Erasmus+

SCU – School Company Union

Students get in touch with local food production companies

ALKANES

Alkanes are satured hydrocarbons, they' ve got hydrogen and they' ve got carbon.Their general formula is $CnH(2n + 2)$.Every carbon atom in an alkane has four single bonds with other atoms.Alcane mulecules are tetrahedral around each carbon and each carbon atom has four pairs of bonding electrons around it.

The boiling point of an alkane depends on its size and shape. The smallest alkanes are gases and the largest alkanes are liquids.Alkanes have covalent bonds and between the mulecules there are Van der Waals forces. The longer the carbon chain, the stronger the Van der Waals forces.Alkanes burn completely in oxygen and happen between gases, so liquid alkanes have to be vaporised first.

Larger alkanes release heaps more energy per mole because they have more bonds to react.Burning alkanes in limited oxygen produces carbon monoxide and it is poisonous. The oxygen is carried around by haemoglobin, carbon monoxide is better at binding to haemoglogin than oxygen is. Any appliance that burns alkanes can produce carbon monoxide and all applicens that use an alkane-based fuel need to be properly ventilated.

ALKANES

Breaking a covalent bond is called bond fission. There are two types of bond fission: Homolytic and Heterolytic.Homolytic fission: in heterolytic fission two different substances are formed a positively changed cation and a negatively changed anion. Heterolytic fission: in homolytic fission two electrically uncharged 'radicals' are formed.Halogens react with alkanes in photochemical reactions, forming halogenoalkanes. Photochemical reactions are started by light . Hydrogen atom is substitued by chlorine or bromine, this is a free-radical substitution reaction.Chlorine and methane react with a bit of a bang to form chloromethane, the reaction mechanism has three stages:

1) Initiation reactions (free radicals are produced);

2) Propagation reactions (free radicals are used up and created in a chain reaction);

3) Termination reactions (free radicals are mopped up).

The big problem with free-radical substitution is that you don't only get chloromethane, but a mixture of product.If there's too much chlorine in the reaction mixture, some of the remaining hydrogen atoms on the chloromethane molecule will be swapped for chlorine atoms.The propagation reactions happen again, this time to make dichloromethane. Another substitution reaction can take place to form trichloromethane.Tetrachloromethane is formed in the last possible substitution.

ALKENES

Alkenes are made of carbon and hydrogen atoms, so they are called hydrocarbons.

Their general formula is: C_nH_{2n} and the Alkene molecules have at least one carbon-carbon double covalent bond (C=C) which is nucleophilic that is it's attracted to places that don't have enough electrons. That means the double bonds is attracted to positive charges.

For example

Because of C=C double bonds the molecules are unsatured, because they can make more bonds with extra atoms, and instables; so they have to do a reaction for being satured and stables, like in addiction reactions with electrophiles, hydrogen, hydrogen halides and polymers.Thanks to this the alkenes are more reactive than alkanes, because the double bond has a really high electron density and also because of its spatial position made the bond sticks out above and below the rest of the molecule. For this the bond is easier to be attacked by electrophiles.So alkenes are handy starting points for making organic compounds and petrochemicals as well.

Alkenes's reactions: Most addition reactions of alkenes follow the mechanism of electrophilic addition.

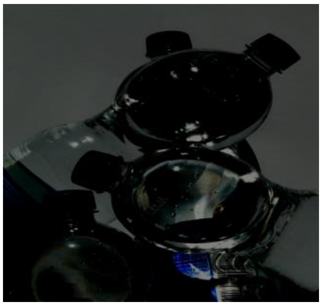
Alkenes join up to form addition polymers (or addiction polymerisation) using the catalysts or other units. (X and Y, if they are catalysts, they are regenerated at the end of the reaction, instead if they are molecules, X is at the top of the polymers and Y is at the end of it.)The double bonds can open up and join up another molecule to make long chains called polymers, instead the short chain, with only one double bond, is called monomer.

ALKENES

Instead to find the monomer you have to form an addition polymer, take the repeat unit and add a double bond. *Remember:* different alkenes give polymers with different properties in effect there are three types of polymerisation: anionic, cationic and radical.

Alkenes react with electrophilic addition;

The double bonds open up and atoms are added to the carbon atoms; this happens because the double bond is negatively charged and it is easily attacked by electrophiles (positively charged).



