Master

Kirkcaldy High School

N4/5 Chemistry

Unit 2 – part 1

Natures Chemistry

Name: _____

Class: _____

Teacher: _____

Assessment Page

End of topic questions

Topic title	Date	Mark/Total Mark
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Homework

Homework title	Date	Mark/Total Mark
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Check tests

Test title	Date	Mark/Total Mark
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Teacher comments

Using Command Words

Command words in questions are crucial as they guide us on the specific type of response required. Let's delve into some examples within the context of simple chemistry concepts, focusing on the states of matter. These are arranged into the level of detail that must be given and therefore their difficulty, from least to most.

In chemistry, often a drawn diagram will give you a mark instead of a written answer as long as it is labelled.

Identify:

This command word requires you to establish and name a particular item or concept.

For instance*, "Identify the three states of matter."*

In response, you would say*, "The three states of matter are solid, liquid, and gas."*

State: This command word requires you to express the main points concisely.

For instance, "State the process of changing from a solid to a gas."

Your answer would be*, "The process of changing from a solid to a gas is called sublimation."*

Indicate: This command word requires you to point out or show something.

For instance, *"Indicate whether the volume of a gas is fixed or variable."*

Your answer would be, *"The volume of a gas is variable."*

Provide/Give: These command words mean you need to present a specific item or concept, often an example.

For instance, *"Provide an example of a liquid."*

You could answer, *"An example of a liquid is water."*

Describe: Here, you are expected to provide a detailed account of a particular topic.

For example, *"Describe the properties of a solid state of matter."*

You would respond by saying*, "Solids have a definite shape and volume. The particles in solids are closely packed together and vibrate in fixed positions."*

Outline: This command word asks you to give a brief summary or overview of a topic.

For example, *"Outline the process of evaporation."*

You might respond, *"Evaporation is the process by which liquid turns into gas upon heating. It occurs when the particles of a liquid gain enough energy to leave the liquid and become gas."*

Explain: This command word asks you to make something clear or easy to understand by describing it in more detail.

For example, "Explain why gases easily fill their containers."

An appropriate answer might be, *"Gases easily fill their containers because their particles are free to move in all directions and will spread out until they occupy the entire container."*

Discuss: This command word is asking you to present a detailed and balanced argument about a specific topic.

For example, "Discuss the importance of understanding the states of matter."

Your response would involve discussing various aspects like the role of states of matter in natural phenomena, their significance in various scientific and industrial processes, etc.

Create: This command word often represents one of the highest levels of difficulty in command words. It requires not just recall or understanding of existing knowledge, but the ability to generate new ideas or products based on that knowledge. It involves synthesis, imagination, and critical thinking, and it's often used in tasks such as designing an experiment, writing an original essay, or proposing a solution to a problem.

Date: _____

Fuels

Learning Intentions

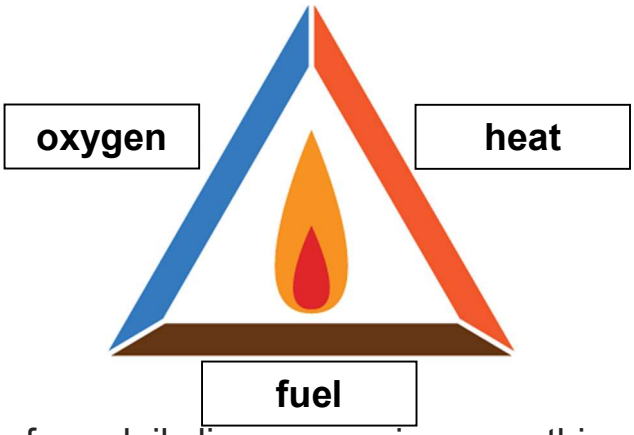
- To learn about fuels, fossil fuels and renewable energy.

Success Criteria

- ☐ I can state the definition of a 'fuel'.
- ☐ I can explain how coal, oil and natural gas are formed.
- ☐ I can explain the drawbacks of using fossil fuels.
- ☐ I can state examples of renewable energy.

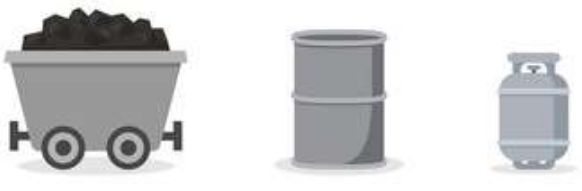
Introduction

Fuels are substances that can be **burned** (a **combustion** reaction) to **release stored energy** used to produce heat or power.



Fuels are a crucial part of our daily lives, powering everything from our cars to our homes. In chemistry, fuels are studied for their **composition**, their **energy** content, and the **reactions** they undergo when they are burned.

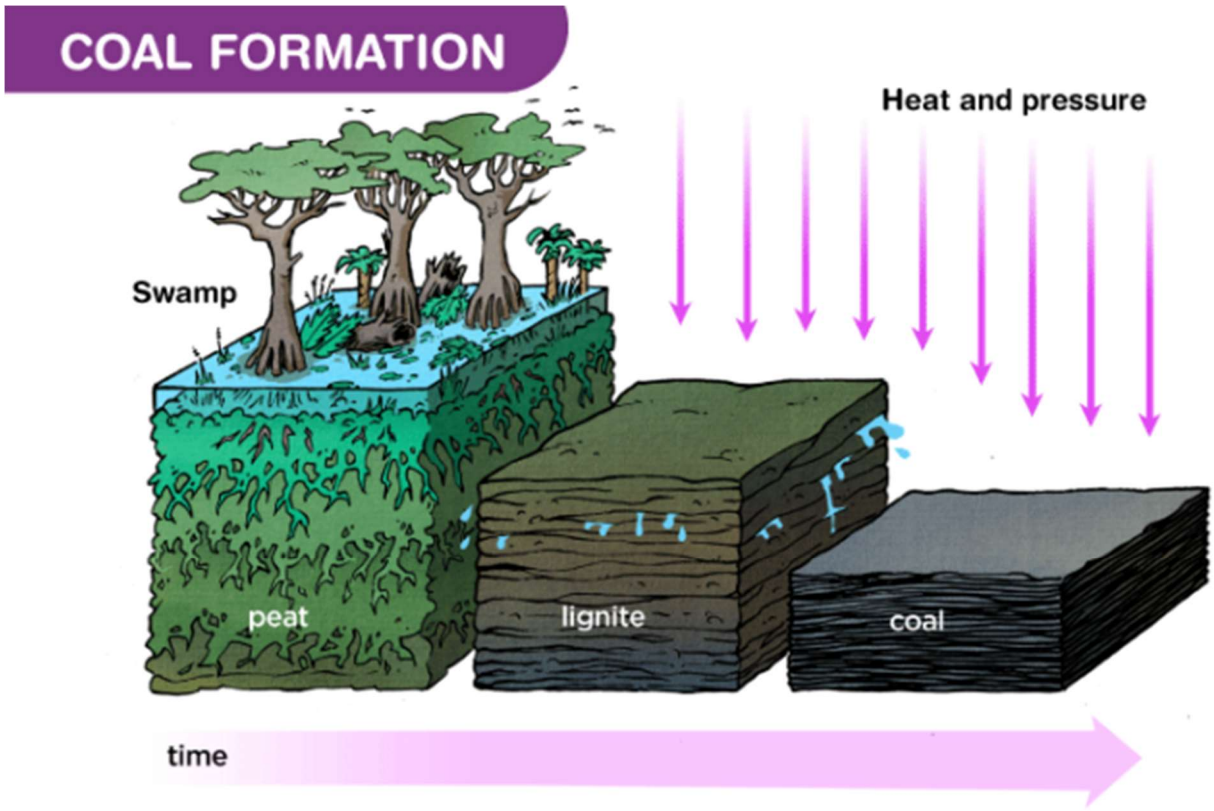
One of the most common types of fuel is **fossil fuels**. Fossil fuels, including **coal**, oil, and **natural** gas, are formed from the remains of **ancient plants** and **animals** that lived **millions** of years ago. Over time, these **organic** materials were buried and subjected to intense **heat** and **pressure**, transforming them into the energy-dense substances we use today.



Formation of Oil, Gas and Coal

Coal is formed primarily from the remains of **plants** that lived and died in **swampy**, **tropical** environments. As these plants died, they **sank** to the bottom of the swamp, forming a layer of organic material called **peat**. Over millions of years, layers of sediment built up over the peat, **compressing** and **heating** it and transforming it into **coal**.

Oil, on the other hand, is formed from tiny **marine** organisms called **plankton**. When these organisms died, they sank to the bottom of the sea, where they were buried under layers of **sediment**. Over millions of years, the **heat** and **pressure** transformed this organic material into **oil**.



Sustainability

While fossil fuels have been a vital part of our energy infrastructure for centuries, they are not without their drawbacks. They are **non-renewable**, meaning that once they are used up, they **cannot be replaced**. They also contribute to **air pollution** and **climate change** when they are burned.

In response to these challenges, there has been a growing interest in **renewable** energy sources. Renewable energy comes from sources that are naturally replenished, such as **sunlight**, **wind**, and **water**. These sources of energy are considered more sustainable because they do not **deplete** the Earth's resources and they produce fewer **greenhouse gases** compared to fossil fuels.

Examples of renewable energy and how they produce energy:

Renewable energy source	How does it produce energy?

In conclusion, while fossil fuels have played a crucial role in powering our society, the future of energy likely lies in renewable sources. As we continue to **innovate** and develop new technologies, we can expect to see a **shift** towards **more** sustainable and environmentally-friendly sources of energy.

Fuels questions

1. **Define** what a fuel is.

2. **List** three types of fossil fuels.

3. **Describe** how coal is formed.

4. **Explain** the process of oil formation.

5. **Compare** the formation processes of coal and oil.

6. **Identify** two drawbacks of using fossil fuels.

