

WJEC Chemistry GCSE

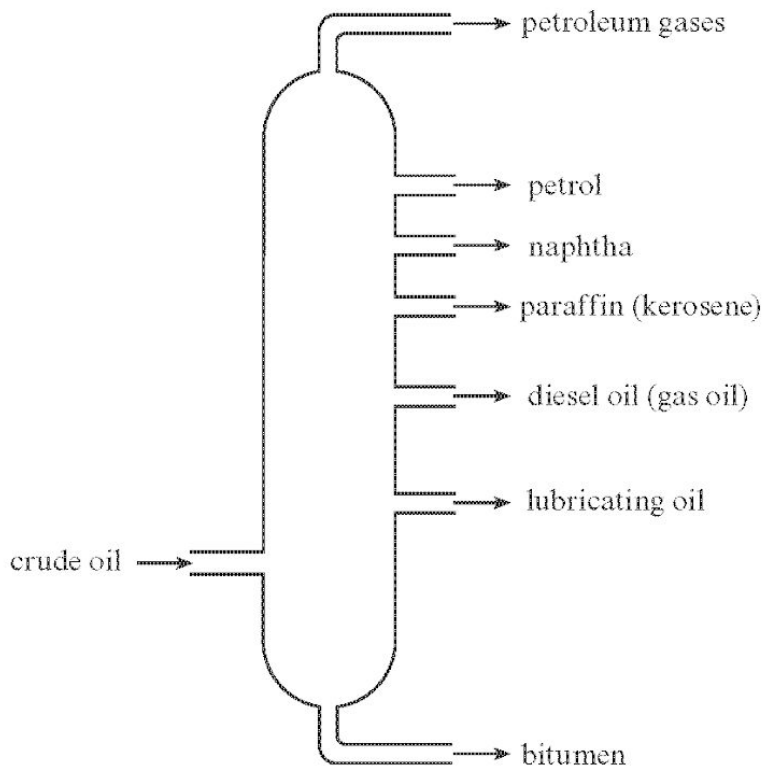
2.5: Crude Oil, Fuels and Organic Chemistry

Practice Questions

Wales Specification

1.

The diagram below represents the separation of crude oil into useful fractions in industry.



Write an account of this industrial process.

[6 QWC]

Include in your answer

- the name of the separation method,
- what crude oil is,
- a description of how crude oil is separated.

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2.

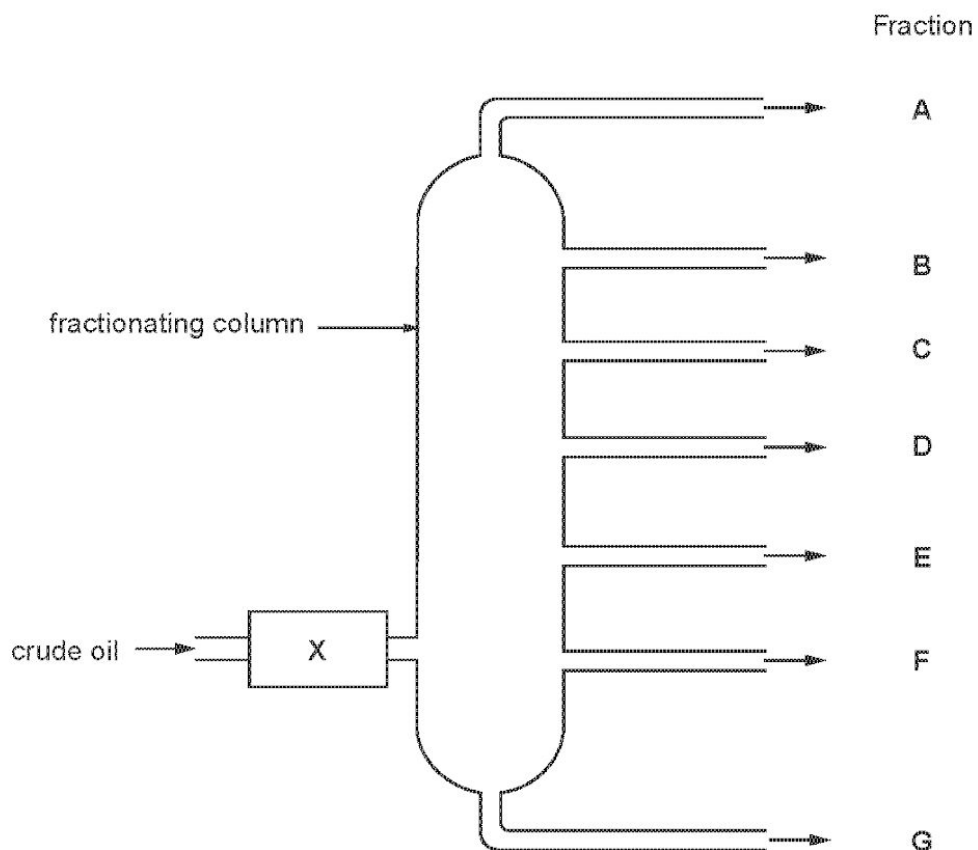
(a) Crude oil is a source of some very important fuels. State how crude oil was formed. [2]

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(b) Crude oil is a mixture of compounds called hydrocarbons. They are separated into different fractions in a fractionating column.



(i) State what happens to the crude oil in X before it is allowed to enter the fractionating column. [1]

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(ii) State the property of hydrocarbons which allows them to be separated using this method. [1]

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(c) A similar process can also be used to separate gases from air.

The table below shows the boiling points of three gases that can be obtained from air.

Gas	Boiling point (°C)
argon	-186
nitrogen	-196
oxygen	-182

To separate the gases, air is compressed and cooled to become liquid air. The liquid air is then allowed to warm up slowly.

State which of the three gases boils first when liquid air warms up and give the reason for your answer. [2]

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3.

Crude oil can be separated into fractions using fractional distillation.

(a) Explain why it is possible to separate crude oil using this process. [2]

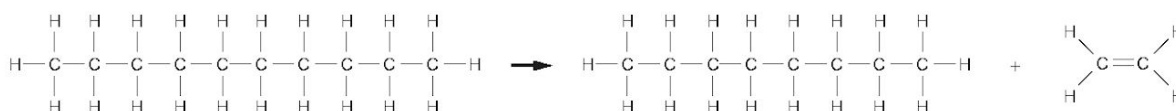
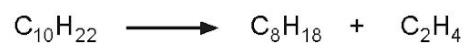
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(b) Naphtha is one fraction not usually used as a fuel. It contains decane, $C_{10}H_{22}$, which can be further processed by cracking as shown below.

decane \longrightarrow octane + ethene



State how the process is carried out and explain why it is important. [4]

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4. (a) Crude oil is a mixture of hydrocarbons.

