Topic(s) –Alkenes and Branched Alkenes

This set of work is to be done over the week, from Monday 27th April to Friday 1st May.

Here is a list of the resources you should be using this week, on the following pages the resources have been screenshotted so you all only need this one document open to work from for the whole week.

Video solutions to homework 5 can be found in the files section now.

As a 'starter' for this week please attempt the Microsoft Form on the work you completed last week on Branched Chain Alkanes.

1. Notes to copy into notes jotter and learn – Alkenes and then Branched Alkenes. *The teaching instructions are in the text boxes down the side, in italic text. There are 8 notes in total.* **If you have the option to do so at home, feel free to print and stick them into your notes jotter.**

2. Self Checks – 10 & 11.

3. Homework – 6 & 7.

4. Additional resources:
   Alkenes:
   Hydrocarbons - https://www.twigscotland.com/film/factpack-hydrocarbons-1378/
   Naming Alkenes - https://www.youtube.com/watch?v=WCmwLwyPb0c
   Drawing Alkenes - https://www.youtube.com/watch?v=2NskPCMhBnw

Notes to copy and learn:

1. *Until now we've only been looking at straight chain and branched alkanes. However there are two more homologous series you need to know about – alkenes, straight chain and branched. This new homologous series have different, but similar physical and chemical properties to the hydrocarbons you have learnt about so far.*

The following slides will explain what alkenes are, how to name them and how to write their shortened structural formula.

Alkenes

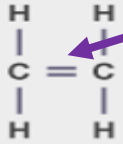
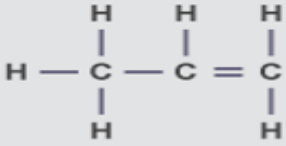
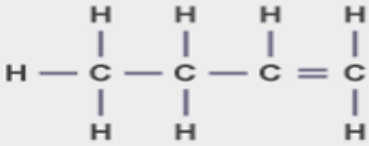
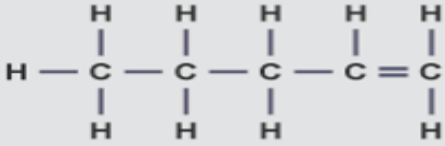
The second homologous series is the alkenes. Their names all end in –ene, for example ethene.

Alkenes all contain a carbon to carbon double bond functional group (-C=C-) which makes them more reactive than the alkanes. The alkenes have the general formula C_nH_{2n}.

The alkenes have many uses:

- as fuels
- as solvents
- as starting materials for everyday products such as plastics and vinegar.

2.

Name	Molecular formula	Full structural formula
Ethene	C_2H_4	
Propene	C_3H_6	
But-1-ene	C_4H_8	
Pent-1-ene	C_5H_{10}	

This is the Carbon to Carbon double bond in the structure of the alkenes.

Also note each Carbon atom still only has 4 bonds and each Hydrogen atom still only has 1 bond.

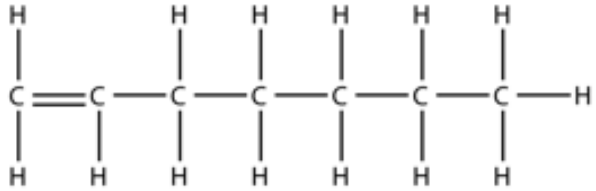
There is no such thing as 'Methene' as you can't have a carbon to carbon double bond with only 1 carbon atom.

For alkenes with FOUR OR MORE carbon atoms, the position of the double bond must be given in the name.

As with naming the branched alkanes, the position of the double bond MUST have the LOWEST number possible – you start numbering the carbon atoms from the end closest to the double bond.

3.

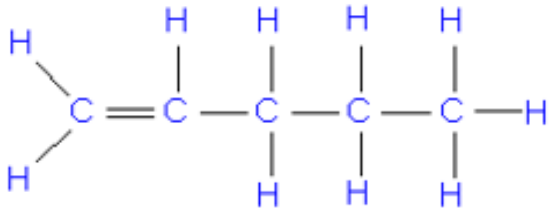
Complete the following table:

Name	Molecular Formula	Full Structural Formula
Hex-2-ene	C_6H_{12}	
Hept-1-ene		
Oct-4-ene	C_8H_{16}	

4.

Shortened structural formula

For large alkenes, such as pentene, we can also write a shortened structural formula.

Name	Molecular Formula	Full Structural Formula	Shortened Structural Formula
Pent-1-ene	C_5H_{10}		$CH{=}CHCH_2CH_2CH_3$

5.

