

2 Carbon Compounds

Fossil fuels are carbon-based substances. You are expected to be able to recall information from the Preliminary course on carbon and its compounds. The main points are summarised below.

Carbon (electron configuration 2.4) forms many compounds because of its properties.

- A carbon atom has 4 valency electrons, so it can form 4 strong covalent bonds, which can be single, double or triple bonds. Saturated compounds contain only single bonds (e.g. ethane). Unsaturated compounds contain double and/or triple bonds (e.g. ethene and ethyne).
- A carbon atom can join onto other carbon atoms to form chains and rings. The chains can be straight or branched.
- A carbon atom can form strong covalent bonds with other non-metals (e.g. hydrogen, oxygen, nitrogen and the halogens).

Hydrocarbons (e.g. alkanes, alkenes and alkynes) are organic (carbon-based) compounds containing only atoms of carbon and hydrogen.

A **homologous series** is a group or family of compounds with similar structures and chemical properties. As you go down the homologous series, each member of the group becomes bigger by a CH_2 group.

A **functional group** is a grouping of atoms that is common to all members of that series (e.g. single bond, double bond, $-\text{O}-\text{H}$ (hydroxyl) group).

Table 2.1 Homologous hydrocarbon series

Homologous series	General formula	Functional group
Alkane	$\text{C}_n\text{H}_{2n+2}$	$-\text{C}-\text{C}-$
Alkene	C_nH_{2n}	$-\text{C}=\text{C}-$
Alkyne	$\text{C}_n\text{H}_{2n-2}$	$-\text{C}\equiv\text{C}-$

Combustion of hydrocarbons produces carbon dioxide and water. In a limited supply of oxygen, it may also produce carbon and/or carbon monoxide.

Use the questions below to check that you know and understand this basic presumed knowledge. Discuss any problems with your teacher.

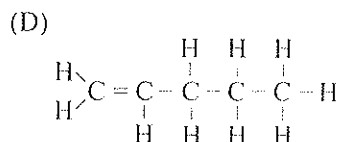
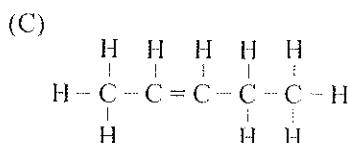
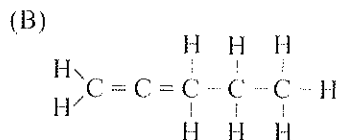
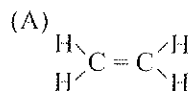
You should be able to name and write formulae for C_1 to C_8 compounds in each series. For example, ethene (common name ethylene):

- structural formula:** $\begin{array}{c} \text{H} \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{H} \end{array}$
- condensed structural formula:** CH_2CH_2
- molecular formula:** C_2H_4

(See Topic 13, page 21, for more revision of naming.)

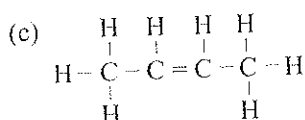
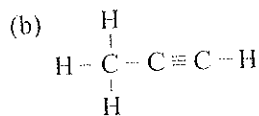
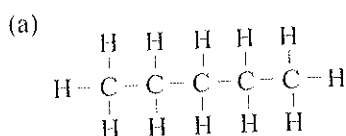
For You To Do

- The compound containing a double bond would be:
 - $\text{CH}_3\text{CHCHCH}_2\text{CH}_2\text{CH}_3$
 - $\text{CH}_3\text{CH}_2\text{CH}_3$
 - $\text{CH}_3\text{CH}_2\text{CCCH}_2\text{CH}_3$
 - $\text{CHCl}_2\text{CHClCH}_3$
- The compound 2-pentene has the structural formula:



- Recall definitions of the following terms:
 - homologous series
 - hydrocarbon
 - halogen
 - functional group
 - alkane
 - covalent bond
 - saturated
- Fossil fuels all contain carbon.
 - Describe the position of carbon on the periodic table.
 - State the electron configuration of carbon.
 - Carbon is able to form an enormous number of compounds. Outline three reasons to account for this.
 - Identify three fuels that are naturally synthesised by geological processes acting on carbon compounds.
- Identify two homologous series of hydrocarbons and state the general formula of each.
- State whether you would expect to find a double bond in octane, octene or octyne.
- Compare saturated and unsaturated hydrocarbons and name one example of each.
- Write structural formulae for:
 - ethene
 - ethane
 - hexane
- In a structural formula, what does the dash (—) represent?

10. Identify the following hydrocarbons:



11. (a) Distinguish between the conditions causing complete and incomplete combustion.
 (b) Identify the products of complete combustion of hydrocarbons.
 (c) Sometimes carbon particles and carbon monoxide are produced by the combustion of carbon compounds. Explain.

12. State two safety issues associated with the use of hydrocarbons.

13. Write structural formulae for the following:

- (a) 2-pentene
 (b) propene
 (c) 3-octene
 (d) 1,3-pentadiene
 (e) 2-hexene
 (f) 2-butene
 (g) 1,2-dichloroethene
 (h) 2,3-dimethyl-2-butene

14. Name the following alkenes:

- (a) $\text{CH}_2 = \text{CHCH}_2\text{CH}_2\text{CH}_3$
 (b) $\text{CH}_3\text{CH}_2\text{CH} = \text{C}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_3$
 (c) $\text{CH}_2 = \text{CHCH}_2\text{CH}_3$
 (d) $\text{CH}_2 = \text{C}(\text{CH}_3)\text{CH}_3$

15. Write balanced equations for the following reactions:

- (a) complete combustion of methane
 (b) photosynthesis
 (c) incomplete combustion of ethene

16. Draw electron dot diagrams to show the structure and bonding of:

- (a) methane
 (b) ethene
 (c) propyne

17. Check your knowledge with this quick quiz:

- (a) Name C_7H_{14} .
 (b) Name C_4H_8 .
 (c) What is the molecular formula for pentane?
 (d) What do we call a group or family of compounds that have similar structures and chemical properties?
 (e) What do we call a grouping of atoms that is common to all members of an homologous series?
 (f) How many electrons in a carbon atom?
 (g) What is the valency of carbon?
 (h) State the name given to compounds of carbon and hydrogen only.
 (i) Combustion with a plentiful supply of oxygen is called _____ combustion.
 (j) Combustion with a limited supply of oxygen is called _____ combustion.
 (k) Ethene belongs to the homologous series of hydrocarbons called _____.
 (l) Ethane belongs to the homologous series of hydrocarbons called _____.
 (m) State a common name for ethene.
 (n) What ending would you use for the name of a hydrocarbon in order to show that it contains single bonds?
 (o) The stem of a hydrocarbon with two carbon atoms would be eth-. What stem would you use for a hydrocarbon containing 6 carbons?
 (p) What is the functional group for an alkene?
 (q) State the general formula for an alkane.
 (r) What is the formula for ethene?
 (s) State the formula for ethane.
 (t) Identify the homologous hydrocarbon series containing only single bonds.
 (u) What symbol is used to represent a covalent bond in a compound?
 (v) Halide ions are formed from atoms in which group of the periodic table?