Edexcel IAL Chemistry A-Level

Topic 10 - Organic Chemistry: Halogenoalkanes, Alcohols and Spectra

Flashcards

Define the term nucleophile

Define the term nucleophile

A molecule or ion that donates electrons.

What are halogenoalkanes?

What are halogenoalkanes?

Alkanes with at least one halogen atom bonded to the carbon chain.

Depending on which halogen is present, they have the prefixes:

Chloro-

Bromo-

Iodo-

What do the displayed, structural and skeletal formulae of a halogenoalkane with 2 carbon atoms and one halogen atom, X, look like?

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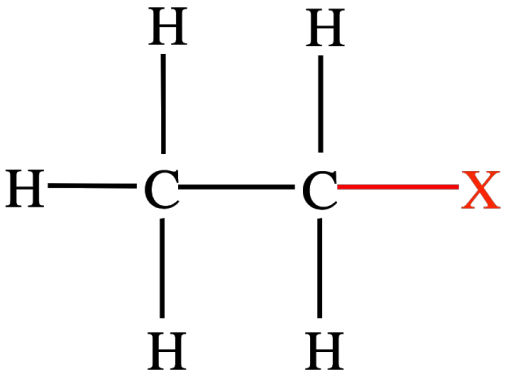
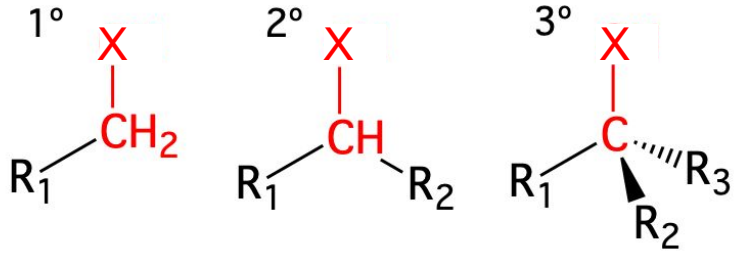


CH_3CH_2X

What is the difference between primary, secondary and tertiary halogenoalkanes?

What is the difference between primary, secondary and tertiary haloalkanes?

- Primary haloalkanes: the halogen atom is bonded to a carbon which is directly bonded to 1 other carbon atom.
- Secondary haloalkanes: the halogen atom is bonded to a carbon which is directly bonded to 2 other carbon atoms.
- Tertiary haloalkanes: the halogen atom is bonded to a carbon which is directly bonded to 3 other carbon atoms.



What is formed when a halogenoalkane reacts with an aqueous alkali, like KOH?

What is formed when a halogenoalkane reacts with an aqueous alkali, like KOH?

An alcohol is formed.

The OH^- ion acts as a nucleophile.

What is formed when a halogenoalkane reacts with ethanolic potassium hydroxide? What type of reaction takes place?

What is formed when a halogenoalkane reacts with ethanolic potassium hydroxide? What type of reaction takes place?

An alkene is produced.

It is an elimination reaction.

What is formed when a halogenoalkane reacts with alcoholic ammonia under pressure?

What is formed when a halogenoalkane reacts with alcoholic ammonia under pressure?

An amine is produced.

Ammonia acts as the nucleophile.

What is formed when a halogenoalkane reacts with alcoholic potassium cyanide?

What is formed when a halogenoalkane reacts with alcoholic potassium cyanide?

An nitrile is produced.

The cyanide ion acts as the nucleophile.

How can halogenoalkanes be qualitatively identified?

How can halogenoalkanes be qualitatively identified?

Add ethanol, followed by aqueous silver nitrate solution to the halogenoalkane. If a halogenoalkane is present then a silver halide precipitate will form in the solution.

What colour precipitate will form when chloroethane is added to silver nitrate?

What colour precipitate will form when chloroethane is added to silver nitrate?

AgCl - White precipitate

What colour precipitate will form when bromoethane is added to silver nitrate?

What colour precipitate will form when bromoethane is added to silver nitrate?

