REPUBLIC OF UZBEKISTAN
MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATIONS

NAMANGAN STATE UNIVERSITY

Department of organic chemistry

Training and metodology complex
of the subject
"ORGANIC CHEMISTRY"

Field of knowledge:	500000-Natural sciences, mathematics and statistics
Field of study:	530000-Physics and natural sciences
Undergraduate course of study:	60530100-Chemistry (daytime)

Namangan-2023

The educational methodological complex was developed on the basis of the science program approved by the meeting of the Council of Namangan State University on August __, 2023.

Compiler: **D.Sattarova – k.f.f.d, dotsent.**

Reviewer: **Sh.V.Abdullayev – Dsc, professor**

The educational methodological complex was considered and recommended for use at the meeting of the Council of Namangan State University "__" ____________ "__" in2023.

CONTENT

STUDY MATERIALS
5th semester

LECTURE No. 1
AROMATIC HYDROCARBONS
Plan:

1. Structure of benzene, aromatic properties.

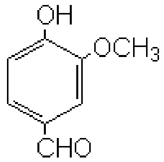
2. Hueckel's rule.

3. Methods of isomerization, naming and preparation of aromatic hydrocarbons.

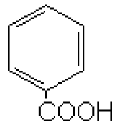
Basic phrases.*Structure of benzene, aromatic properties. Hueckel's rule. Methods of isomerization, naming and extraction of aromatic hydrocarbons.*

Aromatic hydrocarbons are compounds rich in carbon, having a molecular ring structure, specific chemical bonds, and physical and chemical properties.

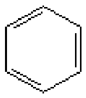
The first representatives of aromatic hydrocarbons were isolated from naturally occurring compounds known as aromatics, which have a characteristic long-lasting smell. Mn, one such compound is vanillin, which has a similar structure to benzoic acid:



vanilin

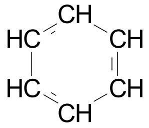


benzoy kislota

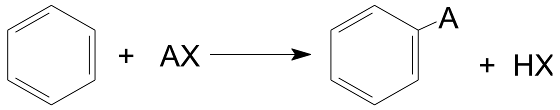

benzol

If we compare these two substances with the benzene molecule, the similarity between them and the connection between "aromaticity" is obvious. Currently, when using the term "aromaticity", it is understood that some unsaturated compounds undergo exchange reactions rather than coupling reactions, and are resistant to temperature and oxidants.

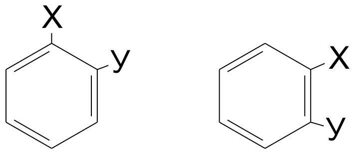
Benzene, the first representative of aromatic hydrocarbons, was synthesized by Faraday in 1825. Kekule determined the structure of benzene in 1865, showed that it consists of six carbons and six hydrogens, and proposed the following formula:



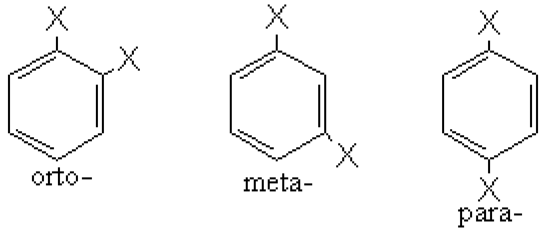
Benzene and its homologues can be represented by the formula CnH2n-6. Based on this formula, benzene should undergo the same coupling reaction as alkenes. But under normal conditions, the benzene molecule is resistant to bromine or oxidizing agents. In a benzene molecule, all carbon and hydrogen atoms are equivalent. If one hydrogen atom is replaced by another group, one derivative is obtained:



The given formula does not fully reflect the structure of the benzene molecule. Mn, the following two substituted derivatives of the benzene molecule should be two different substances:

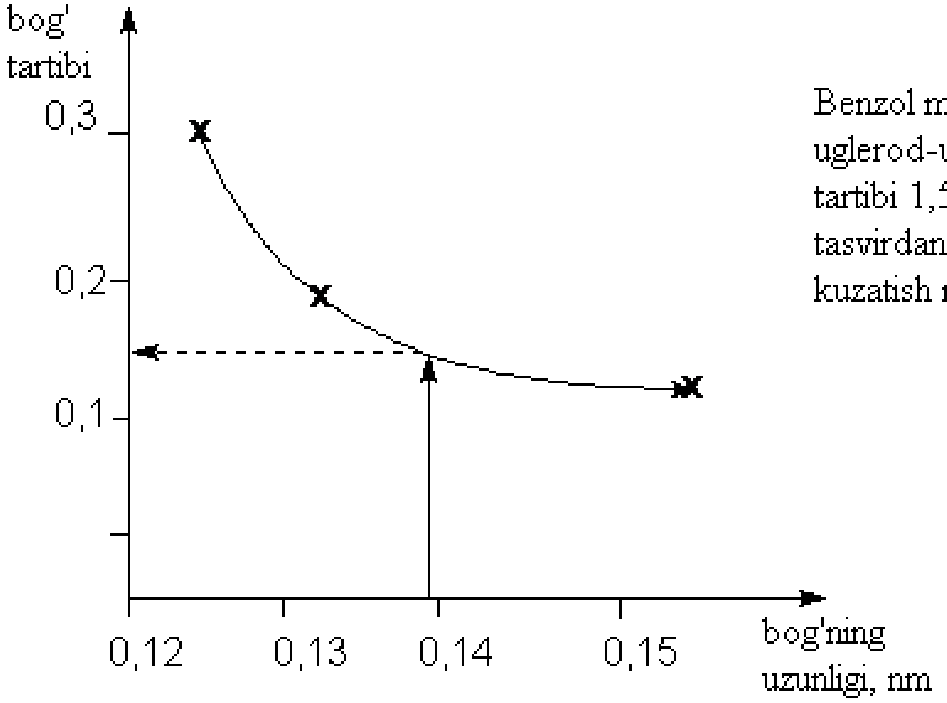


But it is known that there are no such isomers, and both formulas represent the same substance. If there are two substituents and their position on the benzene ring is different, then there are three benzene derivatives:



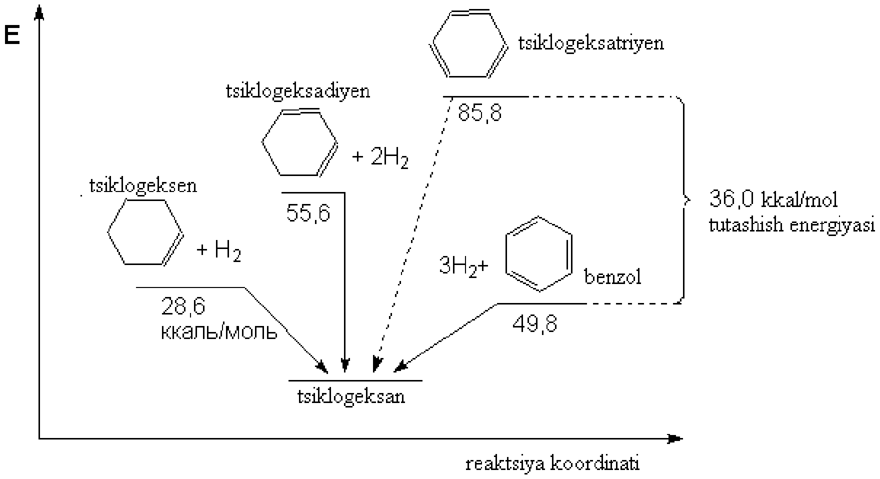
The peculiar nature of the benzene molecule has attracted the attention of chemists for more than 100 years. Finally, in the 1930s, the most modern physical methods and mathematical calculations were used to develop the currently accepted explanations. X-ray structure analysis showed that the length of the CC bond in the benzene molecule is 0.139 nm, the value of the angles is 1200, and the molecule lies in one plane.

CC bonds in the molecule have an equivalent value. The carbon atoms have 6 sp2 bonds that form a regular hexagon. Due to the symmetry of the molecule, the r-orbital of each carbon is covered with the same probability as the r-orbitals of neighboring carbon atoms on both sides. This leads to the formation of a cloud of p-electrons above and below the plane of the benzene ring and their bonding. These electrons are not localized between carbon atoms, but above and below the plane of the benzene molecule π-electrons are delocalized in their orbitals. Each CC bond is a pair of π- electrons and π. Considering that the -bond consists of 1.6 electrons, it can be seen that this bond consists of three electrons, and it becomes clear that the order of the bond is 1.5.



Benzol molekulasida uglerod-uglerod bog'ining tartibi 1,5 ekanligini grafik tasvirdan ham yaqqol kuzatish mumkin

The fact that each C-C bond consists of three electrons causes the electron clouds to overlap, and as a result, the benzene ring is attached at the top and bottom of the plane.π- causes a cloud of electrons to form and the molecule to remain stable.



