

Hydrocarbons- (Structural Formula and Uses)



Learning Outcomes

Students will be able to:

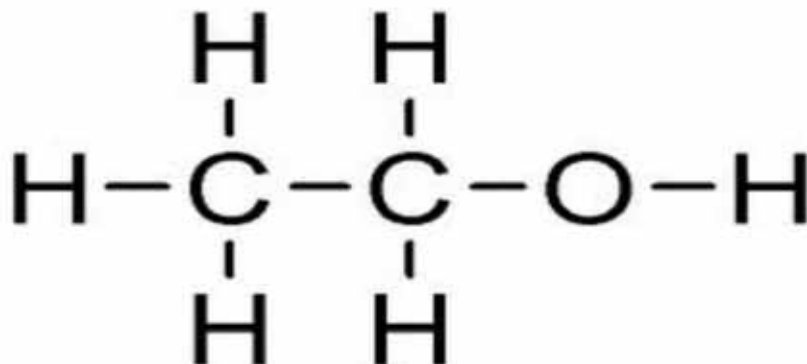
1. define a structural formula;
2. draw the structural formula of alkanes, alkenes and alkynes upto 5 carbon atoms;
3. explain hydrocarbons as fuel;
4. explain hydrocarbons as feed stock in industry.

Structural Formula

As we know that a molecular formula states the number and kind of atoms in the molecule. Therefore, *ethyl alcohol* has a molecular formula of C_2H_6O which implies that a molecule of this compound is made up of two carbon atoms, six hydrogen atoms and one oxygen atom. The molecular formula, however, remains silent as to how these atoms of various elements are joined in a molecule.

Hence, a formula showing a complete picture of the way various atoms are joined to each other in a molecule is known as *Structural Formula*.

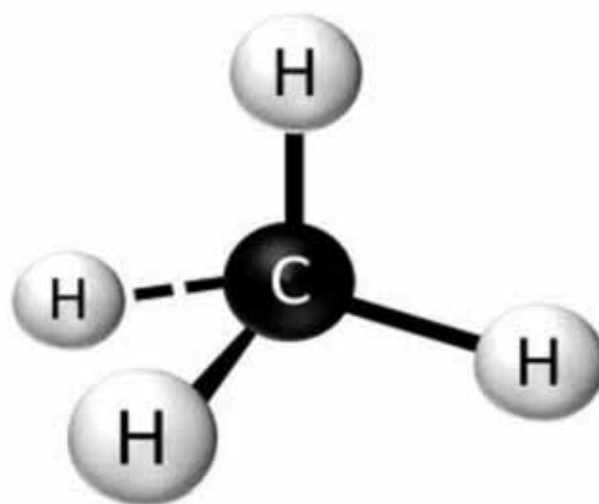
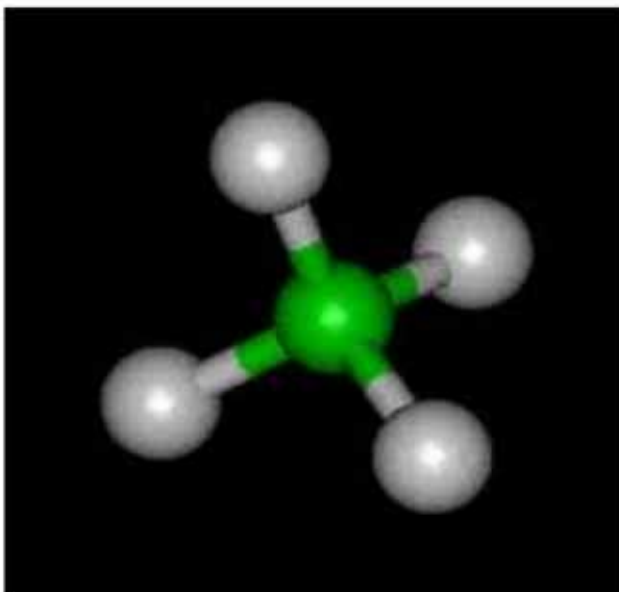
For example, *ethyl alcohol* having a molecular formula of C_2H_6O possesses the structural formula as under:



It may be noted that the structural formula of an organic compound does not necessarily specify the exact shape of the molecule. This is due to the fact that the four valency bonds of carbon are distributed in space in a tetrahedral geometry and thus a representation written in the plane of the paper does

not convey the exact picture of the molecular structure. Actually there are the two dimensional representations.

