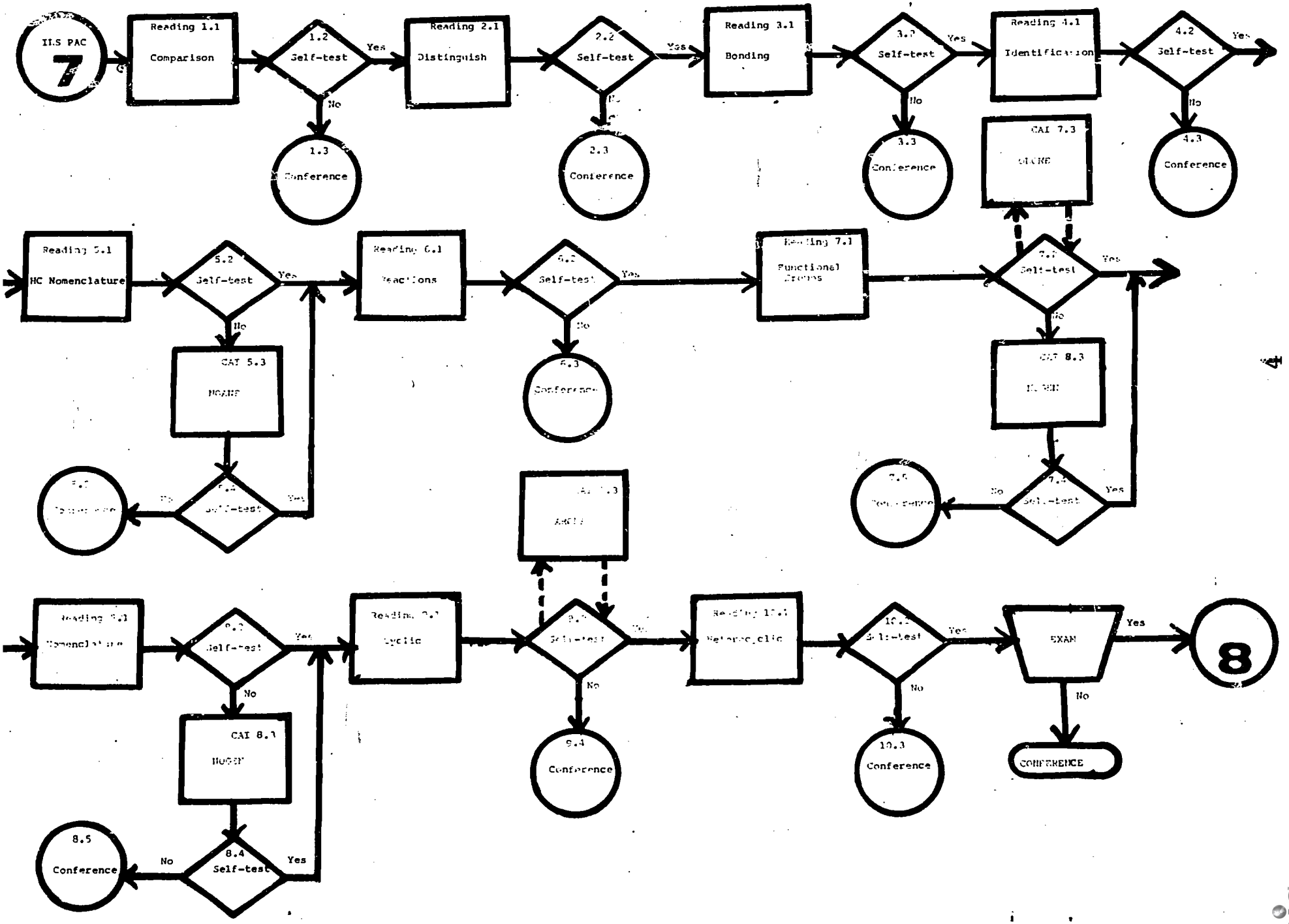
b) Use the appropriate ending to indicate the functional groups present in the molecule. → **pentene ol** (–ene for the double bond; –ol for the alcohol group)

c) Number the longest continuous carbon chain, starting at the end which will give the principal functional group the smallest number. →



d) Locate the functional groups by the numbers of the carbon atoms to which they are attached. → **2 – pentene – 1 – ol**

e) Name and locate by number any other atoms or groups attached to the longest continuous chain. → **4 – methyl – 2 – pentene – 1 – ol** (The methyl group is a substituent on the fourth carbon atom of the main chain)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OBJECTIVES

Upon completion of the ILS Chem Pac on Carbon the student should be able to

1. Compare

Given a list of six properties, compare organic compounds in general with inorganic compounds on the basis of any five of the following properties:

a. combustion
b. rate of reaction
c. melting points
d. solubility in water
e. molecular or ionic reactions
f. number of atoms and complexity of structure

2. Distinguish

Given a list of five possible organic compounds, select the one compound which is inorganic--or given a list of five possible inorganic compounds, select the one compound which is organic.

3. Bonding

Demonstrate an understanding of the nature of organic chemistry by defining, identifying, or distinguishing between such terms as seven of the following:

a. aliphatic
b. aromatic
c. cyclic
d. halogenated methanes
e. heterocyclic
f. hydrocarbon
g. isomer
h. molecular formula
i. structural formula

4. Identification

Given the empirical formulas of ten hydrocarbon molecules, identify eight of the molecules as an alkane, an alkene, an alkyne, and/or as a saturated or an unsaturated hydrocarbon.

5. Hydrocarbon Nomenclature

Given the empirical formula of a hydrocarbon molecule, write and name the structural formulas for all the isomers of the given molecule--or given the names of five hydrocarbons, draw the structural formulas for four of the compounds--or given five structural formulas, name four of the hydrocarbons.

6. Reactions

Given the name or formula of a hydrocarbon molecule and that of a halogen or hydrogen halide, identify the product or products formed when a reaction occurs in eight out of ten given reactions.

