



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.

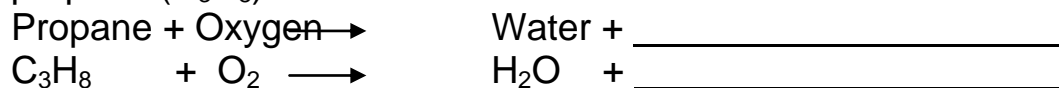
What are Hydrocarbons?

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.

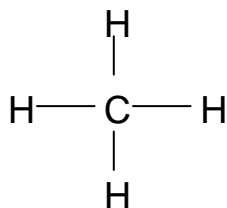
Complete the word and chemical equations for the combustion of propane (C_3H_8):



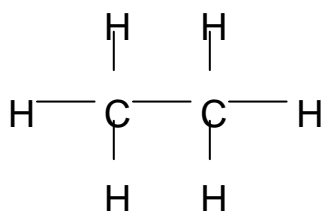
How do Hydrogen and Carbon Atoms Bond to make Compounds?

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*.

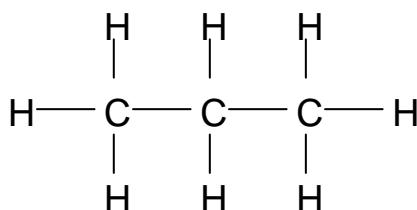
Methane is the smallest hydrocarbon with the chemical formula of CH_4 and the structural formula of



Ethane is the second smallest hydrocarbon. Its chemical formula is C_2H_6 and its structural formula is



Propane has the chemical formula of C_3H_8 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)

<i>Alkane</i>	<i>Chemical Formula</i>	<i>Structural Formula</i>	<i>Melting Point (°C)</i>	<i>Boiling Point (°C)</i>
Methane	CH_4		-182	-161
Ethane	C_2H_6		-183	-89
Propane	C_3H_8		-190	-42
Butane	C_4H_{10}		-138	-1
Pentane	C_5H_{12}		-130	36
Hexane	C_6H_{14}		-95	69
Heptane	C_7H_{16}		-91	98

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

1. What do you notice about the naming of hydrocarbons with the number of carbon atoms greater than 4? _____

2. How many hydrogen atoms would be in an alkane containing 12 carbon atoms? _____
3. The general formula of an alkane is C_nH_{2n+2} . What does this mean? _____

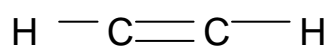
4. Complete: The melting point of a substance is the temperature at which it changes from a solid to a liquid and vice versa. The boiling point is the temperature at which a substance changes from liquid to a _____ and vice versa.
5. What do you notice about the *increase* in carbon atoms in alkanes and their melting and boiling points? _____

6. Look at the boiling points. Which alkanes are gases at the room temperature of $25^\circ C$? _____
7. In the Snowy Mountains, school bunsen burners are fueled by propane not butane. Why? _____

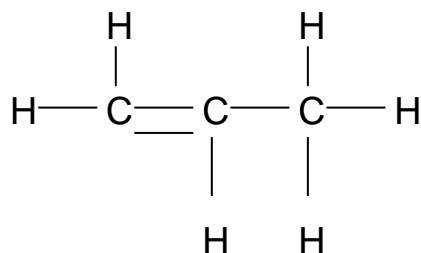
Alkenes (Unsaturated Double-bonded Hydrocarbons)

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.

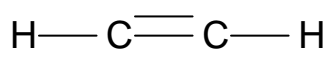
<i>Alkene</i>	<i>Chemical Formula</i>	<i>Structural Formula</i>
Ethene	C ₂ H ₄	
Propene	C ₃ H ₆	
Butene	C ₄ H ₈	
Pentene		
Hexene		

1. Complete the chemical formulae for pentene and hexene.
2. The general formula for alkanes above was C_nH_{2n+2}. 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 C₂H₂ 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? ____