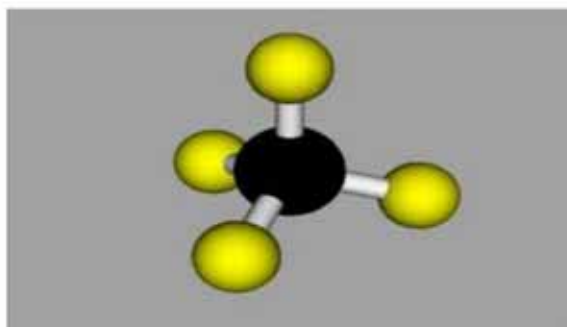
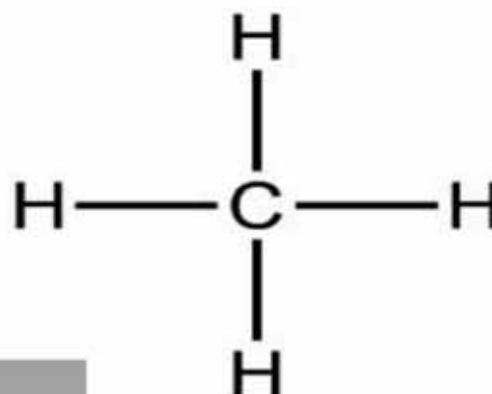
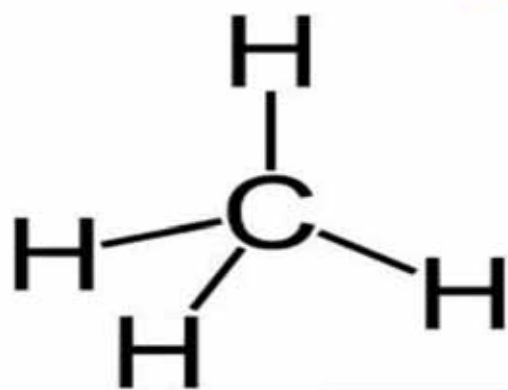
A model of a molecule is often useful to facilitate our thinking about the structure of the molecule. One simple kind of model to represent the structure of a molecule consists of coloured balls and sticks of metal wire. This is called a ***ball-and-stick model***. For example the model of methane as shown in the picture.