AgBr - Cream precipitate

What colour precipitate will form when iodoethane is added to silver nitrate?

What colour precipitate will form when iodoethane is added to silver nitrate?

AgI - Yellow precipitate

What is the name of the mechanism for the reaction between a halogenoalkane and ammonia?

What is the name of the mechanism for the reaction between a halogenoalkane and ammonia?

Nucleophilic substitution

What is the condition required for a halogenoalkane to produce an alcohol rather than an alkene when it reacts with KOH?

What is the condition required for a halogenoalkane to produce an alcohol rather than an alkene when it reacts with KOH?

The KOH needs to be aqueous.

If the KOH is ethanolic, an alkene will be produced.

What is the trend in reactivity of primary, secondary and tertiary halogenoalkanes?

What is the trend in reactivity of primary, secondary and tertiary halogenoalkanes?

Tertiary > Secondary > Primary

The tertiary halogenoalkane is the most reactive and the primary halogenoalkane is the least reactive.

What is the trend in reactivity of chloro-, bromo- and iodo- halogenoalkanes? Explain in terms of bond enthalpy

What is the trend in reactivity of chloro-, bromo- and iodo- halogenoalkanes? Explain in terms of bond enthalpy

iodo- > bromo- > chloro-

Iodo- halogenoalkanes are the most reactive. This is because the C-I bond is the weakest (low bond enthalpy) and so it is broken easily.

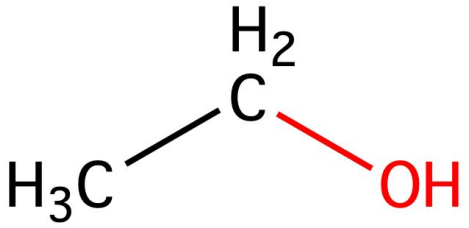
Chloro- halogenoalkanes are the least reactive because the C-Cl bond has a high bond enthalpy and therefore requires a lot of energy to break.

What is an alcohol?

What is an alcohol?

An alcohol is an organic compound that contains an OH functional group.

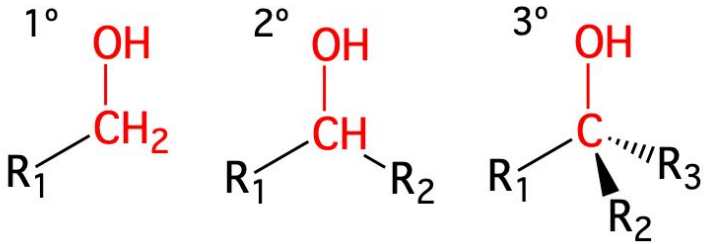
General formula: $C_nH_{2n+1}OH$



What is the difference between primary, secondary and tertiary alcohols?

What is the difference between primary, secondary and tertiary alcohols?

- Primary haloalkanes: the hydroxyl group is bonded to a carbon which is directly bonded to 1 other carbon atom.
- Secondary haloalkanes: the hydroxyl group is bonded to a carbon which is directly bonded to 2 other carbon atoms.
- Tertiary haloalkanes: the hydroxyl group is bonded to a carbon which is directly bonded to 3 other carbon atoms.



What is the suffix for an alcohol?

What is the suffix for an alcohol?

-ol

The letters ‘-ol’ are added after the name of the compound. E.g. ethanol.

If this is not possible, the prefix ‘hydroxy-’ is used instead. E.g. hydroxyethanoic acid.

What do the displayed, structural and skeletal formulae of ethanol look like?

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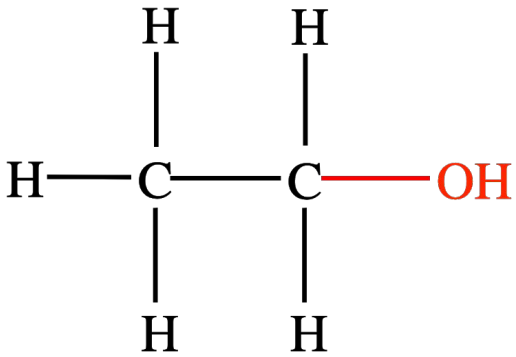
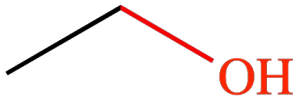


CH_3CH_2OH



What is the chemical equation for the complete combustion of ethanol?