7. Functional Groups

Given the name of a class of organic compounds and a list of seven general formulas, identify the formula representative of the given class--or given a general formula, identify the class of organic compounds which it represents. The organic compounds are:

a. acids
b. alcohols
c. aldehydes
d. amines
e. esters
f. ethers
g. ketones

8. Derivative Nomenclature

Given the structural formulas of seven hydrocarbon derivatives, name six of the compounds according to IUPAC nomenclature--or given the IUPAC name, draw or identify the corresponding structural formula. The classes of compounds are:

a. acids
b. alcohols
c. aldehydes
d. amines
e. esters
f. ethers
g. ketones

9. Cyclic Compounds

Demonstrate a knowledge of cyclic compounds by recognizing and/or naming cyclic compounds such as benzene and its halogen derivatives, methyl derivatives, hydroxy derivatives, and multi-benzene ring compounds--as well as aromatic aldehydes, ketones, acids and amines--and state a use for any such compound in eight out of ten given compounds.

10. Heterocyclic Compounds

Demonstrate a knowledge of heterocyclic compounds by classifying and/or describing a compound as a pyrrole, pyridine, pyrimidine, or a purine and stating the medicinal use of various alkaloids in four out of five given compounds.

Reading 1.1 - Read pages 200-201 in Medeiros, page 186 of Sackheim & Schultz, and pages 208-210 in Holum.
Notes:

Generally speaking, most organic compounds are combustible, whereas most inorganic compounds are not combustible. Organic compounds generally react much more slowly than do inorganic compounds. Most organic compounds have a low melting point compared to the higher melting points of most inorganic compounds. Most organic compounds are insoluble in water while many inorganic compounds are water soluble. Organic reactions occur between molecules while inorganic reactions mainly occur between ions. Organic compounds contain many atoms in complex structures whereas inorganic compounds contain fewer atoms in simpler structures.

Self-test 1.2

Compare organic and inorganic compounds on the basis of:

1. combustion
2. rate of reaction
3. melting points
4. solubility in water
5. molecular or ionic reactions
6. number of atoms and complexity of structure

Conference 1.3

If you missed more than one comparison in Self-test 1.2, please consult your instructor. This is the only NO route available at this time.

Date:

Notes:

Reading 2.1 - Read pages 202-203 in Medeiros and first paragraph of page 186 in Sackheim & Schultz.

Notes:

Organic chemistry is the study of the compounds of carbon--both natural and synthetic. Except for carbonates, which are usually studied as inorganic compounds, organic compounds can thus be recognized by the presence of the element carbon. Sodium chloride, NaCl, is inorganic (no carbon) whereas the sugar glucose, $C_6H_{12}O_6$, is an organic compound (six carbon atoms). Carbohydrates, fats, proteins, vitamins, hormones, enzymes, wool, silk, cotton, nylon, rayon, dacron, soap, plastics, and gasoline are also organic compounds. There are more than a million organic compounds containing the element carbon compared to maybe 200,000 known compounds that do not include the element carbon.

Self-test 2.2

Identify the following compounds as organic or inorganic:

1. dacron
2. metal
3. fat
4. vitamin
5. ammonia
6. hydrochloric acid
7. linen
8. dyes
9. calcium hydroxide
10. methane

Conference 2.3

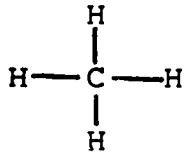
If you missed more than two identifications in Self-test 2.2, please consult your instructor. This is the only NO route available at this time.

Date:

Notes:

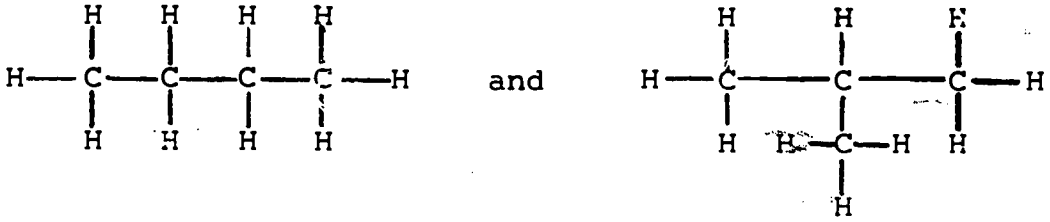
Reading 3.1 - Read pages 203 and 204 in Medeiros, pages 187-190 in Sackheim & Schultz, and pages 211-213 in Holum.
Notes:

The unique feature of the carbon atom is its ability to combine with other carbon atoms to form single, double, and triple covalent bonds in both chains and rings. Carbon is tetravalent--that is, carbon always has four bonds. The simplest hydrocarbon-- a compound consisting exclusively of the elements hydrogen and carbon-- is methane. The molecular formula, CH_4, informs us that there is one carbon and four hydrogen atoms present in the methane molecule. However, it tells us nothing about the arrangement of these five atoms. The four bonds of the carbon atom are arranged in the shape of a tetrahedron. The angle between each pair of hydrogens is 109.5°. This actual structural formula, which is three-dimensional, is represented on a planar surface as:

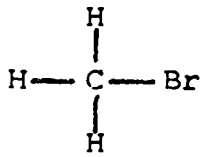


where each dash represents a chemical bond or pair of electrons.

Isomers are defined as compounds having the same molecular formula but different structural formulas. The compound C_4H_{10} has two possible arrangements or isomers:

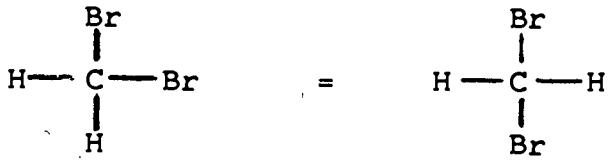


Carbon also forms compounds with elements other than hydrogen. If a bromine atom bonds to a carbon atom, the resulting compound is bromomethane.