State how it was formed.

[2]

(b) The table below shows properties of some fractions that can be obtained from crude oil.

Fraction	Size of molecule (number of carbon atoms)	Boiling point range (°C)	Colour of fraction	Viscosity at room temperature	How it burns
fuel gas	C ₁ -C ₄	-160 to 20	colourless		very easily with a clean yellow flame
petrol	C ₅ -C ₁₀	20 to 70	pale yellow	runny	easily with a clean yellow flame
naphtha	C ₈ -C ₁₂	70 to 120	yellow	fairly runny	quite easily with a yellow flame and some soot
kerosene	C ₁₀ -C ₁₆	120 to 240	dark yellow	quite viscous	harder to burn with quite a smoky flame
diesel oil and lubricating oil	C ₁₅ -C ₃₀	240 to 350	brown	viscous	hard to burn and a smoky flame

Use the information in the table opposite to answer parts (i) and (ii).

(i) Describe how any two properties of crude oil fractions depend on the size of the molecule. [2]

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(ii) Two fuels used in caravans are propane, C₃H₈, and butane, C₄H₁₀. Both fuels are used in the summer but propane is preferred during the winter.

Explain why.

[2]

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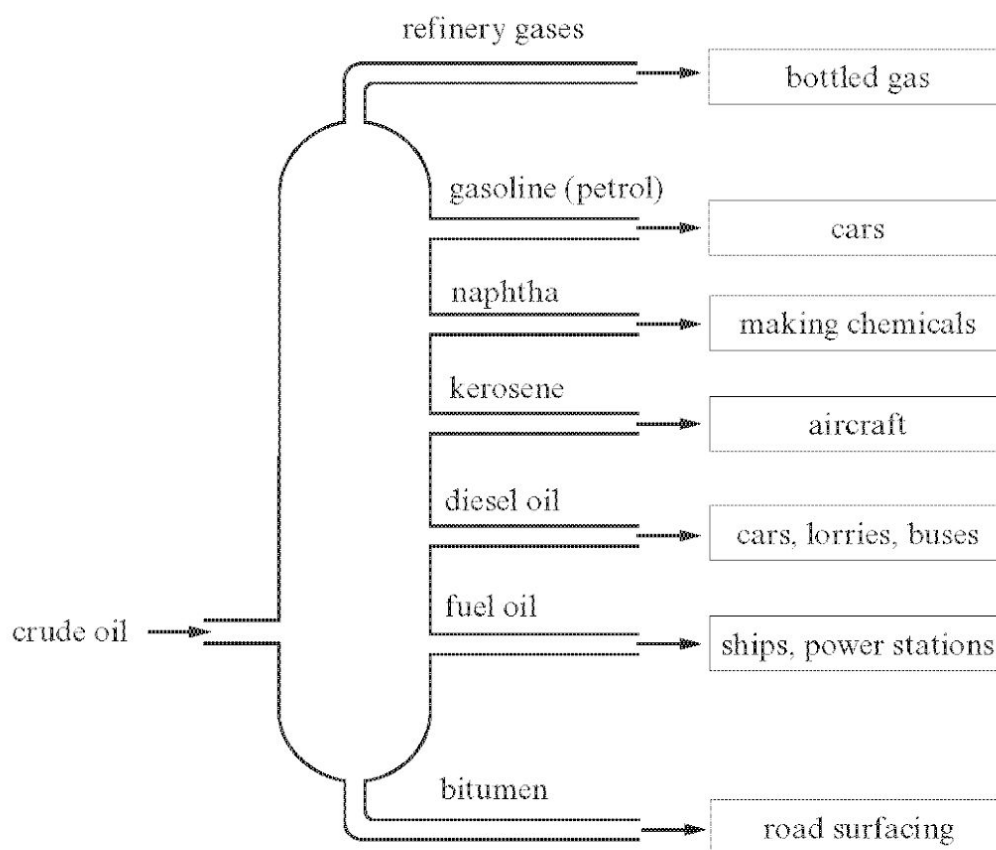
Crude oil is a mixture of hydrocarbons that is formed from the remains of simple marine organisms.

(a) State what is meant by a *hydrocarbon*.

[1]

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(b) Crude oil is separated into fractions in a process called fractional distillation.



State why the fractions obtained are not single compounds.

[1]

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(c) Most fractions are used as fuels. However, others are converted into small reactive molecules that can be used to form plastics.

Name the process used to

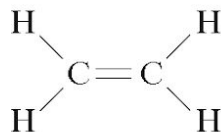
(i) produce the small reactive molecules,

..... [1]

(ii) make plastics from these small reactive molecules.

..... [1]

(d) Ethene is an example of a monomer. It is used to produce polythene. The structure of ethene is shown below.



Describe what happens to ethene molecules in the production of polythene. [2]

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(e) Give **one** disadvantage of the use of plastics such as polythene. [1]

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(a) Crude oil is a mixture of hydrocarbons.

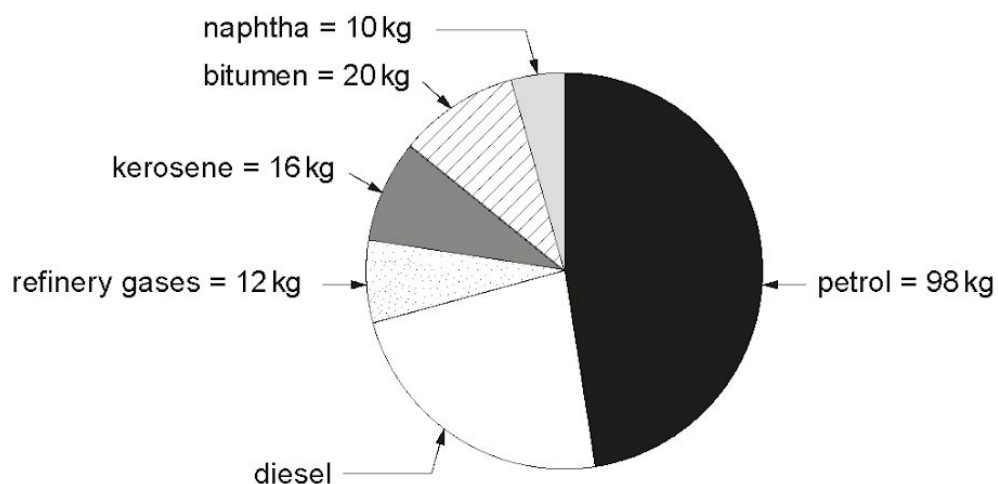
(i) State what is meant by a *hydrocarbon*. [1]

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(ii) Describe how crude oil was formed. [2]

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(b) The following pie chart shows the mass in kg of each fraction present in 200 kg of crude oil.