For example:

Alkenes react with hydrogen (H) addition;It uses the same process of electrophilic addition, but the result is an alkane.Alkenes react with hydrogen halides (H+halide) addition;The double bond is open up and atoms are added to the carbon atoms, but there can be two possibilities. The first, if the alkene is unsymmetrical (like propene), can have two possible products, because the halide can be added to the first carbon or the second. Instead the second, if the alkene is symmetrical (like ethene), has only one product, because the halide is added to the first carbon.For example: ethene reacts with hydrobromic acid (HBr)

ALKENES

VOCABULARY:

- Alkenes: alcheni
- Hydrocarbon: idrocarburo
- Nucleophilic: nucleofilo
- Ethylene/ethene: etile
- Hydrogen halides: idracidi
- Polymers: polimeri
- Monomers: monomeri
- Alkanes: alcani
- Electrophiles: elettrofili
- Petrochemicals: prodotto petrolchimico
- Catalysts: catalizzatori
- Anionic polymerisation: polimerizzazione anionica
- Cationic polymerisation: polimerizzazione cationica
- Radical polymerisation: polimerizzazione radicale
- Negatively charged: caricato negativamente
- Positively charged: carico positivamente
- Halides: alogeno
- Hydrobromic acid: acido bromidrico

ALKYNE

TYPICAL REACTIONS

As for alkenes, even most of the reactivity of alkynes is carried out through addition reactions to the triple bond. Addition reactions can be allowed to proceed until obtaining saturated compounds (ie atoms with links between them only by single bonds) or may be conducted under conditions such as to favor an addition partial, thus transforming the triple bond into a dou

Addition of hydrogen

It takes place at temperatures and pressures not higher in the presence of metal catalysts such as platinum, nickel palladioo, producing the corresponding alkane.

The hydrogenation dell'alchino is so easy that with most of the catalysts is impossible to stop the reaction before the latter is transformed nell'alcano.

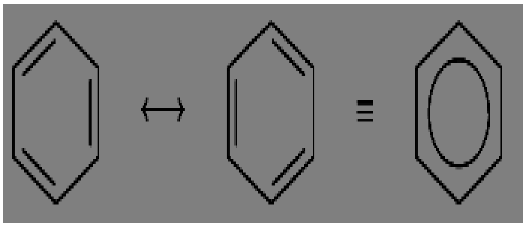
-Addition of water (formation of ketones) The treatment of an alkyne with dilute sulfuric acid in the presence of mercury salts leads to the formation of a vinyl alcohol,unstable, which is transformed into the corresponding ketone

Oxidation

Treatment with potassium permanganate in aqueous solution at cold leads to the formation of 1,2-diketones

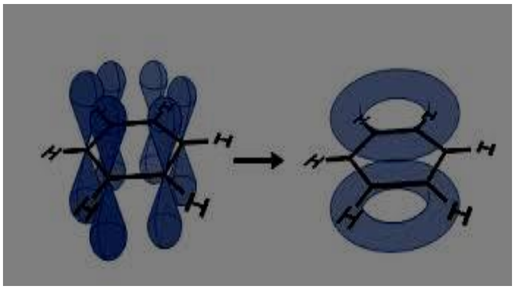
Aromatic compounds

Each carbon atom forms three sigma bonds, then leaves one electron spare on each of the six carbon atoms. Each carbon atom uses this electron to form a pi bond with another C atom. The pi bonds in benzene spread over all six carbon atoms in the hexagonal ring. The six electrons in the pi bonds are said to be delocalised. The pi bonding in benzene is formed by the overlap of carbon p atomics orbitals, one from each of the six carbon atoms. The lobes of the p orbitals overlap to form a ring of delocalised electrons above and below the plane of the carbon atoms in the benzene molecule.



REACTIONS OF ARENES

Most reaction of benzene maintain the highly stable delocalised ring of the pi bonding electrons intact. This occurs by substituting an hydrogen atom in the ring with a different atom, or group of atoms. The initial attack is usually aided by an electrophile catalyst.



Aromatic compounds

Electrophilic substitution with bromine

Benzene will react with bromine in the presence of an anhydrous iron bromide catalyst. The electrophile is created when an iron bromide molecule polarises a bromine molecule. The Br_2 molecule forms a dative bond with iron bromide by donating a lone pair of electrons from one bromide atom. This draws electrons from other bromine atom in the Br_2 molecule making it partially positive, creating the electrophile. We can think of the electrophile as a Br^+ cation. The Br^+ and the “electron-rich” benzene ring are attracted to each other.

Aromatic compounds

NITRATION OF BENZENE

The nitration of benzene is an electrophile substitution. Nitration refers to the introduction of the $–NO_2$ group into a molecule. The electrophile is the NO_2^+ ion, known as the nitronium ion (or nitryl cation).