What is the chemical equation for the complete combustion of ethanol?

$$CH_3CH_2OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$

What condition is required to ensure complete combustion takes place?

What condition is required to ensure complete combustion takes place?

Excess oxygen

What is the chemical equation for the incomplete combustion of ethanol to produce carbon monoxide?

What is the chemical equation for the incomplete combustion of ethanol to produce carbon monoxide?

$$C_2H_5OH + 2O_2 \rightarrow 3H_2O + 2CO$$

How can chloroalkanes be formed from alcohols?

How can chloroalkanes be formed from alcohols?

Add PCl_5

What is the equation for the reaction of ethanol with PCl_5?

What is the equation for the reaction of ethanol with PCl_5?

$$C_2H_5OH + PCl_5 \longrightarrow C_2H_5Cl + POCl_3 + HCl$$

How can alcohols be chemically tested for by using PCl_5?

How are alcohols chemically tested for?

First, the liquid being tested must be neutral and contain no water. Then PCl_5 should be added to the liquid. If a violent reaction occurs in which hydrogen chloride gas is released, then an alcohol is present.

How can bromoalkanes be formed from alcohols?

How can bromoalkanes be formed from alcohols?

Add potassium bromide and concentrated sulfuric acid. This produces hydrogen bromide that will react with the alcohol.

What are the equations for the 2-step reaction of ethanol with potassium bromide and concentrated sulfuric acid?

What are the equations for the 2-step reaction of ethanol with potassium bromide and concentrated sulfuric acid?

$$2KBr + H_2SO_4 \rightarrow K_2SO_4 + 2HBr$$

$$HBr + C_2H_5OH \rightarrow C_2H_5Br + H_2O$$

How can iodoalkanes be formed from alcohols?

How can iodoalkanes be formed from alcohols?

Add red phosphorus and iodine.

What are the equations for the 2-step reaction of ethanol with red phosphorus and iodine?

What are the equations for the 2-step reaction of ethanol with red phosphorus and iodine?

$$2P + 3I_2 \rightarrow 2PI_3$$

$$3C_2H_5OH + PI_3 \rightarrow 3C_2H_5I + H_3PO_3$$

An alcohol can be converted into an alkene. Name the type of reaction and the reagent required.

An alcohol can be converted into an alkene. Name the type of reaction and the reagent required.

Reaction: Elimination

Reagent: Concentrated phosphoric(V) acid

What can be used to oxidise alcohols? What is the colour change after oxidation?

What can be used to oxidise alcohols? What is the colour change after oxidation?

Acidified potassium dichromate(VI) - $K_2Cr_2O_7$

Colour change from orange to green.

What type of alcohol can be oxidised to an aldehyde? What is the condition required?

What type of alcohol can be oxidised to an aldehyde? What is the condition required?

Primary alcohol.

The apparatus must have a horizontal condenser so that the product is distilled immediately.

What type of alcohol can be oxidised to a carboxylic acid? What is the condition required?

What type of alcohol can be oxidised to a carboxylic acid? What is the condition required?

Primary alcohol

The apparatus must be set up in reflux. The primary alcohol is oxidised to an aldehyde which is then further oxidised to a carboxylic acid.

What type of alcohol can be oxidised to a ketone?

