Edexcel IAL Chemistry A-Level

Topic 4 - Introductory Organic Chemistry and Alkanes

Flashcards

What is a hazard?

What is a hazard?

A hazard is something that could cause you harm. For example, in the lab this could be a certain chemical or a bunsen burner.

What is a risk?

What is a risk?

A risk is the harm a hazard can cause.

- The risk for dilute hydrochloric acid is that is it an irritant to skin and eyes etc.
- A greater risk would be the carcinogenic properties of benzene that increase your risk of developing cancer if you are exposed to it.

Why is it important to carry out a risk assessment when dealing with hazardous materials?

Why is it important to carry out a risk assessment when dealing with hazardous materials?

The risk assessment is important as it identifies the hazards and potential risks materials and apparatus pose. It then puts in place precautions and actions that can be taken if the risk arises.

How can risks be reduced when carrying out a reaction?

How can risks be reduced when carrying out a reaction?

- Work on a smaller scale.
- Take precautions specific to each hazard identified.
- If possible, use an alternative method that uses less hazardous substances.

What is a homologous series?

What is a homologous series?

A series of organic compounds with the same functional group and where each successive member differs by CH_2. The compounds have the same general formula.

What is a functional group?

What is a functional group?

An atom or group of atoms responsible for the characteristic reactions of that compound.

What is a structural formula?

What is a structural formula?

A structural formula shows the number, type and arrangement of atoms in the molecule.

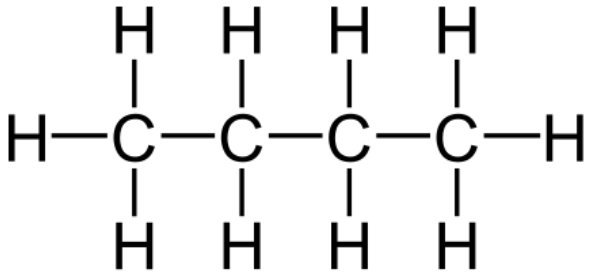
- Butane: $CH_3(CH_2)_2CH_3$
- Propan-2-ol: $CH_3CH(OH)CH_3$

What is a displayed formula?

What is a displayed formula?

A displayed formula shows the relative positions of all atoms in the molecule and every bond between them.

Butane:

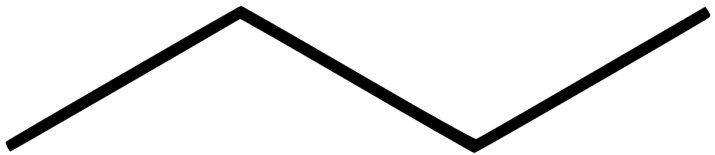


What is a skeletal formula?

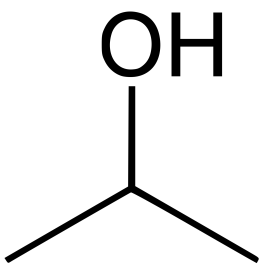
What is a skeletal formula?

A simplified organic formula whereby alkyl groups are drawn as lines and only functional groups are written as symbols.

Butane:



Propan-2-ol:



What is an addition reaction?

What is an addition reaction?

A reaction in which one molecule combines with another molecule to produce one larger molecule and no other products.

What is a substitution reaction?

What is a substitution reaction?

A reaction in which an atom, ion or group of atoms/ions in a molecule is replaced by an atom, ion or group of atoms/ions.

What is an oxidation reaction?

What is an oxidation reaction?

An oxidation reaction is a reaction in which a molecule, atom or ion loses at least one electron during the reaction.

What is a reduction reaction?

What is a reduction reaction?

A reduction reaction is a reaction in which a molecule, atom or ion gains at least one electron during the reaction.

What is a polymerisation reaction?

What is a polymerisation reaction?

A reaction in which short chain monomers join together to form a long chain polymer.

What are the two types of bond breaking that can occur and what are the products of each type?

What are the two types of bond breaking that can occur and what are the products of each type?

Homolytic - produces free radicals

Heterolytic - produces ions

Define electrophile

Define electrophile

Electron pair acceptor.

