OCR (B) Chemistry GCSE

C3 - Chemicals of the Natural Environment

Flashcards

Describe the chemical bonds found in metals

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- Metallic bonding.
- Many positive metal ions fixed in a giant regular structure surrounded by a sea of delocalised negative electron.
- There is strong electrostatic attraction between opposite charges.

What are the general properties of metals?

What are the general properties of metals?

- High melting points
- Solid at room temperature
- Strong and hard
- Malleable (can be pressed into shape)
- Ductile (can be drawn into wires)
- Good electrical and thermal conductors

Why do metals have high melting points?

Why do metals have high melting points?

Lots of energy is required to overcome the many strong metallic bonds.

Why are metals hard?

Why are metals hard?

Very strong metallic bonds hold the giant structure together.

Why are metals malleable and ductile?

Why are metals malleable and ductile?

Metals are made up of uniform layers of atoms which can easily slide over one another. So the shape of the metal can be easily changed.

Why are metals good conductors?

Why are metals good conductors?

The delocalised electrons are free to move to carry charge.

Write the general equation for the reaction of metals with water

Write the general equation for the reaction of metals with water

metal + water → metal hydroxide + hydrogen

Write the general equation for the reaction of metals with dilute acid

Write the general equation for the reaction of metals with dilute acid

metal + acid → salt + hydrogen

What is a displacement reaction in terms of metals?

What is a displacement reaction in terms of metals?

A reaction in which a more reactive metal displaces (replaces) a less reactive metal from a compound.

How can the order of the reactivity of metals be deduced from the results of an experiment?

How can the order of the reactivity of metals be deduced from the results of an experiment?

More reactive metals can displace less reactive metals from their compounds in a displacement reaction. A series of displacement reactions can be carried out to compare the reactivities of metals.

What is meant by the reactivity of metals?

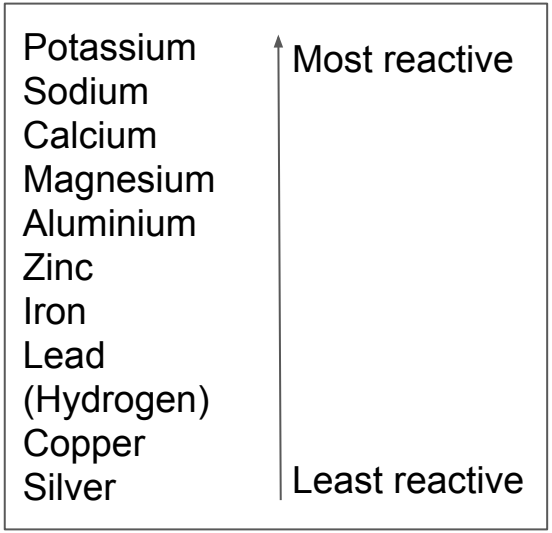
What is meant by the reactivity of metals?

The tendency of a metal atom to lose electrons and form its positive ion.

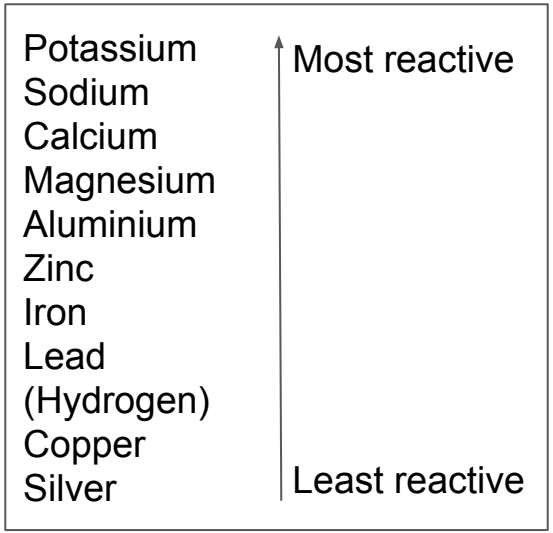
Which metal in the reactivity series reacts with water most vigorously?

Which metal in the reactivity series reacts with water most vigorously?