Saturated and Unsaturated Hydrocarbons

The **alkenes** are **unsaturated**. This is because they have a carbon to carbon double bond.

(Remember the **alkanes** are **saturated** because they only contain Carbon to Carbon single bonds.)

An unsaturated hydrocarbon decolourises bromine water quickly. Alkanes do this slowly. This is known as the test for unsaturation – you will learn more about this after the holiday weekend.

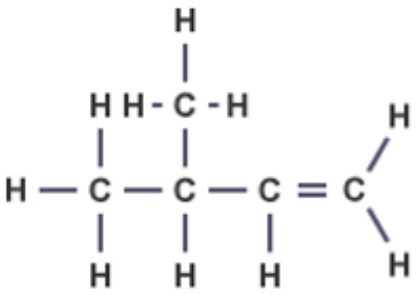
6.

Naming alkenes

Naming alkenes has the same rules as alkanes.

However, the position of the carbon to carbon double bond must be identified.

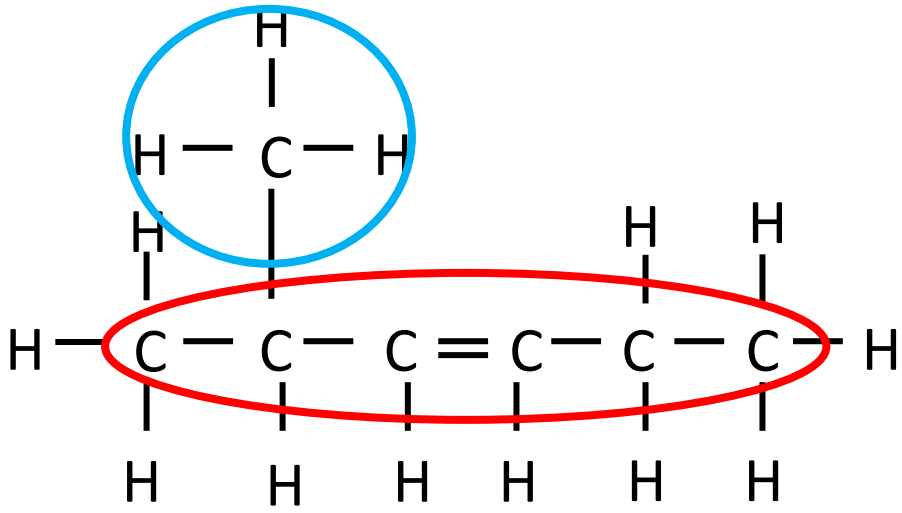
Example: 3-methylbut-1-ene



Note that the functional group (in the case of alkenes, the double bond) is given the lowest possible number first (you start numbering the molecule from the end closest to the double bond), before any branches are numbered.

7.