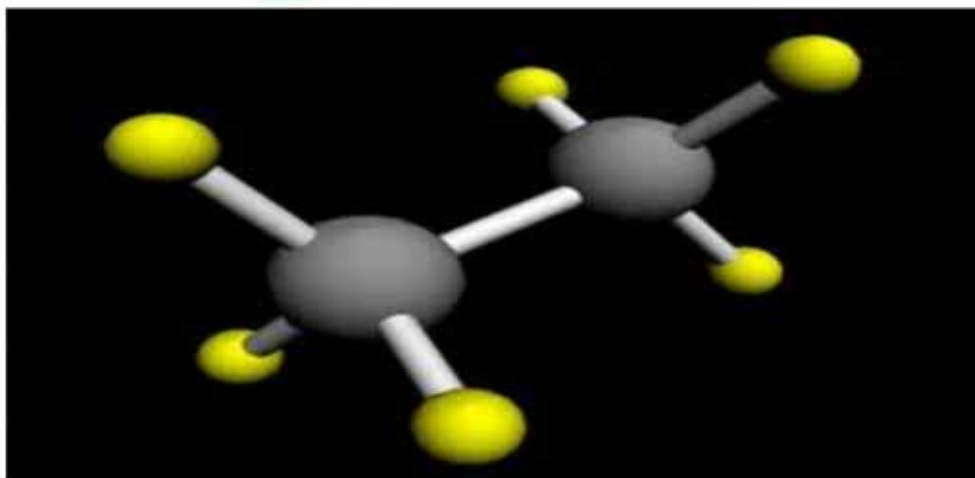
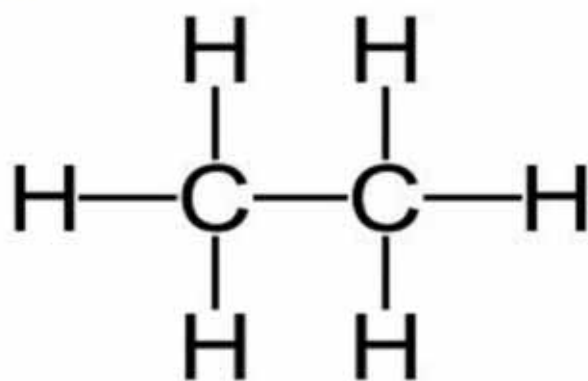
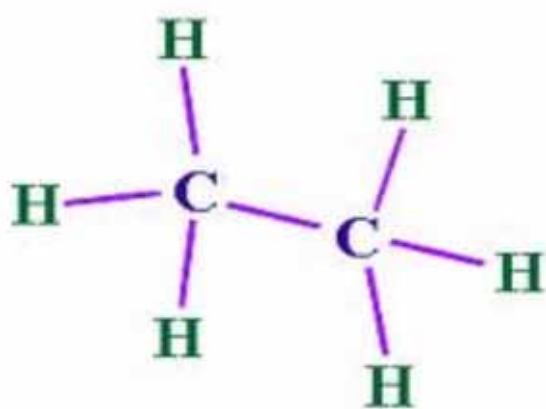
Such models represent a three dimensional structure of the molecule showing exact angle between the bonds and are particularly helpful in telling us as to how the various atoms of the molecules are arranged in space.

Structural Formula of Alkanes upto Five Carbon Atoms

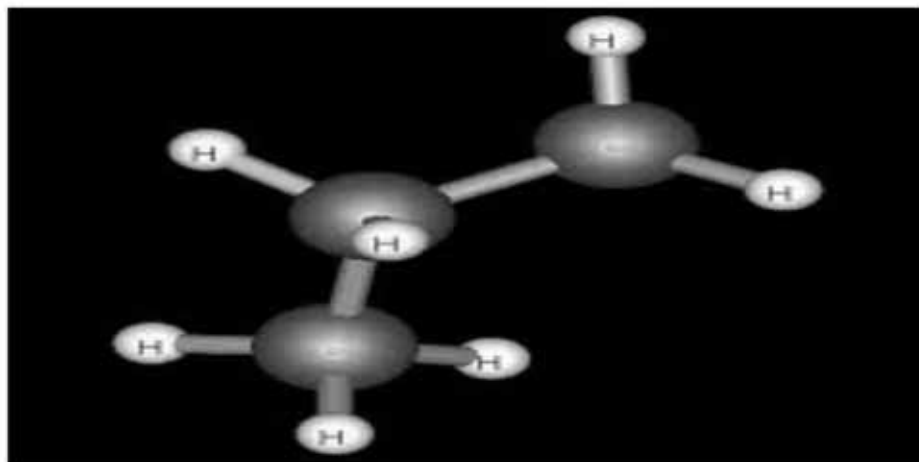
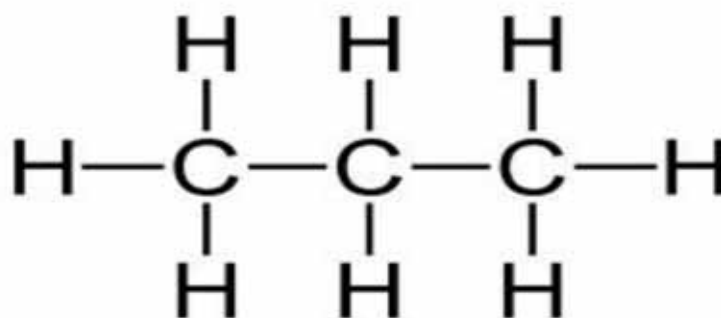
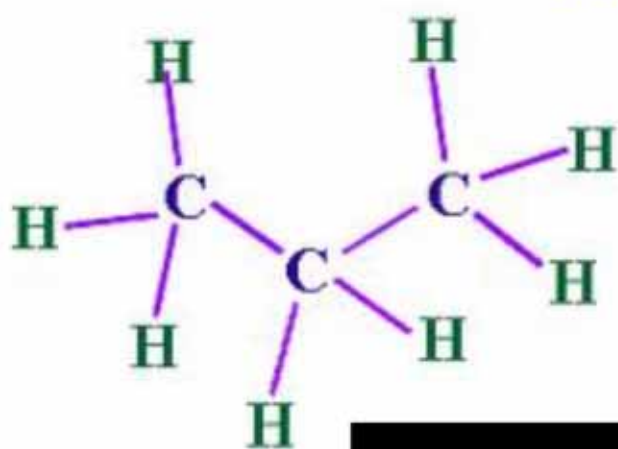
Methane