Because of the tetrahedral nature of the carbon atom, all four bonds are equivalent and the bromine atom can attach to any one of the four positions. Likewise, if two bromine atoms attach

to one carbon atom, there is only one compound formed--dibromomethane:



These chain type carbon compounds are called aliphatics. Carbon atoms also bond together to form ring compounds called cyclic compounds. Benzene ring compounds are also called aromatic. If some element other than carbon is in the ring, the compounds are called heterocyclic.

Self-test 3.2

Match the following terms with the items supplied:

1. aliphatic
2. aromatic
3. cyclic
4. halogenated methane
5. heterocylic
6. hydrocarbon
7. isomers
8. molecular formula
9. structural formula

a. CH_3-CH_3

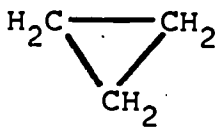
b. CH_3Cl and CH_2Cl_2

c. CH_3-CH_2OH and CH_3-O-CH_3

d.

e.

f.



Conference 3.3

If you missed more than two terms in Self-test 3.3, please consult your instructor. This is the only NO route available at this time.

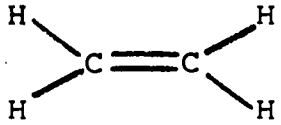
Date:

Notes:

Reading 4.1 - Read pages 204-206 in Medeiros, pages 193-196 and 200-203 in Sackheim & Schultz, and pages 223, 233 & 241 in Holum.
Notes:

The various series of hydrocarbons can be represented by general formulas. The general formula for an alkane (methane series) is: C_nH_{2n+2} where n is the number of carbon atoms. Therefore the number of hydrogen atoms in any alkane is always twice the number of carbon atoms plus two. The compound in reading 3.1, C_4H_{10}, is the alkane called butane. Alkanes have only single bonds between the carbon atoms and are also classified as saturated compounds.

The general formula for an alkene (ethene series) is: C_nH_{2n} There are twice as many hydrogen atoms as carbon atoms in every alkene compound. The first member of this series, C_2H_4, is ethene:



Alkenes thus have one double bond. Unsaturated hydrocarbons contain at least one double bond or one triple bond.

The general formula for an alkyne (acetylene series) is: C_nH_{2n-2}

The first member of this series, C_2H_2, is ethyne: $H-C\equiv C-H$

Self-test 4.2

Identify the following compounds as an alkane, alkene, or alkyne and saturated or unsaturated:

1. C_4H_{10}
2. C_4H_8
3. C_4H_6
4. C_3H_4
5. C_3H_8
6. C_3H_6
7. C_2H_6
8. CH_4
9. C_2H_4
10. C_2H_2

Conference (4.3)

If you missed more than two compounds in Self-test 4.2, please consult your instructor. This is the only NO route available at this time.

Date:

Notes:

Reading 5.1 - Read pages 197-199 in Sackheim & Schultz, and pages 224-230 in Holum.
Notes:

The following information is absolutely essential to naming hydrocarbon compounds and should be committed to memory.

The first ten members of the alkane series.

Name	Molecular Formula
methane	CH_4
ethane	C_2H_6
propane	C_3H_8
butane	C_4H_{10}
pentane	C_5H_{12}
hexane	C_6H_{14}
heptane	C_7H_{16}
octane	C_8H_{18}
nonane	C_9H_{20}
decane	$C_{10}H_{22}$

The names of organic radicals (formed by removing a hydrogen atom from a hydrocarbon) are obtained by changing the ending of the name from --ane to --yl in the above list. Thus C_2H_5 is the ethyl radical while CH_3 is the methyl radical.

The names of the alkenes are obtained by changing the ending of the name from --ane to --ene in the previous list. Thus we obtain ethene for C_2H_4, propene for C_3H_6, and so on.

The names of the alkynes are obtained by changing the ending of the name from --ane to --yne in the same list. C_2H_2 is ethyne and C_3H_4 is propyne.

Consequently, by knowing the names of the first ten members of the alkane series and the characteristic ending for naming the other series, you should be able to name any hydrocarbon by following these rules:

1. Select the longest, continuous chain of carbon atoms as the basic name.

2. Indicate by number the C atom at which any radicals are attached.

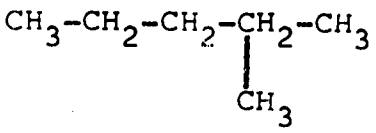
3. Number the carbon atoms in the chain consecutively from one end to the other but start at whichever end of the chain yields the smallest numbers to the carbons having radicals attached.

4. Use prefixes di, tri, etc., if the same group appears more than once as well as numbers to denote the location of each group.

5. Use commas to separate numbers and dashes to separate numbers from letters. No spaces should appear in the name.

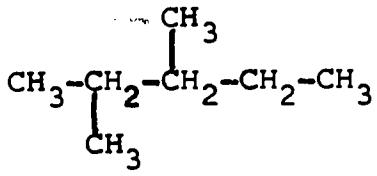
6. Ring compounds begin their name with the term cyclo.

Identify the following compound:



The longest chain contains ..... (1) carbon atoms; therefore, the basic name is pentane. Attached to the chain is a radical of one carbon atom, the CH_3 or ..... (2) radical. Thus, the compound is methyl pentane. Next we number the carbons in the chain. It can be observed that the methyl radical is located on the second carbon atom from the right and/or the fourth carbon atom from the left end. Consequently, the correct name of this compound is .....(10) which indicates that there is a methyl radical on the second carbon atom from the end in a chain of five carbon atoms. It does not matter whether the methyl group is located above or below the carbon atom to which it is attached.