In stage 1, the electrophile, NO_2^+ , is attracted to the high electron density of the pi bonding system in benzene. A pair of electrons from the benzene ring is donated to the nitrogen atom in NO_2^+, and forms a new covalent bond; and so the benzene's delocalised ring of electrons is disrupted. There are now four pi bonding electrons and a positive charge spread over five carbon atoms. In stage 2 the full delocalised ring is restored when C-H bond breaks. Both electrons in the C-H covalent bond go into nitrobenzene's pi bonding system, and hydrogen leaves as an H^+ ion, and so the chemical stability of the benzene ring is retained in the substitution reaction.

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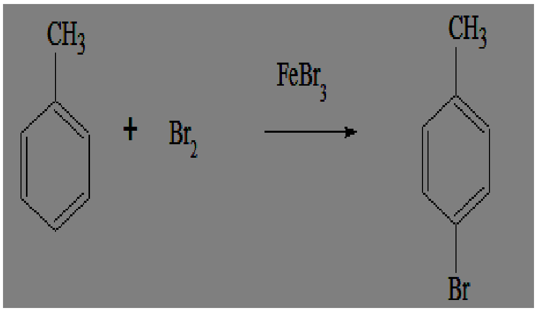

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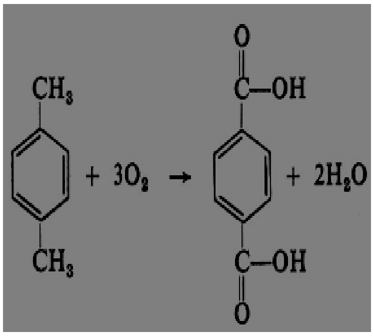
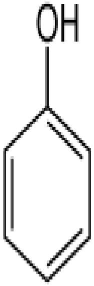
Aromatic compounds

Oxidation of the side-chain in arenes

The presence of the benzene ring in an alkylarene can affect the characteristic reactions of its alkyl side-chain. For example, alkanes are not usually oxidised by a chemical oxidising agent, however in alkylarenes the alkane side-chain is oxidised to form a carboxylic acid.





Phenol

Phenol, C_6H_5OH, is a crystalline solid which melts at 43° C. The melting point of the phenol is relatively high for an aryl compound of its molecular mass because of hydrogen bonding between its molecules.

It is used to manufacture a wide range of products.

The large non-polar benzene ring makes phenol only sparingly soluble in water as it disrupts hydrogen bonding whit water molecules.

Phenol is weakly acid but still a stronger acid than water or alcohol.

Alcohol

An alcohol is a molecule where you can found an- OH group:

ALCHOOL: R-OH

It can be primary, secondary or tertiary, this depend on which carbon atom the –OH group is bonded to.

Propriety:

This chemicals groups are miscible with water, because they form hydrogen bonds between –OH and H2O: if it' s a small alcohols. In larger alcohols, most of the molecule is a non-polar carbon chain, so there's less attraction for the polar H2O molecules. This means that as alcohols increase in size, their miscibility in water decreases.

Hydrogen bonding is the strongest kind of intermolecular force, so it gives alcohols high boiling points compared to non-polar compounds, e.g alkanes of similar size.

Alcohols have 2 types of reacting:

-breaking of the bond between carbon and hydrogen, and they are dehydrated and nucleophilic substitution reactions. Esempio.

-breaking of the bond between Oxygen and Hydrogen, and they are: oxidation, esterification and salification reactions. Esempio…

Alcohols are also use into alimentary factories for the production of alcoholic drinks; other are also use for the production of industrial solvent of methylated spirits. Finally, a bit fraction is used as a fuel, particularly in countries with few oil reserves.

Aldheydes

The Aldheydes are organic compounds that in them functional group have formyl group, It is indicated with -CHO.

The group C=O is called Carbonyl or "Carbonyl group", and it is bonded to a hydrogen atom and the alkyl radical.

PREPARATION OF ALDEHYDES

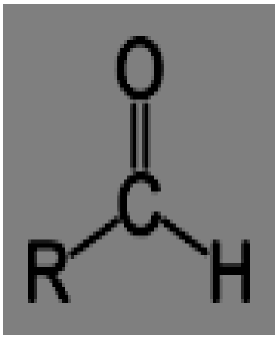
-Oxidation of primary alcohol

The general equation in which an aldehyde is formed starting from a primary alcohol is the following:

Primary alcohol + oxygen atom from oxidising agent

Aldehyde + water

The oxidising agent used is a solution of potassium dichromate, which is orange, acidified with dilute sulfuric acid. To make the aldehyde, the primary alcohol is heated gently with acidified dichromate solution. The reaction mixture turns green as the orange dichromate ions, $Cr_2O_7^{2-}$ ions are reduced to Cr^{3+} ions.