7. **Discuss** why fossil fuels are considered non-renewable.

8. **Analyse** the impact of fossil fuels on air pollution and climate change.

9. **Evaluate** the benefits of using renewable energy sources over fossil fuels.

10. **Predict** the future of energy production and the role of renewable energy sources in it.

Extension questions:

Chemcord purple books (N5): page 63 – 65

Date: _____

Combustion

Learning Intentions

- To learn how about the reaction that occurs when a fuel is burned.

Success Criteria

☐ I can state the definition of a combustion reaction.

☐ I can write the word equation for a combustion reaction.

☐ I can write a balanced chemical equation for a combustion reaction.

☐ I can tell the difference between complete and incomplete combustion.

Introduction

A **combustion** reaction is a chemical reaction that occurs when a substance reacts with **oxygen**, releasing **energy** in the form of **heat** and **light**.

In the context of fuels, the substances undergoing combustion are typically **hydrocarbons**.

- **Hydrocarbons** are substances consisting of **hydrogen** and **carbon only**.

Combustion of Hydrocarbons

When a hydrocarbon combusts, it reacts with oxygen to produce carbon dioxide and water, releasing energy in the process.

The general equation for the complete combustion of a hydrocarbon is:

Hydrocarbon + Oxygen → Carbon Dioxide + Water

For example, the combustion of methane (CH_4), the primary component of natural gas, can be represented as:

$$\mathbf{CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O}$$

This is an example of an **exothermic** reaction, a reaction that **releases energy**.

Incomplete Combustion

However, in real-world conditions, combustion is often **incomplete** due to **insufficient** oxygen.

Incomplete combustion can result in the production of **carbon monoxide (CO)**, a poisonous gas, and even solid carbon, in the form of soot.

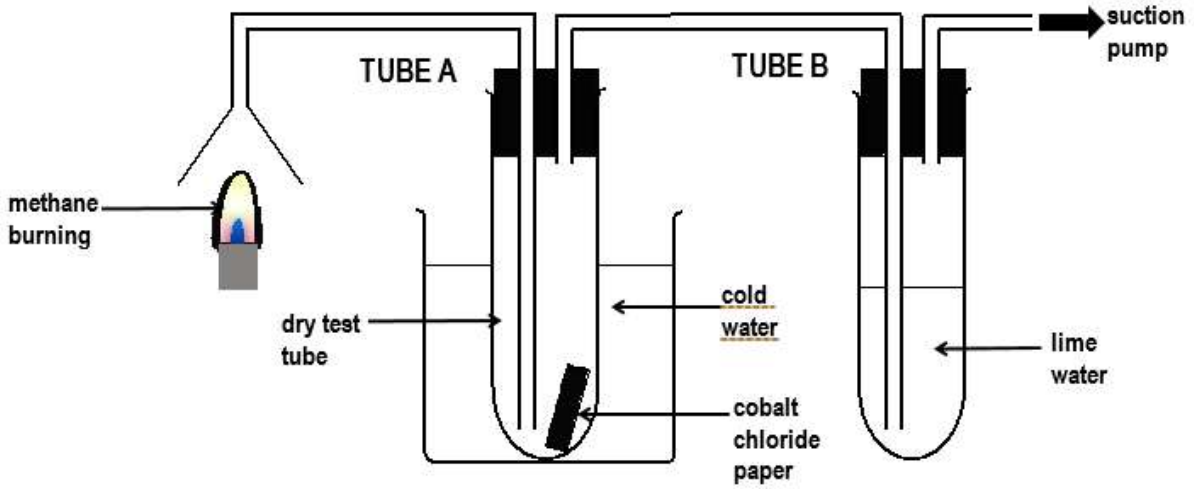
Hydrocarbon + Oxygen → Carbon monoxide + carbon + water

Combustion Experiment

Aim: _____

_____

Method:



Results: _____

_____

_____

Conclusion: _____

_____

_____

Combustion questions

1. **Define** what a combustion reaction is.

2. **Describe** the products of a complete combustion reaction.

3. **Explain** the difference between complete and incomplete combustion.

4. **Analyse** the impact of incomplete combustion on air quality and human health.

5. **Evaluate** the role of combustion reactions in the context of renewable energy sources.

Balance the following equations (fractions are possible)

Balancing order C, H then O

1. $\square CH_4 + \square O_2 \rightarrow \square CO_2 + \square H_2O$

2. $\square C_2H_6 + \square O_2 \rightarrow \square CO_2 + \square H_2O$

3. $\square C_3H_8 + \square O_2 \rightarrow \square CO_2 + \square H_2O$

4. $\square C_4H_{10} + \square O_2 \rightarrow \square CO_2 + \square H_2O$

5. $\square C_5H_{12} + \square O_2 \rightarrow \square CO_2 + \square H_2O$

6. $\square C_6H_{14} + \square O_2 \rightarrow \square CO_2 + \square H_2O$

7. $\square C_7H_{16} + \square O_2 \rightarrow \square CO_2 + \square H_2O$

8. $\square C_8H_{18} + \square O_2 \rightarrow \square CO_2 + \square H_2O$

Date: _____

Distillation & Fractional Distillation

Learning Intentions

- To learn about the process of distillation and fractional distillation.

Success Criteria

- ☐ I can state the what the process of distillation is used for.
- ☐ I can state the names of the apparatus used in a distillation experiment.
- ☐ I can draw the distillation apparatus set-up.
- ☐ I can explain the process of fractional distillation for producing different fossil fuel products from crude oil.

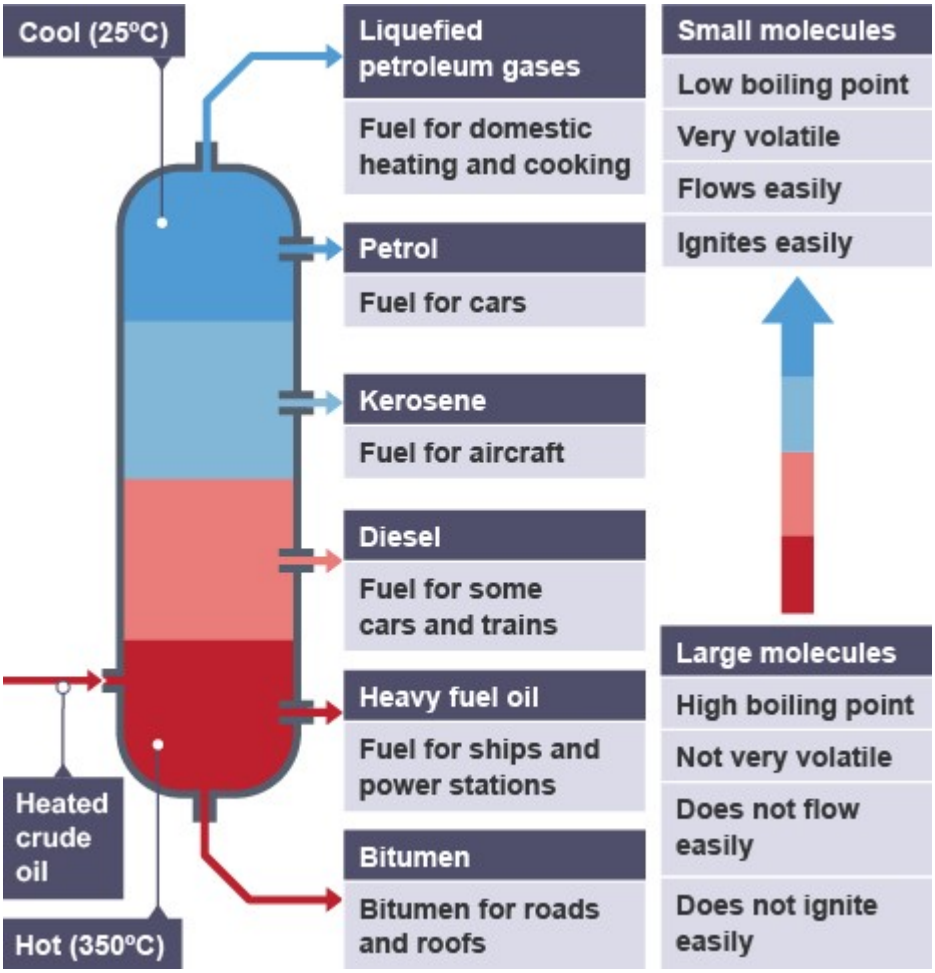
Introduction

Distillation is a technique used to **separate** mixtures based on their **different boiling points**. The mixture is heated until the component with the **lowest** boiling point **evaporates**. This vapor is then **cooled** in a **condenser** and collected as a separate liquid phase.

Draw the apparatus for a distillation experiment below:

Fractional Distillation

Fractional distillation is used when **components** have **close boiling points**. As the mixture heats, **vapours rise**. Higher-boiling-point components **condense** at the **bottom**, while lower-boiling-point components **rise** to the **top**. This creates a temperature **gradient** and enables efficient separation of the mixture's components. This process is used to separate **crude oil** into useful products.