(i) Name the two fractions that are **not** used as fuels. [1]

..... and

(ii) Calculate the percentage of diesel present in this crude oil. [2]

Percentage of diesel = %

(iii) The names of some processes are given in the box below.

cracking	polymerisation	distillation	electrolysis
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Name the process by which

I. large hydrocarbon molecules can be made into smaller molecules, [1]

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II. small reactive molecules can be joined together to produce long chains. [1]

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7. Fossil fuels such as coal release sulfur dioxide into the atmosphere when burned. This causes acid rain. Describe how acid rain is formed and its effects on the environment. [6 QWC]

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8.

The following table shows the main products formed during the burning of coal and hydrogen.

Fuel	Main product(s) of burning
coal	carbon dioxide sulfur dioxide water
hydrogen	water

- (a) (i) Name the **three** elements that must be present in coal to give the products shown in the table. [1]

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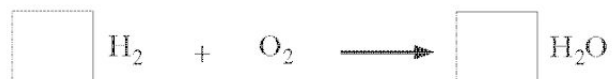
- (ii) Coal is a finite (non-renewable) resource.

State what is meant by a *finite resource*. [1]

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- (b) (i) Balance the symbol equation for the burning of hydrogen in air. [1]



- (ii) State the chemical test for hydrogen gas and give the expected result. [1]

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- (iii) Give **two** disadvantages of using hydrogen as a fuel. [2]

1.

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2.

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9.

Fossil fuels such as coal release sulfur dioxide into the atmosphere when burned. This causes acid rain. Describe how acid rain is formed and its effects on the environment. [6 QWC]

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10.

- (a) An unknown alkane, X, was found to contain 9.0g of carbon and 2.0g of hydrogen. Calculate the simplest formula for this alkane. [3]

$$A_r(\text{H}) = 1$$

$$A_r(\text{C}) = 12$$

Simplest formula

- (b) Calculate the percentage by mass of carbon in butane, an alkane containing four carbon atoms. [2]

$$A_r(\text{H}) = 1$$

$$A_r(\text{C}) = 12$$

Percentage by mass of carbon = %

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11.

Satellite images are used to show the area of Arctic sea ice.



Photograph: National Snow and Ice Data Centre,
Colorado.

- (a) The shrinking of the ice cap is interpreted by environmental groups as the result of global warming. State and explain the **main** cause of global warming. [2]

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- (b) Give **one** consequence of the reduction of Arctic sea ice. [1]

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- (c) Scientists are currently developing a process called **carbon capture and storage (CCS)** to reduce the problem of global warming. There are three main steps to CCS. Firstly, carbon dioxide is trapped and separated from other gases produced in coal-powered electricity plants. The captured carbon dioxide is transported to a storage location and finally stored far away from the atmosphere (underground or deep in the ocean).

Use this information to suggest **two** reasons why some scientists do not support the use of CCS. [2]

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12.

- (a) State how the burning of coal results in the production of sulfur dioxide and why this leads to environmental problems when released into the atmosphere. Include in your answer one example of the resulting environmental damage. [3]

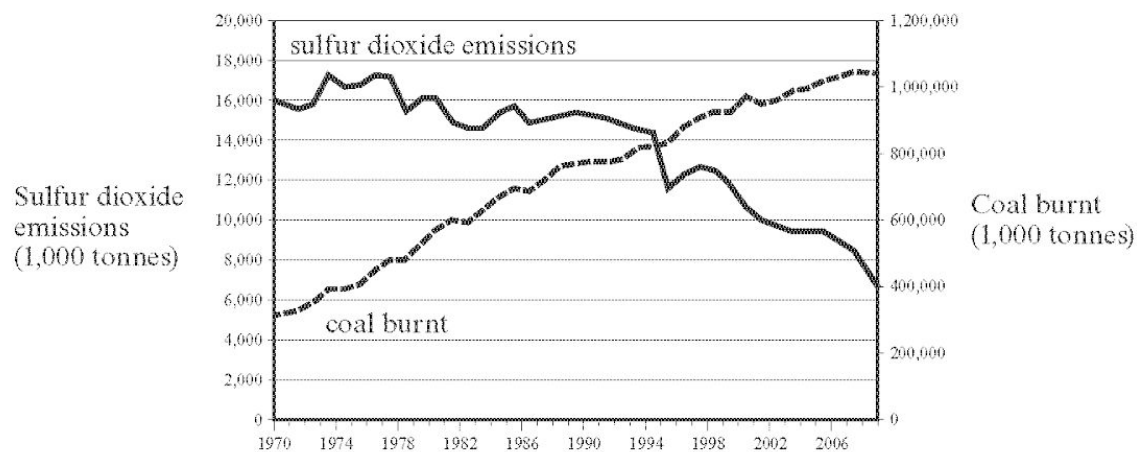
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- (b) The following graph shows the amount of coal burnt and sulfur dioxide emissions in the USA between 1970 and 2008.



- (i) State why the data shown in this graph is not as expected. [2]

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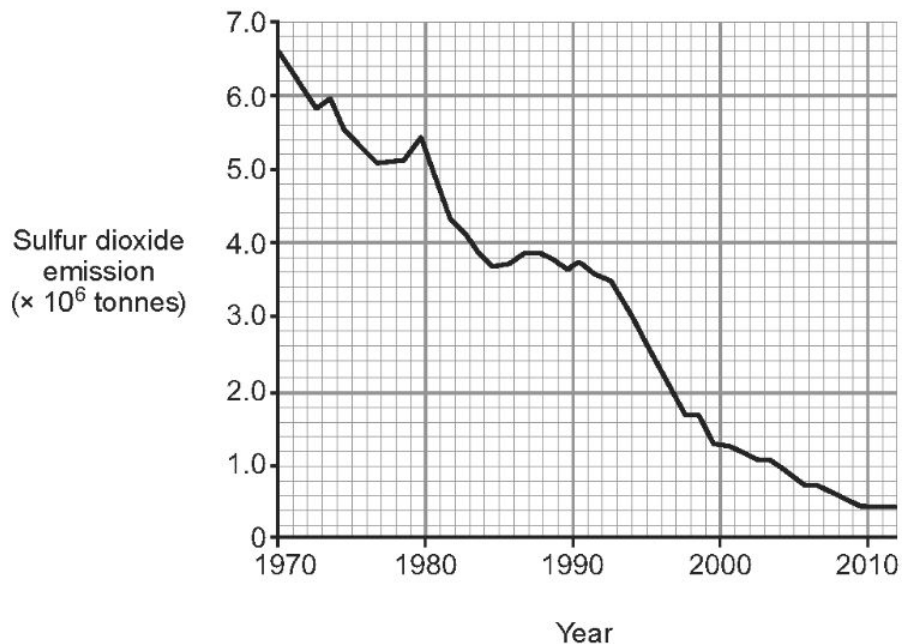
- (ii) Suggest a possible reason for the unexpected data. [1]

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13.