Potassium

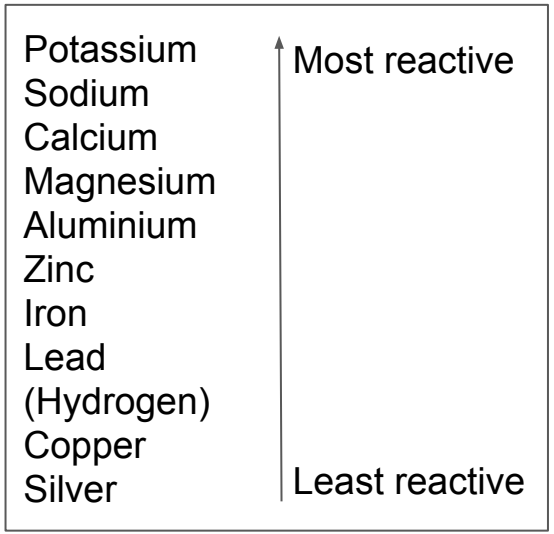


Using the reactivity series, which elements don't react with acids? Why?



Using the reactivity series, which elements don't react with acids? Why?

Copper and silver because they are below hydrogen in the reactivity series so are less reactive than hydrogen.



What is the principle of conservation of mass?

What is the principle of conservation of mass?

A closed system has a constant mass during a reaction, no matter is gained or lost, so the mass of reactants is equal to the mass of products.

Write a balanced symbol equation for the displacement reaction between calcium and copper(II) sulfate

Write a balanced symbol equation for the displacement reaction between calcium and copper(II) sulfate

$$Ca(s) + CuSO_4(aq) \rightarrow CaSO_4(aq) + Cu(s)$$

Write the ionic equation for the reaction between sodium and iron(II) carbonate (Higher only)

Write the ionic equation for the reaction between sodium and iron(II) carbonate (Higher only)

$$2Na(s) + Fe^{2+}(aq) \rightarrow 2Na^{+}(aq) + Fe(s)$$

What is an ore?

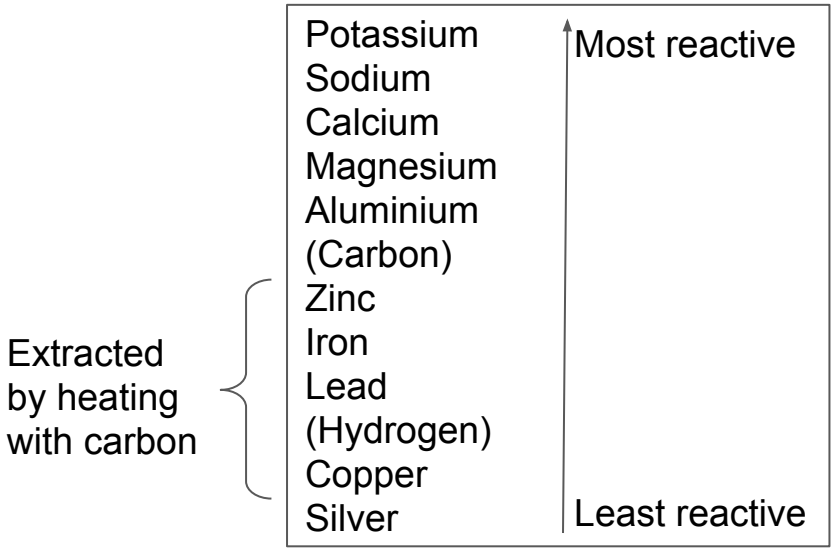
What is an ore?

A rock that contains a mineral that can be extracted.

Which metals can be extracted from their ores by heating with carbon?

Which metals can be extracted from their ores by heating with carbon?

Metals which are below carbon in the reactivity series, such as zinc.



Describe how zinc can be extracted from its ore

Describe how zinc can be extracted from its ore

Heat zinc oxide with carbon to reduce it and form zinc. Carbon is the reducing agent and is oxidised. Carbon displaces zinc from its oxide.