Define free radical

Define free radical

An uncharged molecule with an unpaired valence electron.

What is an alkane?

What is an alkane?

An alkene is a saturated hydrocarbon with the general formula C_nH_{2n+2}.

What is a cycloalkane? What is their general formula?

What is a cycloalkane? What is their general formula?

A molecule containing a ring of carbon atoms, joined together by single bonds.

General formula: C_nH_{2n}

What does saturated mean?

What does saturated mean?

An organic substance that does not contain any carbon-carbon double bonds, C=C. It contains only single carbon-carbon bonds, C-C.

What is structural isomerism?

What is structural isomerism?

Structural isomerism is when compounds have the same molecular formula but a different arrangement of atoms - so a different structural formula.

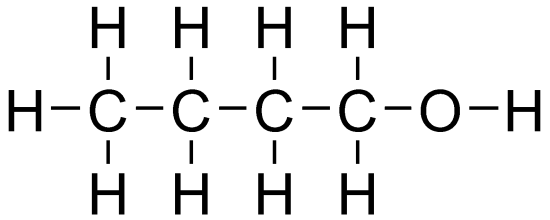
What are the three types of structural isomerism?

What are the three types of structural isomerism?

- Chain isomerism
- Functional group isomerism
- Position isomerism

Which of the following compounds show structural isomerism?

1.



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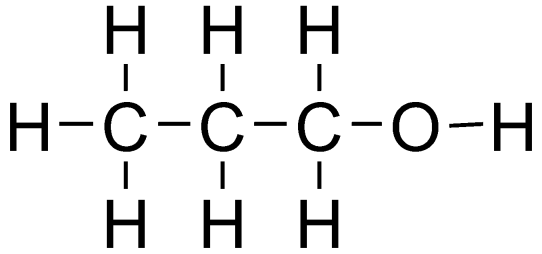

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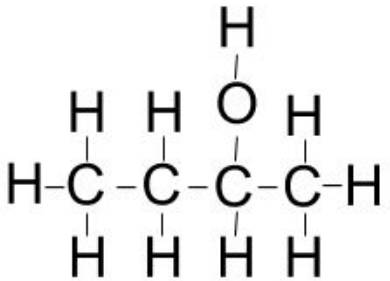
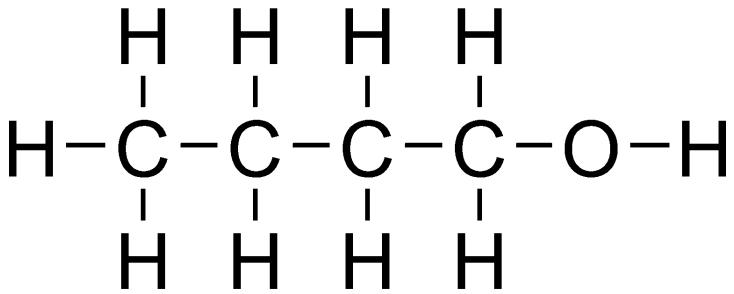
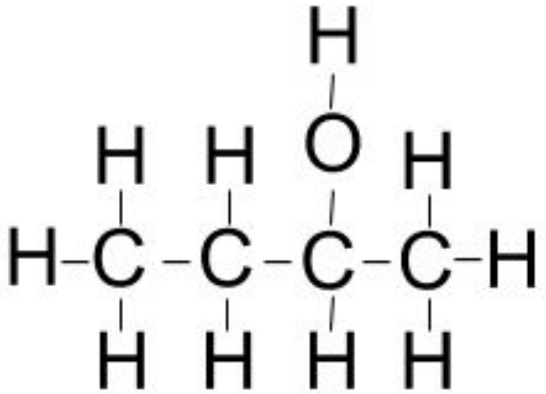


Which of the following compounds show structural isomerism?

1 and 3 are structural isomers. They are position isomers.





What are the different structural isomers of C_5H_{12}?