Name the following compound:



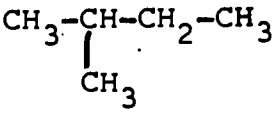
The longest chain contains five carbon atoms; therefore, it is some kind of ..... (4). There are ..... (5) methyl radicals attached to the chain. This time we number from left to right and the name of the compound is .....(6) where the prefix di- indicates that there are two radicals. Dimethyl means two methyl radicals and the numbers 2,3- tell us one methyl group is attached to the second carbon atom from the end of the chain and the other methyl group is attached to the third carbon atom.

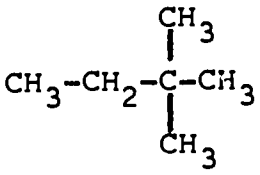
The answers to Reading 5.1 are:

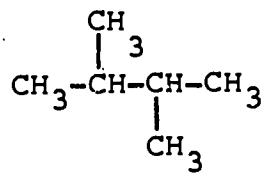
1. 5
2. methyl
3. 2-methylpentane
4. pentane
5. 2
6. 2,3-dimethylpentane

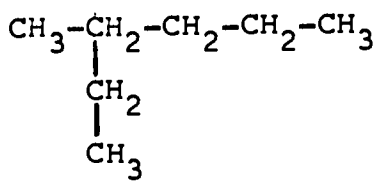
Self-test 5.2

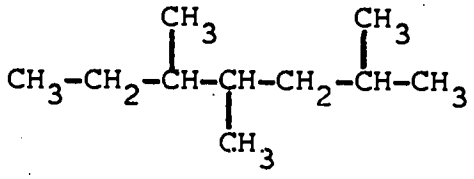
Name the following compounds:

1. 

2. 

3. 

4. 

5. 

Draw structural formulas for the following compounds:

6. hexane
7. pentene
8. propyne
9. octane
10. cyclopropane

If you missed more than one formula or one name in Self-test 5.2, take the NO route (CAI 5.3).

CAI 5.3 - NOANE - Organic Nomenclature

The first part of this module will require you to demonstrate your knowledge of the names and formulas of the alkanes, methane through decane. A brief review of IUPAC nomenclature rules is available. The rest of the module is a drill on IUPAC alkane and cycloalkane nomenclature.

You may stop at any time. A computer system idiosyncrasy requires that any name containing one or more commas be headed by quotes (").

An example of the correct format is:

"2,3-dimethylbutane" for $CH_3-CH(CH_3)-CH(CH_3)-CH_3$

Date completed:

Self-test 5.4

This Self-test is CAI module QUANE. The module is a five question examination of your proficiency in alkane and cycloalkane nomenclature, four of which should be answered correctly.

You may terminate this quiz at any time by entering ST. Names containing one or more commas must be headed by quotes (").

Conference 5.5

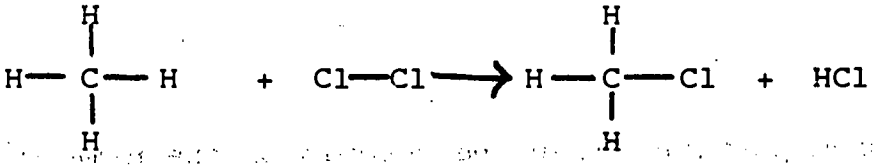
If you are still having difficulty with organic nomenclature at this point, please see your instructor.

Date:

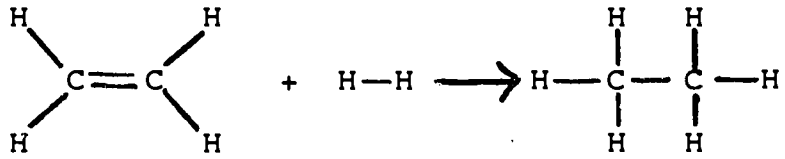
Notes:

Reading 6.1 - Read pages 206-209 in Medeiros, page 203 in Sackheim & Schultz, and pages 231, 232, & 235-240 in Holum.
Notes:

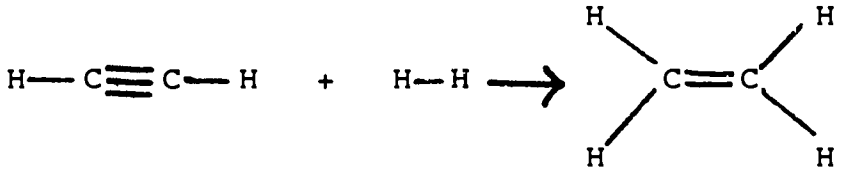
Saturated hydrocarbons (alkanes) react by substitution--an atom of an element is substituted for one of the hydrogen atoms. Methane, CH_4, reacts with chlorine, Cl_2, to produce chloromethane and hydrogen chloride.



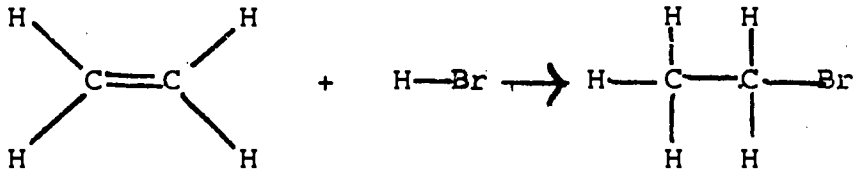
Unsaturated hydrocarbons (alkenes and alkynes) react by addition--atoms add to the double bond or triple bond forming a single bond out of the double or triple bond eventually. Ethene, C_2H_4, reacts with hydrogen, H_2, to form ethane, C_2H_6.