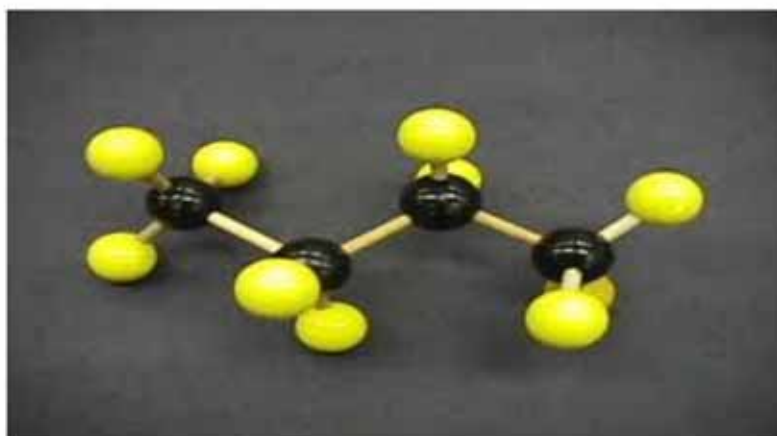
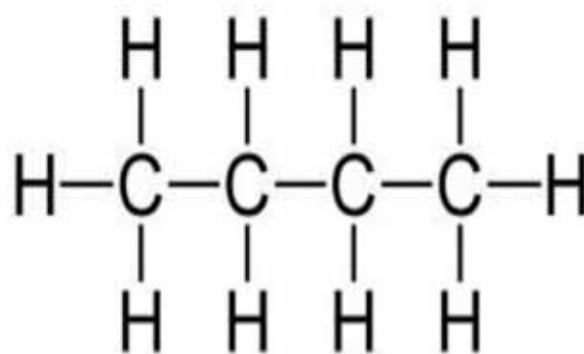
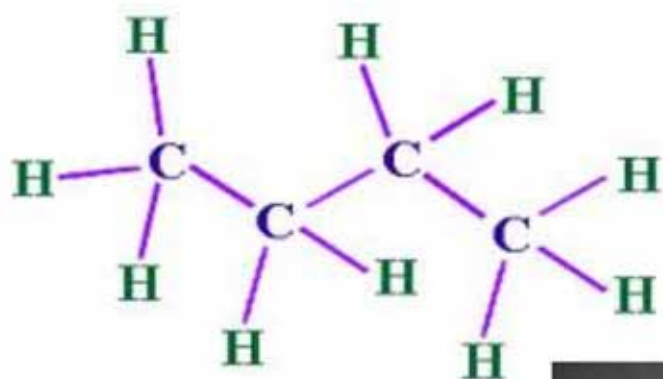
Ethane



