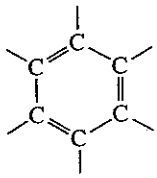
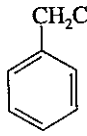
Summary of Hydrocarbon Classification

Compound Type	*Functional Group*	*Example*
alkanes	none (no double or triple bonds)	$CH_3—CH_2—CH_3$, propane
alkenes	$>C=C<$ double bond	$CH_2=CH—CH_3$, propene
alkynes	$—C\equiv C—$ triple bond	$H—C\equiv C—CH_3$, propyne
aromatics	benzene ring 	 ethylbenzene

atom. These alkanes differ only by the number of methylene groups in the chain. If the molecule contains n carbon atoms, it must contain $(2n + 2)$ hydrogen atoms. Figure 3-1 shows this representation of alkane structure and how it leads to formulas of the form C_nH_{2n+2}.

A series of compounds, like the n-alkanes, that differ only by the number of $—CH_2—$ groups, is called a **homologous series,** and the individual members of the series are called **homologs.** For example, butane is a homolog of propane, and both of these are homologs of hexane and decane.

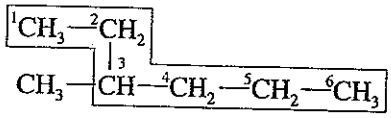
Although we have derived the C_nH_{2n+2} formula using the n-alkanes, its use is not limited to unbranched molecules. Any isomer of one of these n-alkanes has

TABLE 3-1 Formulas and Physical Properties of the Unbranched Alkanes, Called the *n*-Alkanes

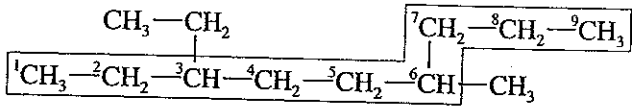
Alkane	*Number of Carbons*	*Structure*	*Formula*	*Boiling Point (°C)*	*Melting Point (°C)*	*Density*[a]
methane	1	$H—CH_2—H$	CH_4	−164	−183	0.55
ethane	2	$H—(CH_2)_2—H$	C_2H_6	−89	−183	0.51
propane	3	$H—(CH_2)_3—H$	C_3H_8	−42	−189	0.50
butane	4	$H—(CH_2)_4—H$	C_4H_{10}	0	−138	0.58
pentane	5	$H—(CH_2)_5—H$	C_5H_{12}	36	−130	0.63
hexane	6	$H—(CH_2)_6—H$	C_6H_{14}	69	−95	0.66
heptane	7	$H—(CH_2)_7—H$	C_7H_{16}	98	−91	0.68
octane	8	$H—(CH_2)_8—H$	C_8H_{18}	126	−57	0.70
nonane	9	$H—(CH_2)_9—H$	C_9H_{20}	151	−51	0.72
decane	10	$H—(CH_2)_{10}—H$	$C_{10}H_{22}$	174	−30	0.73
undecane	11	$H—(CH_2)_{11}—H$	$C_{11}H_{24}$	196	−26	0.74
dodecane	12	$H—(CH_2)_{12}—H$	$C_{12}H_{26}$	216	−10	0.75
tridecane	13	$H—(CH_2)_{13}—H$	$C_{13}H_{28}$	235	−5	0.76
tetradecane	14	$H—(CH_2)_{14}—H$	$C_{14}H_{30}$	254	6	0.76
pentadecane	15	$H—(CH_2)_{15}—H$	$C_{15}H_{32}$	271	10	0.77
hexadecane	16	$H—(CH_2)_{16}—H$	$C_{16}H_{34}$	287	18	0.77
heptadecane	17	$H—(CH_2)_{17}—H$	$C_{17}H_{36}$	303	23	0.76
octadecane	18	$H—(CH_2)_{18}—H$	$C_{18}H_{38}$	317	28	0.76
nonadecane	19	$H—(CH_2)_{19}—H$	$C_{19}H_{40}$	330	32	0.78
eicosane	20	$H—(CH_2)_{20}—H$	$C_{20}H_{42}$	343	37	0.79
triacontane	30	$H—(CH_2)_{30}—H$	$C_{30}H_{62}$	>450	66	0.81

[a] Densities are given in g/mL at 20°C, except for methane and ethane, whose densities are given at their boiling points.

The following alkanes show the use of the alkyl group nomenclature.