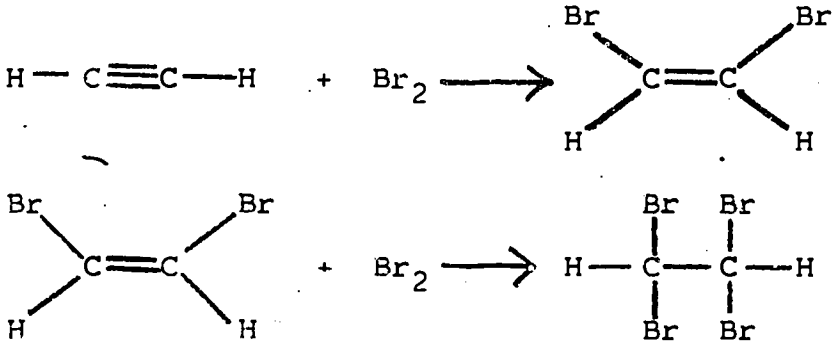
Ethyne, C_2H_2, reacts with hydrogen, H_2, to first form ethene, C_2H_4 -- and if enough hydrogen is available, the final product is ethane as in the above reaction.



The halogens and hydrogen halides add to alkenes and alkynes in the same manner as hydrogen. Ethene, C_2H_4, plus hydrogen bromide, HBr, yields bromoethane, C_2H_5Br.



Ethyne, C_2H_2, plus bromine, Br_2, yields at first dibromoethene and finally tetrabromoethane.



Self-test 6.2

Name the major product of each reaction:

1. $CH_4 + 2\ Br_2 =$
2. $CH_4 + 3\ Br_2 =$
3. $CH_4 + 4\ Br_2 =$
4. $C_2H_4 + Br_2 =$
5. $C_2H_4 + HCl =$
6. $C_2H_2 + Cl_2 =$
7. $C_2H_2 + 2\ Cl_2 =$
8. $C_2H_2 + HBr =$
9. $C_2H_2 + H_2 =$
10. $C_2H_2 + 2\ H_2 =$

Conference 6.3

If you missed more than two reactions in Self-test 6.2, please consult your instructor. This is the only NO _oute available at this time.

Date:

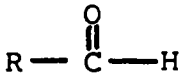
Notes:

Reading 7.1 - Read pages 212-219 in Medeiros, pages 207-212 and 215-225 in Sackheim & Schultz, and page 216 in Holum.
Notes:

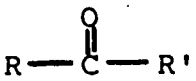
A functional group imparts certain properties to the radical to which it is attached. The functional group of an alcohol is the hydroxyl (-OH) group. The general formula for an alcohol is ROH where R represents a hydrocarbon radical. Alcohols, therefore, are derivatives of hydrocarbons in which one or more hydrogen atoms have been replaced by a hydroxyl group.

The general formula for an ether is ROR'. R' may or may not be the same radical as R.

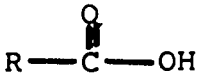
Aldehydes all contain the -CHO group in which the oxygen is double bonded to the carbon and the hydrogen is attached by a single bond. The general formula for an aldehyde is RCHO which is:



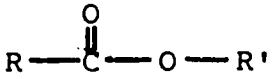
The functional group of a ketone is the carbonyl group C=O (which is also present in aldehydes). However, the general formula of a ketone is RCOR' which is:



The functional group of an organic acid is the carboxyl group (-COOH) and the general formula of an acid then is RCOOH. The carboxyl group consists of a carbonyl group and a hydroxyl group as indicated:



The general formula for an ester is RCOOR' which is:



Amines are derived from ammonia. RNH_2 is the general formula of a primary amine.

Self-test 7.2

Match the functional groups with the class name:

1.	acid	a.	-OH
2.	alcohol	b.	-O-
3.	aldehyde	c.	-CHO
4.	amine	d.	-CO-
5.	ester	e.	-COOH
6.	ether	f.	-COO-
7.	ketone	g.	$-NH_2$

If you are still having difficulty with recognizing functional groups, go to CAI 8.3 which also involves their nomenclature.

CAI 7.3 - OLONE - Alcohol Oxidation

This is NOT a NO route. It is an additional and optional excursion.

This module is a simulated experiment involving the oxidation of cyclohexanol to cyclohexanone using $Na_2Cr_2O_7$ and H_2SO_4.

During this experiment you may review a list of the experimental actions possible by entering CODES.

Self-test 7.4

Computer module NOGEN (CAI 8.3) will also serve as Self-test 7.4 Six out of the seven classes represented should be correctly identified.

Date Completed:

Conference 7.5

If you are still having difficulty recognizing functional groups, please see your instructor.

Date:

Notes:

Reading 8.1 - Read the same references given in Reading 7.1.

Notes:

Once again you need only to remember the first ten members of the alkane series, the functional group for a particular class of organic compounds, and the characteristic ending used in naming the class to be able to name these hydrocarbon derivatives. The characteristic ending used in naming alcohols (ROH) is -ol. Thus CH_3OH is methanol and CH_3CH_2OH is ethanol.

Ethers (ROR') are named as -oxy compounds. Thus CH_3OCH_3 is methoxymethane; $CH_3OCH_2CH_3$ is methoxyethane; and $CH_3CH_2OCH_2CH_3$ is ethoxyethane.

The characteristic ending in naming aldehydes (RCHO) is -al. Thus CH_3CHO is ethanal and CH_3CH_2CHO is propanal.

Ketones (RCOR') are named using the ending -one. CH_3COCH_3 is propanone and $CH_3CH_2COCH_3$ is butanone.

Acids (RCOOH) are named using the ending -oic plus the word acid. Thus HCOOH is methanoic acid while CH_3COOH is ethanoic acid.

Esters (RCOOR') are named as alky salts of organic acids. The characteristic ending is -oate. $HCOOCH_3$ is methyl methanoate and $HCOOCH_2CH_3$ is ethyl methanoate.

Amines (RNH_2) can be named as amino substituted hydrocarbons. CH_3NH_2 is amino methane and $CH_3CH_2NH_2$ is amino ethane.

