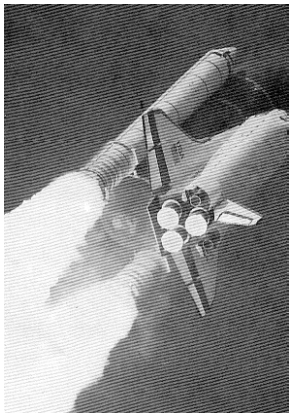
Nature's Chemistry

National 4-5

Fuels & Hydrocarbons



St. Ninian's High - East Renfrewshire

Version 1 May / 2012

Self Check 1

1. The combustion of carbon is exothermic.

(a) Explain the meaning of the underlined words.
(b) Write an equation, using symbols and formulae, for the combustion of carbon.
(c) Will carbon burn better in air or oxygen? Explain your answer.
(d) What is the test for oxygen?
(e) What will happen when a burning splint is put into a jar of pure oxygen.
(f) What is the test for carbon dioxide?

2. Coal is a solid fuel used for heating in houses.

(a) What is meant by the word *fuel*?
(b) What gas is used up when coal burns?
(c) Name the **three** things needed for burning to happen.

3. Squirting water at a fire will often put the fire out.
Explain why water puts the fire out.

4. Oil fires in the home are fought with fire blankets.
Explain how a fire blanket will put out a fire.

5. Scientists are concerned that burning fossil fuels increases the amount of carbon dioxide in the atmosphere, ways of "capturing" the carbon dioxide being released from power stations are being explored.
(a) Why are scientists worried about the increased carbon dioxide in the atmmosphere?
(b) Explain how exhausted oil wells may be useful for carbon capture and storage.

Self Check 2

1. Carbon has two main oxides, carbon monoxide and carbon dioxide.

(a) Which of the oxides is poisonous?
(b) Which oxide is produced when carbon burns in excess oxygen?

2. Carbon is an important fuel. Normally when carbon burns it produces carbon dioxide, although under certain conditions it will burn to produce carbon monoxide.

(a) What are the formulae of carbon monoxide and carbon dioxide respectively.
(b) Under what conditions will carbon burn to make carbon monoxide?
(c) Write an equation for the reaction in which carbon burns to form carbon monoxide.
(d) Write a balanced equation for the reaction in which carbon burns to form carbon monoxide

3. Hydrogen is a useful fuel. It is often used to power rockets.

(a) What is formed when hydrogen burns?
(b) Write an equation for hydrogen burning.
(c) Write a balanced equation for the burning of hydrogen.

Self Check 3

1. When an acid is added to an alkali the temperature of the resulting mixture increases.

(a) What name is given to reactions which result in an increase in temperature?
(b) What energy change occurs in these reactions?

2. Addition of ammonium nitrate to water results in a decrease in the temperature of the water.

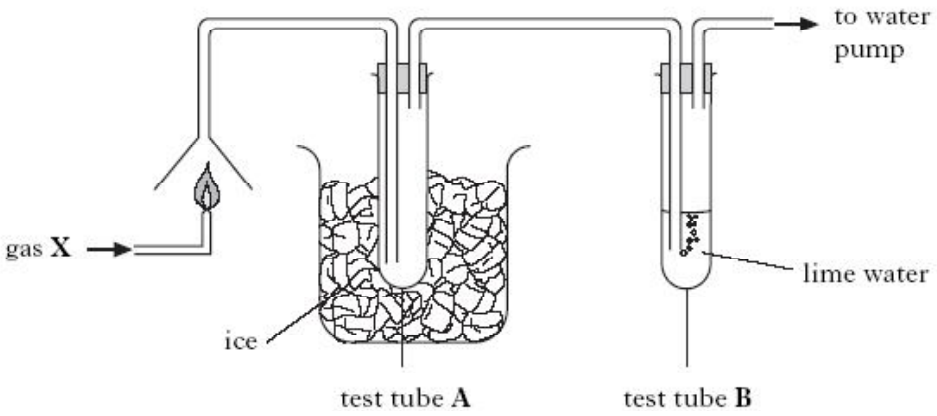
(a) What name is given to reactions which result in a decrease in temperature?
(b) What energy change occurs in these reactions?

3. Chemists are developing biofuels.

(a) What is meant by a biofuel?
(b) Give an advantage of using biofuels as a source of power.

Self Check 4

1. To detect the products of burning hydrocarbons in excess oxygen the following apparatus is used -



(a) What is a hydrocarbon?
(b) What are the products of burning hydrocarbons in excess oxygen?
(c) How would you show that a liquid trapped in A was water
(d) Container B contains lime water. Which gas turns the lime water chalky?

(e) What would you see in the above apparatus if the following substances were burned?
(i) Carbon (ii) A hydrocarbon (iii) Hydrogen

Self Check 5

1. Natural gas is a hydrocarbon. A bunsen burner uses natural gas as a fuel. When the air hole in the bunsen is open, the gas burns efficiently.

(a) What are the products of combustion of natural gas in excess air.
(b) Why can combustion of natural gas have fatal consequences?

2. Some fuels contain sulphur. Combustion of these fuels produces a poisonous gas which can damage the environment.

(a) What gas is produced when sulphur is burned?
(b) Give a balanced equation for the combustion of sulphur.
(c) How can the fumes from burning sulphur damage the environment?

3. The exhaust fumes from a car is a complex mixture of chemicals including unburnt petrol, nitrogen dioxide, nitrogen monoxide, water, carbon dioxide, carbon monoxide and soot.

(a) Explain why the following gases are present in car exhausts:
(i) Carbon monoxide (ii) Oxides of nitrogen.
(b) Explain why the following substances are dangerous.
(i) Carbon monoxide (ii) Nitrogen Dioxide

4. Many cars now come equipped with catalytic converters. Explain what catalytic converters do.

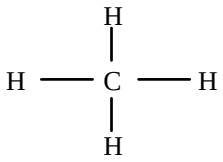
Self Check 6

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

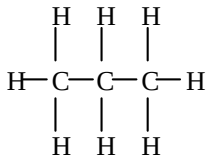
(a) Ethane (b) Butane (c) Heptane.

2. Name the following hydrocarbons. Give the molecular formula and formula mass of each.

(a)



(b)



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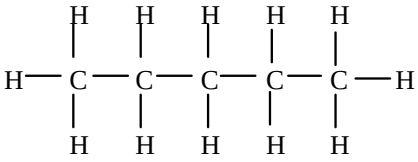


3. The alkanes are a series of hydrocarbons of general formula Cn H2n+2

(a) Explain the meaning of *hydrocarbon*.
(b) What is produced by complete combustion of an alkane?
(c) What is the molecular formula of the alkane which contains 12 carbon atoms in its molecule.

Self Check 7

1. (a) What are the products of combustion of hydrocarbons in excess oxygen? Give a test and the result for each of the products of combustion.
(b) Combustion of hydrocarbons is an exothermic reaction which must have a plentiful supply of air to prevent possible fatal results.
Why can combustion of hydrocarbons possibly have fatal results?

2. Balance the following equations of combustion.

(a) $CH_4 + 0_2$ ---> $CO_2 + H_2O$

(b) $C_3H_8 + 0_2$ ---> $CO_2 + H_2O$

(c) $C_5 H_{12} + 0_2$ ---> $CO_2 + H_2O$

Self Check 8

1. From the shortened structural formulae below, draw extended structural formulae and name the molecules.

(a) $CH_3CH_2CH_3$ (b) $CH_3CH_2CH_2CH_3$

(c) CH_3CH_3 (d) $CH_3CH_2CH_2CH_2CH_3$

2. Draw the shortened structural formulae of the following compounds.

(a) Hexane (b) Octane

Self Check 9

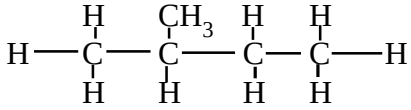
1. Draw the (i) extended and (ii) shortened structural formulae of the following hydrocarbons

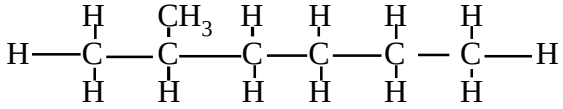
(*a*) 2 methyl propane (b) 3-methyl pentane

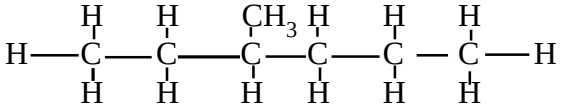
(c) 2 methyl pentane

2. For each of the hydrocarbons below give:

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

(a) 

(b) 

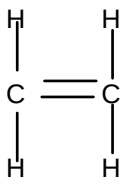
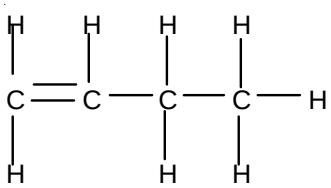
(c) 

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.