Write a word and symbol equation for the reduction of zinc oxide with carbon

Write a word and symbol equation for the reduction of zinc oxide with carbon

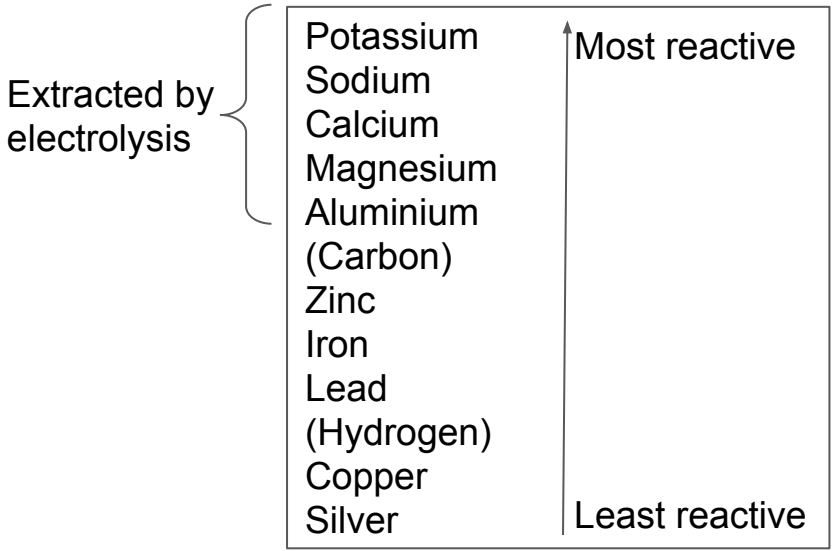
zinc oxide + carbon → zinc + carbon monoxide

$ZnO(s) + C(s) \rightarrow Zn(l) + CO(g)$

Why must electrolysis be used to extract some metals from their ores?

Why must electrolysis be used to extract some metals from their ores?

Metals above carbon in the reactivity series are more reactive than carbon so they will not be displaced from their ores by carbon.



Why is electrolysis not used to extract zinc from its ore?

Why is electrolysis not used to extract zinc from its ore?

- Zinc is less reactive than carbon so can be extracted by heating with carbon.
- Electrolysis is expensive and requires a lot of energy.

How can plants be used as an alternative metal extraction method? (Higher only)

How can plants be used as an alternative metal extraction method? (Higher only)

Phytoextraction:

Plants are grown in areas with metals in the soil. The plants take up metals through their roots and concentrate them in their shoots and leaves. These plants are burned and the metals are removed from the ash.

How can bacteria be used as an alternative metal extraction method? (Higher only)

How can bacteria be used as an alternative metal extraction method? (Higher only)

Bacterial extraction:

Some bacteria absorb metal compounds. These bacteria produce solutions called leachates containing the metals. Scrap iron can be used to remove the metal from the leachate.

What are the limitations of biological methods of extraction?

(Higher only)

What are the limitations of biological methods of extraction? (Higher only)

- Produces smaller quantities of metals.
- Slow processes.
- Require displacement or electrolysis for the final step.
- Bacteria require acidic conditions and may introduce toxic substances to the environment.

When do ionic compounds conduct electricity? Why?

When do ionic compounds conduct electricity? Why?

When molten or aqueous (dissolved in water) because the ions are free to move. When solid, the ions are fixed in the lattice so they can't move to carry a charge.

What is an electrolyte?

What is an electrolyte?

A molten or aqueous ionic compound that conducts electricity.

What is electrolysis and what can it be used for?

What is electrolysis and what can it be used for?

Electrolysis is the decomposition of an electrolyte using an electric current. It can be used to extract metals from their ores.

When using inert electrodes, what happens at the cathode?

When using inert electrodes, what happens at the cathode?

Cations (positive ions) move towards the cathode (negative electrode). Positive metal ions gain electrons to form metal atoms. If the metal is more reactive than hydrogen, hydrogen will form at the cathode instead and the metal will remain in the electrolyte.

When using inert electrodes, what happens at the anode?

When using inert electrodes, what happens at the anode?

Anions (negative ions) move towards the anode (positive electrode). Negative non-metal ions lose electrons to form non-metal atoms.

Predict what will form when molten lead(II) bromide is electrolysed

Predict what will form when molten lead(II) bromide is electrolysed

Lead atoms (Pb) at cathode.

Bromine molecules (Br_2) at anode.

Write half equations for the reactions that take place when calcium chloride undergoes electrolysis (Higher only)

Write half equations for the reactions that take place at each electrode when calcium chloride undergoes electrolysis (Higher only)

Cathode: $Ca^{2+} + 2e^- \rightarrow Ca$

Anode: $2Cl^- \rightarrow Cl_2 + 2e^-$

Describe oxidation and reduction in terms of electrons

(Higher only)

Describe oxidation and reduction in terms of electrons (Higher only)

Oxidation is loss of electrons.