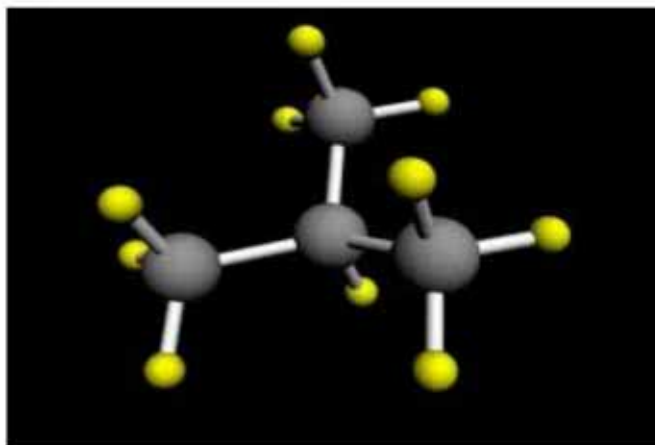
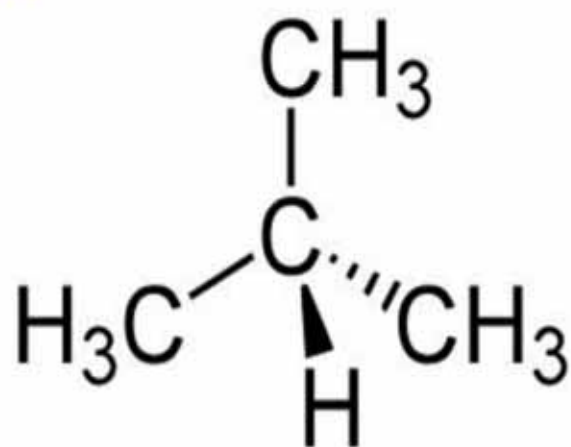
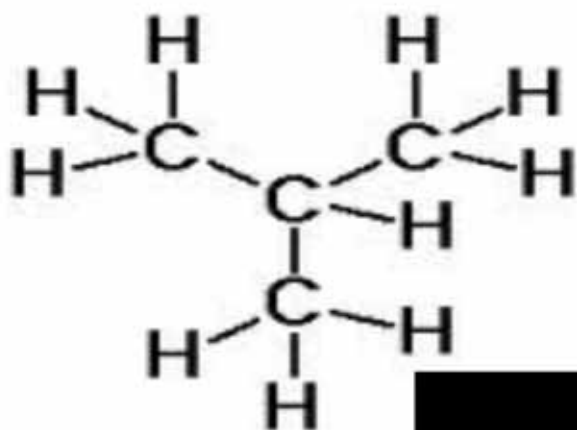
Propane