Self-test 8.2

Name the following compounds:

1. $CH_3-CH_2-CH_2-OH$
2. $CH_3-O-CH_2-CH_2-CH_3$
3. $CH_3-CH_2-CH_2-CHO$
4. $CH_3-CH_2-CH_2-CO-CH_3$
5. CH_3-CH_2-COOH
6. $CH_3-COO-CH_2-CH_3$
7. $CH_3-CH_2-CH_2-NH_2$

Write formulas for:

8. ethanol

9. propanal

10. butanone

If you missed more than one name or formula in Self-test 8.2, take the NO route (CAI 8.3).

CAI 8.3 - NOGEN - Organic Nomenclature

This module provides drill and practice in naming selected examples of various classes of organic compounds. The classes represented are:

1. Aliphatics
2. Cyclics
3. Alkyl halides
4. Alcohols
5. Ethers
6. Esters
7. Acids

You may enter AID for any compound that is presenting difficulty and a representative example of that class of compound is presented and named. You may STOP at anytime. Again any name containing one or more commas must be headed by quotes (").

Date Completed:

Self-test 

CAI 8.3 will also serve as Self-test 8.4. Eight out of ten compounds presented in serial order should be correctly named.

Conference 

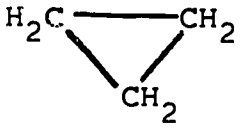
If you are still having difficulty naming organic compounds, please see your instructor.

Date:

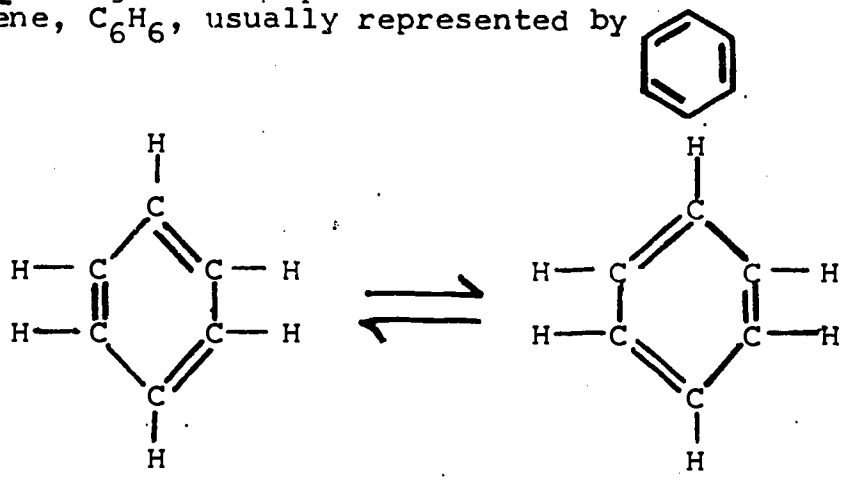
Notes:

Reading 9.1 - Read pages 207-209 in Medeiros, pages 228-242 in Sackheim & Schultz, and pages 241-243 in Holum.
Notes:

A cyclic compound is a ring compound. The simplest cyclic hydrocarbon is cyclopropane:



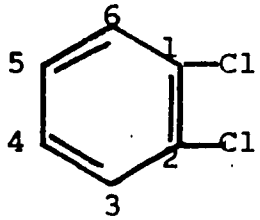
Aromatic designates compounds whose structure is based upon that of benzene, C_6H_6, usually represented by



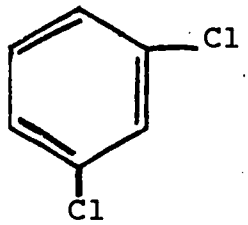
The position of the double and single bonds can change, as indicated above. Resonance is the term applied to this shifting of the bonds.

Benzene reacts with chlorine to form chlorobenzene. Since all six hydrogen atoms and all carbon atoms are equivalent in the benzene ring, there is only one possible chlorobenzene.

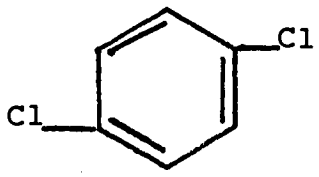
When two of the hydrogen atoms in the benzene ring are replaced, there are three possible products. To name such products, the benzene ring is numbered from 1 to 6.



1,2-dichlorobenzene



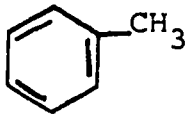
1,3-dichlorobenzene



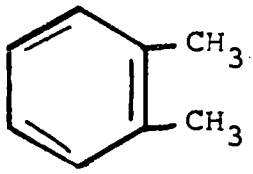
1,4-dichlorobenzene

Another system utilizes prefixes rather than numbers to indicate positions in the benzene ring. The prefix ortho indicates substances on the benzene ring in positions next to each other (positions 1 and 2). When substituents on the benzene ring are separated by one carbon atom (positions 1 and 3), the prefix used is meta. When the two substitutents are opposite one another on the benzene ring (positions 1 and 4) the prefix used is para. Thus, the previous compounds can also be named orthodichlorobenzene, metadichlorobenzene, and paradichlorobenzene.

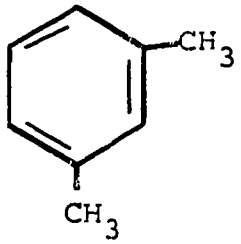
The methyl derivative of benzene is commonly called toluene.



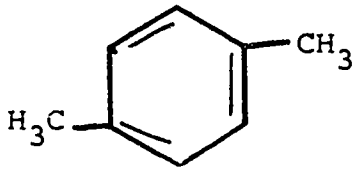
Dimethyl benzene is commonly called xylene. There are three possible structures:



orthoxylene

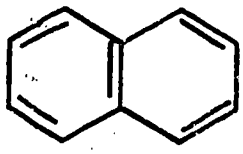


metaxylene

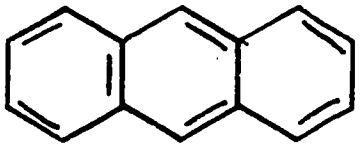


paraxylene

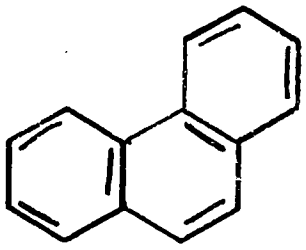
Naphthalene, $C_{10}H_8$, is an aromatic compound containing two benzene rings.