Aldheydes

REDUCTION OF ALDEHYDES

The reduction of an aldehyde produces an alcohol:

Aldehyde + reducing agent primary alcohol

The reducing agent is usually sodium tetrahydridoborate, $NaBH_4$. The aldehyde is warmed with an aqueous solution of sodium tetrahydridoborate in the reduction reaction. The reduction reaction can be illustrated of as a **nucleophilic addition** reaction, when the nucleophile is the H^- ion.

NUCLEOPHILIC ADDITION WITH “HCN”

In the case of aldehyde the reaction takes place across the C=O bond, but the attack is by a nucleophile, not an electrophile. The HCN is generated in the reaction vessel by the reaction of potassium cyanide, KCN, and diluite sulfuric acid.

Ketones

In chemistry, a ketone is an organic compound with the structure R-C(=O)-R, where R can be a variety of carbon-containing substituents. It contains a carbonyl group (a carbon-oxygen double bond).

Secondary alcohols are easily oxidized to ketones.The reaction can be halted at the ketone stage because ketones are generally resistant to further oxidation. Oxidation of a secondary alcohol to a ketone can be accomplished by many oxidizing agents, most often chromic acid (H2CrO4), pyridinium chlorochromate (PCC), potassium permanganate (KMnO4), or manganese dioxide (MnO2). With a few exceptions (such as oxidative cleavage of cyclohexanone, C6H10O, to adipic acid, a compound used to make nylon 6,6), the oxidation of ketones is not synthetically useful.

Nomenclature of Ketones

The International Union of Pure and Applied Chemistry (IUPAC) name of a ketone is derived by selecting as the parent the longest chain of carbon atoms that contains the carbonyl group. The parent chain is numbered from the end that gives the carbonyl carbon the smaller number. The suffix -e of the parent alkane is changed to -one to show that the compound is a ketone. For example, CH3CH2COCH2CH(CH3)2 is named 5 methyl-3-hexanone. The longest chain contains six carbon atoms and numbering of the carbon must begin at the end that gives the smaller number to the carbonyl carbon. The carbonyl group is on carbon 3, and the methyl group is on carbon 5. In cyclic ketones, numbering of the atoms of the ring begins with the carbonyl carbon as number 1. Common names for ketones are derived by naming each carbon group bonded to carbon as a separate word followed by the word “ketone.”However, traditional nonsystematic names are still generally used, for example acetone and benzophenone.

Ketones

REACTIONS OF KETONES

Ketones are highly reactive. Much of their chemical activity results from the nature of the carbonyl group. Ketones readily undergo a wide variety of chemical reactions. A major reason is that the carbonyl group is highly polar; it has an uneven distribution of electrons. This gives the carbon atom a partial positive charge, making it susceptible to attack by nucleophiles, which are species attracted to positively charged centres. Typical reactions include oxidation-reduction and nucleophilic addition. The polarity of the carbonyl group affects the physical properties of ketones as well. Because the carbonyl group interacts with water by hydrogen bonding, ketones are typically more soluble in water than the related methylene compounds. Ketones are hydrogen-bond acceptors. Ketones are not usually hydrogen-bond donors and cannot hydrogen-bond to themselves. Because of their inability to serve both as hydrogen-bond donors and acceptors, ketones tend not to "self-associate" and are more volatile than alcohols and carboxylic acids of comparable molecular weights.

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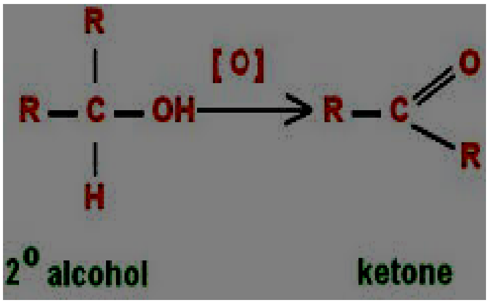


Carboxylic Acids

Carboxylic acids are organic compounds that contains a carboxylic groups (COOH).

Carboxylic acids can be aliphatic or aromatic depending on wether the carboxylic groups is linked an aliphatic or aromatic radical.

Carboxylic acids display the typical reactions of all acids due to the presence of excess H^+ ions in their aqueous solution.