Reduction is gain of electrons.

How can electrolysis be used to extract aluminium from its ore bauxite?

How can electrolysis be used to extract aluminium from its ore bauxite?

- Purified to form aluminium oxide.
- Dissolved in molten cryolite.
- Insert inert electrodes and connect to power supply.
- Aluminium ions gain electrons at cathode to produce pure aluminium and oxide ions lose electrons to form oxygen at anode.

Why is aluminium oxide dissolved in cryolite during electrolysis?

Why is aluminium oxide dissolved in cryolite during electrolysis?

- Cryolite has a lower melting point than aluminium oxide.
- Aluminium oxide is insoluble in water.
- Reduces energy use and cost.

Why must the inert graphite electrodes be replaced regularly when aluminium is being extracted from its ore?

Why must the inert graphite electrodes be replaced regularly when aluminium is being extracted from its ore?

The oxygen produced at the anode reacts with carbon in the electrode forming carbon dioxide meaning carbon is lost from the anode.

When would oxygen not be produced at the anode during the electrolysis of an aqueous ionic compound? What would form instead?

When would oxygen not be produced at the anode during the electrolysis of an aqueous ionic compound? What would form instead?

When halide ions are present (chloride, bromide or iodide ions). A halogen would form (chlorine, bromine or iodine).

Write the balanced half equation for the formation of oxygen from hydroxide ions at the anode

(Higher only)

Write the balanced half equation for the formation of oxygen from hydroxide ions at the anode
(Higher only)

$$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$$

Describe how to carry out electrolysis on an aqueous salt solution

Describe how to carry out electrolysis on an aqueous salt solution

1. Pour the salt solution into a beaker.
2. Insert 2 graphite electrodes and connect to a power supply.
3. Fill 2 test tubes with salt solution and place over the electrodes to collect any gas produced.
4. Turn on the power supply, ensuring the electrodes don't touch.
5. Turn off power and test gases.

What is a hydrocarbon?

What is a hydrocarbon?

A compound made up of only hydrogen and carbon atoms.

Fill in the blank:

‘Crude oil is the main source of _____’

Fill in the blank: ‘Crude oil is the main source of _____’

Hydrocarbons

What is crude oil a feedstock for?

What is crude oil a feedstock for?

The petrochemical industry

Is crude oil finite or infinite?

Is crude oil finite or infinite?

Finite

Why is modern life dependent on hydrocarbons?

Why is modern life dependent on hydrocarbons?

Hydrocarbons are a source of fuel which is relied on heavily for modern life.

What is a homologous series?

What is a homologous series?

A series of organic molecules with the same general formula. Successive members in the series differ by $-CH_2$.

Molecules in a homologous series have similar chemical properties because they have the same general formula.

What is the general formula for the alkane homologous series?

What is the general formula for the alkane homologous series?

C_nH_{2n+2}

What is a fraction of crude oil?

What is a fraction of crude oil?

A mixture of similar-sized hydrocarbon molecules with similar boiling points. These compounds are generally members of the alkane homologous series and have the formula C_nH_{2n+2}.

Why can crude oil be separated by fractional distillation?

Why can crude oil be separated by fractional distillation?

Because the different hydrocarbons have different boiling points so condense at different temperatures.

Describe the fractional distillation of crude oil

Describe the fractional distillation of crude oil

- Crude oil is heated and evaporates.
- Crude oil vapours enter and rise up a fractionating column which is hot at the bottom and cold at the top.
- Vapours condense when the temperature is below its boiling point.
- Separated liquids leave the column at different heights.

Do the longest hydrocarbons leave the fractionating column at the top or bottom?

Do the longest hydrocarbons leave the fractionating column at the top or bottom?

Bottom

Which forces must be overcome for alkanes to turn from liquid to gas? What other bond is found in alkane molecules?

Which forces must be overcome for alkanes to turn from liquid to gas? What other bond is found in alkane molecules?

Intermolecular forces must be overcome for an alkane to evaporate.

Covalent bonds are found between carbons and between carbon and hydrogen. These are not broken during boiling.

Why do different alkanes have different boiling points?

Why do different alkanes have different boiling points?

- Longer hydrocarbons have stronger intermolecular forces.
- More energy is required to overcome the stronger forces.
- Longer hydrocarbons have higher boiling points.