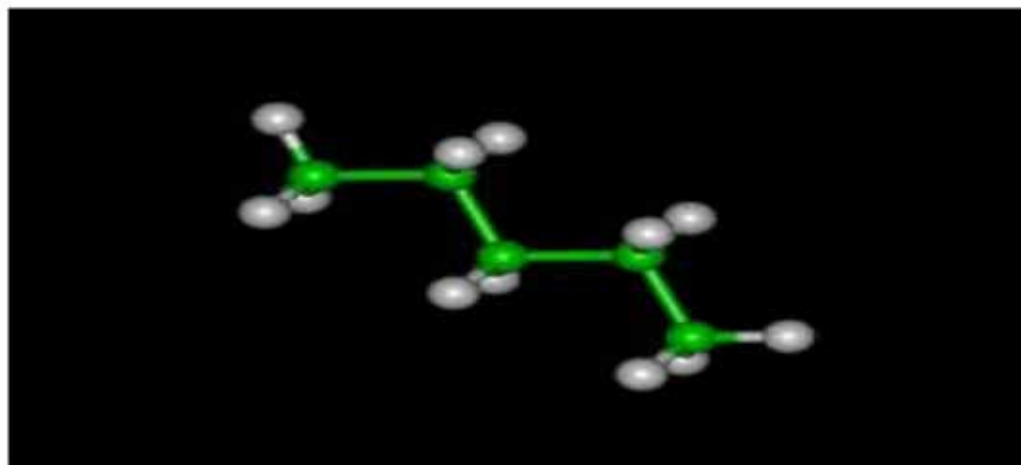
Butane



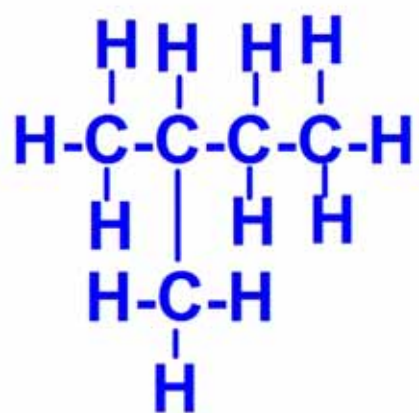
Isobutane



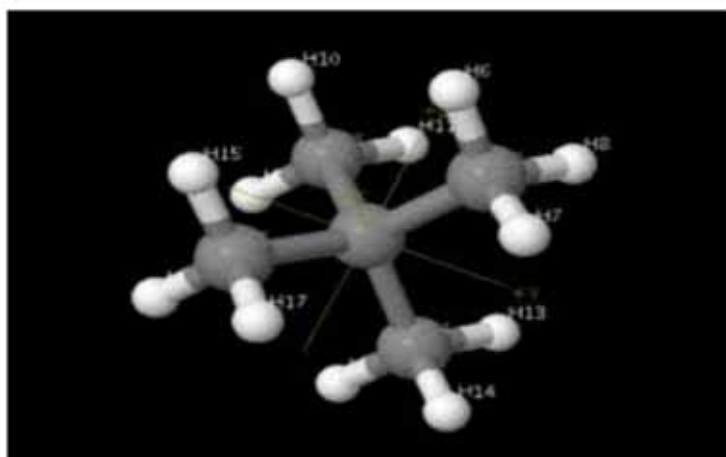
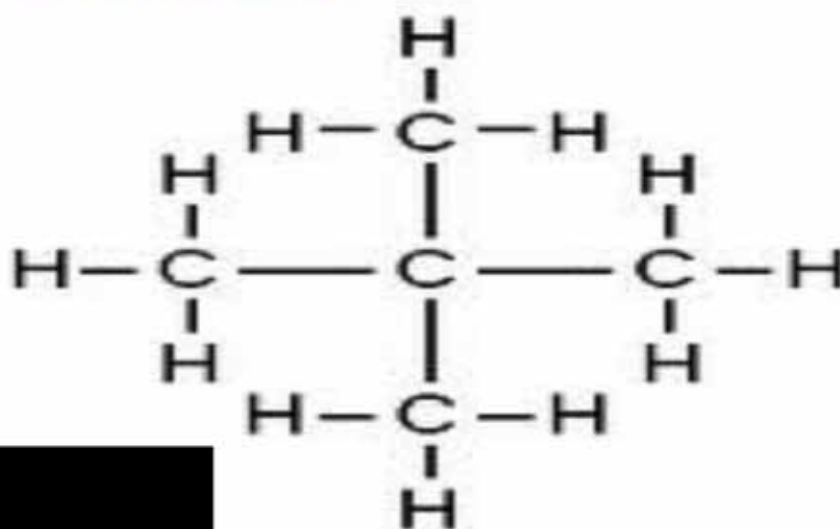
n-Pentane