Key words:

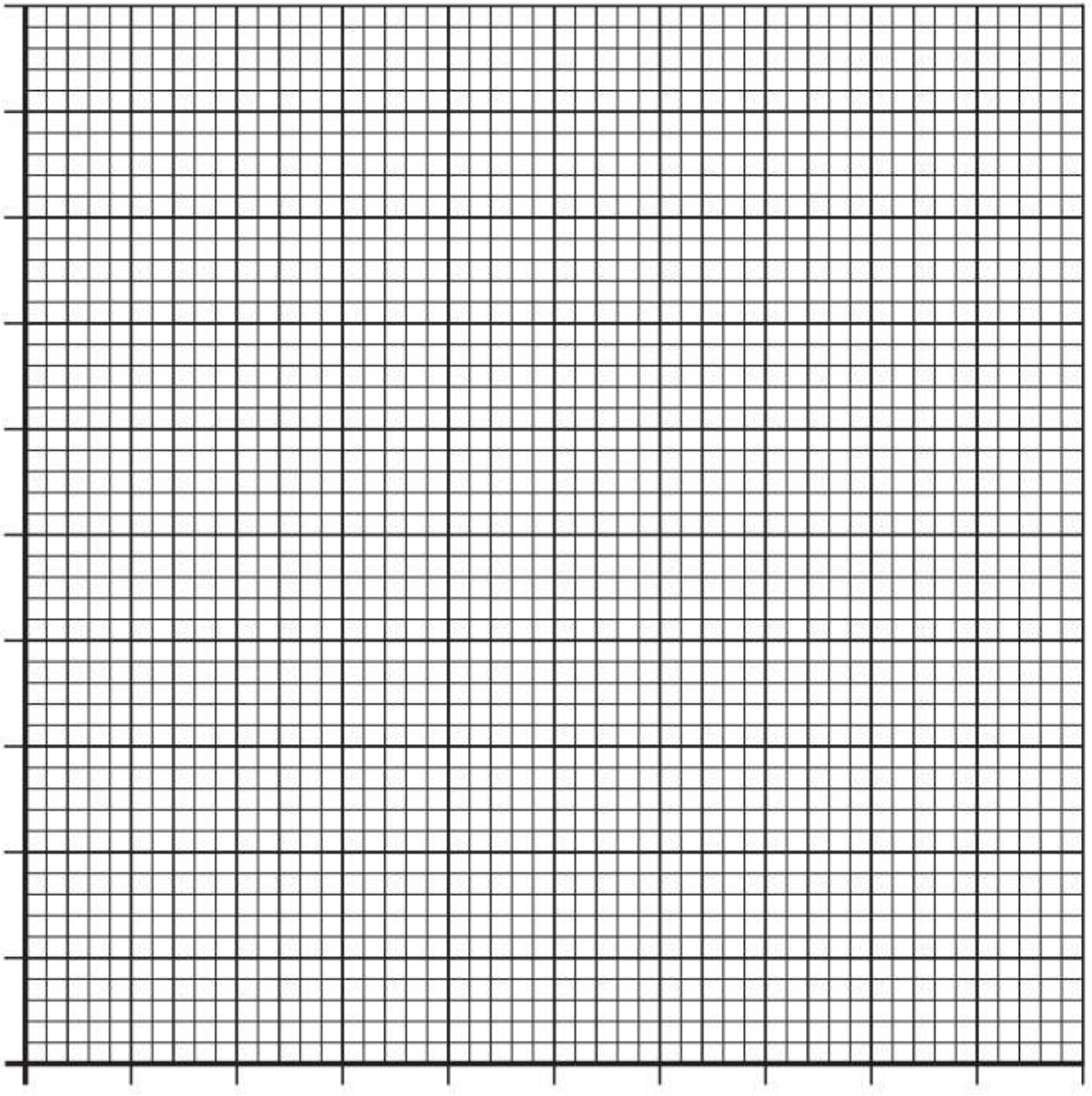
Condensation: The process of a gas or vapour changing its physical state to a liquid due to cooling or compression

Condenser: A piece of apparatus used to condense a substance

Numeracy

Use the information in the table to produce a bar graph. Use the fraction and midpoint of range values.

Fraction	Boiling Point Range (ºC)	Midpoint of Range (ºC)
Gasoline	40-205	122.5
Kerosene	150-275	212.5
Diesel Fuel	200-350	275
Lubricating Oil	300-370	335
Fuel Oil	370-600	482
Bitumen	600+	600



Distillation and fractional distillation questions

1. **Explain** the principle behind the distillation process.

2. **Explain the difference** between fractional distillation and simple distillation.

3. **Discuss** why a fractionating column is necessary in fractional distillation.

4. **Identify** the major application of fractional distillation in industry.

5. **Describe** the process of collecting fractions during fractional distillation.

Check your answers.

Extension questions:

Chemcord purple books (N5): page 66

Date: _____

Homologous Series - Alkanes

Learning Intentions

- To learn about a family of hydrocarbons known as alkanes

Success Criteria

- ☐ I can state the definition of 'hydrocarbon'.
- ☐ I can state the definition of 'homologous series'.
- ☐ I can remember (or know where to look for) the prefixes for the first 8 alkanes.
- ☐ I can name, draw, and write the molecular formula for the first 8 alkanes.
- ☐ I can draw the shortened structural formulae for the first 8 alkanes.
- ☐ I can state (and use) the general formula for alkanes.
- ☐ I can describe the trends in properties of alkanes.

Hydrocarbons

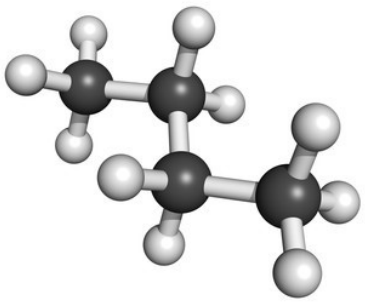
Hydrocarbons are compounds (molecules) made of **carbon** and **hydrogen** only.

Bonding:

carbons must make **4** bonds hydrogen must make **1** bond.

Hydrocarbons are split into three different subgroups (**homologous series**), these are **alkanes**, **alkenes** and **cycloalkanes**.

A **homologous series** is a family of compounds with the same **general formula** and **similar** chemical properties.



Systematic naming general

When naming hydrocarbons there is always part of the name that relates to how many carbon atoms there are in the longest chain. You must remember each of these prefixes (the first part of the word). The prefixes are shown below

No. of carbon molecules	Prefix
1	meth-
2	eth-
3	prop-
4	but-
5	pent-
6	hex-
7	hept-
8	oct-

Try and remember these off by heart. Use the space below to find a way to remember them. You could use a mnemonic.

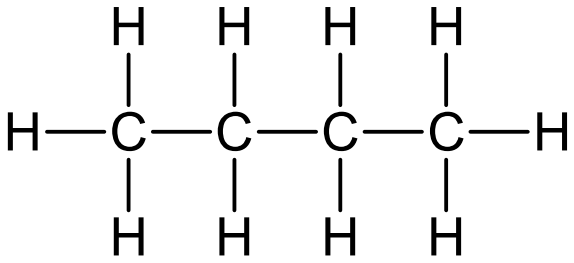
Alkanes

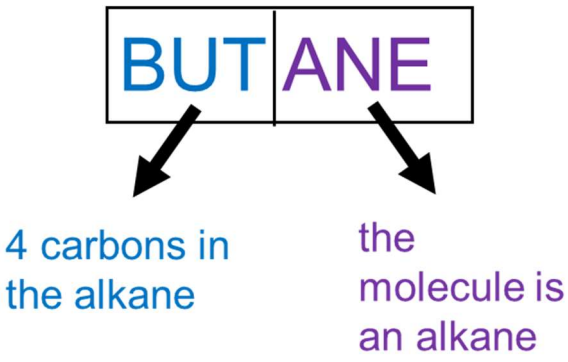
Alkanes are the simplest form of **hydrocarbon**.

Alkanes are **saturated** meaning they only contain **single bonds.**

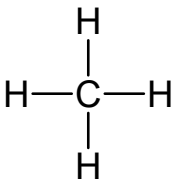
Naming alkanes

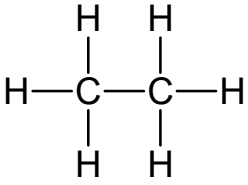
1. The first part of the name is the **prefix** based on the number of carbons in the **longest** carbon chain. *Use the previous page to help you.*
2. Alkanes always end their name in **–ANE**. The end of the name is called a **suffix**.

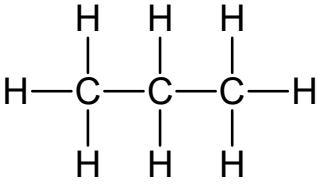




Try naming these hydrocarbons …



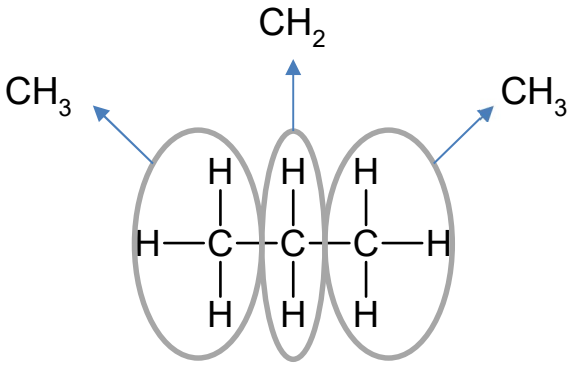




Shortened Structural Formula

When writing shortened structural formula, you will use the full structural formula. You will rewrite the formula from left to right, separating out each individual carbon with how many hydrogens is bonded to it.

e.g.



Full Structural Formula

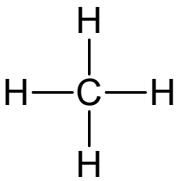
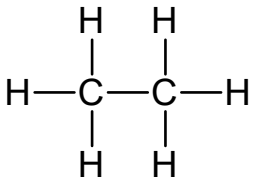
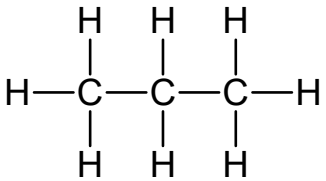
$CH_3CH_2CH_3$

Shortened Structural Formula

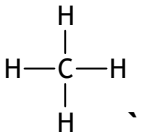
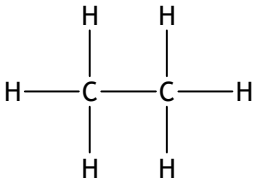
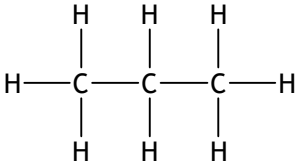
The **molecular formula** shows the number of carbons and hydrogens in the **whole** molecule.

e.g. C_3H_8

Examples are shown below.