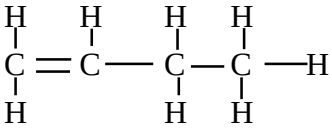
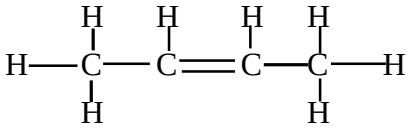
(a) $C_2H_4 + O_2 \longrightarrow CO_2 + H_2O$

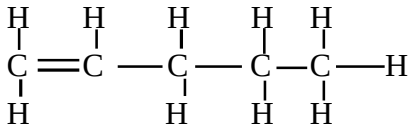
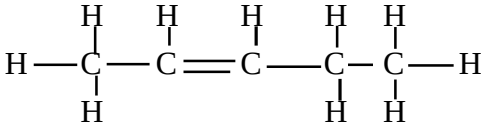
(b) $C_4H_8 + 0_2 \longrightarrow CO_2 + H_2O$

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) $CH_3CHCHCH_2CH_2CH_3$

Self Check 12

1. Give the structural and molecular formulae of the following hydrocarbons.

(a) Cyclohexane (b) Cyclopentane (c) Cyclobutane.

2. (a) What is the general formula of the cycloalkanes.
(b) Name two hydrocarbons with molecular formula C_4H_8

3. Give the structural and molecular formulae of the following hydrocarbons.

(a) (i) propane
(ii) propene

(b) Write a balanced equation for the combustion of

(i) propane
(ii) propene

Self Check 13

1. C_4H_{10} can exists as two isomers.

(a) Define isomers.
(b) Name and give the entended and shortened structural formula of each isomer.

2. C_4H_8 can exist as isomers.

(a) Give the name and entended structural formula of the three **unsaturated** isomers whose molecular formula is C_4H_8.
(b) Give the name and extended structural formula of a **saturated** isomer whose molecular formula is C_4H_8.

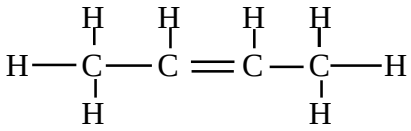
Self Check 14

1. Draw the structure of the molecules formed in the following reactions -

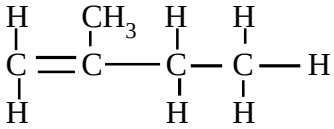
(a) Propene and Bromine
(b) But-1-ene and Bromine
(c) Ethene and Bromine
(d) But-2-ene and Bromine

2. Draw the structure of the molecules produced when the molecules below react with bromine.

(a)

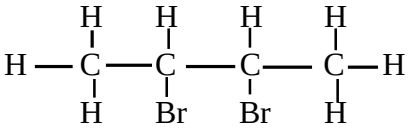


(b)

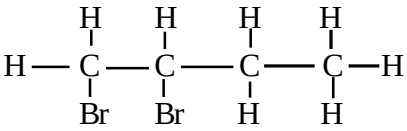


3. Draw the extended structural formula of, and name the hydrocarbons which **react with bromine** to make the compounds shown below.

(a)



(b)



Self Check 15

1. For the following hydrocarbons

Propane, cyclobutane, propene, methane, ethene

(a) Which are unsaturated?
(b) Which do **not** decolourise bromine water?
(c) Which contain more than 2 carbon atoms per molecule?
(d) Which will undergo adddition reactions?
(e) Which will react with hydrogen to make ethane?

2. (a) Identify the following hydrocarbons

(i) Molecular mass 30 ; saturated
(ii) Molecular mass 42 ; unsaturated
(iii) Molecular mass 16 ; saturated
(iv) Molecular mass 42 ; saturated

(b) Which of the above hydrocarbons are isomers?

Self Check 16

1. A sample of crude oil is split into a series of fractions

Fraction No.	Number of carbon atoms in the chain
1	1 - 4
2	5 - 10
3	11 - 16
4	17 - 24
5	25 - 30
6	more than 30

(a) What name is given to the process which has separated the crude oil into fractions,
(b) Which fraction is most difficult to turn into a gas?
(c) Which fraction is made up exclusively of gases?
(d) Which fraction is the most difficult to ignite?
(e) Which of the fractions 2, 3, 4, or 5 is the most viscous?
(f) Which of the fractions 2, 3, 4, or 5 has the longest carbon chains in a molecule?

2. Coal and oil are formed by the decay of plants and animals over millions of years.

(a) What name is given to fuels like coal and oil which are formed from the decay of plants and animals?
(b) Name another fuel produced from the decay of plants and animals.
(c) These fuels are said to be a finite resource, what does this mean?
(d) How long does it take for fossil fuels to form? Is it
  (i) hundreds of years
  (ii) thousands of years
  (iii) millions of years

Self Check 17

1. America possesses large hydrocarbon reserves in the form of a viscous liquid called Kerogen. Although not useful as a fuel the Kerogen can be catalytically cracked to yield useful fuels such as octane.

(a) Explain the meaning of the underlined words.
(b) Kerogen is said to be viscous; what does this tell us about

(i) The chain length of the hydrocarbons in kerogen?
(ii) The ease of ignition of kerogen?

(c) Why is catalytic cracking such an important reaction on the oil industry.
(d) Cracking reactions involve the use of catalysts. What is a catalyst?

2. When a sample of a hydrocarbon is heated it breaks down as follows

C_8H_{18} ---> C_5H_{12} + X

(a) What is the molecular formula of the hydrocarbon X?
(b) Name the hydrocarbons C_8H_{18} & C_5H_{12} and give the formula mass of each.

3. Cracking is an important industrial process.

(a) Draw a labeled diagram of the apparatus used in the laboratory to crack long-chain hydrocarbons.
(b) How did you show that alkenes are always formed in the process ?

Cloze Test 1

What are the missing words in the following passage?

Carbon burns easily in _1_ gas in an _2_ reaction, i.e. a reaction which changes chemical energy into _3_ energy. When there is _4_ (plenty of) oxygen then _5_ _6_ is formed, but if there is _7_ (not enough) oxygen then _8_ _9_ is formed.

Carbon monoxide and carbon dioxide have different properties, e.g. _10_ _11_ , which is poisonous will burn in excess oxygen to form _12_ _13_ . On the other hand carbon dioxide will not react with oxygen and so is often used in fire extinguishers.

To test for carbon dioxide we use _14_ _15_ ,when carbon dioxide is bubbled through the liquid becomes _16_ .

Cloze Test 2

What are the missing words in the following passage?

The exhaust gases from a car contain a variety of compounds. Petrol is a _1_ , that is it consists of compounds of carbon and _2_ only. If petrol is burned in _3_ (plenty of) air then _4_ _5_ and _6_ are produced and the _7_ energy in the petrol is changed into _8_ energy.

The reactions in a petrol engine are much more complex. Insufficient _9_ is present for complete combustion and so the exhaust contains carbon _10_ . Inside the car engine the nitrogen and _11_ in the air react and form _12_ _13_ , if this gas dissolves in rain it turns the rain _14_ .

The dangerous chemicals in a car exhaust can be converted into harmless products by fitting the car with a _15_ converter.

Cloze Test 3

What are the missing words in the following passage?

The simplest compound of carbon and oxygen is carbon _1_ which is formed when carbon is burned in insufficient _2_. Carbon _3_ is dangerous as it is _4_.

The simplest carbon and _5_ compound is called methane which is a member of a series of compounds called the _6_ which have a _7_ formula of CnH2n+2. The next member of this series is _8_ which has a _9_ formula of C_2H_6. The formula mass of this compound is _10_

Because these compounds contain only the elements hydrogen and carbon they are said to be _11_. When methane is burned in oxygen heat is given out (the reaction is _12_) and the products of the reaction are _13_ _14_ and _15_.

To show that burning methane produces _16_ _17_, the fumes from burning methane should be passed through _18_ _19_, which will turn _20_.

Cloze Test 4

What are the missing words in the following passage?

Oil fresh from the oil well is known as _1_ oil and is a mixture of different _2_ (compounds containing only _3_ and carbon). Oil is formed from the remains of long dead sea creatures and is thus a _4_ fuel.

To separate crude oil a technique known as fractional _5_ is used. This separates compounds which have different _6_ points. The _7_ oil is heated until it vapourises (turns into a _8_).
The different substances then condense (turn into a _9_) at different temperatures and so can be separated.

The simplest fraction obtained contains very _10_ molecules which have between one and four carbon atoms in their molecules. As the molecules are so small they have very _11_ boiling _12_ and so are all _13_ at room temperature. The next fraction contains between four and ten carbon atoms and is used for _14_. The next fraction is Kerosene which is more commonly known as _15_ .The last fraction obtained is _16_ which is a thick black solid.

As the _17_ point of the fractions increases they become _18_ in colour, and _19_ difficult to ignite. Also the viscosity or _20_ of the fraction increases.

Cloze Test 5

What are the missing words in the following passage?

Combustion is a reaction which is common to most hydrocarbons, that is compounds containing carbon and hydrogen _1_. In combustion the hydrocarbon reacts with _2_, a gas which makes up about 3 percent of the atmosphere. All combustion reactions are _4_ i.e. they change _5_ energy into 6 energy. The products of combustion of a hydrocarbon depend on the amount of oxygen available. When there is excess oxygen , carbon _7_ and water (_8_ oxide) are produced, whereas with insufficient oxygen _9_ _10_ may be produced : this is dangerous as it is a _11_ gas.