- (a) The graph below shows the total sulfur dioxide emissions in the UK between 1970 and 2012.



- (i) Use the graph to calculate the decrease in sulfur dioxide emissions in tonnes between 1994 and 2004. [1]

Decrease in sulfur dioxide emissions = tonnes

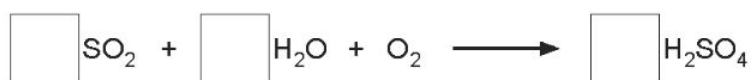
- (ii) Suggest and explain a possible reason for the trend shown in the graph. [2]

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- (iii) Balance the symbol equation below which shows a reaction that can lead to the formation of sulfuric acid in the atmosphere. [1]

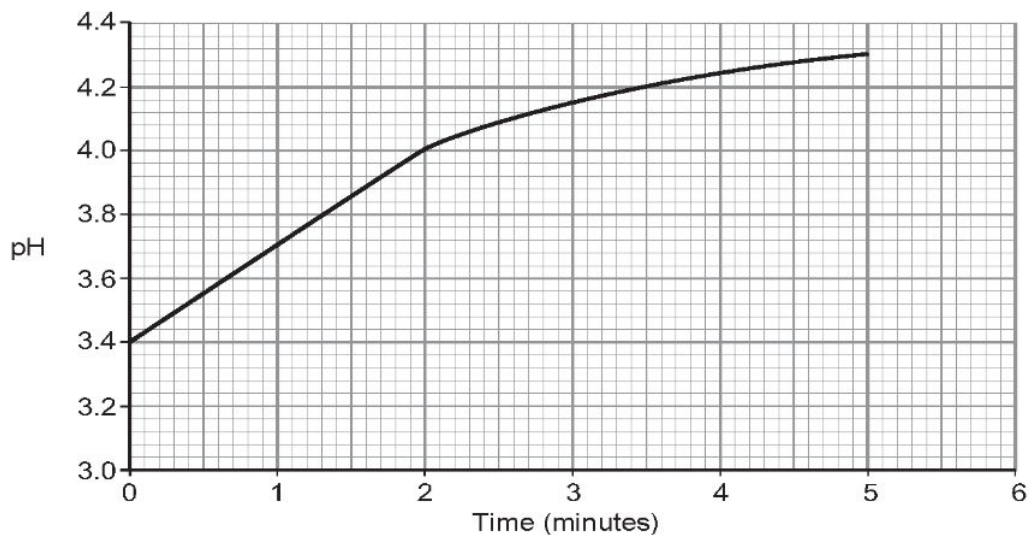


- (b) A group of pupils investigated the pH change which occurs when limestone reacts with acid rain. The group collected rain water during a rain shower.

They used the apparatus shown below.



The graph below shows the results recorded.



- (i) Name the type of reaction taking place. [1]

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- (ii) Limestone affects the acidity of acid rain. Describe how the graph supports this statement. [2]

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- (iii) Apart from destroying limestone buildings and statues, give **one other** problem associated with acid rain. [1]

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14.

Organic substances are arranged in families of compounds with similar properties.

- (a) The table below shows the first four members of two families of organic compounds, alkanes and alcohols.

Alkanes	Alcohols
methane CH_4	methanol CH_3OH
ethane C_2H_6	ethanol $\text{C}_2\text{H}_5\text{OH}$
propane C_3H_8	propanol $\text{C}_3\text{H}_7\text{OH}$
butane C_4H_{10}	butanol $\text{C}_4\text{H}_9\text{OH}$

The general formula for members of the alkane family is $\text{C}_n\text{H}_{2n+2}$.

Give the general formula for members of the alcohol family. [1]

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- (b) Isomers are compounds which have the same molecular formula but different structural formulae.

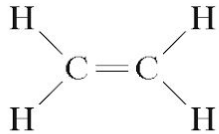
Propanol has two isomers. Draw the two positional isomers of propanol. [2]

Isomer 1	Isomer 2
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(c) Another family of organic compounds is the alkene family.

Complete the table below.

[2]

Name	Molecular formula	Structural formula
ethene	C_2H_4	
	C_3H_6	

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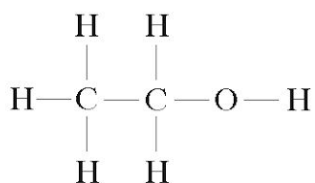
(a) The table below shows the names, molecular formulae and structural formulae of some alkanes.

Complete the table.

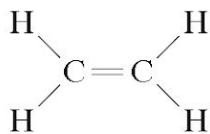
[3]

Name	Molecular formula	Structural formula
	CH_4	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array} $
ethane	C_2H_6	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $
propane		$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array} $
butane	C_4H_{10}	

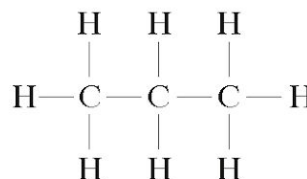
(b) The structural formulae of five carbon compounds are shown below.



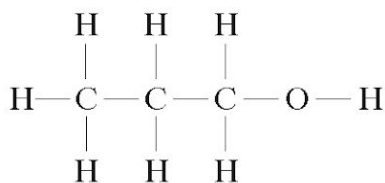
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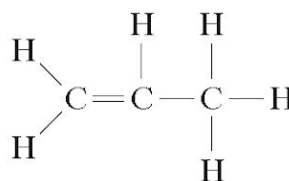
B



C



D



E

Give the letter A-E of the structure which shows

(i) ethanol, $\text{C}_2\text{H}_5\text{OH}$,

[1]

(ii) propene, C_3H_6

[1]

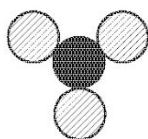
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16. (a) The key below represents atoms of some elements.