Systematic name	methane	ethane	propane
Full structural Formula			
Shortened Structural formula	CH_4	CH_3CH_3	$CH_3CH_2CH_3$
Molecular formula	CH_4	C_2H_6	C_3H_8

Complete the following tables

No. Carbon atoms	*Name*	*Molecular Formula*	*<u>Full</u> Structural Formula*
1	**methane**	**CH_4**	
2			
3			
4			
5			
6			
7			
8			

No. Carbon atoms	Name	Shortened structural formula (use your full structural formula on the previous page to help you)
2		
3		
4		
5		
6		
7		
8		

Properties

Alkanes are relatively unreactive except in reactions like combustion.

Linking statements (using your data booklet)

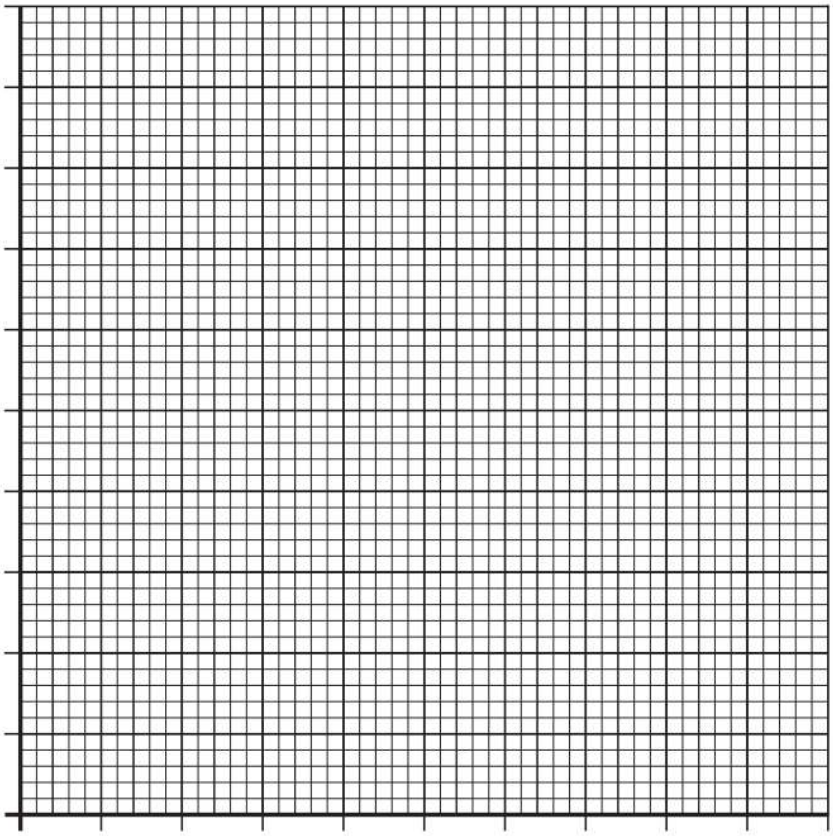
1. Write a general statement linking the length of the carbon chain in an alkane to its melting point.

2. Write a general statement linking the length of the carbon chain in an alkane to its boiling point.

3. **Explain** why the melting/boiling point have the trend? Relate your answer to the type of bonding and structure these chemicals have.

Graph

Draw a line graph for the first 8 alkanes with number of carbons vs boiling point.



General Formula

A **general formula** is a type of formula that represents the composition of any member of an entire **homologous** series (e.g. alkanes).

If you know the number of carbons of a given alkane, you can calculate the number of hydrogens.

The general formula for the alkanes is: C_nH_{2n+2}

where n = the number of carbons

Using the general formula for alkanes, complete the following formulae.

1. C_9H

2. $C_{12}H$

3. $C_{15}H$

4. $C_{18}H$

5. $C_{27}H$

6. $C_{33}H$

7. $C_{36}H$

8. $C_{42}H$

9. $C\ H_{22}$

10. $C\ H_{28}$

11. $C\ H_{32}$

12. $C\ H_{42}$

13. $C\ H_{56}$

14. $C\ H_{66}$

15. $C\ H_{84}$

16. $C\ H_{116}$

Date: _____

Homologous Series – Branched Alkanes

Learning Intentions

- To learn about branched alkanes and how to name them

Success Criteria

- ☐ I can state the definition of 'isomers'.
- ☐ I can name branched alkanes with 1 branch.
- ☐ I can name branched alkanes with 2 – 4 branches.
- ☐ I can draw branched alkanes given the systematic name
- ☐ I can draw isomers of alkanes.

Isomers

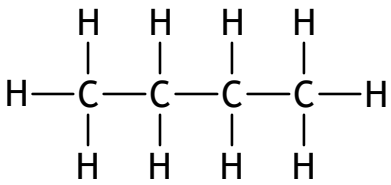
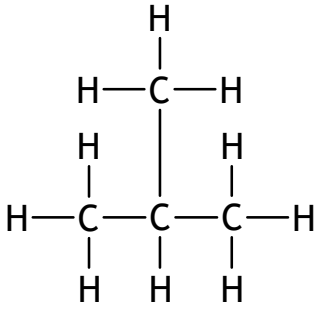
Isomers are compounds with the same **molecular formula** but different **structural formulae**.

This means they will have the same number of atoms of each element but are drawn and named differently.

Isomers may belong to different homologous series and usually have different physical properties

Straight chain and branched chain alkanes

To form an isomer of an alkane, the carbon chain can be shortened and branches may be added. e.g.

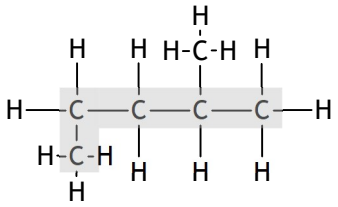
	Straight Chain Alkane	Branched Chain Alkane
Full structural formula		
Molecular formula	**C H**	**C H**

Systematic naming with branches

In order to differentiate between isomers, each structure can be given its own unique name, knwn as a **systematic** name.

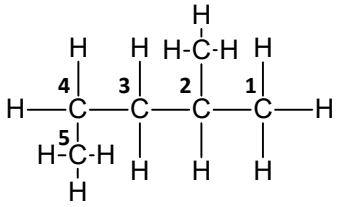
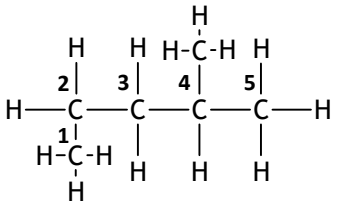
The rules for systematically naming alkanes are as follows.

1. Identify the longest chain of carbons in the molecule. The name of the molecule will be based upon the alkane with this number of carbons.

   e.g. 

   This molecule has a five membered chain and so its name will be based on pentane.

2. Number the carbons so that any branches are on the smallest number of carbon possible.

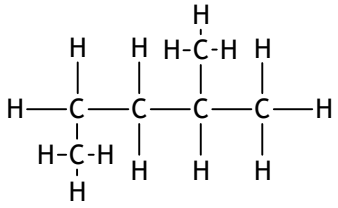
   e.g.  <u>not</u> 

3. Any carbons which are not in the longest chain are part of a branch. Branches are named and their position given.

   Branches are named based on their size. They have the same prefixes as used by the alkanes and the suffix –yl. For example a one carbon branch, as seen in the above example, is named methyl.

   If more than one branch of the same size is present then greek prefixes (di, tri, tetra etc.) are used to show the number. For example two methyl branches would be dimethyl.

4. The name is put together as follows

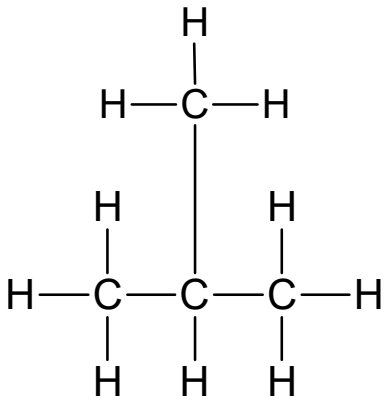
   

   Longest chain: pentane
   Branches: on number 2 C there is a methyl branch so *2-methylpentane*

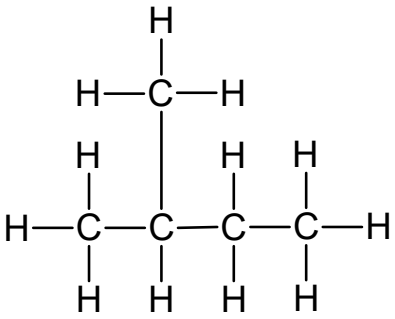
Naming Questions

Write the full systematic name the following hydrocarbons:

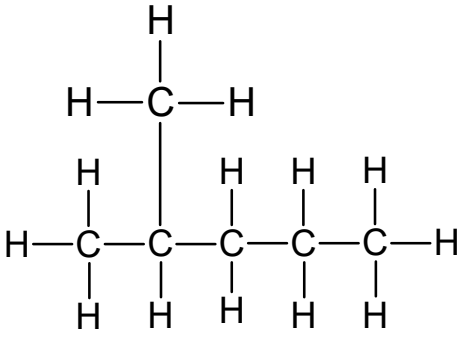
1.



2.



3.