Not all hydrocarbons burn equally easily. _12_ chain hydrocarbons have a lower ignition temperature than_13_ chain e.g. bitumen a _14_ chain hydrocarbon mixture has a _15_ ignition temperature.

The energy which is in hydrocarbons may be traced back originally to the _16_. In the case of crude oil the origin is the decaying bodies of sea animals (plankton) which died many _17_ of years ago and were buried in muddy sediments.

Cloze Test 6

What are the missing words in the following passage?

When the fractions in crude _1_ are separated by fractional _2_ too little petrol is obtained and too much of the tarry solid called _3_, which is no use as a fuel because it has a _4_ chain of carbon atoms and so is _5_ to ignite.

To convert the bitumen into petrol a process known as _6_ cracking is used. In this process _7_ and a_8_ are used to break chemical bonds (a _9_ is something which is used to _10_ up a chemical reactions.)

The Bitumen is heated in the absence of air and passes over a catalyst of aluminium oxide .
A catalyst _11_ up a chemical _12_ .This causes some of the molecules in the bitumen to break.
The process produces a mixture of _13_ chain hydrocarbons which can be _14_ by fractional _15_ .

An example of this is that _16_, C_4H_{10} can be cracked to produce ethane, C_2H_6 which contains only _17_ bonds and is said to be _18_ ; and _19_ which has a _20_ formula of _21_.
To distinguish between saturated and unsaturated hydrocarbons _22_ water is used . Saturated hydrocarbons do not _23_ _24_ water , while unsaturated hydrocarbons do _25_ bromine water.

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Extra Work

Self Check 1

1. Nature turns plants into fossil fuels using heat and pressure in the absence of air.
By turning cellulose from household and agricultural waste into oil, scientists can do in minutes what took nature millions of years. The result is a high quality oil.
The process is not economical as a source of fuel, but it could be used to get rid of the increasingly large amounts of household waste which contain cellulose. Also, as the oil produced does not contain sulphur, it does not produce acid rain when burned.
As well as household waste, the process can use the residue from sugar beet and grape harvesting. Recent experiments have show that the oil can be processed to provide a substitute for petrol.

(a) What must not be present when plants are changed into fossil fuel?
(b) Give one disadvatage of the process for changing cellulose from waste into oil.

2. The table below shows the relationship between the percentage ofethanol and the density of alcoholic drinks.

Percentage of ethanol (%)	40	50	60	70	80
Density of alcoholic drink (g/cm^3)	0·928	0·907	0·886	0·865	0·844

(a) Write a general statement describing how the percentage of ethanol affects the density of the alcoholic drink.
(b) The density of a particular brand of alcoholic drink is 0·970 g/cm3.Predict the percentage of ethanol in this alcoholic drink.

3. The table shows the mass of various pollutants produced by recycling aluminium.

Pollutant	**Mass of pollutant produced per tonne of aluminium/kg**
sulphur dioxide	1·0
dust	1·5
carbon monoxide	2·5
nitrogen oxides	7·0
hydrocarbons	5·0

Present this information on a bar chart.

Extra Work

Self Check 2

1. Scuba divers can suffer from painful and potentially fatal problems if they rise to the surface of the water too quickly. This causes dissolved nitrogen in their blood to form bubbles of nitrogen gas.

Distance from surface of water/m	Concentration of dissolved nitrogen/units
0	11·5
10	23·0
20	34·5
30	46·0
40	57·5

(a) Describe the relationship between the distance from the surface of the water and the concentration of dissolved nitrogen.

(b) Predict the concentration of dissolved nitrogen at 60 m.

2. The following equations are all unbalanced. Rewrite them as balanced equations.

(a) $N_2 + O_2 \text{ ---> } NO_2$

(b) $S + O_2 \text{ ---> } SO_3$

(c) $Na + O_2 \text{ ---> } Na_2O$

(d) $Na + Cl_2 \text{ ---> } NaCl$

(e) $Al + Cl_2 \text{ ---> } AlCl_3$

(f) $Si + Cl_2 \text{ ---> } SiCl_4$

(g) $NO + O_2 \text{ ---> } NO_2$

(h) $N_2 + O_2 \text{ ---> } N_2O_4$

(i) $I_2 + Cl_2 \text{ ---> } ICl_7$

Extra Work

Self Check 3

1. The following equations are all unbalanced. Rewrite them as balanced equations.

(a) $S + F_2 \text{ ---> } SF_6$

(b) $P + O_2 \text{ ---> } P_2O_5$

(c) $H_2O_2 \text{ ---> } H_2O + O_2$

(d) $P + Cl_2 \text{ ---> } PCl_3$

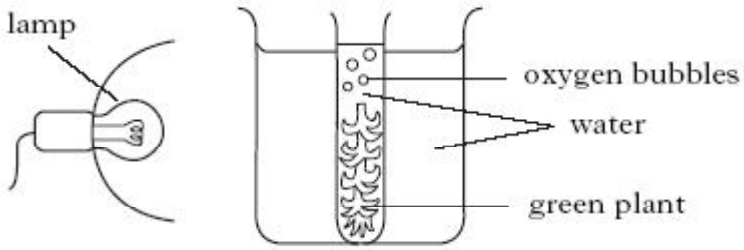
(e) $U + F_2 \text{ ---> } UF_6$

(f) $Sb + O_2 \text{ ---> } Sb_2O_3$

(g) $Ag_2O \text{ ---> } Ag + O_2$

(h) $Ca + P \text{ ---> } Ca_3P_2$

2. A student set up an experiment to investigate the rate of photosynthesis in different plants.



The rate of photosynthesis was measured by counting the number of bubbles of oxygen gas produced in 3 minutes. The results of the investigation are shown in the table.

Name of plant	Number of bubbles of oxygen gas produced in 3 minutes
Elodea	19
Cabomba	32
Hornwort	12
Parrots Feather	24
Duckweed	8

Draw a bar graph to show the information in the table.

Extra Work

Self Check 4

1. The table gives information on the hardness of some steel alloys.

Carbon present in steel alloy/%	*Hardness/units*
0·1	123
0·2	157
0·3	190
0·4	220
0·5	260

Predict the hardness of a steel alloy containing 0.6% carbon.

2. Airbags in cars are designed to prevent injuries in car crashes.
They contain sodium azide (NaN_3) which produces nitrogen gas on impact.
The nitrogen inflates the airbag very quickly.
The table gives information on the volume of nitrogen gas produced.

Time/microseconds	Volume of nitrogen gas produced/litres
0	0
5	46
10	64
15	74
20	82
25	88
30	88

(a) Draw a line graph of the results.
(b) The equation for the production of nitrogen gas is:

$$NaN_3 \text{ ---> } Na + N_2.$$

Balance the equation .

3, Loft insulation is an effective way of keeping houses warmer and reducing heating costs. Up to 20% of heating costs can be saved by installing effective loft insulation.The three main types of loft insulation are blown insulation, blanket insulation and loose-fill insulation. Blanket and loose-fill insulation can be easily installed, but blown insulation must be installed by a specialist contractor.
Most houses have blanket insulation. Blanket insulation can be made from mineral fibre or rock fibre and is supplied in rolls. Mineral fibre and rock fibre are non-flammable but must be treated to protect them from rot, vermin and dampness. When installing blanket insulation, protective clothing including gloves and a face mask must be worn to prevent fibres damaging skin and lungs. Loose-fill insulation can be made from cork granules, vermiculite or cellulose fibre. This type of insulation is not advised for use in a draughty loft because the material can blow about.

(a) How much can heating costs be reduced by installing effective loft insulation?
(b) Which type of insulation must be installed by a specialist contractor?
(c) Why must protective clothing be worn when installing blanket insulation?
(d) Why should loose-fill insulation **not** be used in a draughty loft?

Extra Work

Self Check 5

1. Solder is made by melting together a mixture of tin and lead.
Callum investigated three types of solder. He heated the solders and recorded the temperature at which one started to melt.
The table shows Callum's results.

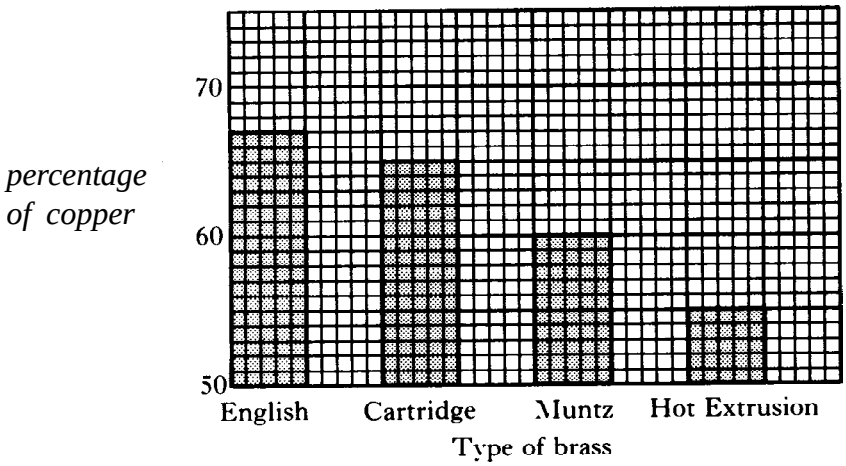
Solder	*Percentage of metals present*		*Melting point* ^oC
	lead	*tin*	
type 1	67	33	265
type 2	50	50	220
type 3	40	60	185

(a) Draw a conclusion from these results relating the melting point to the % of tin.
(b) A new type of solder contains 45% lead.
Predict the temperature at which the new type of solder will start to melt.