Three benzene rings can also be joined together.

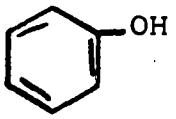


anthracene

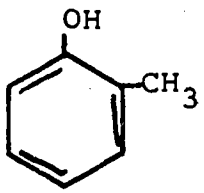


phenanthrene

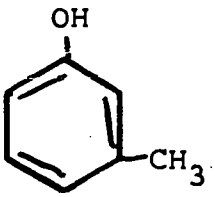
Phenols are a class of compounds in which an -OH is attached to a ring system.



The methyl derivative of phenol is called cresol. There are three possible structures:



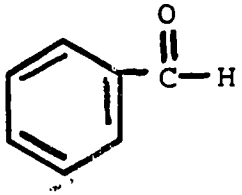
o-cresol



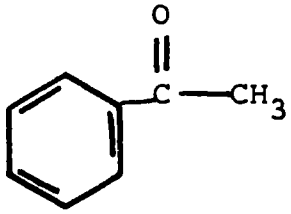
m-cresol

p-cresol

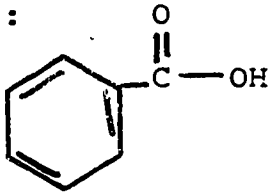
The general classes of organic compounds are also valid for ring compounds. Aldehydes, with a general formula of RCHO, can have either a radical or a ring for the "R". The simplest aromatic aldehyde is benzaldehyde--an aldehyde group attached to a benzene ring.



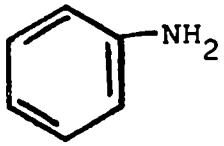
Likewise, an aromatic ketone is:



and benzoic acid is:

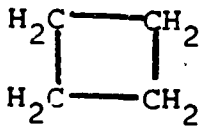


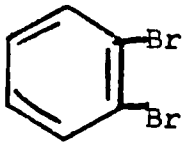
while aminobenzene is commonly called aniline:

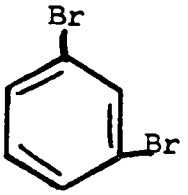


Self-test 9.2

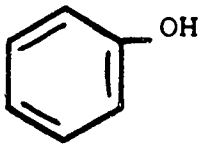
Name the following compounds:

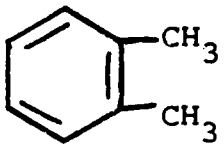
1. 

2. 

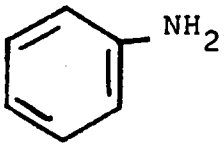
3. 

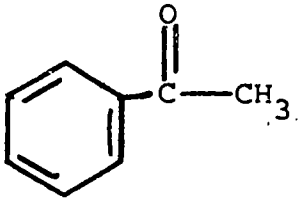
4. 

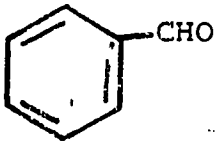
5. 

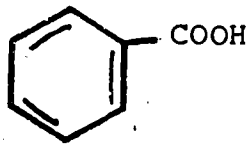
6. 

Classify the following compounds:

7. 

8. 

9. 

10. 

Conference 9.4

If you are still having difficulty with cyclic compounds, please consult your instructor. This is the only NO route available at this time.

Date:

Notes:

CAI 9.3 - AROMA - Organic Synthesis

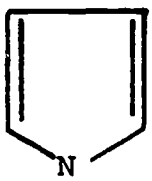
This is NOT a NO route. It is an additional and optional excursion.

This module is a simulated experiment involving syntheses that are related to electrophilic aromatic substitution reactions. The reagents benzene, ethylbenzene, HNO_3/H_2SO_4, Br_2/Fe and $KMnO_4$ may be used in the synthesis of the compound which is randomly generated. You indicate choice of reagent or request SKIP, AID, RESTART, ANSWER, or STOP.

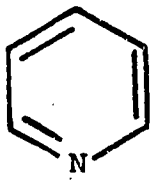
Date Completed:

Reading 10.1 - Read pages 245 and 259-261 in Medeiros, and pages 245-248 in Sackheim & Schultz, and pages 272 & 273 in Holum.
Notes:

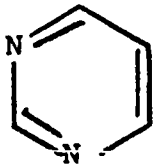
Heterocyclic compounds are ring compounds that contain some element other than carbon in the ring. Common examples are:



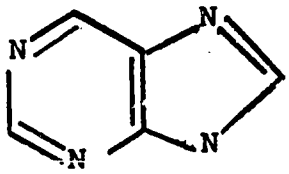
pyrrole



pyridine



pyrimidine

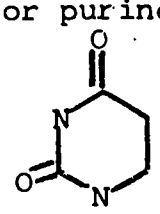


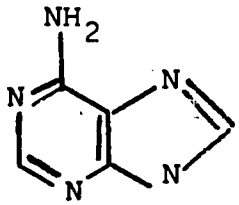
purine

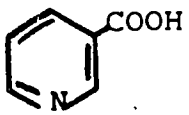
Alkaloids are nitrogen-containing compounds of plant origin that, for the most part, have a marked effect upon the central nervous system. Reading 10.1 will indicate the medicinal use of various alkaloids.

Self-test 10.2

Classify the following compounds as a pyrrole, pyridine, pyrimidine, or purine:

1. 

2. 

3. 

4. hemoglobin

5. chlorophyll

Conference (10.3)

If you are still having difficulty with heterocyclic compounds, please see your instructor. This is the only NO route available at this time.

Date:

Notes:

EXAM

ILS Pac 7 Exam will consist of 30 questions.