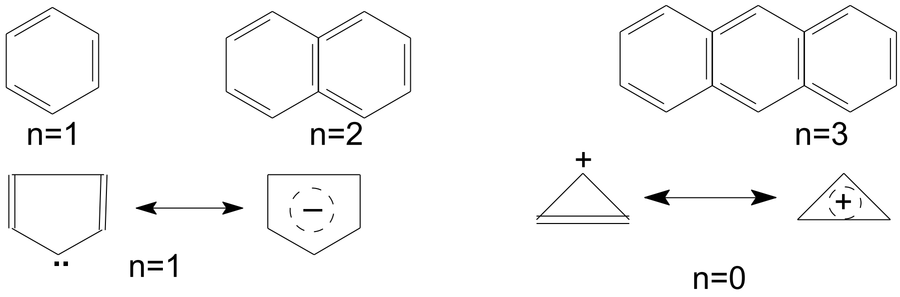
The following examples show that the benzene molecule is energetically stable. When a cyclohexane molecule becomes saturated with hydrogen, heat is released because a saturated hydrocarbon is more stable than an unsaturated hydrocarbon.

So, the double bond and single bond electrons are connectedπ-organization of the electron system stabilizes the molecule.

In addition, in order for the benzene molecule to react like alkenes, it is necessary to spend additional energy (usually high temperature), which localizes the delocalized electron clouds.

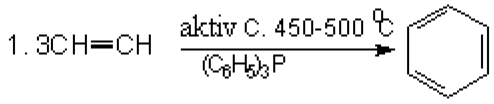
Thus, the simplest concept of aromaticity is systemπ- is the lowest energy of the molecule due to delocalization of electrons.

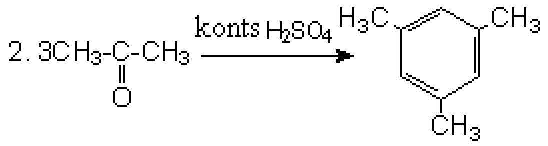
In 1931, as a result of quantum-mechanical calculations, Hückel found a closed-chain, plane-lying generalized 4n+2πconcluded that a molecule with -electron will have aromatic properties (n=0,1,2,3):



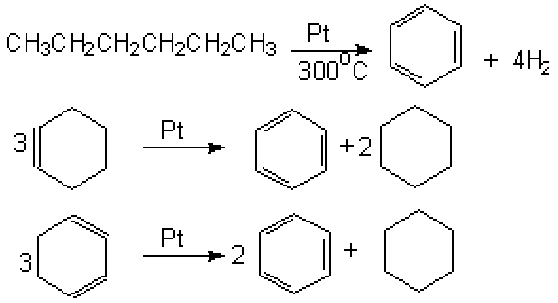
Methods for obtaining aromatic hydrocarbons. Aromatic hydrocarbons such as benzene are found in some oils. Therefore, they can be obtained from oil. Benzene and its homologues can be obtained from the tar produced during coal coking. Dry burning of coal (pyrolysis) is carried out in airless conditions at 10000C. 75-80% of coke (for the metallurgical industry) and coke gas are obtained (consisting of benzene, toluene, xylenes and methane, hydrogen, CO2, ethylene and acetylene). Coal tar: consists of benzene, toluene, xylenes, ethylbenzene, etc. The heavy fraction is a mixture of naphthalene, anthracene, phenanthrene and their derivatives, which is processed and separated into components.

Aromatic hydrocarbons can be synthesized using the following methods:

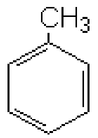




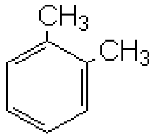
3. Dehydrogenation and cyclization



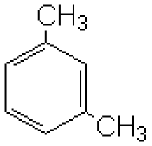
Isomerization and naming



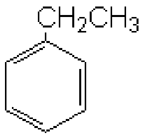
metilbenzol
toluol



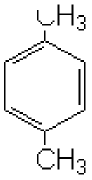
1,2-dimetilbenzol
o-ksilol



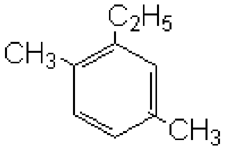
1,3 -dimetilbenzol
m-ksilol



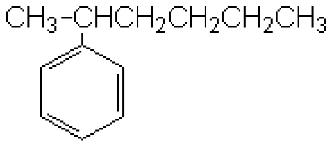
etilbenzol



1,4 -dimetilbenzol
p-ksilol

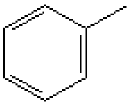


1,4-dimetil-2-etilbenzol

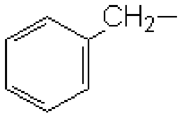


2-fenilgeksan

Radikallar:



fenil-



benzil

Control questions:

