



## HYDROCARBONS

### What is Organic Chemistry?

Organic chemistry is the chemistry of compounds containing *carbon*. Examples include carbon dioxide, carbohydrates, proteins, fats, alcohol, rubber, petrol, plastics and many more.

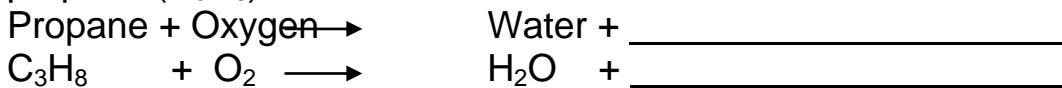
### What are Hydrocarbons?

Hydrocarbons are organic compounds containing *only hydrogen and carbon atoms*. For example, the gas used in gas stoves and bunsen burners can be either propane ( $C_3H_8$ ) or butane ( $C_4H_{10}$ ).

### Combustion of Hydrocarbons

All hydrocarbons burn 'cleanly' to form *water and carbon dioxide* in the presence of sufficient oxygen.

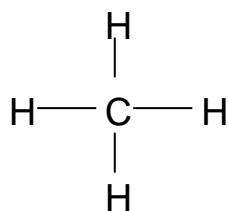
Complete the word and chemical equations for the combustion of propane ( $C_3H_8$ ):



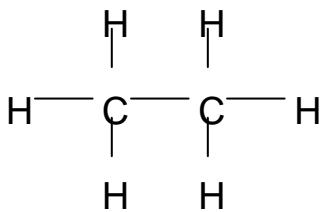
### How do Hydrogen and Carbon Atoms Bond to make Compounds?

A single bond between two atoms means that each atom shares a pair of electrons. *Hydrogen atoms can only have 1 single bond with another atom* at a time. Carbon atoms have 4 electrons in their outer levels. Therefore, carbon atoms can share electrons with up to 4 other atoms, that is, *carbon atoms can make up to 4 single bonds with other atoms*.

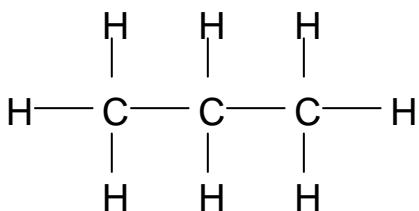
*Methane* is the smallest hydrocarbon with the chemical formula of  $CH_4$  and the structural formula of



*Ethane* is the second smallest hydrocarbon. Its chemical formula is C<sub>2</sub>H<sub>6</sub> and its structural formula is



Propane has the chemical formula of C<sub>3</sub>H<sub>8</sub> and the structural formula of



Note in the structural formulae above that each carbon atom makes 4 single bonds and each hydrogen atom makes 1 single bond. These hydrocarbons are called *saturated* hydrocarbons because they contain *only single bonds*. They are also called *Alkanes*.

### Alkanes (Saturated Single-bonded Hydrocarbons)

Alkane	Chemical Formula	Structural Formula	Melting Point (°C)	Boiling Point (°C)
Methane	CH <sub>4</sub>		-182	-161
Ethane	C <sub>2</sub> H <sub>6</sub>		-183	-89
Propane	C <sub>3</sub> H <sub>8</sub>		-190	-42
Butane	C <sub>4</sub> H <sub>10</sub>		-138	-1
Pentane	C <sub>5</sub> H <sub>12</sub>		-130	36
Hexane	C <sub>6</sub> H <sub>14</sub>		-95	69
Heptane	C <sub>7</sub> H <sub>16</sub>		-91	98

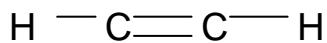
Octane	$C_8H_{18}$		-57	126
Nonane	$C_9H_{20}$		-54	151
Decane	$C_{10}H_{22}$		-30	174

- What do you notice about the naming of hydrocarbons with the number of carbon atoms greater than 4? \_\_\_\_\_
- How many hydrogen atoms would be in an alkane containing 12 carbon atoms? \_\_\_\_\_
- The general formula of an alkane is  $C_nH_{2n+2}$ . What does this mean? \_\_\_\_\_
- Complete: The melting point of a substance is the temperature at which it changes from a solid to a liquid and vice versa. The boiling point is the temperature at which a substance changes from liquid to a \_\_\_\_\_ and vice versa.
- What do you notice about the *increase* in carbon atoms in alkanes and their melting and boiling points? \_\_\_\_\_
- Look at the boiling points. Which alkanes are gases at the room temperature of  $25^{\circ}C$ ? \_\_\_\_\_
- In the Snowy Mountains, school bunsen burners are fueled by propane not butane. Why? \_\_\_\_\_

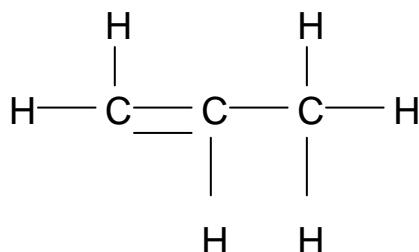
### Alkenes (Unsaturated Double-bonded Hydrocarbons)

Hydrocarbons with *double or triple bonds* are called *unsaturated*.

In alkenes, a double bond is one in which two pairs of electrons are shared between carbon atoms. For example, the smallest alkene is ethene with the chemical formula of  $C_2H_2$  and the structural formula of



Propene has the chemical formula of  $C_3H_6$  and *one* possible structural formula of



There is a double bond between carbon atoms and a single bond between the hydrogen and carbon atoms. Altogether, each carbon atom has 4 bonds (lines) from each atom and only 1 bond (line) from each hydrogen atom.

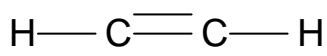
<i>Alkene</i>	<i>Chemical Formula</i>	<i>Structural Formula</i>
Ethene	C <sub>2</sub> H <sub>4</sub>	
Propene	C <sub>3</sub> H <sub>6</sub>	
Butene	C <sub>4</sub> H <sub>8</sub>	
Pentene		
Hexene		

1. Complete the chemical formulae for pentene and hexene.
2. The general formula for alkanes above was C<sub>n</sub>H<sub>2n+2</sub>. What do you think is the general formula for alkenes? \_\_\_\_\_
3. Complete the structural formula for the alkenes above.
4. How many possible structural formulae are there for hexene? (Do your working on a scrap of paper. Count mirror images of each other as one possibility.) \_\_\_\_\_

### Alkynes (Unsaturated Triple-bonded Hydrocarbons)

Hydrocarbons with *double or triple bonds* are called *unsaturated*.

In alkynes, a triple bond is one in which three pairs of electrons are shared between carbon atoms. For example, the smallest alkyne is ethyne with the chemical formula of C<sub>2</sub>H<sub>2</sub> and the structural formula of



There is a triple bond between carbon atoms and a single bond between the hydrogen and carbon atoms. Altogether, each carbon atom has 4 bonds (lines) from each atom and only 1 bond (line) from each hydrogen atom.

1. Draw the possible structural formulae for propyne and butyne (each with 1 triple bond).

2. What is the general formula for alkynes? \_\_\_\_\_
  3. The old name for ethyne is acetylene. For what is it used? \_\_\_\_\_
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