2. The yellow alloy called brass does not corrode easily.

Brass is a mixture of the metals copper and zinc. The more zinc in the brass, the lighter the yellow colour becomes. More zinc in brass makes it hard-wearing. The bigger the percentage of copper in brass, the easier the brass is to shape. More copper in brass makes the yellow colour darker.

The graph below shows the percentage of copper in different types of brass.



(a) Which type of brass would be lightest in colour?
(b) Do you think hot extrusion brass would be easy to shape? Explain your answer.
(c) Give **two** properties of English brass.

Extra Work

Self Check 6

1. Here is some information about different types of **batteries.**

Alkaline batteries are used in cassette players and have a storage life of 5 years. Both silver oxide batteries and zinc chloride batteries have a storage life of 2 years. Silver oxide batteries are used in calculators and zinc chloride batteries are used in torches. Computers have lithium batteries with a storage life of 10 years.

Present the information as a table with three headings.

2. Food is made up of carbohydrate, protein and fat. The function of carbohydrate and fat is to provide energy for the body. This energy is measured in kilojoules (kJ). One gram of carbohydrate provides 16 kJ of energy while one gram of fat provides 37 kJ of energy. Protein is required for growth and repair of body cells and one gram can produce 17 kJ of energy.

Present this information in a table with three headings.

3. Gold, palladium and platinum are metals used in jewellery.

Gold, which is yellow in colour, has a melting point of 1063 ^{o}C . Palladium, which is white, melts at 1555 ^{o}C. Platinum, which has a melting point of 1773 ^{o}C, is also white in colour .

Present this information in a table with three headings

Extra Work

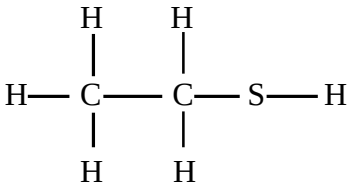
Self Check 7

1. One of the first anaesthetics to be used was choroform ($CHCl_3$).
The table below shows the anaesthetic effects of some compounds (like chloroform) which are based on methane.

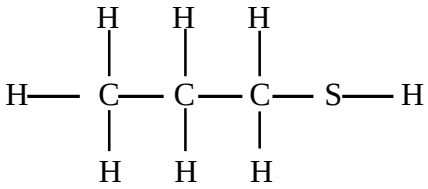
Compound	*Anaesthetic effect*
CH_4	none
CH_3Cl	weak
CH_2Cl_2	moderate
$CHCl_3$	strong

(a) Predict the anaesthetic effect of CCl_4.
(b) Use the information in the table to make a general statement about the compounds and their anaesthetic effects.

2. The chemicals with the most powerful smell are the mercaptans. Two of the most powerful are ethyl mercaptan and propyl mercaptan. The structural formulae of these compounds are shown below.



Ethyl Mercaptan



Propyl Mercaptan

(a) What is the molecular formula of ethyl mercaptan?
(b) When ethyl mercaptan is burned it produces carbon dioxide, water, and an acidic gas. What could this gas be?
(c) Draw the structural formula of butyl mercaptan.

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

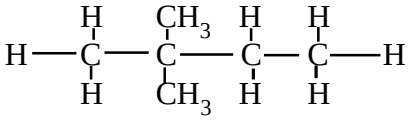
SiH_4 Si_2H_6 Si_3H_8 Si_4H_{10}

(a) What is the general formula of the silanes?
(b) Draw the structural formula of Si_3H_8.
(c) The compound Si_3H_8 reacts with oxygen to form silicon dioxide and water. Write a balanced equation for this reaction .

Extra Work

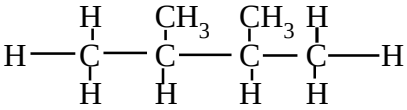
Self Check 8

1. The hydrocarbon below is called 2,2 dimethyl butane. Dimethyl indicates that it has *two* methyl groups in its structure. The numbers 2,2 indicate that both methyl groups are on carbon 2.
Its shortened structural formula is $CH_3C(CH_3)_2CH_2CH_3$



2,2 dimethyl butane

The hydrocarbon below is called 2,3 dimethyl butane. The numbers 2,3 indicate that one of the methyl groups is on carbon 2 and the other methyl group on carbon 3.
Its shortened structural formula is $CH_3CH(CH_3)CH(CH_3)CH_3$



2,3 dimethyl butane

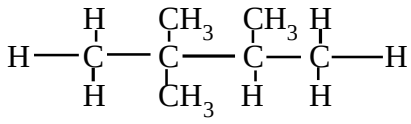
Draw the (i) extended and (ii) shortened structural formulae of the following hydrocarbons

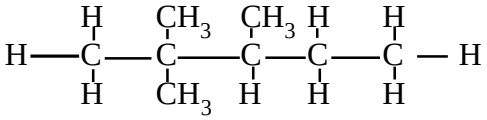
(*a*) 2,2 dimethyl propane (b) 2,3 dimethyl pentane

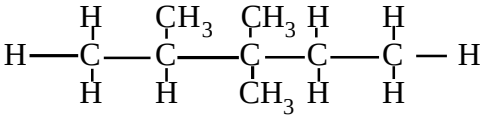
(c) 2,4 dimethyl pentane (d) 3,3 dimethyl pentane

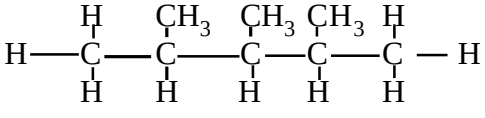
2. A substance with trimethyl in its name contains three methyl groups.
For each of the hydrocarbons below give:

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

(a) 

(b) 

(c) 

(d) 

3. Write balanced equations for the combustion of:

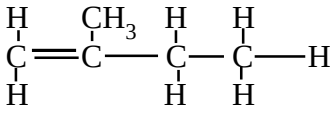
(a) butane (b) 2 methyl butane

(c) 3 methyl pentane

Extra Work

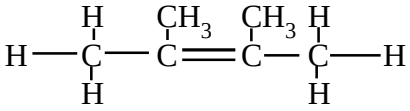
Self Check 9

1. The hydrocarbon below is called 2 methyl but-1-ene.
Its shortened structural formula is $CH_2C(CH_3)CH_2CH_3$



2 methyl but-1-ene

The hydrocarbon below is called 2,3 dimethyl but-2-ene. The numbers 2,3 indicate that one of the methyl groups is on carbon 2 and the other methyl group on carbon 3.
Its shortened structural formula is $CH_3C(CH_3)C(CH_3)CH_3$



2,3 dimethyl but-2-ene

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

(*a*) 2,3 dimethyl but-1-ene

(b) 2,3 dimethyl pent-1-ene

(c) 2,4 dimethyl pent-1-ene

(d) 2,4 dimethyl pent-2-ene

2. Write balanced equations for the combustion of:

(a) 2 methyl but-2-ene

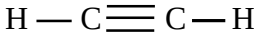
(b) 2,3 di methyl but-2-ene

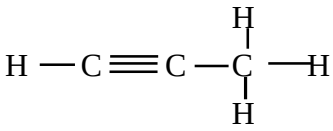
(c) 2, 3 dimethyl pent1-ene

Extra Work

Self Check 10

1. A series of hydrocarbons called the alkynes exist. Alkynes contain *one* carbon to carbon triple bond. The first two alkynes are shown below.





Shortened structural formula	CH CH	$CHCCH_3$
Name	ethyne	propyne

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

(*a*) but-1-yne (b) but-2-yne

(c) 3 methyl but-1-yne (d) pent-2-yne

2. (a) Give the molecular formulae of

(i) ethyne (ii) propyne

(iii) but-1-yne (iv) pent-1-yne

(b) What is the general formula of the alkynes?

Extra Work

Self Check 11

1. A series of hydrocarbons called the Cycloalkenes exist. Cycloalkenes are like the cycloalkanes but contain *one* carbon to carbon double bond.

(a) Give the name, extended structural formula and molecular formula of the first three cycloalkenes.

(b) What is the general formula of the cycloalkenes?

---

2. What is the general formula of the cycloalkanes?

A. CnHn+2
B. CnH2n+2
C. CnH2n
D. CnHn+1

3. What is the molecular formula of cyclopropane?

.