The carboxylic acids are weak acids but their are stronger than alcohls.

The majority of their molecules are undissociated in water.

PHYSICAL PROPRIETIES

Carboxylic acids are polar because they may from hydrogen bonds, so they are water soluble compounds.

Carboxylic acids have higher bolling points than water.

CHEMICALS PROPRIETES

Many useful compounds can be synthesised from carboxylic acids.

However the synthesised reactions that are needed can be difficult to do because carboxylic acids are quiet unreactive.

One way round this is to convert the carboxylic acids into a compounds called an ACYL CHLORIDE, that are reactive compounds.

To prepare acyl chloride we can using phosphorus chloride of sulfur dichloride oxide ($SOCl_2$).

Carboxylic Acids

DICTONARY

- Weak acids=acidi deboli
- Water-soluble compounds=composti idrosolubili
- Synthesised reactions= reazione di sintesi
- Acyl chloride= acido cloridrico
- Phosphorus chloride= cloruro di fosforo
- Sulfur dichloride oxide= ossido di zolfo dicloruro

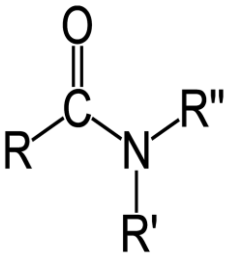
Amide and Ester

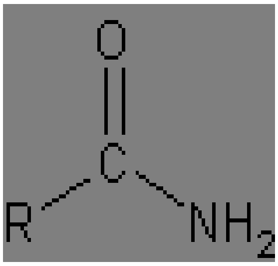
AMIDE

Amide is also known as an acid amide, is a compound with the functional group RCONH2.

Amide can also refer to the conjugate base of ammonia (the anion H2N−) or of an organic amine (an anion R2N−). The simplest amides are derivatives of ammonia wherein one hydrogen atom has been replaced by an acyl group. The ensemble is generally represented as RC(O)NH2. Closely related and even more numerous are amides derived from primary amines (R'NH2) with the formula RC(O)NHR'. Amides are also commonly derived from secondary amines with the formula RC(O)NR'R''. Amides are usually regarded as derivatives of carboxylic acids in which the hydroxyl group has been replaced by an amine or ammonia. The lone pair of electrons on the nitrogen is delocalized into the carbonyl, thus forming a partial double bond between N and the carbonyl carbon. Consequently, the nitrogen in amides is not pyramidal.

The solubilities of amides and esters are roughly comparable. Typically amides are less soluble than comparable amines and carboxylic acids since these compounds can both donate and accept hydrogen bonds.



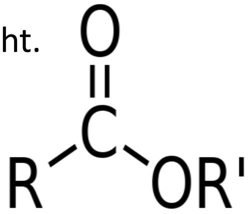


Amide and Ester

ESTER

In chemistry, esters are chemical compounds derived from an acid (organic or inorganic) in which at least one -OH (hydroxyl) group is replaced by an -O-alkyl (alkoxy) group.NUsually, esters are derived from a carboxylic acid and an alcohol. Glycerides, which are fatty acid esters of glycerol, are important esters in biology, being one of the main classes of lipids, and making up the bulk of animal fats and vegetable oils. Esters with low molecular weight are commonly used as fragrances and found in essential oils and pheromones. Phosphoesters form the backbone of DNA molecules.

Esters can also be derived from an inorganic acid and an alcohol. Thus, the nomenclature extends to inorganic oxo acids, e.g. phosphoric acid, sulfuric acid, nitric acid and boric acid. For example, triphenyl phosphate is the ester derived from phosphoric acid and phenol. Organic carbonates are derived from carbonic acid; for example, ethylene carbonate is derived from carbonic acid and ethylene glycol. Esters are more polar than ethers but less polar than alcohols. They participate in hydrogen bonds as hydrogen bond acceptors, but cannot act as hydrogen-bond donors, unlike their parent alcohols. This ability to participate in hydrogen bonding confers some water-solubility. Because of their lack of hydrogen-bond-donating ability, esters do not self-associate. Consequently, esters are more volatile than carboxylic acids of similar molecular weight.



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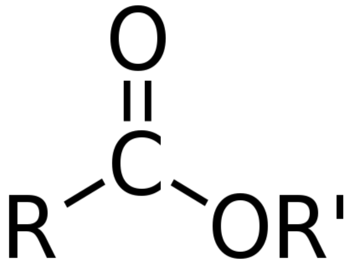

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The authors…
Here we are!