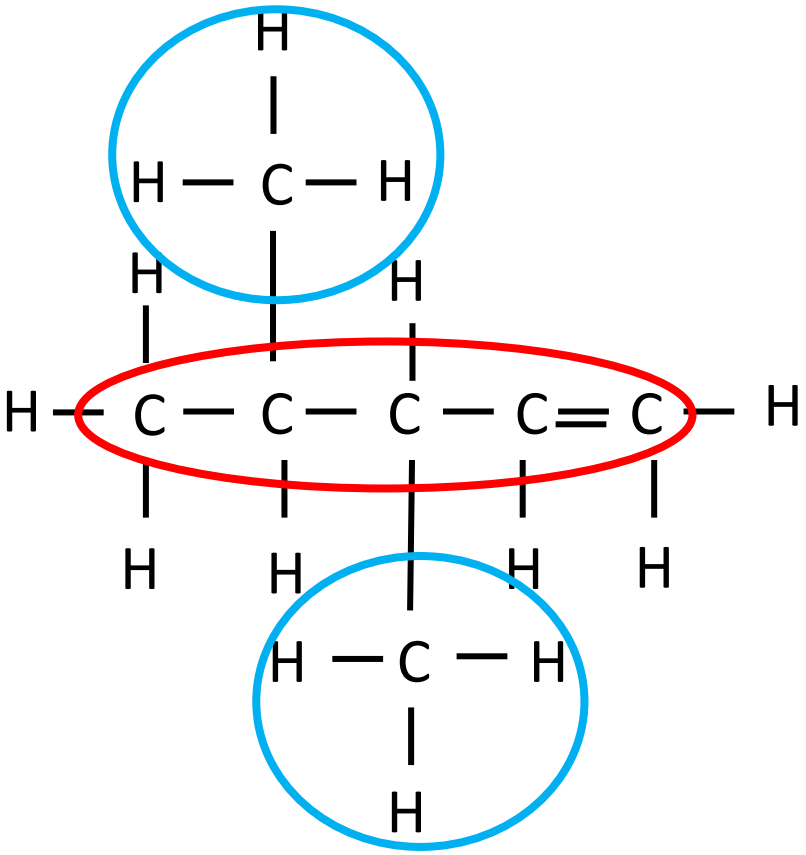
2-methylhex-3-ene



- *The longest carbon chain (in red circle) is 6 Carbons long.*
- *Start numbering the Carbons from the left side to give the lowest possible number to the double bond AND the branch.*
- *The double bond is between Carbons 3 and 4, so gets numbered three, so you get **hex-3-ene** for the main chain*
- *The branch (in blue circle) is a methyl branch and is on carbon number 2, so you get **2-methyl***
- *Add it all together and you get **2-methyl hex-3-ene.***

8.

3, 4-dimethylpent-1-ene



- *The longest carbon chain (in red circle) is 5 carbons long.*
- *Start numbering the carbons from the right side to give the lowest possible number to the double bond.*
- *The double bond is between Carbons 1 and 2, so gets numbered one, so you get **pent-1-ene** for the main chain*
- *There are two methyl branches (in blue circle) so you need the prefix 'di' and they're on carbons 3 and 4, so you get **3, 4 –di methyl***
- *Add it all together and you get **3, 4-di methyl pent-1-ene.***

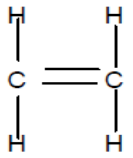
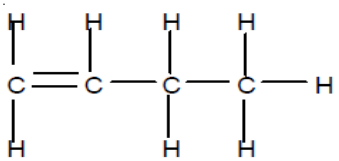
Self Checks:

Self Check 10

1. Give the extended and shortened structural formulae, molecular formulae and formula mass of the following hydrocarbons.

(a) Propene (b) pentene (c) hexene.

2. Name the following hydrocarbons and give their molecular formula, shortened structural formulae, and molecular mass.

(a)  (b) 

3. Balance the following equations for the combustion of hydrocarbons.

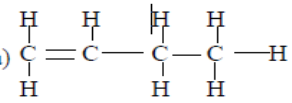
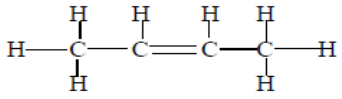
(a) $C_2H_4 + O_2 \longrightarrow CO_2 + H_2O$

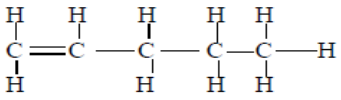
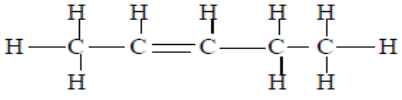
(b) $C_4H_8 + 0_2 \longrightarrow CO_2 + H_2O$

Self Check 11

1. For each of the following alkenes give:

(i) the name (ii) the molecular formula (iii) the shortened structural formula

(a)  (b) 

(c)  (d) 

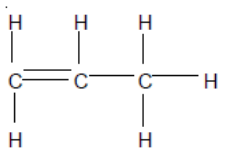
2. Draw the structural formulae and give the name of the following alkenes.

(a) $CH_2CHCH_2CH_2CH_2CH_3$ (b) $CH_3CH_2CHCHCH_2CH_3$

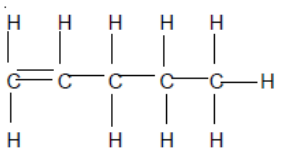
(c) $CH_3CHCHCH_2CH_2CH_3$

Answers to the Self checks are shown on the next page

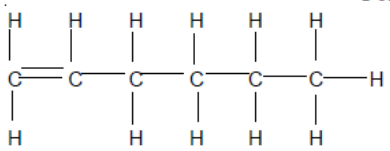
Self Check Answers 10

1. (a) 

C_3H_6 , CH_2CHCH_3 Formula Mass 42

(b) 

C_5H_{10} $CH_2CHCH_2CH_2CH_3$
Formula mass 70

(c) 