iso-Pentane

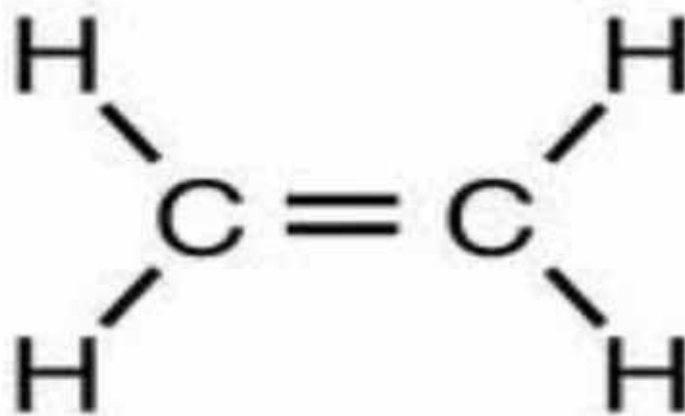


Neopentane

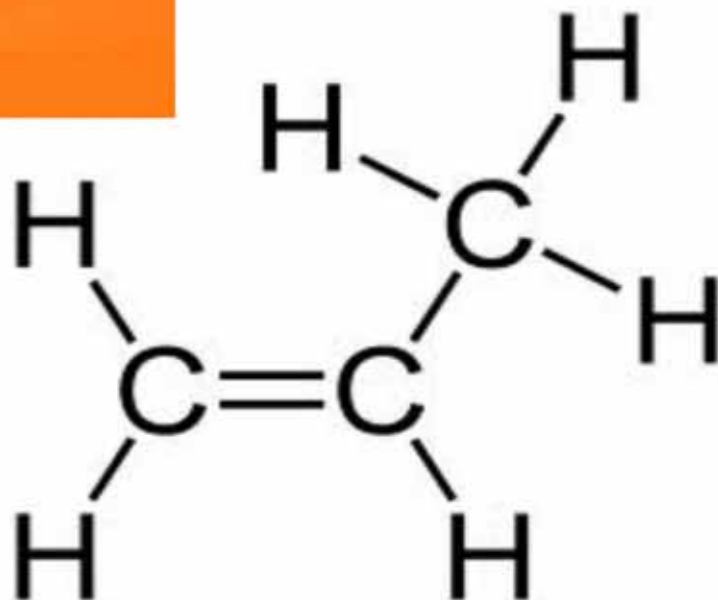
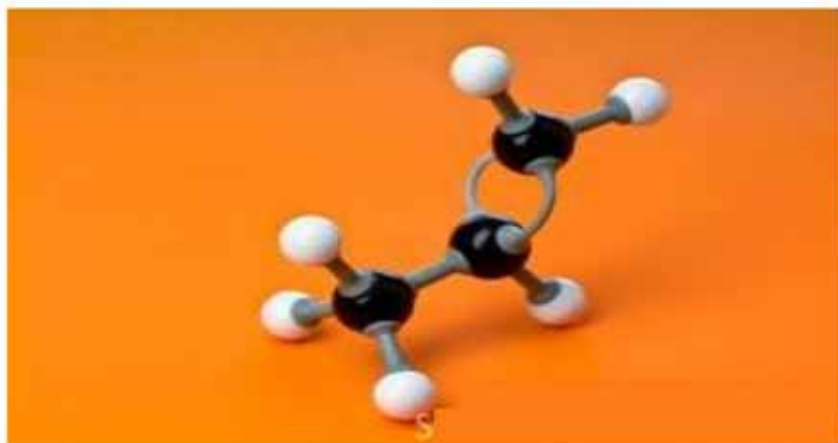


Structural Formula of Alkenes upto Five Carbon Atoms

Ethene



Propene

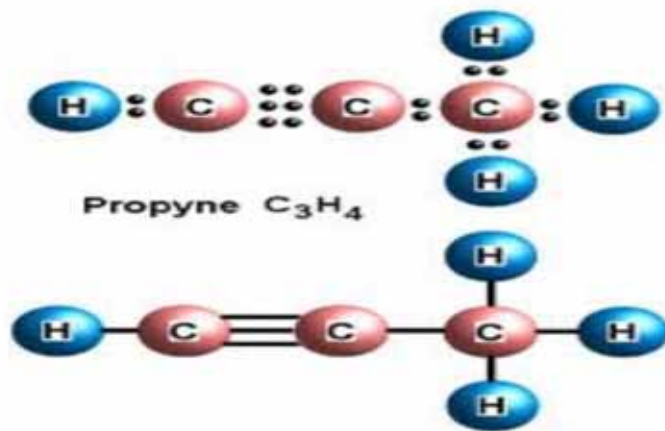
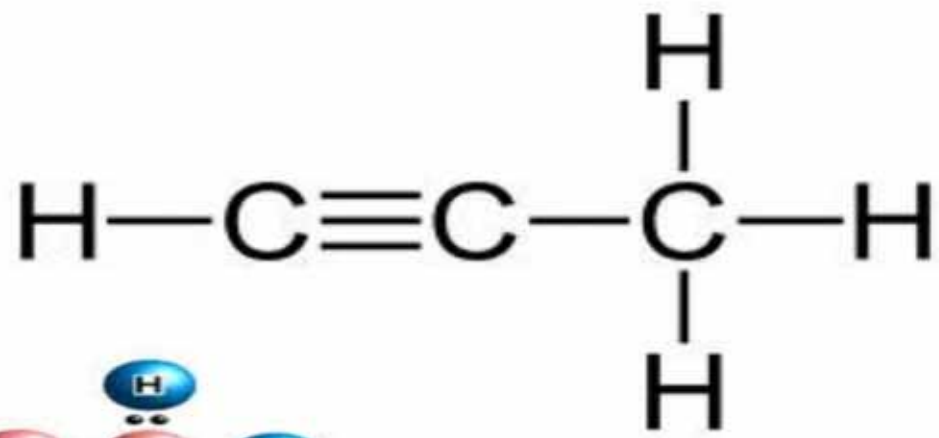