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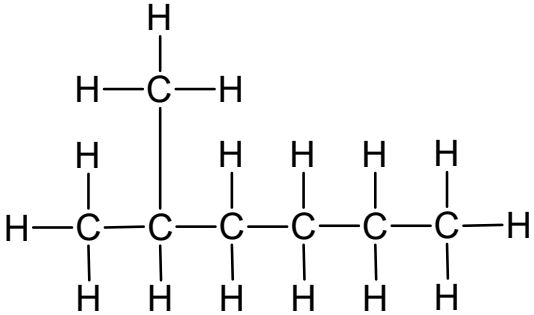
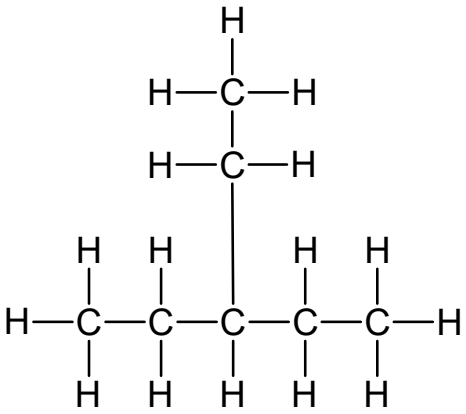


5.



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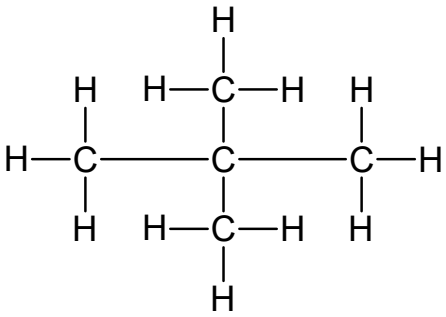

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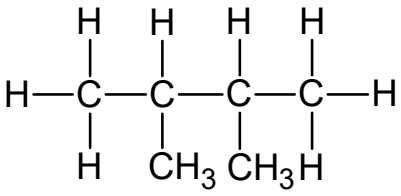
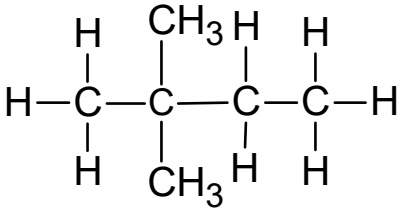


8.



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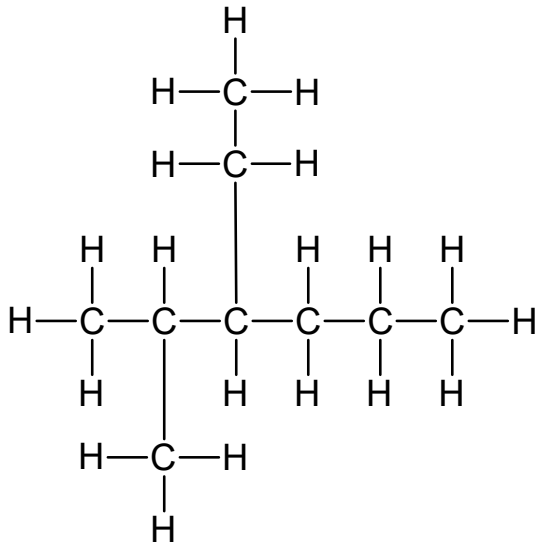

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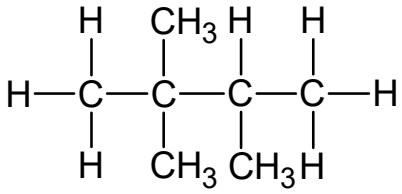
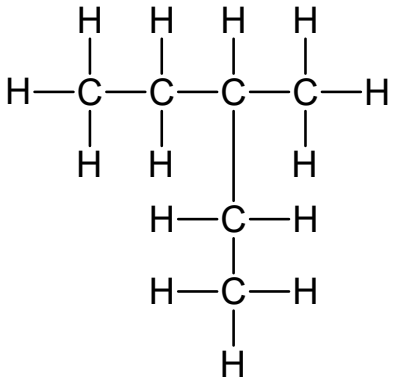
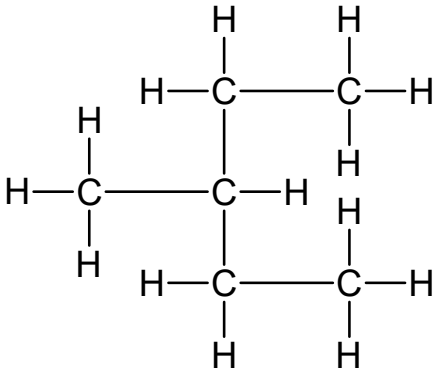


11.



12.



Drawing Questions

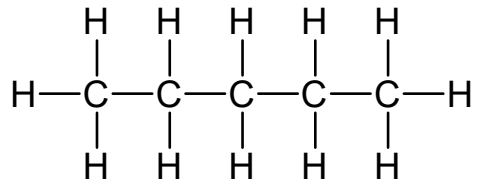
Draw the full structural formula for the following

2-Methylpropane	**2,3-Dimethylbutane**
2-Methylbutane	**2,3-Dimethylpentane**
3-Methylpentane	**3,3-Dimethylpentane**
3-Methylhexane	**3,4-Dimethylhexane**

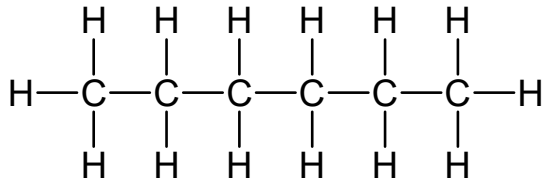
3-Ethylpentane	2,2,3-Trimethylpentane
3-Ethylhexane	**2,2,3-Trimethylbutane**

Isomers questions

Draw and name 3 isomers of pentane.

 **pentane**	

Draw and name 3 isomers of hexane.

 **hexane**	

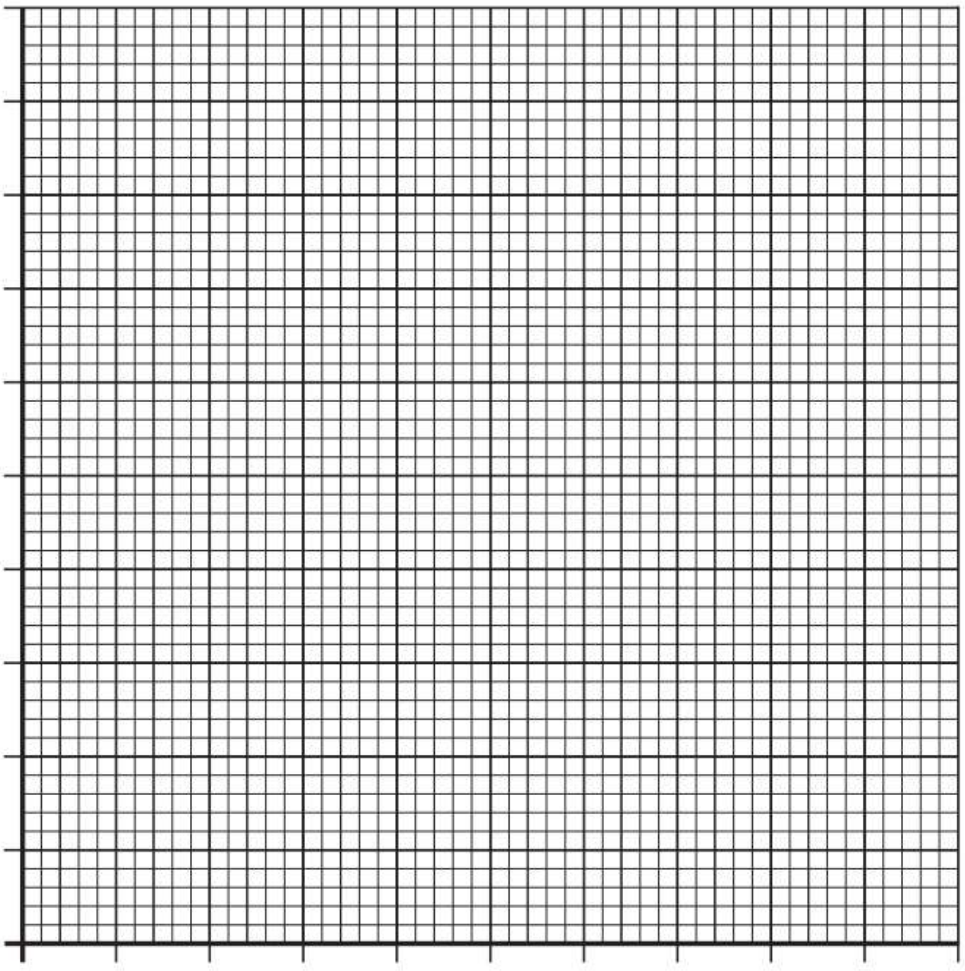
Linking statements (using your data booklet)

1. Write a general statement linking the length of the carbon chain in an alkane to its melting point.

2. Write a general statement linking the length of the carbon chain in an alkane to its boiling point.

Graph

Draw a bar graph of for alkanes with number of carbons vs boiling point.



Date: _____

Homologous Series – Alkenes

Learning Intentions

- To learn about the homologous series known as alkenes.

Success Criteria

- ☐ I can state the difference between alkanes and alkenes.
- ☐ I can name straight chain alkenes.
- ☐ I can name branched alkenes.
- ☐ I can draw alkenes given their systematic name.
- ☐ I can draw isomers of alkenes.
- ☐ I can state (and use) the general formula for alkenes.

Alkenes

The alkenes are another homologous series of hydrocarbons. They are named, just like the alkanes, with a prefix giving the number of carbons and a suffix identifying the homologous series.

The alkenes all end with the suffix **–ene.**

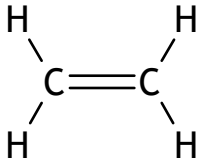
The structure of the alkanes is different from the alkanes in that they contain a **carbon to carbon** double bond.

Due to the presence of the carbon to carbon double bond, the alkenes are described as being **unsaturated**. The **alkanes** are therefore described as being **saturated**.

First member

As each member of the alkene series has a carbon to carbon double bond, there is no alkene with only one carbon. As a result the smallest alkene is named ethene and has the molecular formula C_2H_4.

e.g.