What is meant by the term empirical formula?

What is meant by the term empirical formula?

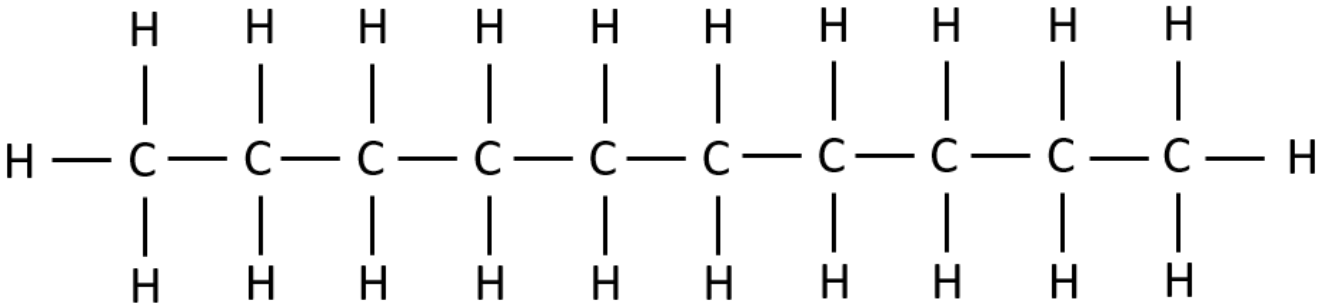
The simplest whole number ratio of atoms of each element in a compound.

What is the empirical formula of C_4H_{10}?

What is the empirical formula of C_4H_{10}?

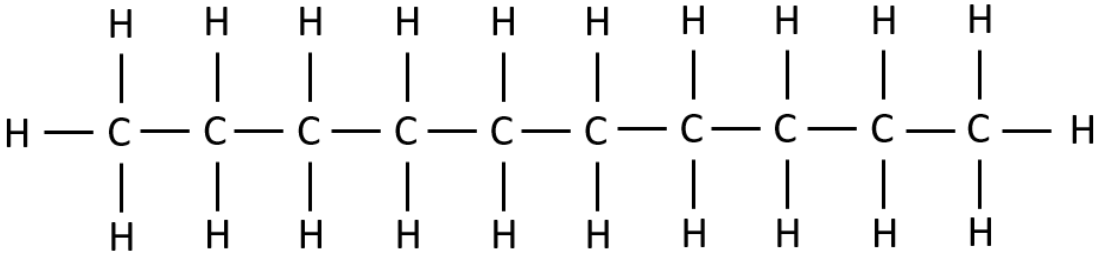
C_2H_5

What is the empirical formula of the compound below:



What is the empirical formula of the compound below:

C_5H_{11}



What is a covalent bond?

What is a covalent bond?

A bond formed from a shared pair of electrons between atoms.

Draw a dot and cross diagram of CH_4, showing outer shell electrons only

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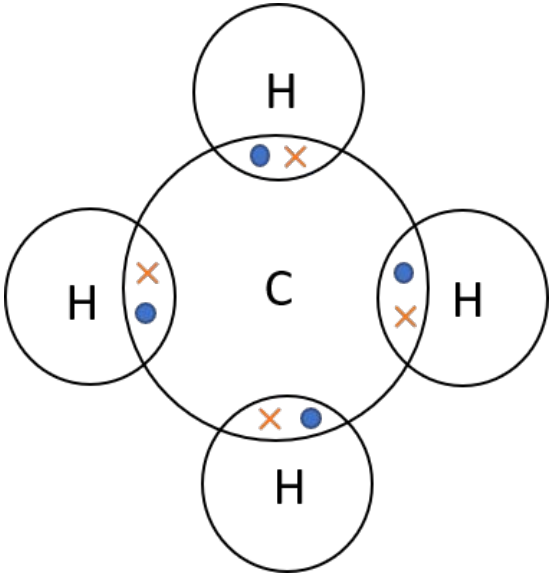


What are the limitations of using dot and cross diagrams to represent covalent compounds?

What are the limitations of using dot and cross diagrams to represent covalent compounds?

- Don’t show the 3D arrangement of atoms in space.
- Doesn’t show the size of atoms relative to one another.

What are the limitations of using 3D diagrams to represent covalent compounds?