Structural Formula of Alkynes upto Five Carbon Atoms

Ethyne



Propyne



Hydrocarbons as a Fuel

Most hydrocarbons are combustible. When burned, they produce carbon dioxide, water, and large quantities of heat. This energy is used to heat homes and other buildings and to generate electricity. When heating a home, for example, oil or natural gas is burned and the energy released is used to heat water or air. The hot water or air is then circulated around the building.

What makes hydrocarbons the best fuel?

Following reactions illustrate the combustion reaction.



Another example of this property is propane:

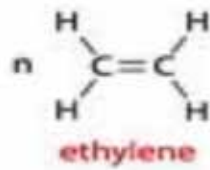


In general, all alkane hydrocarbons react as following:

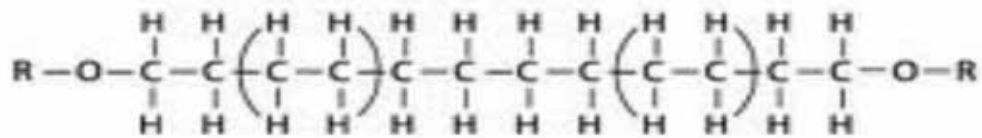


Hydrocarbons as Feedstock in Industry:

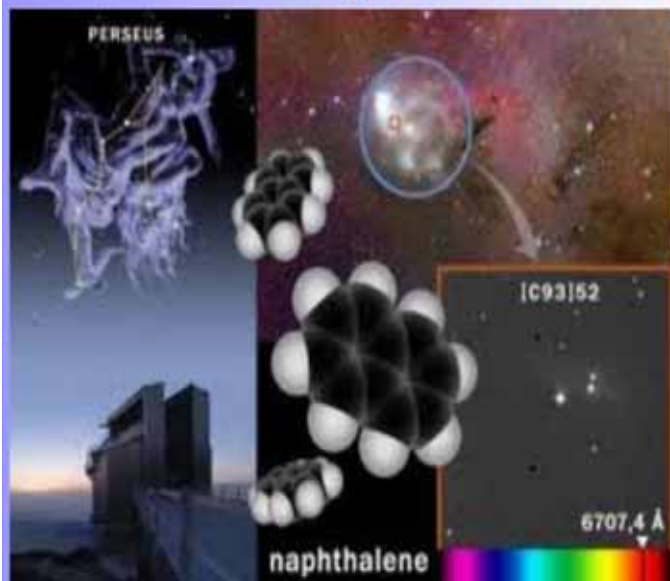
Hydrocarbons are also raw materials that serve as feedstock for the production of a wide range of organic chemicals, which in turn are used for such products such as plastics, pigments, solvents, pharmaceuticals, and explosives. For example, *ethylene*, a simple alkene hydrocarbon, is the basic building block of an important industrial product called **POLYETHYLENE**.



↓ polymerization



Multiple Choice Questions



1. In a molecule of CH₄, the hydrogen atoms are spatially oriented towards the center of a regular

- A. pyramid.**
- B. tetrahedron.**
- C. square.**
- D. rectangle.**

2. Which of the following is expected to act as monomer units for the formation of benzene?

- A. ethane**
- B. ethene**
- C. ethyne**
- D. methane**

3. In which pair of hydrocarbons does each compound contain only one double bond per molecule?

- A. C_2H_2 and C_2H_6**
- B. C_2H_2 and C_3H_6**
- C. C_4H_8 and C_2H_4**
- D. C_6H_6 and C_7H_8**