Note: Each carbon still makes 4 bonds.

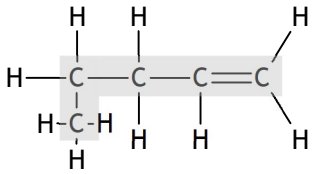
The double bond counts as 2 bonds.

Systematic Naming

As with the alkane series, the alkenes can form isomers which each have their own systematic name. Isomers of alkenes can differ in the position of the double bond and in the branches present.

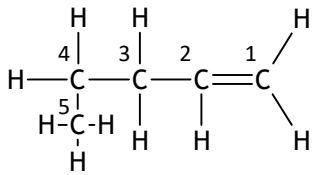
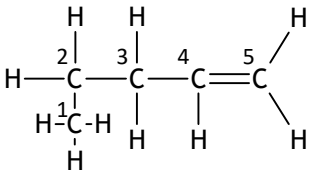
The rules for systematically naming alkenes are as follows.

1. Identify the longest chain of carbons in the molecule. The name of the molecule will be based upon the alkene with this number of carbons.

   e.g. 

   This molecule has a five membered chain and so its name will be based on pentene.

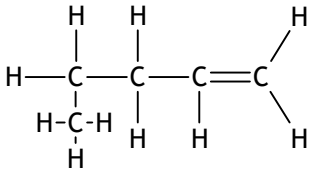
2. Number the carbons so that the double bond is attached to the smallest number of carbon possible.

   e.g.  not 

   Note: Numbering must be for the double bond and not for any branches which may be present.

3. Name any branches.

4. The name is put together as follows

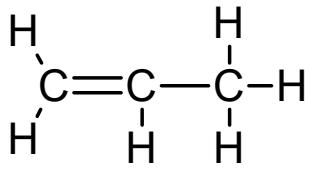
   

   Longest chain: pentene
   Branches: none
   Double bond: between number 1 and 2 C so pent-1-ene

Naming Questions

Write the full systematic name the following hydrocarbons:

1.



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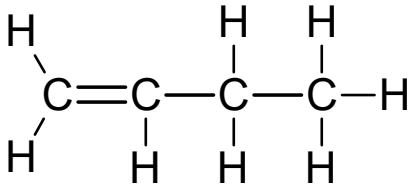

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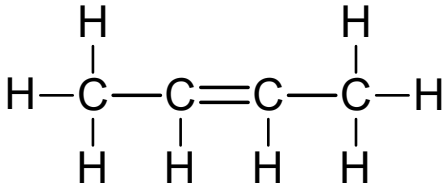

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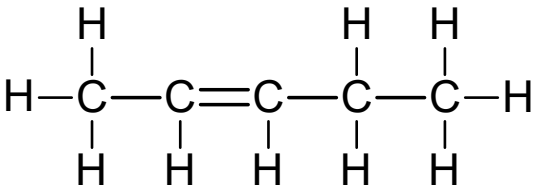

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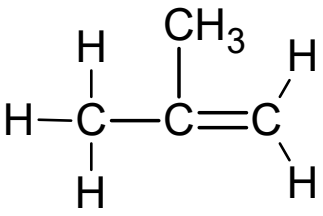

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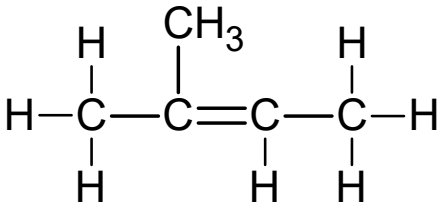

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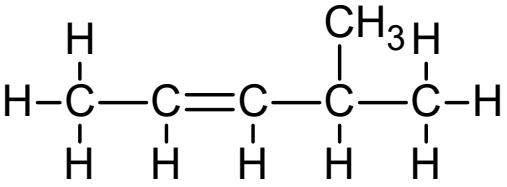
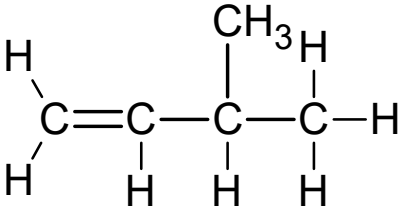
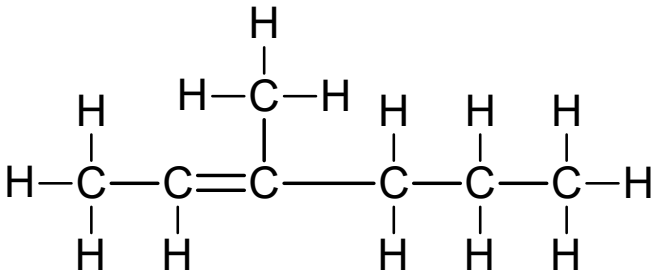


8.



9.



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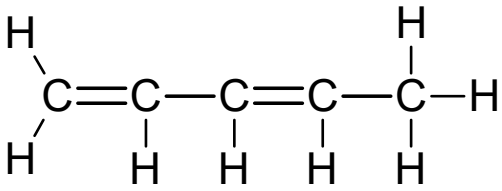

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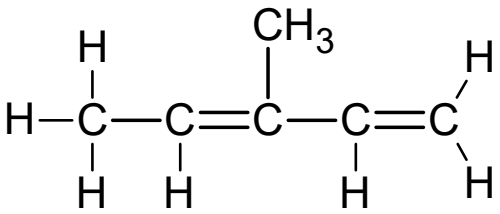

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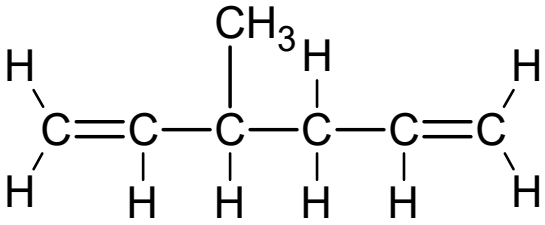


Drawing Questions

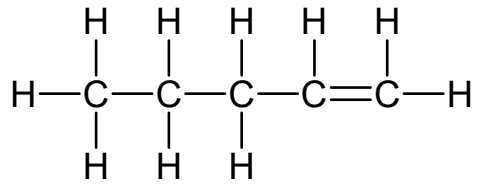
Draw the full structural formula for the following

propene	***2-methylpropene***
But-1-ene	***3-methylbut-1-ene***
But-2-ene	***3-methylpent-1-ene***
Pent-3-ene	***2,3-dimethylbut-1-ene***

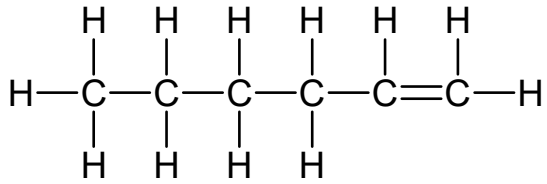
pent-1,3-diene	***2,4-dimethylhex-1-ene***
2-methylpent-1,3-diene	***3,4-dimethylhex-1,3-diene***

Isomers questions

Draw and name 3 isomers of pent-1-ene.

 **Pent-1-ene**	

Draw and name 3 isomers of hex-1-ene.

 **Hex-1-ene**	

General formula

The general formula for the alkenes is: C_nH_{2n}

where n = the number of carbons

1. C_9H
2. $C_{12}H$
3. $C_{15}H$
4. $C_{18}H$
5. $C\ H_{20}$
6. $C\ H_{28}$
7. $C\ H_{32}$
8. $C\ H_{40}$

Linking statements (using your data booklet)

1. Write a general statement linking the length of the carbon chain in an alkene to its melting point.

2. Write a general statement linking the length of the carbon chain in an alkene to its boiling point.

3. Write a general statement linking the difference in boiling point between an alkane of a given length to an alkene of the same length (e.g. propane and propene)

4. Explain why the melting/boiling point have the trend? Relate your answer to the type of bonding and structure these chemicals have.

Date: _____

Homologous Series – Cycloalkanes

Learning Intentions

- To learn about the homologous series known as cycloalkanes.

Success Criteria

☐ I can name cycloalkanes.

☐ I can draw cycloalkanes.

☐ I can draw isomers of cycloalkanes.

☐ I can state (and use) the general formula for cycloalkanes.

Cycloalkanes

The cycloalkanes are another homologous series of hydrocarbons. As with the alkanes and the alkenes, their names contain a prefix which identifies the number of carbon atoms in the molecule. Unlike the other two series, the cycloalkanes have a prefix and a suffix to identify the homologous series.

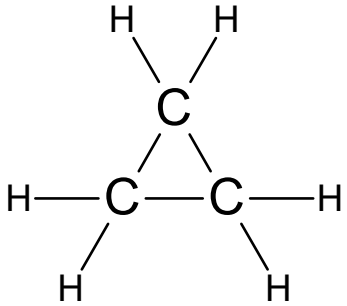
The cycloalkanes all have names which start **cyclo-** and end **–ane.**

Cycloalkanes are **saturated** hydrocarbons with a cyclic or ring structure rather than a long chain structure.

First member

As each member of the cycloalkane series has a cyclic structure, there is no cycloalkane with one or two carbons. As a result the smallest cycloalkane is named cyclopropane and has the molecular formula C_3H_6.

e.g.



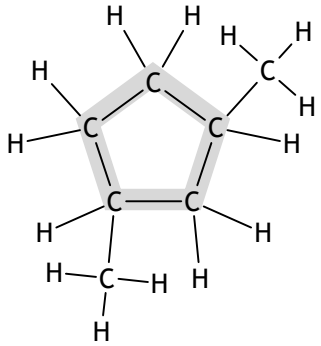
Note: Each carbon still makes 4 bonds.

Systematic naming - Cycloalkanes

Cycloalkanes also form branches and, as a result, can be systematically named.