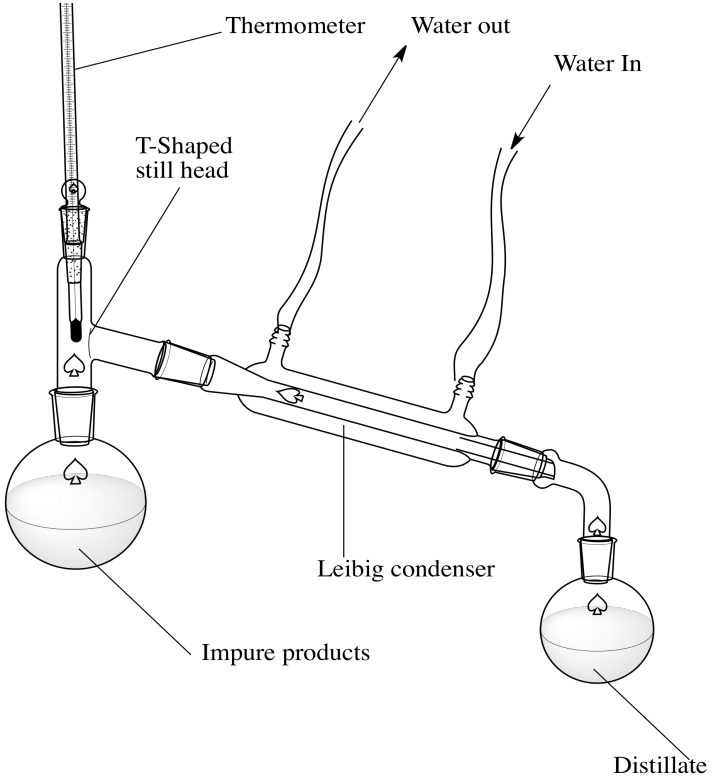
What type of alcohol can be oxidised to a ketone?

Secondary alcohol

How is the apparatus for distillation set up?

How is the apparatus for distillation set up?

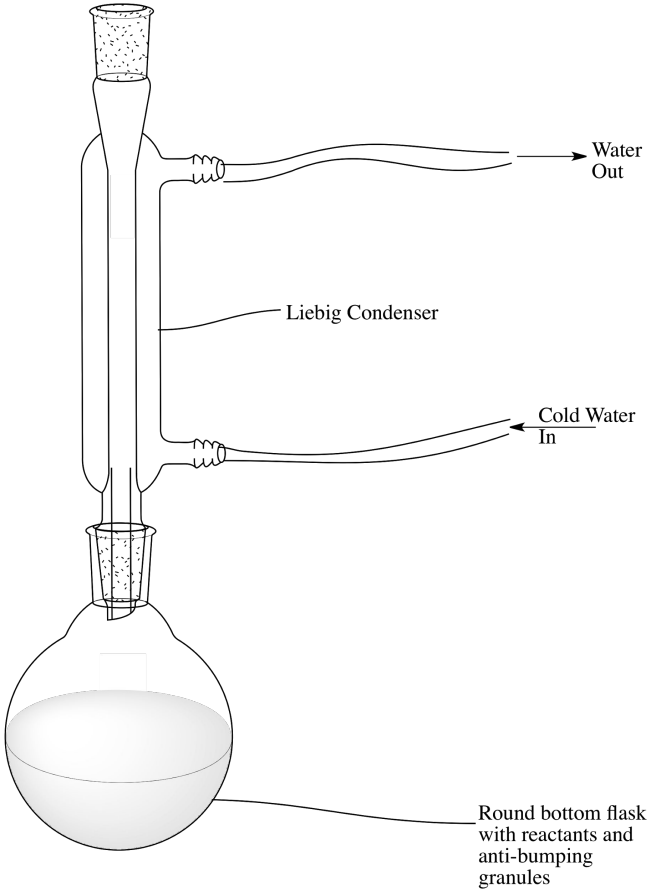
- Round bottomed flask
- Horizontal condenser
- Thermometer
- Bunsen burner
- Beaker to collect distillate
- Water in/out



How is the apparatus for reflux set up?

How is the apparatus for reflux set up?

- Round bottomed flask
- Vertical condenser
- Thermometer
- Bunsen burner
- Water in/out



What data can be analysed to deduce the functional groups present in organic compounds?

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Infrared spectra

How does infrared spectroscopy work?

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Different bonds in compounds vibrate a different amount. Infrared spectroscopy measures the vibrations and from this different functional groups can be identified.