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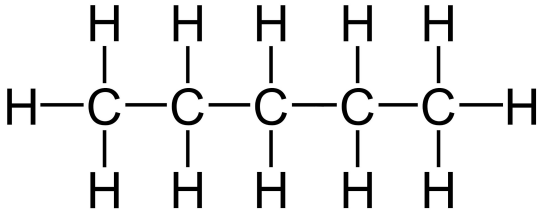
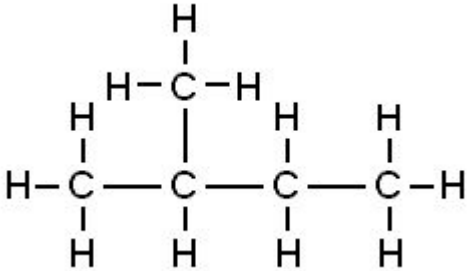
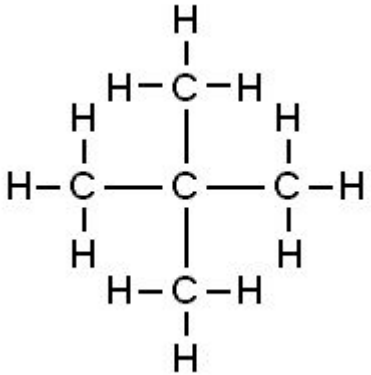
Pentane



2-methylbutane



2,2-dimethylpropane



Name the first four alkanes and give their molecular formulae

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Methane - CH_4

Ethane - C_2H_6

Propane - C_3H_8

Butane - C_4H_{10}

What type of bond forms between carbon and hydrogen atoms in alkanes?

What type of bond forms between carbon and hydrogen atoms in alkanes?

Covalent bonds

What is the displayed formula of ethane?

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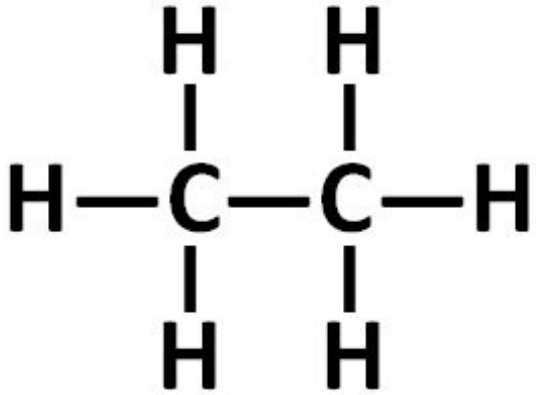

How are alkanes obtained to be used as a fuel?

How are alkanes obtained to be used as a fuel?

Alkanes are obtained by the:

- Fractional distillation of crude oil.
- Cracking of crude oil.
- Reformation of crude oil.

How does the process of fractional distillation work to separate crude oil?

How does the process of fractional distillation work to separate crude oil?

- Crude oil is vaporised before it enters a fractionating column
- The fractionating column is hot at the bottom and cooler at the top. The vapours rise up and condense at different fractions depending on their boiling points.
- Hydrocarbons with low boiling points will be tapped off at the top of the column and hydrocarbons with high boiling points will be tapped off at the bottom of the column.

What is cracking?

What is cracking?

Breaking down large hydrocarbons into smaller more useful ones.

Saturated alkanes are cracked into shorter chain alkanes and short chain unsaturated alkenes.

Why is cracking necessary?

Why is cracking necessary?

The demand for shorter chain alkenes and alkanes is much greater than the demand for long chain alkanes.

What are the only products when a hydrocarbon fuel undergoes complete combustion?

What are the only products when a hydrocarbon fuel undergoes complete combustion?

Water (H_2O) and carbon dioxide (CO_2).

Write a balanced symbol equation for the complete combustion of ethane

Write a balanced symbol equation for the complete combustion of ethane

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

When does incomplete combustion occur? What is required to ensure complete combustion occurs?

When does incomplete combustion occur? What is required to ensure complete combustion occurs?

Incomplete combustion occurs when there is an insufficient supply of oxygen.

To ensure complete combustion occurs, the reaction should be carried out with excess oxygen.

What are the products of incomplete combustion?

What are the products of incomplete combustion?