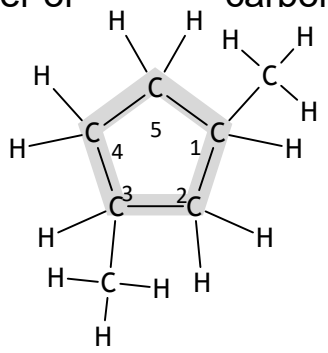
The rules for systematically naming cycloalkanes are as follows.

1. Identify the largest ring of carbons in the molecule. The name of the molecule will be based upon the cycloalkane with this number of carbons.

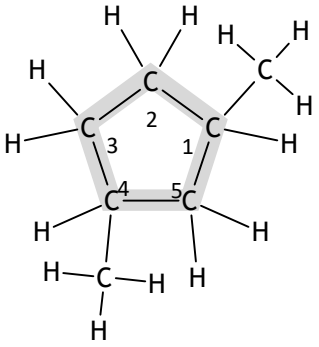
e.g. 

This molecule has a five membered ring and so its name will be based on cyclopentane.

2. Number the carbons so that any branches are attached to the smallest number of carbon possible.

e.g. 

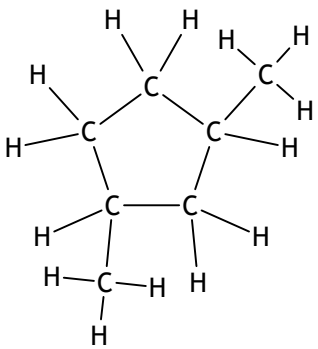
<u>not</u>



Note: Numbering can be clockwise or anti-clockwise.

3. Name any branches.

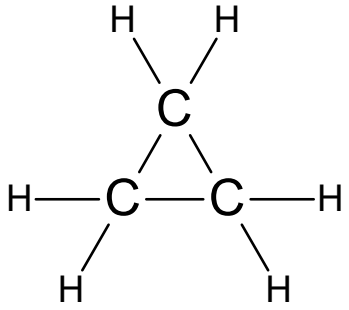
4. The name is put together as follows



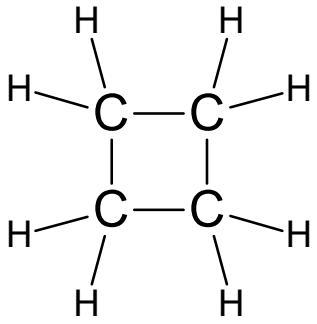
Largest Ring: cyclopentane
Branches: on number 1 and 3 C there is a methyl branch
so
1,3-dimethylcyclopentane

Naming questions

1.



2.



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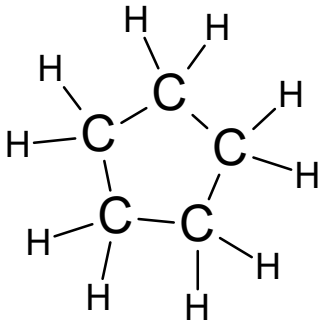

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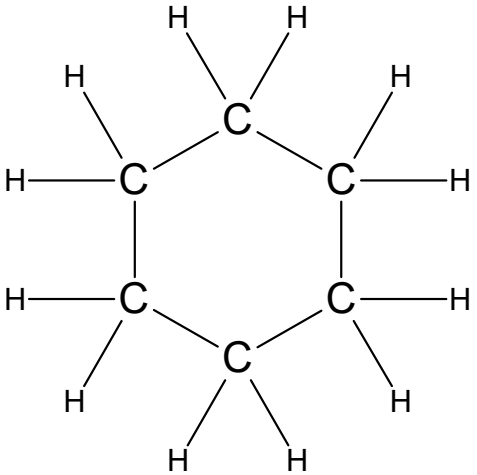

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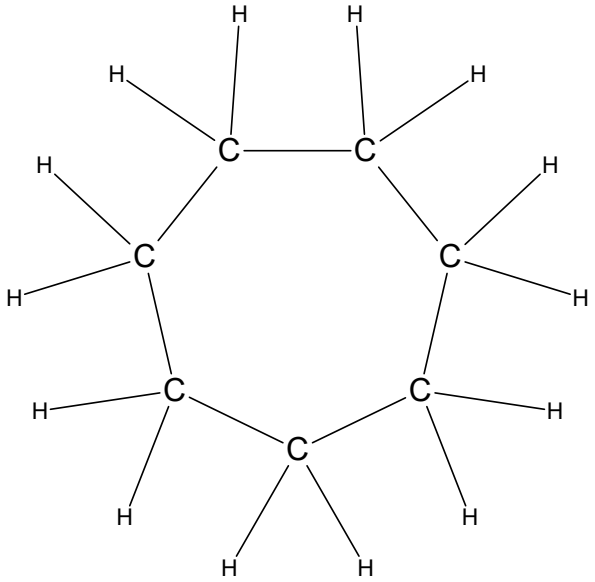
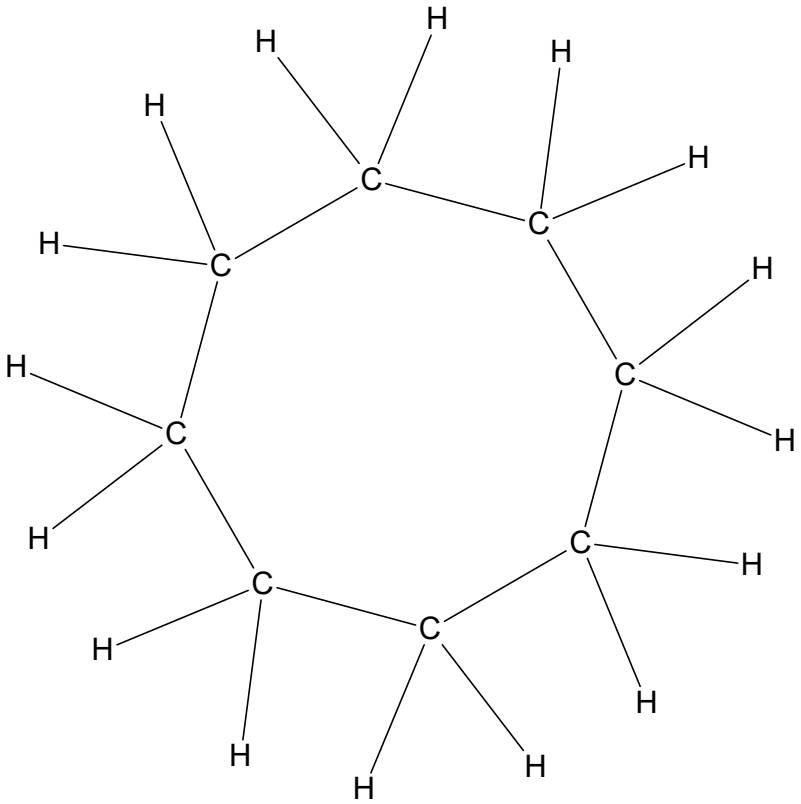


6.



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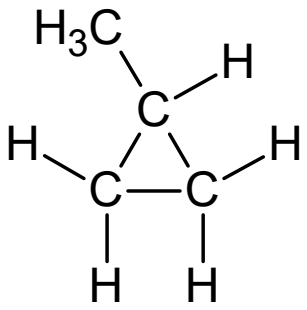
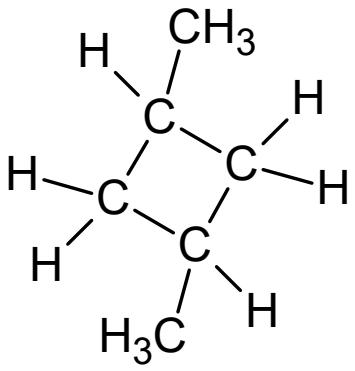
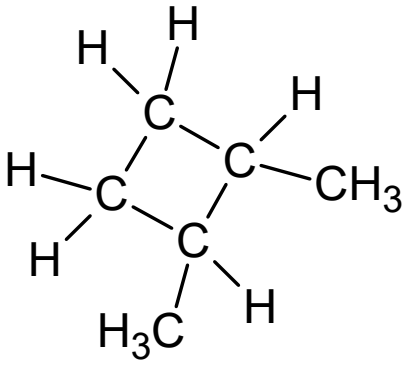


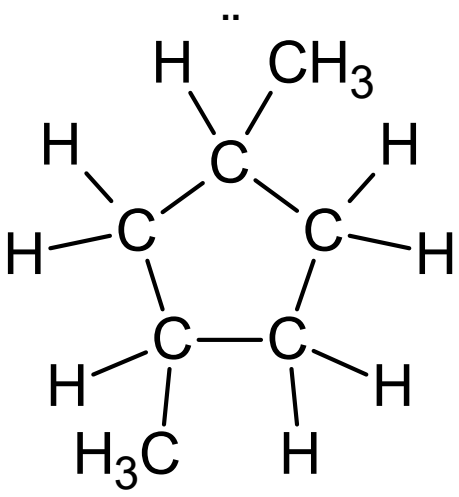
8.


H
CH3
C
H
H
C
C
H
H
C
H
H3C
H

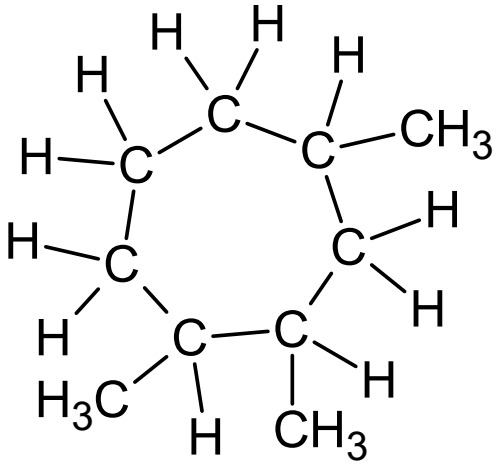
9.