(i) Use the key to draw a diagram representing a molecule of nitrous oxide, N_2O . [1]

(ii) Use the key to give the chemical formula for the following molecule. [1]



Formula

(b) The box below shows the symbols and formulae for some gases.



Choose from the box

(i) two elements, and [1]

(ii) two compounds, and [1]

(c) The chemical formula of nitric acid is HNO_3 .

(i) State how many nitrogen atoms are present in the formula, HNO_3 [1]

(ii) Give the total number of atoms shown in the formula. [1]

(d) You may wish to refer to the table of common ions to help you answer parts (i) and (ii).

(i) Give the formulae of the ions present in the compound $MgCl_2$. [1]

Positive ion Negative ion

(ii) Give the chemical formula for sodium hydroxide. [1]

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17.

The fire triangle is shown below.



- (a) Describe what the fire triangle shows. [1]

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- (b) Use your understanding of the fire triangle to state how each of the following fire-fighting methods work. [3]

Placing a heatproof mat over a beaker that contains burning ethanol

.....
Using water to put out a bonfire

.....
Cutting down trees to provide a fire break in a forest

.....

- (c) A cook notices that a frying pan containing oil has caught fire. He decides to get a fire extinguisher to put the fire out. Choose from the following box the type of fire extinguisher that should **not** be used. [1]

carbon dioxide	foam	powder	water
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Type of fire extinguisher not to be used

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18.

Write an account of your understanding of the fire triangle and its use in fire fighting.

In your answer you should explain how the fire triangle gives rise to three different methods of fire fighting and give an example of each. [6 QWC]

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19.

Fire fighters use their understanding of the fire triangle to put out fires. Every year thousands of acres of moorland are destroyed by fire. Fire fighters use several different methods to put out this type of fire.



Suggest **three different** methods that could be used to put out moorland fires. Each method should refer to a different part of the fire triangle. State how **each** method is effective. [6]

Method 1

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Method 2

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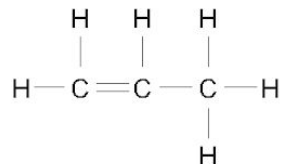
Method 3

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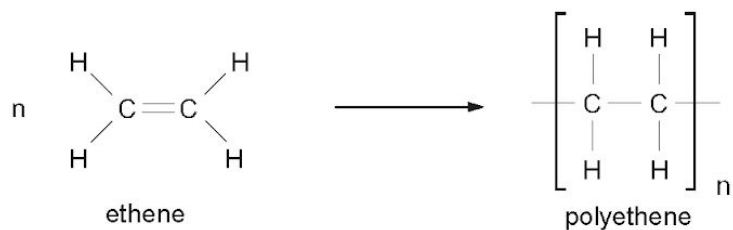
(a) The following diagram shows the structural formula of propene.



Give the molecular formula of propene. [1]

(b) An alkane contains three carbon atoms and eight hydrogen atoms. Draw its structural formula. [1]

(c) The equation below shows the formation of polyethene from ethene.



Describe what happens to ethene molecules during the formation of polyethene. [3]

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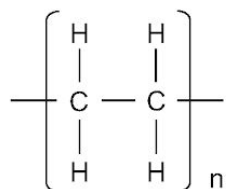
21.

The following table shows information about some organic compounds.

Name	Molecular formula	Structural formula
ethene	C_2H_4	$ \begin{array}{c} H & & H \\ & \diagdown & / \\ & C = C & \\ & / & \diagdown \\ H & & H \end{array} $
propane	C_3H_8	
hexane		$ \begin{array}{cccccc} H & H & H & H & H & H \\ & & & & & \\ H - C - C - C - C - C - C - H \\ & & & & & \\ H & H & H & H & H & H \end{array} $
	CH_4	$ \begin{array}{c} H \\ \\ H - C - H \\ \\ H \end{array} $

(a) Complete the table by filling all **three** empty boxes. [3]

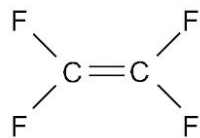
(b) (i) Name the compound from the table above that can be used to form the polymer represented by the following structure. [1]



Compound

(ii) Small reactive molecules, such as alkenes, that join together to form polymers are known as [1]

(c) Another polymer can be formed from the following compound.



(i) Choose from the box below the name of the polymer produced from this compound. [1]

polyethene	polypropene	polyvinylchloride
polytetrafluoroethene	polystyrene	

Polymer

(ii) Draw the repeating unit for this polymer. [1]

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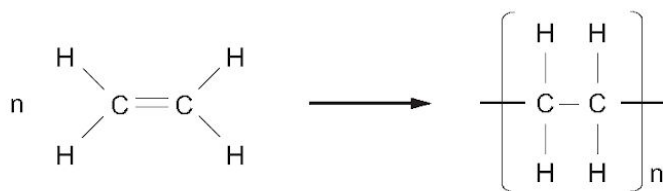
22.

The following table shows some information about four organic compounds.

Name	Molecular formula	Structural formula	Family of hydrocarbons
methane		$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$	
butane	C_4H_{10}		alkane
ethene	C_2H_4	$\begin{array}{c} \text{H} \quad \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \text{H} \end{array}$	
	C_3H_6	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}=\text{C} \\ \quad \quad \\ \text{H} \quad \quad \text{H} \end{array}$	alkene

(a) Complete the table. [4]

(b) Ethene undergoes polymerisation to form polythene. The following equation shows the reaction taking place.



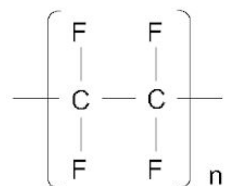
Describe what happens during this process. [2]

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(c) Another polymer is PTFE. Its repeating unit is shown below.



Draw the structure of the monomer used to produce PTFE.

[1]

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23.

- (a) The table below shows the names, molecular formulae and the structural formulae of the first two members of the alkene series. Complete the table by giving the structural formula of butene, C_4H_8 . [1]

Name	Molecular formula	Structural formula
ethene	C_2H_4	$ \begin{array}{c} H & H \\ & \\ C & = & C \\ & & \\ H & & H \end{array} $
propene	C_3H_6	$ \begin{array}{c} H & & H \\ & & \\ H - C & - & C = C \\ & & & \\ H & & H & H \end{array} $
butene	C_4H_8	

- (b) Explain how polypropene is formed from propene. [4]

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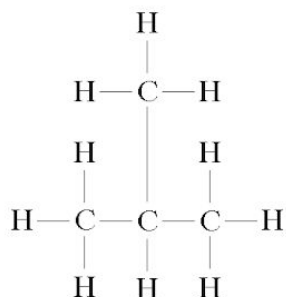
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24.