Carbon particulates - soot (C)

Carbon dioxide (CO_2)

Carbon monoxide (CO)

Water (H_2O)

Write a balanced symbol equation for the incomplete combustion of methane to form carbon monoxide

Write a balanced symbol equation for the incomplete combustion of methane to form carbon monoxide

$$2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$$

Write a balanced symbol equation for the incomplete combustion of methane to form carbon particulates

Write a balanced symbol equation for the incomplete combustion of methane to form carbon particulates

$$CH_4 + O_2 \rightarrow C + 2H_2O$$

What are the problems with incomplete combustion?

What are the problems with incomplete combustion?

- Produces carbon monoxide which is toxic and can be fatal if breathed in.
- Produces carbon particulates (soot) which cause global dimming and respiratory problems.

What are the problems with carbon monoxide?

What are the problems with carbon monoxide?

Carbon monoxide is a toxic gas.

It is colourless and odourless and if breathed in can cause death by preventing the red blood cells from carrying oxygen around the body.

Why is sulfur dioxide sometimes produced when burning hydrocarbon fuels?

Why is sulfur dioxide sometimes produced when burning hydrocarbon fuels?

Some hydrocarbon fuels contain sulfur impurities. When the fuel is burned, the sulfur reacts with oxygen to form sulfur dioxide.

How is acid rain produced?

How is acid rain produced?

Sulfur dioxide gas (produced when combusting impure hydrocarbon fuels) is released into the air. It reacts with water in the clouds to form sulfuric acid. This is ‘acid rain’.

What problems can acid rain cause?

What problems can acid rain cause?

- Corrodes buildings and statues made of limestone.
- Kills/damages vegetation.
- Lowers the pH of large bodies of water, killing the wildlife.

How are oxides of nitrogen produced from car engines?

How are oxides of nitrogen produced from car engines?

The high temperature and pressure of a car engine causes nitrogen and oxygen from the air to react together.

What problems are associated with oxides of nitrogen?

What problems are associated with oxides of nitrogen?

- Produces acid rain with similar effects as SO_2.
- Causes respiratory problems.

Why should we use alternative fuels to fossil fuels?

Why should we use alternative fuels to fossil fuels?

- To conserve fossil fuels (as they're non-renewable).
- To reduce CO_2 and other gas emissions that are directly linked to global warming.
- To prevent air pollution to limit photochemical smog and acid rain.

Explain the idea of carbon neutrality

Explain the idea of carbon neutrality

A fuel can be described as being carbon neutral if it contributes no net increase to carbon dioxide levels in the atmosphere.

For example, bioethanol is often said to be carbon neutral because it is produced from crops which absorb carbon dioxide to grow. This balances out the carbon dioxide produced when the fuel is burnt.

What are the advantages of using hydrogen as a fuel in cars?

What are the advantages of using hydrogen as a fuel in cars?

- It releases more energy per kg compared to most other fuels.
- Water is the only product so there are no pollutants.
- Uses a renewable source as hydrogen can be extracted from water.

What is free radical substitution?

What is free radical substitution?

- A substitution reaction that has free radical reactive intermediates.
- The radicals are usually formed by homolytic fission brought about by UV radiation.

Describe the stages of free radical substitution

Describe the stages of free radical substitution

- Initiation - an initial chemical reaction which forms radicals and triggers further reactions.
- Propagation - a secondary reaction where there is no net gain or loss of free radicals.
- Termination - the final step in a chain reaction where a reactive intermediate is rendered inactive.

How does ethane undergo free radical substitution with chlorine?

How does ethane undergo free radical substitution with chlorine?

Initiation: $Cl_2 \rightarrow \bullet Cl + \bullet Cl$

Propagation: $C_2H_6 + \bullet Cl \rightarrow \bullet C_2H_5 + HCl$

$\bullet C_2H_5 + Cl_2 \rightarrow C_2H_5Cl + \bullet Cl$

Termination: $\bullet Cl + \bullet Cl \rightarrow Cl_2$

$\bullet C_2H_5 + \bullet Cl \rightarrow C_2H_5Cl$

$\bullet C_2H_5 + \bullet C_2H_5 \rightarrow C_4H_{10}$