A C_3H_6
B C_3H_8
C C_5H_{10}
D C_5H_{12}

4. What is the molecular formula of cyclopentane?

A C_3H_6
B C_3H_8
C C_5H_{10}
D C_5H_{12}

5. Which statement is **true** for all cycloalkanes?

A they are carbohydrates
B they contain carbon-carbon double bonds
C they burn to produce carbon dioxide and water
D their names end in ene

6. What is the balanced equation for the combustion of cyclobutane?

A $C_4H_8 + 5\,0_2$ ---> $4CO_2 + 4H_2O$
B $C_4H_8 + 6\,0_2$ ---> $4CO_2 + 4H_2O$
C $C_4H_8 + 5\,0_2$ --> $4CO_2 + 6H_2O$
D $C_4H_8 + 6\,0_2$ ---> $4CO_2 + 6H_2O$

7. What is the shortened structural formula of but-1-ene?

A $CH_2CHCH_2CH_3$
B $CH_3CH_2CH_2CH_3$
C $CH_2CH_2CH_2CH_2$
D $CH_3CHCHCH_3$

8. What is the shortened structural formula of but-2-ene?

A $CH_2CHCH_2CH_3$
B $CH_3CH_2CH_2CH_3$
C $CH_2CH_2CH_2CH_2$
D $CH_3CHCHCH_3$

9. Which alkene has a formula mass of 42?

A ethene
B propene
C but-1-ene
D but-2-ene

10. What is the name of the alkene below?

$CH_3CH_2CH_2CHCH_2$

A pent-1-ene
B pent-2-ene
C pent-3-ene
D pent-4-ene

Extra Work

Self Check 12

1. What is the general formula of the alkenes?

A. CnHn+2
B. CnH2n+2
C. CnH2n
D. CnHn+1

2. What is the molecular formula of pentene?
A C_3H_6
B C_3H_8
C C_5H_{10}
D C_5H_{12}

3. What is the molecular formula of pent-2-ene

A C_3H_6
B C_3H_8
C C_5H_{10}
D C_5H_{12}

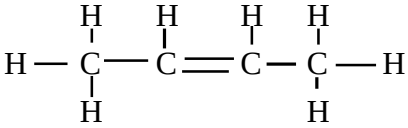
4. Which statement is **false** for all alkenes

A they are carbohydrates
B they contain carbon-carbon double bonds
C they burn to make carbon dioxide and water
D their names end in ene

5. What is the balanced equation for the combustion of ethene?

A $C_2H_4 + 0_2 \text{ ---> } 2CO_2 + 2H_2O$
B $C_2H_4 + 2\,0_2 \text{ ---> } 2CO_2 + 2H_2O$
C $C_2H_4 + 30_2 \text{ --> } 2CO_2 + 2H_2O$
D $C_2H_4 + 4\,0_2 \text{ ---> } 2CO_2 + 2H_2O$

6. What is the name of the alkene below?



A butene
B but-2-ene
C but-1-ene
D but-3-ene

7. What is the general formula of the alkanes?

A. CnHn+2
B. CnH2n+2
C. CnH2n
D. CnHn+1

8. What is the molecular formula of pentane?
A C_3H_6
B C_3H_8
C C_4H_{10}
D C_5H_{12}

9. What is the molecular formula of 2 methyl propane?

A C_3H_6
B C_3H_8
C C_4H_{10}
D C_5H_{12}

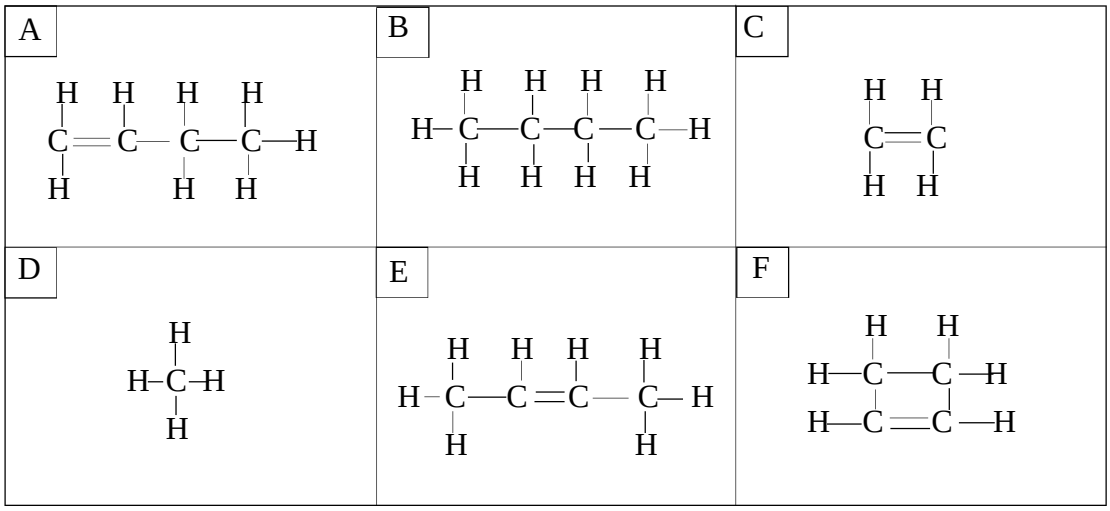
10. What is the balanced equation for the combustion of methane?

A $CH_4 + 3\,0 \text{ ---> } CO_2 + 2H_2O$
B $CH_4 + 4\,0 \text{ ---> } CO_2 + 2H_2O$
C $CH_4 + 0_2 \text{ --> } CO_2 + 2H_2O$
D $CH_4 + 20_2 \text{ ---> } CO_2 + 2H_2O$

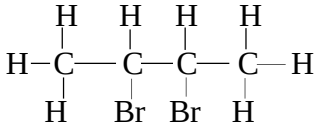
Extra Work

Self Check 13

1. There are many thousands of different hydrocarbons.



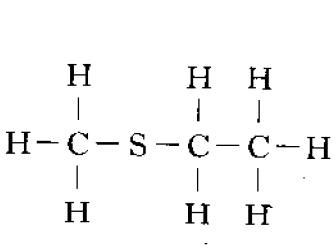
(a) Identify the hydrocarbon which will react with bromine to form the compound shown below.



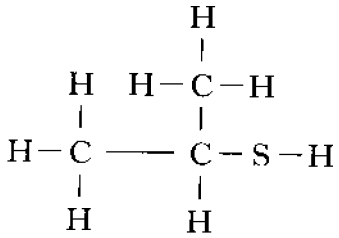
(b) Identify the two hydrocarbons which are isomers.

(c) Identify the hydrocarbon which fits the general formula C_nH_{2n-2}.

2. The two compounds drawn below are added to natural gas to give it a smell.



A



B

(a) What is the molecular formula of compound A?

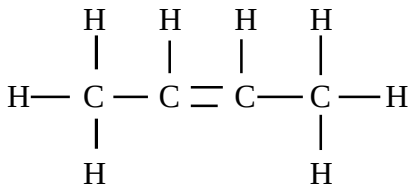
(b) Are A and B isomers? Explain your answer.

Extra Work

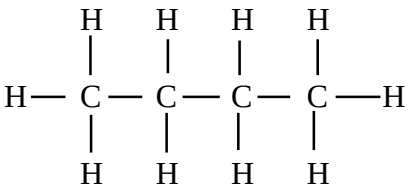
Self Check 14

1. Crude oil is a mixture of many different hydrocarbons.

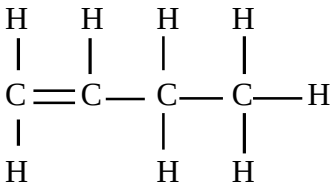
A



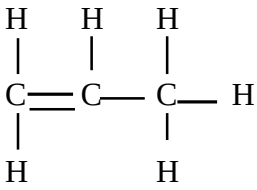
B



C



D



(a) Identify the hydrocarbon which is an isomer of cyclopropane.
(b) Identify the hydrocarbon which is butane.
(c) Identify the hydrocarbon(s) which will react with hydrogen to produce butane.

2. Many different hydrocarbons exist

A Methane	B Propene	C Ethane
D Butane	E Propane	F Ethene

(a) Identify the **two** hydrocarbons which undergo addition reactions.
(b) Identify the hydrocarbon which is formed when ethene reacts with hydrogen.

Extra Work

Self Check 15

1. Fractional distillation separates substances which have different

A. densities
B. melting points
C. boiling points
D. flammabilities

2. Which of the following molecules will be the most viscous?

A C_5H_{12}
B $C_{10}H_{22}$
C $C_{15}H_{32}$
D $C_{20}H_{42}$

3. Which of the following molecules will have the lowest boiling point?

A C_5H_{12}
B $C_{10}H_{22}$
C $C_{15}H_{32}$
D $C_{20}H_{42}$

4. One of the fractions from distillation of crude oil contains between1 and 4 carbon atoms. A use of this fraction is

A jet fuel
B petrol
C lubricating oil
D fuel gases

5. One of the fractions from distillation of crude oil contains between 10 and 15 carbon atoms. A use of this fraction is

A jet fuel
B petrol
C lubricating oil
D fuel gases

6. What test is used to distinguish carbon dioxide from other gases?

A. It puts out a burning splint.
B. It is soluble in water.
C. It turns damp pH paper red.
D. It turns lime water milky.

7. When a hydrocarbon burns in a plentiful supply of air, the products are

A carbon and hydrogen
B carbon and water vapour
C carbon dioxide and hydrogen
D carbon dioxide and water vapour.