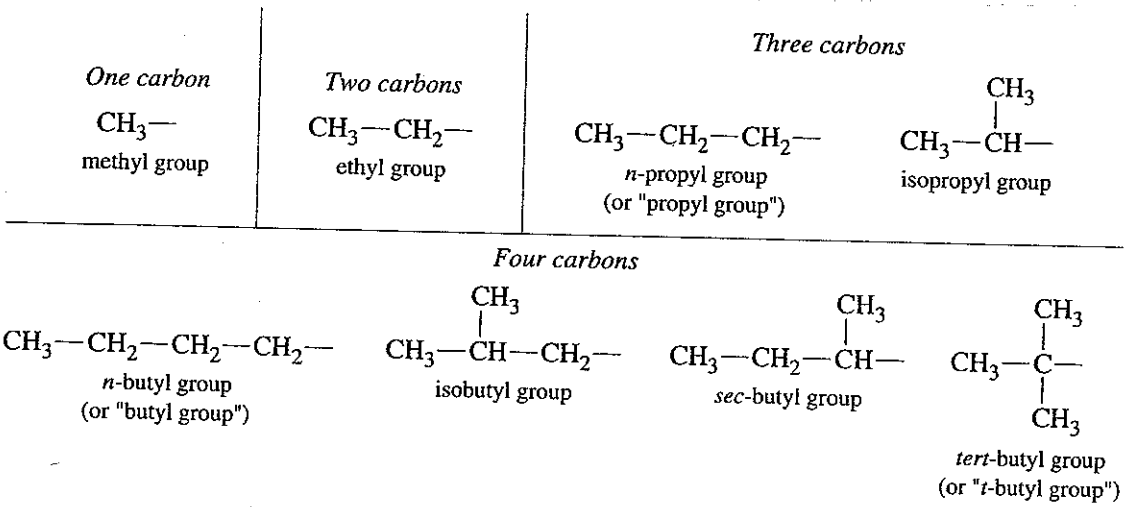


3-methylhexane

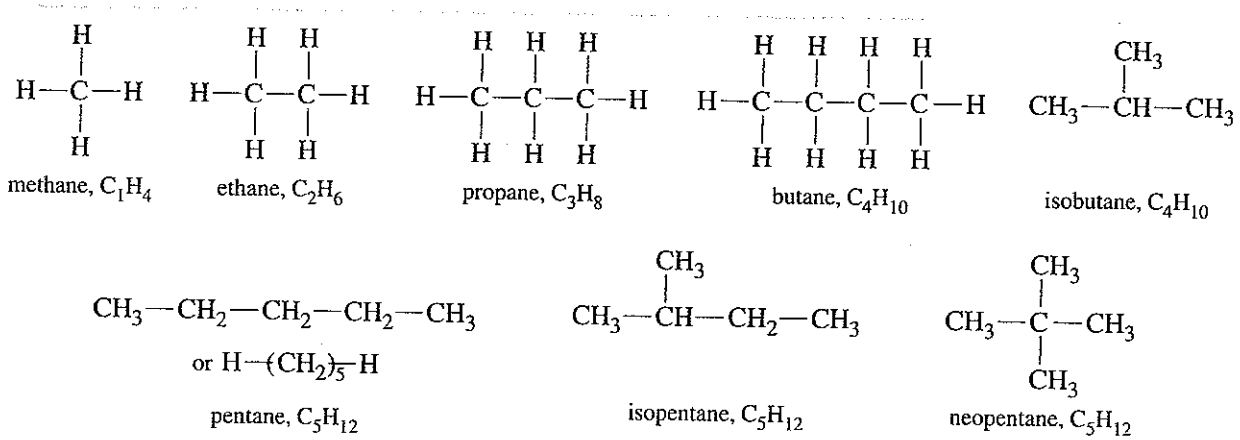


3-ethyl-6-methylnonane

Figure 3-2 gives the names of the most common alkyl groups, those having up to four carbon atoms. The propyl and butyl groups are simply unbranched three- and four-carbon alkyl groups. These groups are often named as "*n*-propyl" and "*n*-butyl" groups, however, to eliminate any question about which kind of propyl group or butyl group is meant.



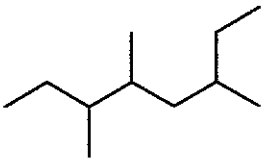
▲ **Figure 3-2**
Some common alkyl groups.



▲ **Figure 3-1**
Examples of the general alkane molecular formula, C_nH_{2n+2}.

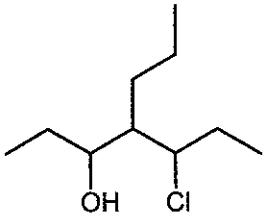
the same molecular formula. Butane and pentane follow the C_nH_{2n+2} rule; therefore, branched alkanes such as isobutane, isopentane, and neopentane also fol-

Name: _____ Date: _____

1. The IUPAC name for  is:

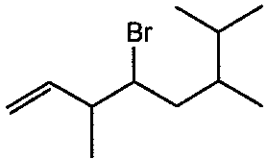
A) 6-Ethyl-3,4-dimethylheptane
B) 2-Ethyl-4,5-dimethylheptane
C) 3,4,6-Trimethyloctane
D) 3,5,6-Trimethyloctane
E) 2-(1-Methylpropyl)-4-methylhexane

2. A correct IUPAC name for the following compound is:

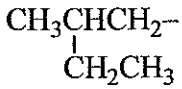


A) 4-propyl-5-chloro-3-heptanol
B) 4-propyl-3-chloro-5-heptanol
C) 4-(1-chloropropyl)-3-heptanol
D) 5-chloro-4-propyl-3-heptanol
E) 3-hydroxy-4-propyl-5-chloroheptane

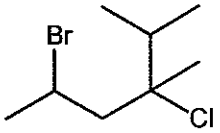
3. A correct IUPAC name for the following compound is:



A) 3,6,7-trimethyl-4-bromo-1-octene
B) 4-bromo-3-methyl-6-isopropyl-1-heptene
C) 4-bromo-3,6,7-trimethyl-1-octene
D) 4-bromo-6-isopropyl-3-methyl-1-heptene
E) 4-bromo-6-isopropyl-3,6-dimethyl-1-hexene

4. An IUPAC name for the group  is:

   A) Isopentyl
   B) Isoamyl
   C) sec-Butylmethyl
   D) 2-Methylbutyl
   E) 2-Ethylpropyl

5. The correct IUPAC name for  is:

   A) 2-Bromo-4-chloro-4-isopropylpentane
   B) 4-Bromo-2-chloro-2-isopropylpentane
   C) 5-Bromo-3-chloro-2,3-dimethylhexane
   D) 2-Bromo-4-chloro-4,5-dimethylhexane
   E) 2-(2-Bromopropyl)-2-chloro-3-methylbutane

6. Alkanes in which some or all of the carbon atoms are arranged in a ring are called _____.

7. Draw the bond-line structural formula corresponding to the name: 2,5,9-trimethyl-2-decen-7-yne