- (a) Give the **molecular** formula of the substance with the structural formula shown below.



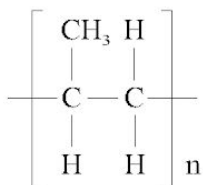
Molecular formula [1]

- (b) Give the name and the **structural** formula of the hydrocarbon with the molecular formula C_3H_8 . [2]

Name

Structural formula

- (c) Polypropene is represented as shown below.



Give the **molecular** formula of the monomer used to make polypropene. [1]

Molecular formula

4

25.

- (a) (i) The table below shows the names, molecular formulae and structural formulae of some alkanes.

Complete the table.

[2]

Name	Molecular formula	Structural formula
methane	CH ₄	
ethane	<pre> H H H-C---C-H H H </pre>
propane	C ₃ H ₈	<pre> H H H H-C---C---C-H H H H </pre>
butane	C ₄ H ₁₀	<pre> H H H H H-C---C---C---C-H H H H H </pre>

- (ii) Octane contains 8 carbon atoms. Give the molecular formula for octane.

[1]

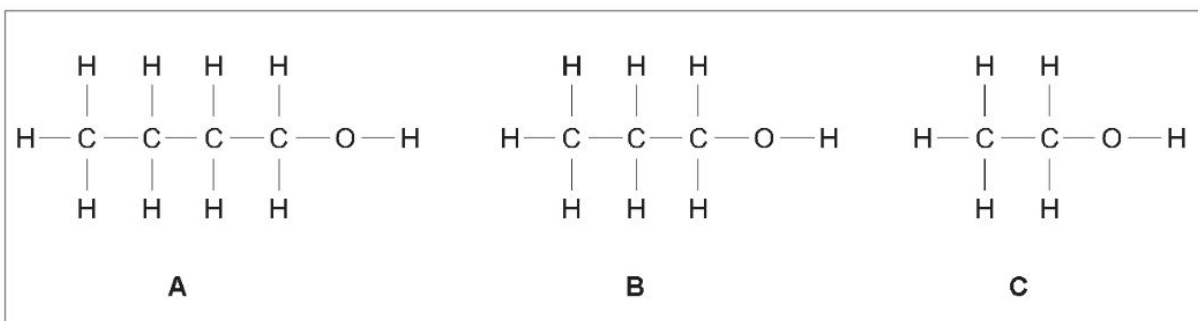
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- (b) (i) Compound X is made by a process called fermentation. The equation below shows the reaction that occurs.



Give the name of compound X. [1]

- (ii) Choose from the box below the structural formula, A, B or C, of compound X. [1]



Letter

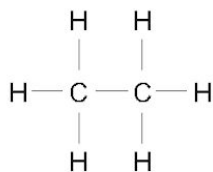
- (iii) Give **one** everyday use of compound X. [1]

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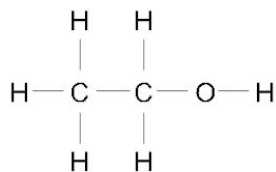
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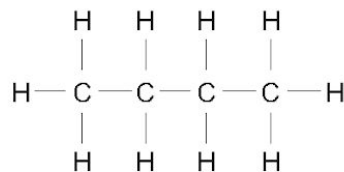
(a) The structural formulae of some organic compounds are shown below.



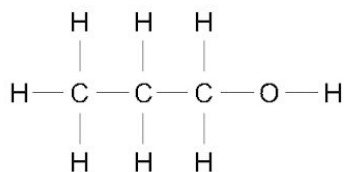
A



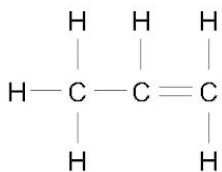
B



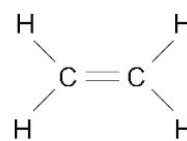
C



D



E



F

(i) Give the letters, A-F, of two alkanes and two alcohols. [2]

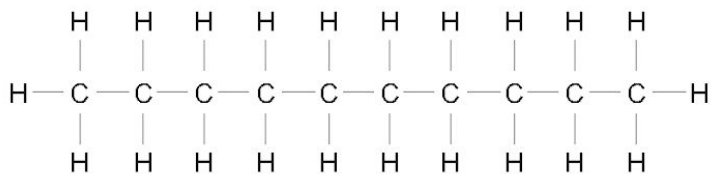
Alkanes and

Alcohols and

(ii) State which compound, A-F, has the molecular formula C_3H_6 . [1]

.....

(b) Give the molecular formula of decane. [1]



.....

4

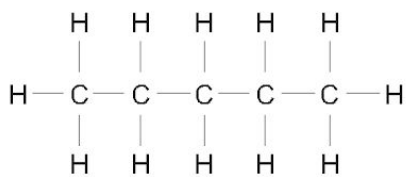
27. (a) The table below shows the first five members of the alkane family.

Alkane	Molecular formula
methane	CH ₄
ethane	C ₂ H ₆
propane	C ₃ H ₈
butane	C ₄ H ₁₀
pentane	C ₅ H ₁₂

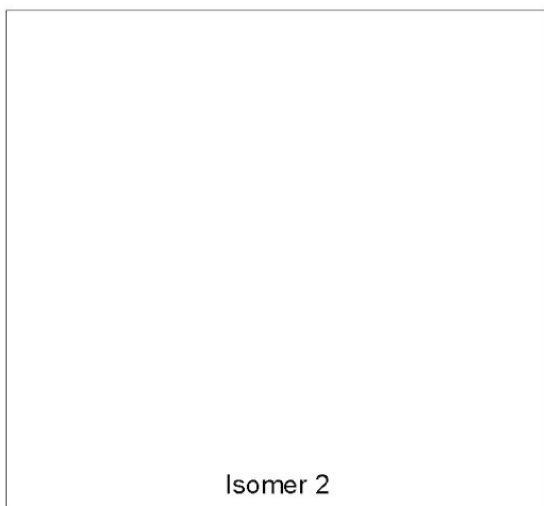
(i) Give the molecular formula for the alkane which contains 18 hydrogen atoms. [1]

.....