What are the limitations of using 3D diagrams to represent covalent compounds?

- They are not show to scale.
- Don’t show how the bond formed.
- Don’t show the shared pair of electrons.

Which is stronger: covalent bonds or intermolecular forces?

Which is stronger: covalent bonds or intermolecular forces?

Covalent bonds

Why do alkanes have low melting and boiling points?

Why do alkanes have low melting and boiling points?

During melting and boiling, intermolecular forces are overcome but covalent bonds aren't broken. Intermolecular forces are relatively weak compared to covalent bonds so require little energy to overcome.

What is cracking?

What is cracking?

Breaking long chain hydrocarbon molecules into smaller hydrocarbons.

What are the products of cracking?

What are the products of cracking?

Alkanes and alkenes

Alkenes are a different homologous series containing a carbon to carbon double bond.

Hexane is cracked to form butane and ethene. Write a word and symbol equation for this reaction.

Hexane is cracked to form butane and ethene. Write a word and symbol equation for this reaction.

hexane → butane + ethene

$C_6H_{14} \rightarrow C_4H_{10} + C_2H_4$

Describe what happens during cracking

Describe what happens during cracking

An alkane is heated. The vapours pass over a catalyst and the covalent bonds break and reform.

Why is cracking important?

Why is cracking important?

- The shorter chained alkanes and alkenes are in higher demand than long chained alkanes.
- Can match the supply of fractions with demand. Typically fractional distillation of crude oil produces too many long chain hydrocarbons.
- Alkenes can be produced for use as a feedstock in the petrochemical industry.

Alkanes are saturated hydrocarbons. Explain what this means

(Chemistry only)

Alkanes are saturated hydrocarbons. Explain what this means (Chemistry only)

Hydrocarbon - contains only hydrogen and carbon.

Saturated - carbon atoms are all joined by single bonds.

What is an alkene? Include the general formula and functional group

(Chemistry only)

What is an alkene? Include the general formula and functional group (Chemistry only)

An unsaturated hydrocarbon.

General formula: C_nH_{2n}

Functional group: C=C

Give examples of molecules that alkenes react with in an addition reaction (Chemistry only)

Give examples of molecules that alkenes react with in an addition reaction (Chemistry only)

React with water when heated with a catalyst to form alcohols.

React with bromine to form bromoalkanes.

React with other alkenes to form addition polymers.

What are the general formula and functional group of an alcohol?

(Chemistry only)

What are the general formula and functional group of an alcohol? (Chemistry only)

General formula: $C_nH_{2n+1}OH$

Functional group: OH

What are the common reactions of alcohols?

(Chemistry only)

What are the common reactions of alcohols? (Chemistry only)

- Complete combustion, producing water and carbon dioxide.
- Oxidation to produce carboxylic acids (needs an oxidation agent).

What are the general formula and functional group of a carboxylic acid? (Chemistry only)

What are the general formula and functional group of a carboxylic acid? (Chemistry only)

General formula: $C_nH_{2n+1}COOH$

Functional group: COOH

What do carboxylic acids react with?

(Chemistry only)

What do carboxylic acids react with? (Chemistry only)

- Metals (forms salt and hydrogen).
- Bases (forms salt and water).
- Carbonates (forms salt, water and carbon dioxide).

Identify the functional group in each of the molecules below (Chemistry only)

CH_4	C_4H_9OH
C_5H_{10}	$C_7H_{15}COOH$
C_2H_5COOH	C_3H_8

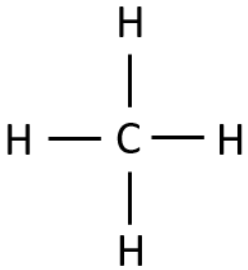
Identify the functional group in each of the molecules below (Chemistry only)

Molecule	Functional group
CH_4	Alkane
C_5H_{10}	Alkene
C_2H_5COOH	Carboxylic acid
C_4H_9OH	Alcohol
$C_7H_{15}COOH$	Carboxylic acid
C_3H_8	Alkane

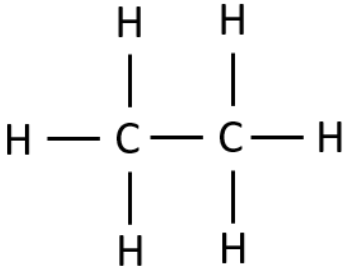
Draw the structural formula of the first 4 straight chain alkanes