8. The presence of carbon monoxide in car exhaust gases is mainly because

A of incomplete combustion
B of complete combustion
C of the presence of excess oxygen
D of decomposition of hydrocarbons

9. It is inadvisable to burn paraffin in a poorly ventilated room because

A poisonous hydrocarbons are formed
B a mixture of paraffin and air is explosive
C hydrogen oxide is made
D carbon monoxide is made

10. Which compound can be present in car exhaust fumes because of a reaction between the gases in the air?

A carbon monoxide
B sulphur dioxidc
C carbon dioxide
D nitrogen dioxide

Self Check Answers 1

1. (a) Combustion : a burning reaction with oxygen.
Exothermic : a change from chemical energy to heat energy.
(b) $C + O_2$ ---> CO_2
(c) Carbon will burn better in oxygen. Oxygen is needed for burning and only 20% of the air is oxygen.
(d) Oxygen relights a glowing spilnt
(e) The splint will burn more brightly
(f) Carbon dioxide turns lime water milky.

2. (a) A fuel is a substance which burns and releases energy.
(b) Oxygen is used up when coal burns.
(c) A fuel, heat and oxygen.

3. The water lowers the temperature.

4. The fire blanket stops oxygen getting to the fire.

5. (a) Carbon dioxide may be increasing the earth's temperature, "Global Warming".
(b) Carbon dioxide from power stations could be pumped into disused oil wells.

Self Check Answers 2

1. (a) Carbon monoxide
(b) Carbon dioxide.

2. (a) CO and CO_2
(b) Carbon monoxide is formed when carbon burns in a shortage of oxygen.
(c) $C + O_2$ ---> CO
(d) $C + 1/2\ O_2$ ---> CO

3. (a) Water
(b) $H_2 + O_2$ ---> H_2O
(c) $H_2 + 1/2\ O_2$ ---> H_2O

Self Check Answers 3

1. (a) Exothermic reaction
(b) Chemical energy --> Heat energy

2. (a) Endothermic reaction
(b) Heat energy --> Chemical energy

3. (a) Fuels obtained from living things
(b) Biofuels are renewable

Self Check Answers 4

1. (a) A compound which contains *only* hydrogen and carbon.
(b) Carbon dioxide and water.
(c) It would boil at $100^{o}C$ and freeze at $0^{o}C$.
(d) Carbon dioxide
(e) (i) Chalkiness in container B (ii) Water in A; chalkiness in B.

(iii) Water in A.

Self Check Answers 5

1. (a) Carbon dioxide and water.
(b) In a shortage of oxygen, methane burns to form carbon monoxide which is poisonous.

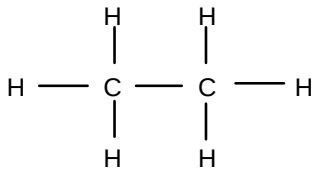
2. (a) Sulphur dioxide
(b) $S + O_2$ ---> SO_2
(c) The sulphur dioxide is poisonous and is a cause of acid rain.

3. (a) (i) Not enough oxygen used to burn the petrol.
(ii) Sparking in the engine causes nitrogen and oxygen to react.
(b) (i) Poisonous
(ii) Poisonous + Acidic

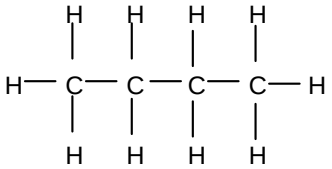
4. Catalytic converters allow dangerous products in the car's exhaust to react together and form safe products.

Self Check Answers 6

1. (a)



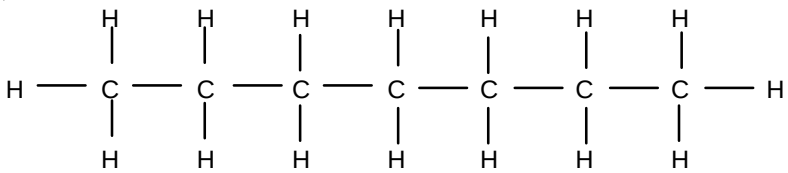
(b)



$C_2 H_6$ formula mass 30

$C_4 H_{10}$ formula mass 58

(c)



$C_7 H_{16}$ formula mass 100

2. (a) Methane, CH_4 16 (b) Propane, C_3H_8 , 44 (c) Pentane, $C_5 H_{12}$, 72

3. (a) Hydrocarbon : A compound which contains *only* hydrogen and carbon.
(b) Carbon dioxide and water (c) $C_{12} H_{26}$

Self Check Answers 7

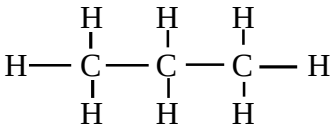
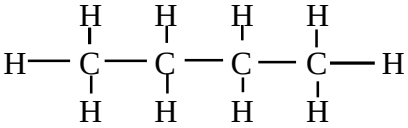
1. (a) Carbon dioxide and water
Carbon dioxide - turns lime water chalky
water - boils at 100°C & freezes at O°C.
(b) A shortage of oxygen will lead to production of carbon monoxide, which is poisonous.

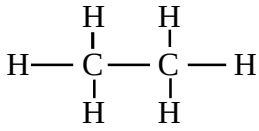
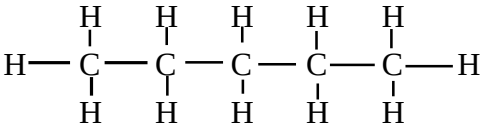
2. (a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (b) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

(c) $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

Self Check Answers 8

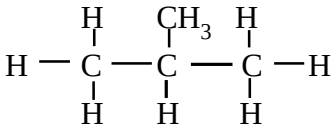
1. The hydrocarbons are

(a) propane  (b) butane 

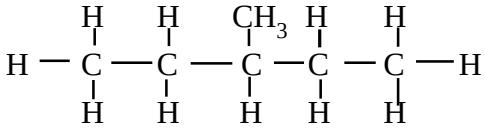
(c) ethane  (d) pentane 

2. (a) $CH_3CH_2CH_2CH_2CH_2CH_3$ (a) $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$

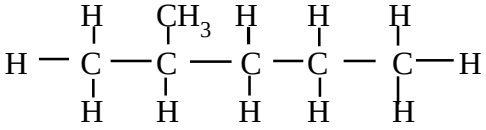
Self Check Answers 9

1. (a) 

$CH_3CH(CH_3)CH_3$

(b) 

$CH_3CH_2CH(CH_3)CH_2CH_3$

(c) 

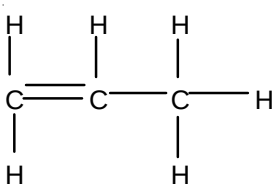
$CH_3CH(CH_3)CH_2CH_2CH_3$

2. (a) $CH_3CH(CH_3)CH_2CH_3$ 2 methyl butane

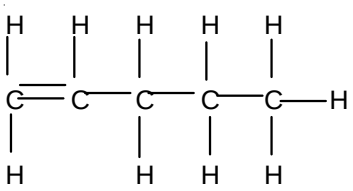
(b) $CH_3CH(CH_3)CH_2CH_2CH_2CH_3$ 2 methyl hexane

(c) $CH_3CH_2CH(CH_3)CH_2CH_2CH_3$ 3 methyl hexane

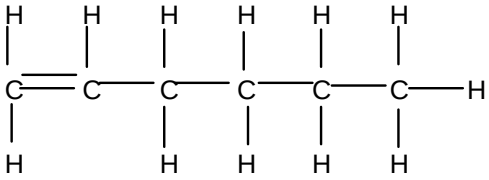
Self Check Answers 10

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

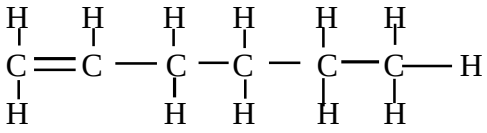
3. (a) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

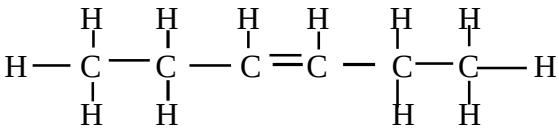
(b) $C_4H_8 + 60_2 \rightarrow 4CO_2 + 4H_2O$

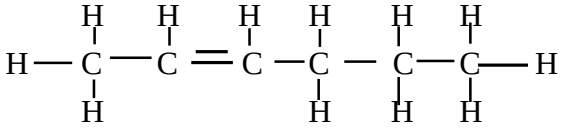
Self Check Answers 11

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}	$CH_3CHCHCH_2CH_3$

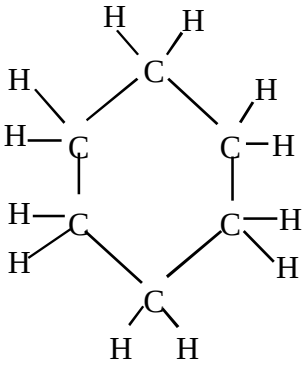
2. (a)  hex-1-ene

(b)  hex-3-ene

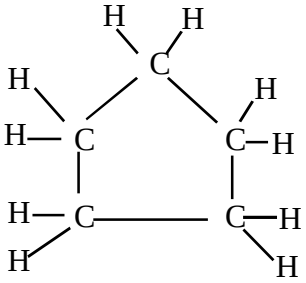
(c)  hex-2-ene

Self Check Answers 12

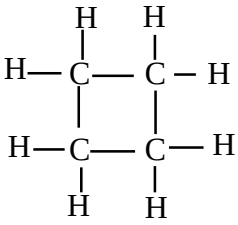
1.