H
H
C
H
H
C
C
CH3
H
C
H
H3C
H

10.


H
CH3
H
C
H
H
C
C
H
C
C
H
H
H3C
H

11.


H
H
H
C
H
C
C
CH3
H
H
C
C
H
H
C
C
H
H3C
H
CH3

Drawing Questions
Draw the full structural formula for the following

Cyclopropane	**Cyclobutane**
cyclopentane	***Methylcyclobutane***
cyclohexane	***1,3-dimethylcyclobutane***

Linking statements (using your data booklet)

1. Write a general statement linking the length of the carbon chain in a cycloalkane to its melting point.

2. Write a general statement linking the length of the carbon chain in an cycloalkane to its boiling point.

3. Explain why the melting/boiling point have the trend? Relate your answer to the type of bonding and structure these chemicals have.

General formula

The general formula for the cycloalkanes is: C_nH_{2n}

where n = the number of carbons

1. C_8H **3.** $C\ H_{34}$

2. $C_{16}H$ **4.** $C\ H_{48}$

Questions

1. What is the definition of homologous series?

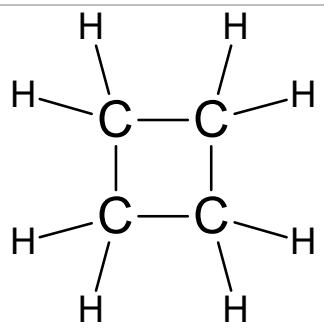
2. Cycloalkanes have the same general formula as which other homologous series?

3. What difference is there between a cycloalkane and the homologous series identified in question 1.

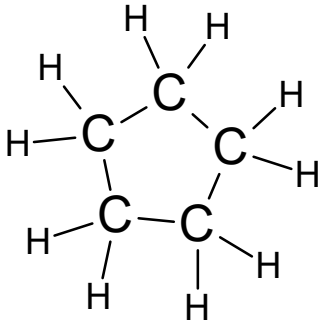
Isomers questions

Since alkenes and cycloalkanes have the **same general formula**, they may be **isomers** of each other if they have the **same molecular formula**.

Draw and name 3 isomers of cyclobutane.

 **cyclobutane**	

Draw and name 3 isomers of cyclopentane.

 **cyclopentane**	

Date: _____

Homologous Series – Addition Reactions

Learning Intentions

- To learn about addition reactions.
- To learn about the chemical test of unsaturation.

Success Criteria

☐ I can identify an addition reaction.

☐ I can state the test for unsaturation including the colour change.

☐ I can identify a halogenation, hydrogenation and hydration reaction.

Testing for Unsaturation

To test for unsaturation, if the molecule has a carbon-to-carbon double bond, a chemical can be shaken with bromine solution.

The **orange/brown** bromine solution will be **decolourised** immediately in the presence of and **unsaturated** molecule.

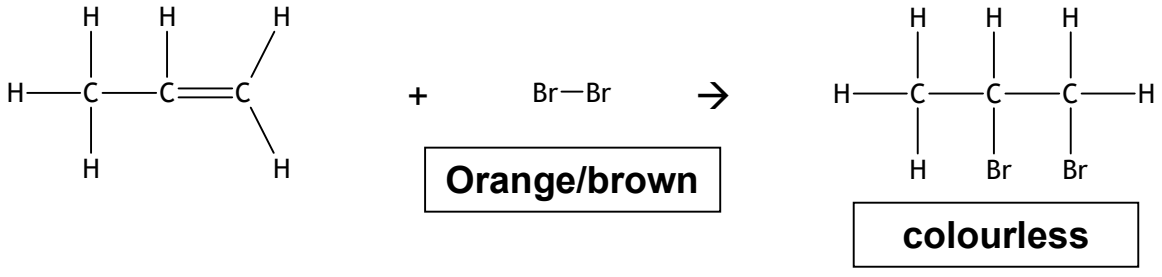
The reaction with bromine is an example of an **addition reaction.**

Addition reactions involve a **small molecule** such as hydrogen (H_2), water (H_2O) or bromine (Br_2) adding **across** the double bond, **removing** the double bond.

In an addition reaction the bromine molecule is added to the alkene across the double bond with one bromine atom bonding to each of the carbons which were double bonded.

This specific type of addition reaction is known as a **halogenation** reaction. This is a reaction where a halogen (e.g. Br_2, Cl_2, F_2, etc.) is added across a carbon-to-carbon double bond.

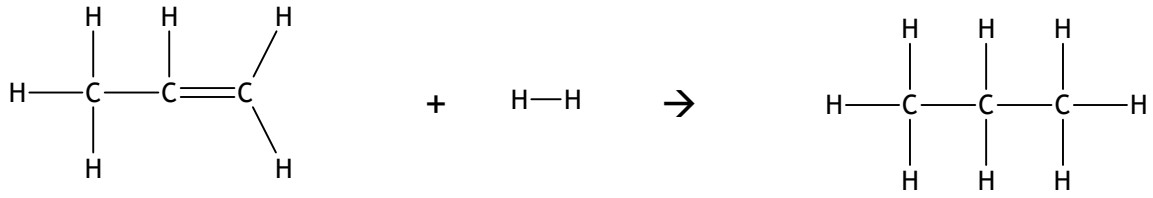
For example.



Alkanes from Alkenes

It is possible to make alkane molecules from alkenes by carrying out an addition reaction, this time with hydrogen.

This addition reaction is known as **hydrogenation.**
e.g.



alkene	hydrogen	alkane

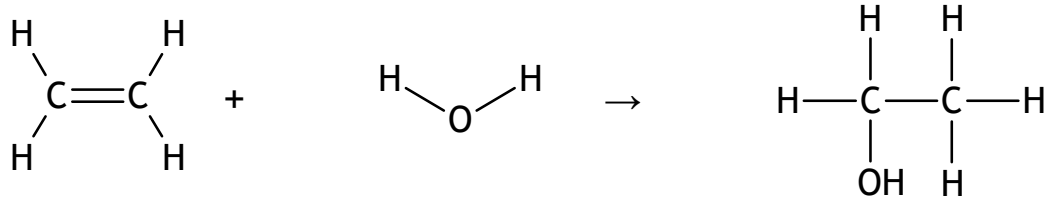
As with the earlier example of an addition reaction, the hydrogen atoms are added across the double bond.

Hydration reactions

Water molecules can be reacted with alkenes in a process known as **hydration** to produce **alcohol**. (we will return to alcohols)

Hydration is another example of an **addition** reaction.

e.g.



alkene	water	alcohol

Reaction Title: _____

Aim: _____

_____

Method:

Results:

Conclusion: _____

_____

_____

Evaluation: _____

_____

_____

Bromine decolourising questions

1. Methane (CH_4) - Is this hydrocarbon saturated or unsaturated? Would bromine solution decolourise in the presence of this molecule?

2. Ethene (C_2H_4) - Is this hydrocarbon saturated or unsaturated? Would bromine solution decolourise in the presence of this molecule?

3. Cyclohexane (C_6H_{12}) - Is this hydrocarbon saturated or unsaturated? Would bromine solution decolourise in the presence of this molecule?

4. Propene (C_3H_6) - Is this hydrocarbon saturated or unsaturated? Would bromine solution decolourise in the presence of this molecule?

5. Butane (C_4H_{10}) - Is this hydrocarbon saturated or unsaturated? Would bromine solution decolourise in the presence of this molecule?

6. Cyclopentane (C_5H_{10}) - Is this hydrocarbon saturated or unsaturated? Would bromine solution decolourise in the presence of this molecule?

7. Hexene (C_6H_{12}) - Is this hydrocarbon saturated or unsaturated? Would bromine solution decolourise in the presence of this molecule?

8. Propane (C_3H_8) - Is this hydrocarbon saturated or unsaturated? Would bromine solution decolourise in the presence of this molecule?

9. Cyclopropane (C_3H_6) - Is this hydrocarbon saturated or unsaturated? Would bromine solution decolourise in the presence of this molecule?

Halogenation, hydrogenation or hydration questions

In each of the following reactions, decide whether it represents a hydration, hydrogenation, or halogenation process:

1. When C_2H_4 is exposed to a catalyst and H_2O vapor, it results in C_2H_5OH. What type of reaction has occurred?

2. C_3H_6 reacts with H_2 in the presence of a metal catalyst to produce C_3H_8. What type of reaction is this?

3. C_2H_2 reacts with H_2O in the presence of a $HgSO_4$ catalyst and H_2SO_4, producing CH_3CHO. What type of reaction has taken place?

4. C_2H_4 reacts with Br_2 in a dark room to produce $C_2H_4Br_2$. Which reaction has taken place?

5. C_3H_6 reacts with F_2, resulting in the formation of $C_3H_6F_2$ and HF. Which type of reaction is this?

6. C_6H_{12} reacts with H_2O in the presence of a strong acid to form $C_6H_{14}O$. What is this process called?

7. C_3H_6 reacts with Cl_2, forming $C_3H_6Cl_2$. What type of reaction is this?

8. C_4H_8 reacts with H_2 in the presence of a Pd catalyst to produce C_4H_{10}. What type of reaction is this?

Date: _____

Homologous Series – Summary

Draw a flow chart to summarise the homologous series topic, including alkanes, alkenes and cycloalkanes. Include general formulae, properties, saturated or unsaturated and if they decolourise with bromine solution.

Extension questions:
Chemcord purple books (N5): page 67 – 70
Hodder and Gibson (N5): page 46 – 58
SCHOLAR

Topic	2015	2016	2017	2018	2019
Rate of reaction	MC – 12-14 S2 – 12	MC – 10-12 S2 –	MC – 10-11 S2 – 9	MC – 10-11 S2 – 4, 9a, 16a	MC – 13-15 S2 – 5a, 5bi&ii, 5cii, 7a&b

MC = multiple choice section, S2 = section 2, the written section.