(ii) C₅H₁₂ has three isomers. The diagram below shows one of these isomers. Draw the other two isomers. [2]



Isomer 1

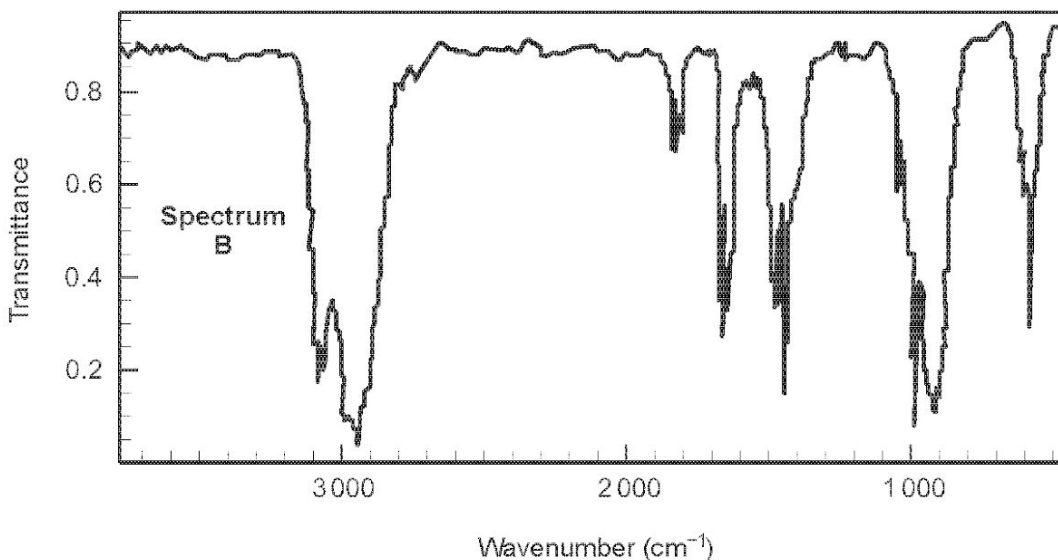
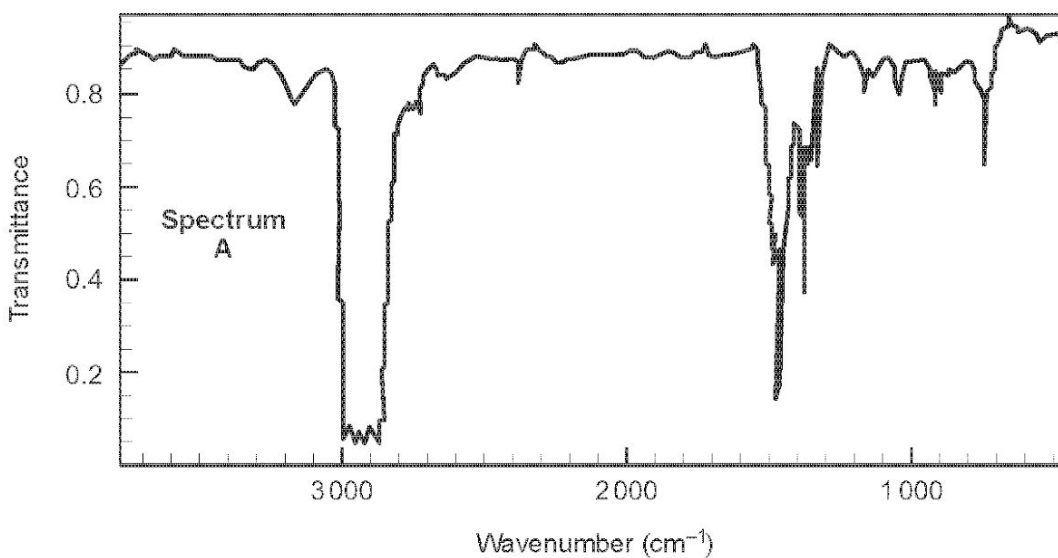


- (b) (i) The first two members of the alkene family are ethene, C_2H_4 , and propene, C_3H_6 . Give the general formula for the alkene family. [1]

.....

- (ii) Draw the structural formula for propene. [1]

- (c) Study the infrared spectra of propane and propene below. Using the information in the table opposite, identify the spectrum of propene and give a reason for your answer. [1]



Bond	Wavenumber/cm ⁻¹
C=C	1 620 to 1 670
C=O	1 650 to 1 750
C—H	2 800 to 3 100
O—H	2 500 to 3 550

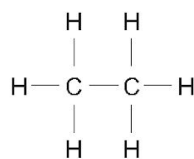
Spectrum

Reason

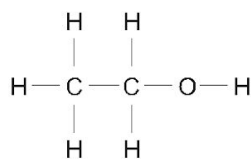
.....

6

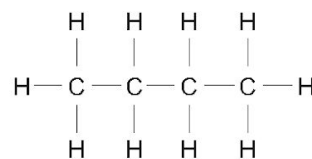
28. The following diagram shows the structures of six organic compounds.



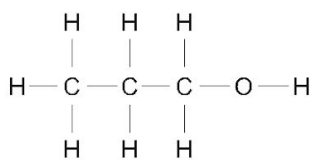
A



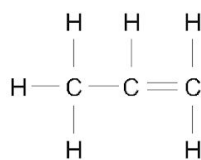
B



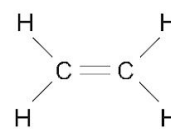
C



D



E



F

(a) Name the family to which each of the following pairs of compounds belong. [2]

B and D

E and F

(b) Describe a chemical test that could be carried out to distinguish between compounds **C** and **E**. Give the expected result for **both** compounds. [2]

.....

(c) Compound C is one of two isomers that have the molecular formula C_4H_{10} .

(i) Give the meaning of the term *isomer*. [1]

.....
.....

(ii) Draw in the space below the structure of the other isomer of C_4H_{10} . [1]

(d) Give the letter, A-F, of one *other* compound that has an isomer. Draw the structure of its isomer. [2]

Compound

Structure

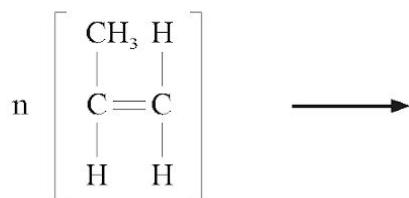
29.

- (a) (i) Give the chemical name of the polymer represented by the diagram below. [1]



- (ii) Propene undergoes polymerisation to give the polymer polypropene.

- I Complete the equation for the production of polypropene. [1]



- II Name this type of polymerisation. [1]

.....

- (b) There are two types of plastic: thermoplastics and thermosets.

Give **one** similarity and **one** difference in their structures. [2]

Similarity

.....

Difference

.....

5

30.

Describe and explain the process of addition polymerisation. Include examples to support your answer. [6 QWC]

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31.