(a) 

C_6H_{12}

(b) 

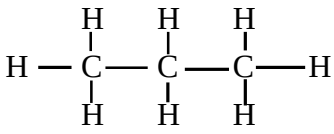
C_5H_{10}

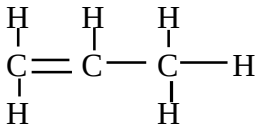
(c) 

C_4H_8

2. (a) CnH2n (b) Cyclobutane and bu-1-tene

3.

(a) 

(b) 

(d) (i) $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

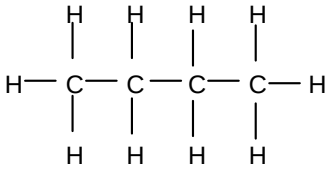
(ii) $C_3H_6 + 4\ 1/2\ O_2 \rightarrow 3\ CO_2 + 3\ H_2O$

Self Check Answers 13

1. (a) Isomers are compounds with the same molecular formula but different structural formulae.

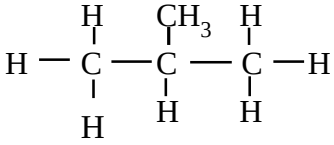
(b) Butane

$CH_3CH_2CH_2CH_3$



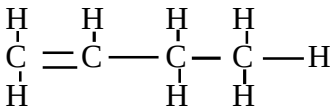
2methyl propane

$CH_3CH(CH_3)CH_3$

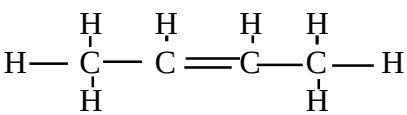


2. (a) The isomers are

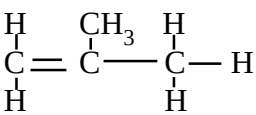
but-1-ene



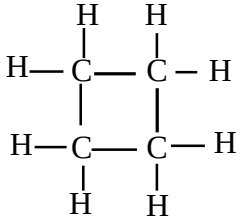
but-2-ene



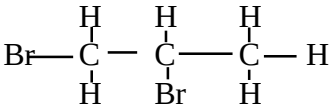
methyl propene

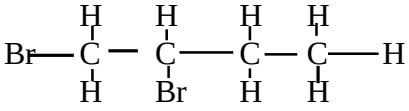


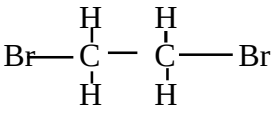
(b) Cyclobutane is a saturated isomer.

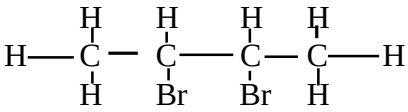


Self Check Answers 14

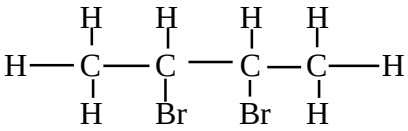
1. (a) 

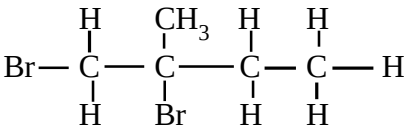
(b) 

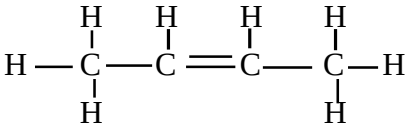
(c) 

(d) 

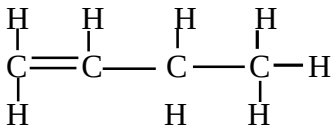
2.

(a) 

(b) 

3. (a) 

But-2-ene

(b) 

But-1-ene

Self Check Answers 15

1. (a) propene, ethene

(b) propane, cyclobutane, methane

(c) propane, propene, cyclobutane

(d) propene and ethene

(e) ethene

2. (i) (a) Ethane (b) Propene (c) Methane (d) Cyclopropane

(ii) Propene and Cyclopropane.

Self Check Answers 16

1. (a) Fractional distillation.
(b) Fraction 6
(c) Fraction 1.
(d) Fraction 6
(e) Fraction 5
(f) Fraction 5

2. (a) Fossil fuels.
(b) Gas or coal
(c) There is a limited amount of the fuels on earth.
(d) (iii) millions of years

Self Check Answers 17

1. (a) *hydrocarbon* : a compound containing the elements hydrogen and carbon only.
viscous : thick, difficult to pour.

(b) (i) The chains are long
(ii) It does not burn easily.

(c) It converts fractions for which there is little demand (bitumen) into those for which the demand is great (petrol.)

(d) A catalyst is a substance which speeds up a chemical reaction.

2. (a) C_3H_6

(b) C_8H_{18} is octane ; formula mass 114

C_5H_{12} is pentane ; formula mass 72

3. (a) Show diagram to your teacher.
(b) T he gases decolourise bromine water.

Cloze Answers 1

1.	oxygen	2.	exothermic	3.	heat	4.	excess
5.	carbon	6.	dioxide	7.	insufficient	8.	carbon
9.	monoxide	10.	carbon	11.	monoxide	12.	carbon
13.	dioxide	14.	lime	15.	water	16.	chalky

Cloze Answers 2

1.	hydrocarbon	2.	hydrogen	3.	excess	4.	carbon
5.	dioxide	6.	water	7.	chemical	8.	heat
9.	oxygen	10.	monoxide	11.	oxygen	12.	nitrogen
13.	dioxide	14.	acidic	15.	catalytic		

Cloze Answers 3

1.	monoxide	2.	oxygen	3.	monoxide	4.	poisonous
5.	hydrogen	6.	alkanes	7.	general	8.	ethane
9.	molecular	10.	thirty	11.	hydrocarbons	12.	exothermic
13.	carbon	14.	dioxide	15.	water	16.	carbon
17.	dioxide	18.	lime	19.	water	20.	chalky

Cloze Answers 4

1.	Crude	2.	Hydrocarbons	3.	Hydrogen	4.	Fossil
5.	Distillation	6.	Boiling	7.	Crude	8.	Gas
9.	Liquid	10.	Small	11.	Low	12.	Points
13.	Gases	14.	Petrol	15.	Paraffin	16.	Bitumen
17.	Boiling	18.	Darker	19.	More	23.	Thickness

Cloze Answers 5

1.	only	2.	oxygen	3.	twenty	4.	exothermic
5.	chemical	6.	heat	7.	dioxide	8.	hydrogen
9.	carbon	10.	monoxide	11.	poisonous	12.	short
13.	long	14.	long	15.	high	16.	sun
17.	millions						

Cloze Answers 6

1.	oil	2.	distillation	3.	bitumen	4.	long
5.	difficult	6.	catalytic	7.	heat	8.	catalyst
9.	catalyst	10.	speed	11.	speeds	12.	reaction
13.	short	14.	separated	15.	distillation	16.	butane
17.	single	18.	saturated	19.	ethene	20.	molecular
21.	C_2H_4	22.	bromine	23.	decolourise	24.	bromine
25.	decolourise						

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Extra Work Answers

Self Check 1

1. (a) Oxygen
(b) It is not economical.