(Chemistry only)

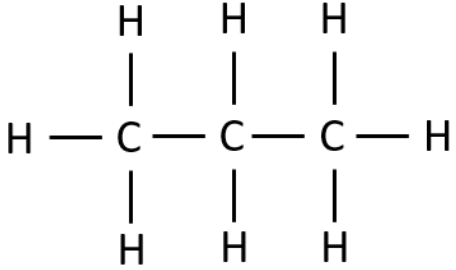
Draw the structural formula of the first 4 straight chain alkanes (Chemistry only)



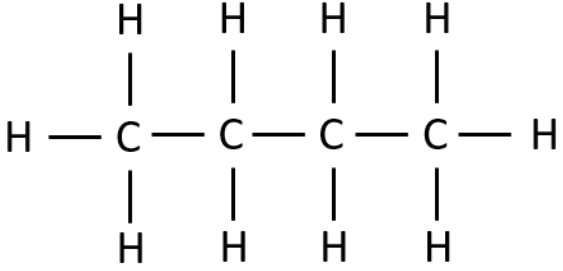
Methane
CH_4



Ethane
C_2H_6



Propane
C_3H_8

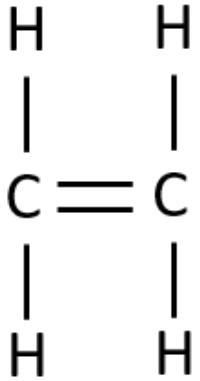


Butane
C_4H_{10}

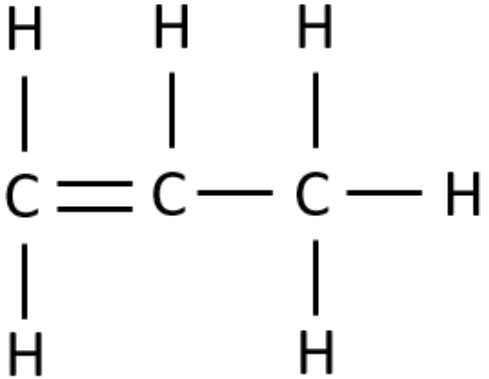
Draw the structural formula of the first 2 straight chain alkenes

(Chemistry only)

Draw the structural formula of the first 2 straight chain alkenes (Chemistry only)



Ethene
C_2H_4

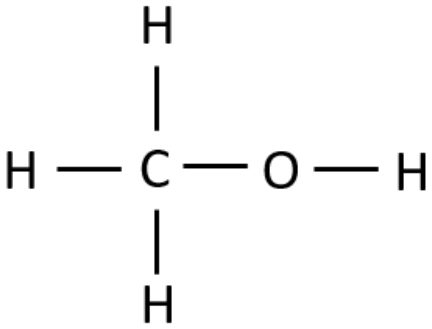


Propene
C_3H_6

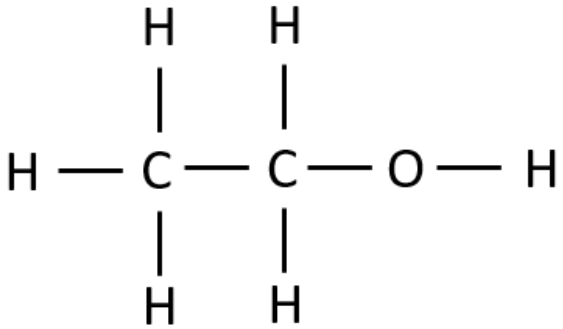
Draw the structural formula of the first 3 straight chain alcohols

(Chemistry only)

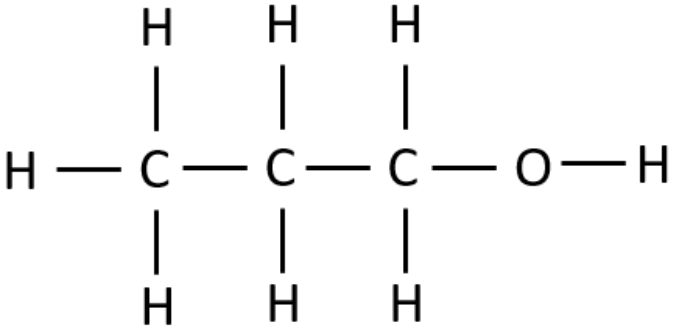
Draw the structural formula of the first 3 straight chain alcohols (Chemistry only)