C_6H_{12} $CH_2CHCH_2CH_2CH_2CH_3$ Formula mass 84

2. (a) Ethene , CH_2CH_2, C_2H_4, mass 28

(b) Butene, $CH_2CHCH_2CH_3$, C_4H_8, mass 56

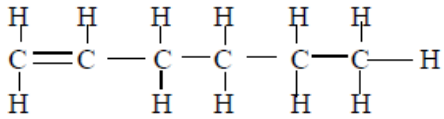
3. (a) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

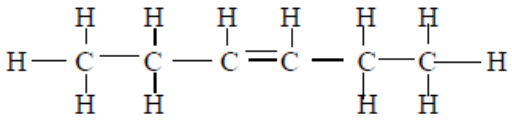
(b) $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$

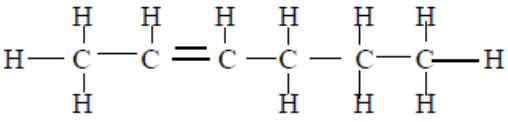
Self Check Answers 11

1.

(a) but-1-ene	C_4H_8	$CH_2CHCH_2CH_3$
(b) But-2-ene	C_4H_8	$CH_3CHCHCH_3$
(c) Pent-1-ene	C_5H_{10}	$CH_2CHCH_2CH_2CH_3$
(d) Pent-2-ene	C_5H_{10}	$CH_3CHCHCH_2CH_3$

2. (a)  hex-1-ene

(b)  hex-3-ene

(c)  hex-2-ene

Your homework is shown on the next page

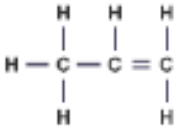
Homework:

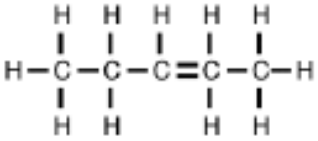
Alkenes 6

1. Give the extended and shortened structural formulae, molecular formulae and formula mass of the following hydrocarbons.

(a) ethene (b) hex-1-ene.

2. Name the following hydrocarbons and give their molecular formulae, shortened structural formulae, and molecular mass.

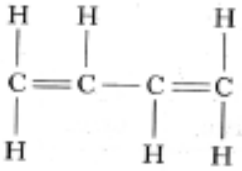
(a) 

(b) 

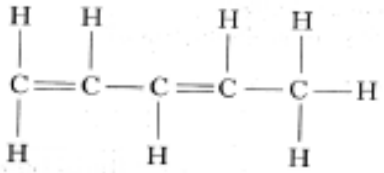
3. Draw the extended structural formula and give the name of each of the following hydrocarbons

(a) $CH_2CHCH_2CH_3$ (b) $CH_2CHCH_2CH_2CH_3$

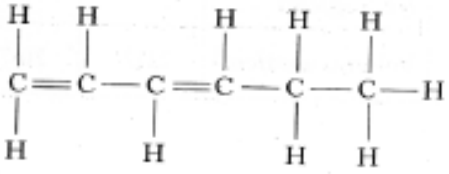
4. Dienes are a homologous series of hydrocarbons which contain two double bonds per molecule.



buta-1,3-diene



penta-1,3-diene



hexa-1,3-diene

(a) What is meant by the term "homologous series"?

(b) Suggest a general formula for the dienes.

(c) Write the **molecular formula** for the product of the complete reaction of penta-1-3-diene with bromine.

Branched alkenes 7

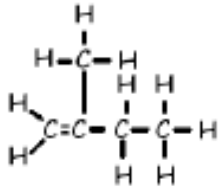
1. Draw the (i) extended and (ii) shortened structural formulae of the following hydrocarbons

(a) 3-methyl pent-1-ene (b) 2,4-dimethyl hex-3-ene.

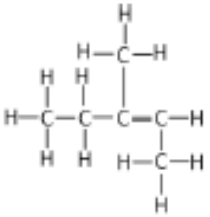
2. For each of the hydrocarbons below give:

(i) the shortened structural formula (ii) the systematic name

(a)



(b)



3 Give the extended structural formula and systematic name of each of the compounds below.

(a) CH_2CHCH_3 (b) $CH_3CHCHCH(CH_3)CH_3$

4. Silicon combines with hydrogen to form a series of compounds called the Silanes.
The formula of the first four silanes is shown below.

Si_2H_2 Si_3H_4 Si_4H_6 Si_5H_8

(a) What is the general formula of the silanes?

(b) Draw the structural formula of Si_6H_{10}.

(c) The compound Si_3H_4 reacts with oxygen to form silicon dioxide and one other substance.
Suggest what this substance might be.