- (a) (i) Give the balanced **symbol** equation for the reaction between ethene and bromine. [2]

..... + \longrightarrow

- (ii) Describe the observation made during this reaction. [1]

.....
.....

- (b) Ethene can also undergo a reaction known as polymerisation to produce polyethene.

- (i) By means of an equation, or otherwise, describe what happens during the polymerisation of ethene. [3]

.....
.....
.....

- (ii) Polymerisation requires the use of a catalyst. Explain the effect of catalysts on chemical reactions. [2]

.....
.....
.....

- (c) The following table shows the observations made when two different plastics, A and B, are heated to a temperature of 150 °C.

Plastic	Effect of heat on plastic
A	softens and can be reshaped
B	does not soften but turns black (chars) if over-heated

Name the two **types** of plastic and explain the different observations in terms of the bonding present. [4]

Type of plastic

A

B

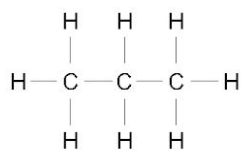
Explanation of observations

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.....

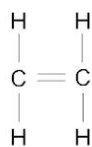
32. (a) Draw a line to link each type of substance to the property that best describes it. [1]

Type of substance	Property
shape memory polymer	does not change when heated
thermoplastic	regains original shape when heated
thermoset	softens when heated

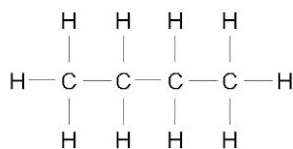
(b) The structural formulae of four organic compounds are shown below.



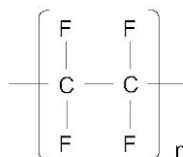
A



B



C



D

(i) Give the chemical name of compound B. [1]

(ii) Give the letter of the compound that is **not** a hydrocarbon and give a reason for your answer. [2]

.....

(iii) Give the letter of the compound that can undergo polymerisation and give a reason for your answer. [2]

.....

(c) The molecular formula of propene is C_3H_6 .

Draw the structural formula of propene.

[1]

33.

Plastics such as polythene and polystyrene are widely used in everyday life.

- (a) The table below shows the properties and some common uses of polythene and polystyrene.

Plastic	Properties	Uses
polythene	flexible, low density, waterproof, non-toxic, unreactive	carrier bags, bin liners, plastic bottles
polystyrene	rigid, low density, non-toxic, easily squashed, good insulator, unreactive	yoghurt pots, disposable cups, egg cartons, protective packaging

Use the information in the table to give a reason why

- (i) polythene is used to make carrier bags and bin liners, [1]

.....

- (ii) polystyrene is used for disposable cups. [1]

.....

- (b) State why the use of plastics causes environmental problems and give one way of overcoming these problems. [3]

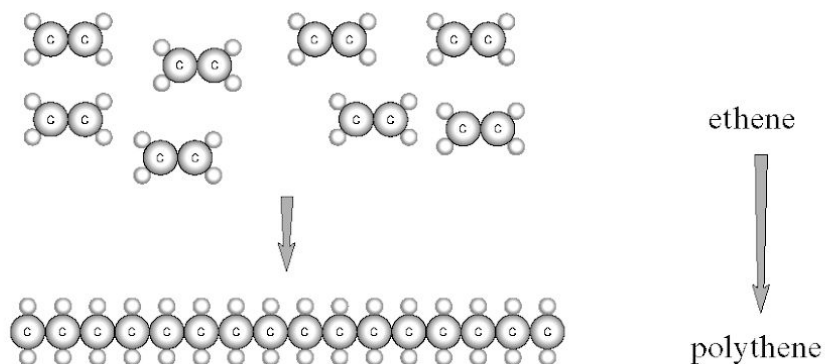
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(c) Polythene can be made from ethene as shown in the following diagram.



Use some of the terms given in the box below to complete the sentences that follow.

cracking	electrolysis	monomer	polymer
polymerisation	reactive	unreactive	

Ethene is a small molecule known as a

Many of these molecules join together in a process called

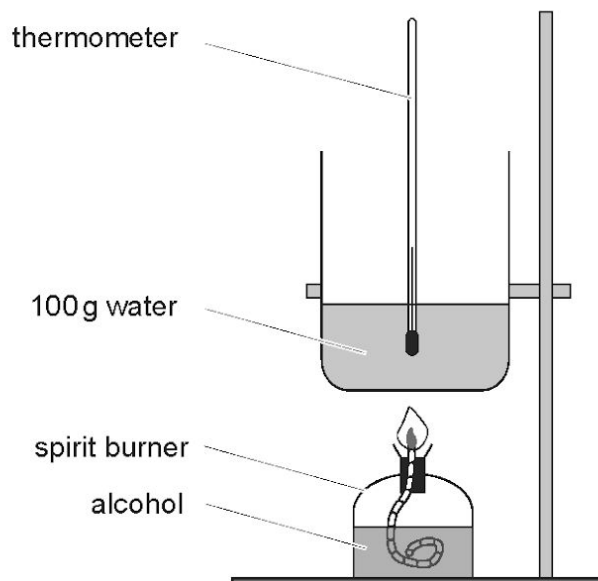
to produce a long chain molecule known as a [4]

9

34.

Methanol, ethanol, propanol and butanol belong to the alcohol family.

An experiment was carried out to discover which alcohol gives out the most energy when burned. The diagram below shows the apparatus used.



1 g of each alcohol was used to heat 100 g of water. The results are shown below.

Alcohol	Initial temperature of water (°C)	Final temperature of water (°C)	Temperature change (°C)	Energy given out (J/g)
methanol	18	31	13	5 460
ethanol	20	45	25	10 500
propanol	19	48	29	12 180
butanol	20	50	30	

(a) The energy given out by each alcohol can be calculated using the formula:

$$\text{energy given out} = \text{mass of water} \times 4.2 \times \text{temperature change}$$

Calculate the energy given out in burning 1 g of butanol. [2]

Energy given out = J/g

(b) Apart from using 1 g of each alcohol and 100 g of water, give one other step that should be taken to ensure a fair test. [1]

.....

(c) The theoretical values for the energy given out by each alcohol are given in the table below.

Alcohol	Theoretical value for energy given out (J/g)
methanol	22 700
ethanol	29 700
propanol	33 600
butanol	36 100

Compare the experimental and theoretical values and give the main reason for the difference between them. [3]

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(d) Some people are opposed to the large-scale use of bioethanol as a fuel. Describe briefly why someone could take this view. [2]

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