2. (a) As the percentage of ethanol increases the density decreases.
(b) About 20% alcohol

3. Show the graph to your teacher.

Self Check 2

1. (a) As the distance from the surface of the water increases the concentration of dissolved nitrogen also increases.
(b) 80.5

2. (a) $1/2\ N_2 + O_2 \rightarrow NO_2$
(b) $S + 1\ 1/2\ O_2 \rightarrow SO_3$
(c) $2\ Na + 1/2\ O_2 \rightarrow Na_2O$
(d) $Na + 1/2\ Cl_2 \rightarrow NaCl$
(e) $Al + 1\ 1/2\ Cl_2 \rightarrow AlCl_3$
(f) $Si + 2\ Cl_2 \rightarrow SiCl_4$
(g) $NO + 1/2\ O_2 \rightarrow NO_2$
(h) $N_2 + 2\ O_2 \rightarrow N_2O_4$
(i) $1/2\ I_2 + 3\ 1/2\ Cl_2 \rightarrow ICl_7$

Self Check 3

1. (a) $S + 3F_2 \rightarrow SF_6$
(b) $2P + 2\ 1/2\ O_2 \rightarrow P_2O_5$
(c) $H_2O_2 \rightarrow H_2O + 1/2\ O_2$
(d) $P + 1\ 1/2\ Cl_2 \rightarrow PCl_3$
(e) $U + 3F_2 \rightarrow UF_6$
(f) $2Sb + 1\ 1/2\ O_2 \rightarrow Sb_2O_3$
(g) $Ag_2O \rightarrow 2Ag + 1/2\ O_2$
(h) $3Ca + 2P \rightarrow Ca_3P_2$

2. Show the graph to your teacher.

Extra Work Answers

Self Check 4

1. Any answer from 285 to 300

2. (a) Show the graph to your teacher.
(b) NaN_3 ---> Na + 1 1/2 N_2

3. (a) Up to 20%
(b) Blown insulation
(c) To prevent fibres damaging skin and lungs.
(d) The material can blow about.

Self Check 5

1. (a) As the percentage of tin increases the melting point of the solder decreases.
(b) About 205^{o}C.

2. (a) Hot Extrusion
(b) No, it has very little copper in it.
(c) Any two from, dark colour, not hard wearing, easy to shape.

Extra Work Answers

Self Check 6

1.

Battery type	*storage life (years)*	*use*
Alkaline	5	cassette players
Silver oxide	2	calculators
Zinc chloride	2	torches
lithium	10	computers

2.

Substance	*Energy per gram (kJ)*	*Function*
carbohydrate	16	provide energy
fat	37	provide energy
protein	17	growth & repair

3.

Metal	*Colour*	*Melting point* ^{o}C
Gold	yellow	1063
Palladium	white	1555
Platinum	white	1773

Extra Work Answers

Self Check 7

1. (a) It will have a very strong effect.

(b) either

as the amount of chlorine increases, the anaesthetic effect increases.

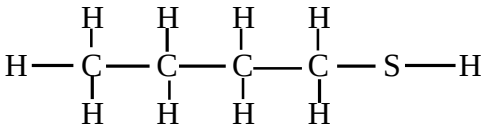
or

as the amount of hydrogen decreases, the anaesthetic effect increases.

2. (a) C_2H_6S

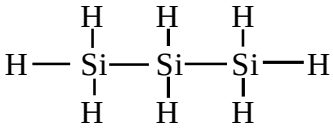
(b) Sulphur dioxide

(c)



3. (a) Si_nH_{2n+2}

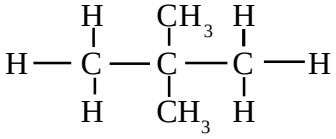
(b)



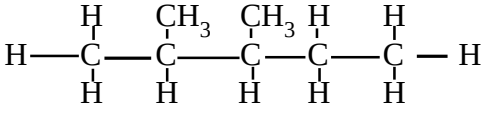
(c) $Si_3H_8 + 5O_2 \rightarrow 3SiO_2 + 4H_2O$

Extra Work Answers

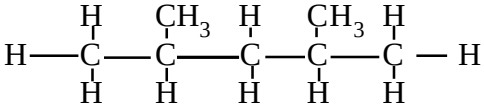
Self Check 8

1. (a) 

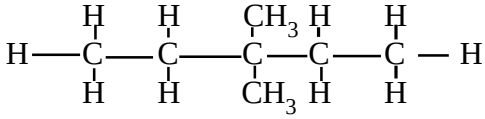
$CH_3C(CH_3)_2CH_3$

(b) 

$CH_3CH(CH_3)CH(CH_3)CH_2CH_3$

(c) 

$CH_3CH(CH_3)CH_2CH(CH_3)CH_3$

(d) 

$CH_3CH_2C(CH_3)_2CH_2CH_3$

2. (a) (i) $CH_3C(CH_3)_2CH(CH_3)CH_3$ (ii) 2,2,3 trimethyl butane

(b) (i) $CH_3C(CH_3)_2CH(CH_3)CH_2CH_3$ (ii) 2,2,3 trimethyl pentane

(c) (i) $CH_3CH(CH_3)C(CH_3)_2CH_2CH_3$ (ii) 2,3,3 trimethyl pentane

(d) (i) $CH_3CH(CH_3)CH(CH_3)CH(CH_3)CH_3$ (ii) 2,3,4 trimethyl pentane

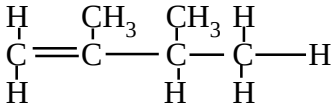
3. (a) $C_4H_{10} + 6\ 1/2O_2 \text{ ---> } 4CO_2 + 5H_2O$

(b) $C_5H_{12} + 8\ O_2 \text{ ---> } 5CO_2 + 6H_2O$

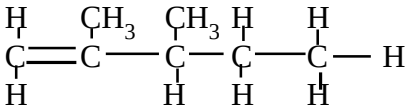
(a) $C_6H_{14} + 9\ 1/2O_2 \text{ ---> } 6CO_2 + 7H_2O$

Extra Work Answers

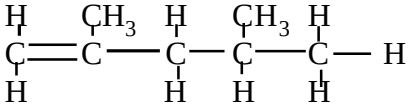
Self Check 9

1. (a) 

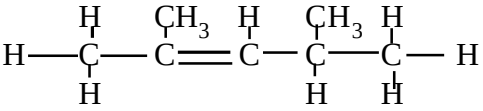
$CH_2C(CH_3)CH(CH_3)CH_3$

(b) 

$CH_2C(CH_3)CH(CH_3)CH_2CH_3$

(c) 

$CH_2C(CH_3)CH_2CH(CH_3)CH_3$

(d) 

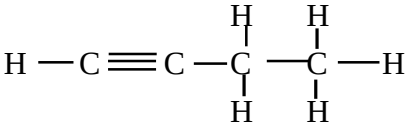
$CH_3C(CH_3)CHCH(CH_3)CH_3$

2, (a) $C_5H_{10} + 7\ 1/2O_2 \text{ ---> } 5CO_2 + 5H_2O$

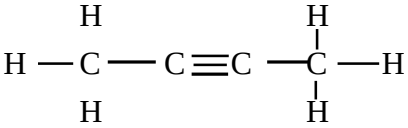
(b) $C_6H_{12} + 9\ O_2 \text{ ---> } 6CO_2 + 6H_2O$

(a) $C_7H_{14} + 10\ 1/2O_2 \text{ ---> } 7CO_2 + 7H_2O$

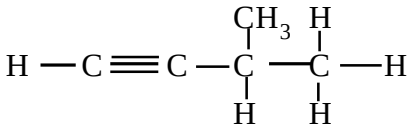
Self Check 10

1. (a) 

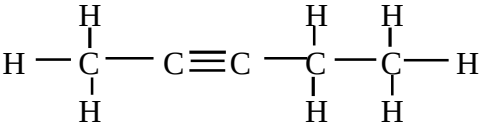
$CHCCH_2CH_3$

(b) 

CH_3CCCH_3

(c) 

$CHCCH(CH_3)CH_3$

(d) 

$CH_3CCCH_2CH_3$

2. (a) (i) C_2H_2 (ii) C_3H_4

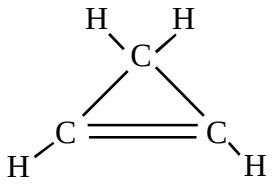
(iii) C_4H_6 (iv) C_5H_8

(b) C_nH_{2n-2}

Extra Work Answers

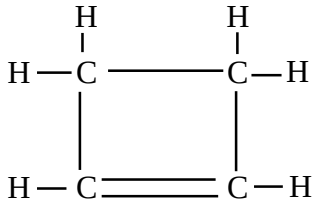
Self Check 11

1. (a)



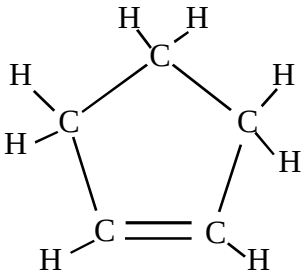
Cyclopropene

C_3H_4



Cyclobutene

C_4H_6



Cyclopentene

C_5H_8

(b) C_nH_{2n-2}

2.	**C**	**7.**	**A**
3.	**A**	**8.**	**D**
4.	**C**	**9.**	**B**
5.	**C**	**10.**	**A**
6.	**B**		

Self Check 12

1.	**C**	**6.**	**B**
2.	**C**	**7.**	**B**
3.	**C**	**8.**	**D**
4.	**A**	**9.**	**C**
5.	**C**	**10.**	**D**

Extra Work Answers

Self Check 13

1. (a) E

(b) A and E

(c) F

2. (a) C_3H_8S

(b) Yes, they have the same molecular formula but different structural formulae.

Self Check 14

1. (a) D

(b) B

(c) A and C

2. (a) B and F

(b) C

Self Check 15

1. C

2. D

3. A

4. D

5. A

6. D

7. D

8. A

9. D

10. D