Objective 1 - Compare - 1 question

Objective 2 - Distinguish - 2 questions

Objective 3 - Bonding - 2 questions

Objective 4 - Identification - 2 questions

Objective 5 - Hydrocarbon Nomenclature - 4 questions

Objective 6 - Reactions - 2 questions

Objective 7 - Functional Groups - 7 questions

Objective 8 - Derivative Nomenclature - 6 questions

Objective 9 - Cyclic Compounds - 2 questions

Objective 10 - Heterocyclic Compounds - 2 questions

See ILS Pac 0 (Student Directions) for Grading System Equivalents. Please remember that although the Exam is necessary for a grade it may not be sufficient. You may also be asked to have a final conference with your instructor.

CONFERENCE

Date:

Notes:

SUPPLEMENTARY MATERIAL

Objective 3 - Bonding

Audio-Tape A6: Structure and Reactions in Organic Chemistry

Audio-Tape A7: Methods of Determining Molecular Structure

Film Loop: Drawing Structures, Part I and Part II

Objective 5 - Nomenclature

Program-Tape #33: Organic Chemistry I, Hydrocarbon Nomenclature

Objective 6 - Reactions

Program-Tape #35: Organic Chemistry III, Reactions

Objective 7 - Functional Groups

Program-Tape #34: Organic Chemistry II, Functional Groups

Objective 9 - Cyclic Compounds

Program-Tape #36: Organic Chemistry IV, Aromatic Nomenclature and Reactions

ANSWERS

Self-test 1.2

Organic compounds are

1. combustible
2. slower
3. lower
4. insoluble
5. molecular
6. many atoms - complex

Self-test 2.2

1. organic
2. inorganic
3. organic
4. organic
5. inorganic
6. inorganic
7. organic
8. organic
9. inorganic
10. organic

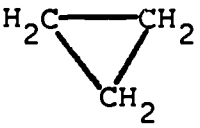
Self-test 3.2

1. a and/or b
2. d
3. f
4. b
5. e
6. a, d and/or f
7. c
8. b
9. a, c, d, e and/or f

Self-test 4.2

1. alkane - saturated
2. alkene - unsaturated
3. alkyne - unsaturated
4. alkyne - unsaturated
5. alkane - saturated
6. alkene - unsaturated
7. alkane - saturated
8. alkane - saturated
9. alkene - unsaturated
10. alkyne - unsaturated

Self-test 5.2

1. 2-methylbutane
2. 2,2-dimethylbutane
3. 2,3-dimethylbutane
4. 3-methylhexane
5. 2,4,5-trimethylheptane
6. $CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$
7. $CH_3-CH_2-CH_2-CH=CH_2$
8. $CH_3-C\equiv CH$
9. $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
10. 

Self-test 6.2

1. dibromomethane
2. tribromomethane (bromoform)
3. tetrabromomethane (carbon tetrabromide)
4. 1,2-dibromoethane
5. chloroethane
6. 1,2-dichloroethene
7. 1,1,2,2-tetrachloroethane
8. bromoethene
9. ethene
10. ethane

Self-test 7.2

1. e
2. a
3. c
4. g
5. f
6. b
7. d

Self-test 8.2

1. propanol
2. methoxypropane
3. butanal
4. 2-pentanone
5. propanoic acid
6. ethylethanoate
7. aminopropane
8. CH_3-CH_2-OH
9. CH_3-CH_2-CHO
10. $CH_3-CH_2-CO-CH_3$

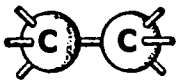
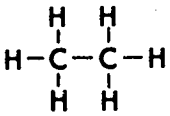
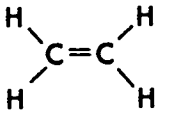
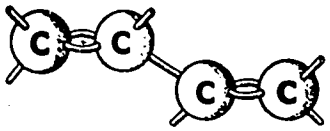
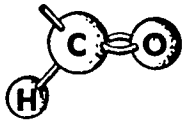
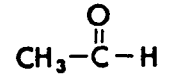
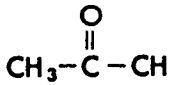
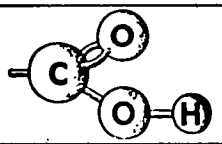
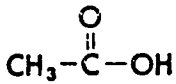
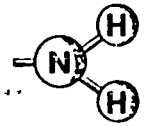
Self-test 9.2

1. cyclobutane
2. 1,2-dibromobenzene (orthodibromobenzene)
3. 1,3-dibromobenzene (metadibromobenzene)
4. 1,4-dibromobenzene (paradibromobenzene)
5. phenol (hydroxybenzene)
6. 1,2-dimethylbenzene (orthoxylene)
7. amine
8. ketone
9. aldehyde
10. acid

Self-test 10.2

1. pyrimidine
2. purine
3. pyridine
4. pyrrole
5. pyrrole

Functional Groups

FUNCTIONAL GROUP	TYPE OF COMPOUND	I. U. P. A. C. ENDING	SPECIFIC EXAMPLE	NAMES	
				COMMON	I. U. P. A. C.
	Alkane	-ane		Ethane	Ethane
	Alkene	-ene		Ethylene	Ethene
	Alkyne	-yne	$H-C\equiv C-H$	Acetylene	Ethyne
	Diene	-diene	$CH_2=CH-CH=CH_2$	Butadiene	1,3-Butadiene
	Alcohol	-ol	CH_3CH_2-OH	Ethyl Alcohol	Ethanol
	Ether	——	$CH_3CH_2-O-CH_2CH_3$	Ethyl Ether	Ethoxyethane
	Aldehyde	-al		Acetaldehyde	Ethanal
	Ketone	-one		Acetone	Propanone
	Carboxylic acid	-oic acid		Acetic acid	Ethanoic acid
	Amine	——	CH_3-NH_2	Methylamine	Aminomethane