Methanol
CH_3OH



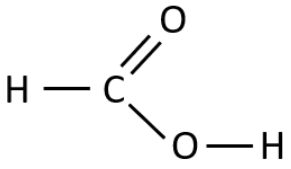
Ethanol
C_2H_5OH



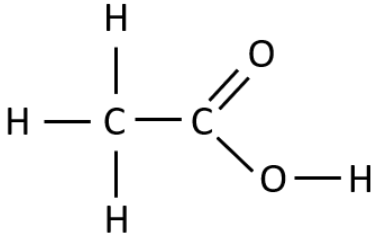
Propanol
C_3H_7OH

Draw the structural formula of the first 4 straight chain carboxylic acids (Chemistry only)

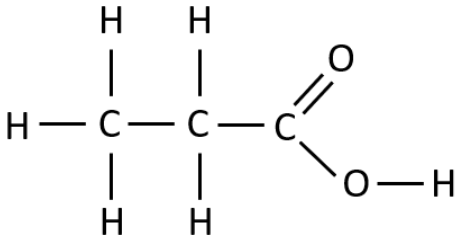
Draw the structural formula of the first 4 straight chain carboxylic acids (Chemistry only)



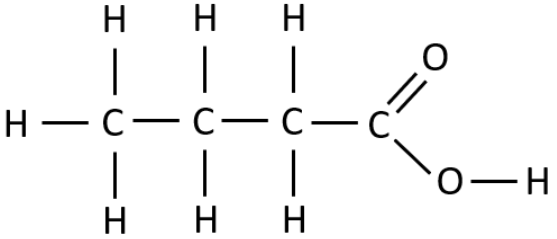
Methanoic acid
HCOOH



Ethanoic acid
CH_3COOH



Propanoic acid
C_2H_5COOH



Butanoic acid
C_3H_7COOH

Why do members of a homologous series react similarly?

(Chemistry only)

Why do members of a homologous series react similarly? (Chemistry only)

Because they all contain the same functional groups.

Predict the formula of the products when pentane is completely combusted

(Chemistry only)

Predict the formula of the products when pentane is completely combusted (Chemistry only)

H_2O and CO_2

Write a balanced symbol equation for the incomplete combustion of ethane

(Chemistry only)

Write a balanced symbol equation for the incomplete combustion of ethane (Chemistry only)

$C_2H_6 + 2O_2 \rightarrow 3H_2O + C + CO$

$C_2H_6 + 2½O_2 \rightarrow 3H_2O + C + CO_2$

$C_2H_6 + 2½O_2 \rightarrow 3H_2O + 2CO$

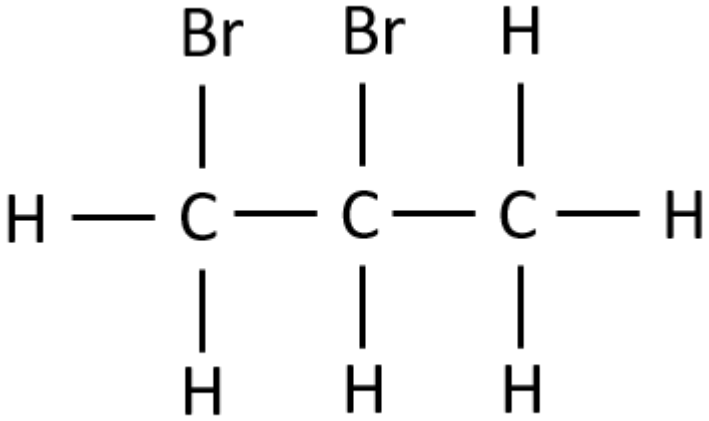
Or any other balanced symbol equation where the products include H_2O and C or CO. Products may also contain CO_2 with C or CO.

Predict the formula of the product when propene reacts with bromine

(Chemistry only)

Predict the formula of the product when propene reacts with bromine (Chemistry only)

$C_3H_6Br_2$



Predict the formula of the products when ethanol is oxidised

(Chemistry only)

Predict the formula of the products when ethanol is oxidised (Chemistry only)

Alcohols are oxidised to form carboxylic acids.

Ethanoic acid: CH_3COOH