1. What compounds are called aromatic hydrocarbons? Give a brief chemical description of benzene and its homologues?

2. Write the methods of obtaining benzene and its homologues.

3. What are the causes of mesomer and induction effect.

4. How does aromatic electrophilic substitution differ from aliphatic nucleophilic (CH1) substitution?

5. Propose the mechanism of nitronium cation formation in nitric acid solution.

6. Why bromobenzene is not formed when chlorination of benzene in the presence of aluminum bromide?

7. Write the reaction of obtaining secondary-butylbenzene from benzene according to Friedel-KrafS reaction, explain the mechanism.

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LECTURE No. 2

ELECTROPHILIC EXCHANGE REACTIONS IN THE AROMATIC SERIES

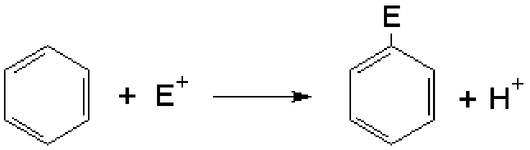
Plan:

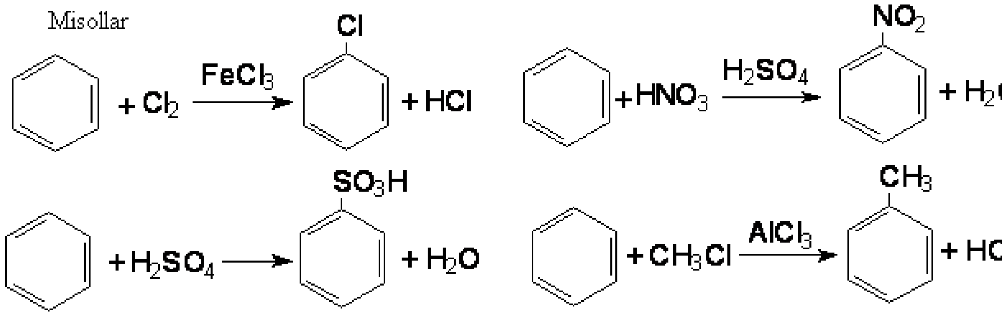
1. Structure of benzene, aromatic properties.
2. Hueckel's rule.
3. Methods of isomerization, naming and preparation of aromatic hydrocarbons.

Basic phrases.*Structure of benzene, aromatic properties. Hueckel's rule. Methods of isomerization, naming and extraction of aromatic hydrocarbons.*

Electrophilic substitution reactions of aromatic compounds

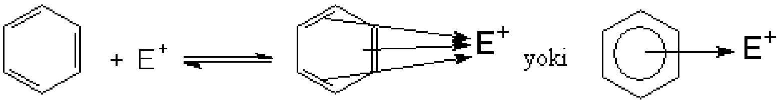
Benzene and its homologues are electrophiles (E^+) reacts with reagents and replaces one or more hydrogen atoms in the aromatic ring with an attacking electrophilic group:



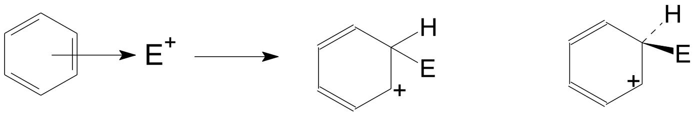


Electrophilic displacement reaction mechanism

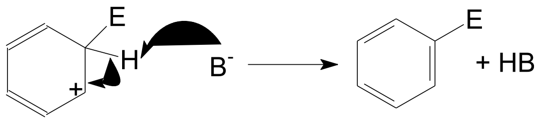
To represent the general view of the electrophilic displacement reaction, the electrophilic particle E^Qwe define as In the aromatic series, all substitutions listed above are the same, that is, the electrophilic particle is aromaticπ-electron goes with the attack of the system and is weakly bound between the aromatic compound and the electrophilic particleπ-complex is formed. In this complex, an aromatic compound acts as a donor, and an electrophilic particle acts as an acceptor:



It was formedπ-complex becomes the □-complex and is aromatic during this rotationπ- the carbon atom attacked by the system breaks down from sp2 hybridization to sp3 hybridization, the electrophile YEQ forms a true covalent bond with carbon:



The electrophilic exchange reaction involves proton release from the □-complex and aromaticityπ-ends with the restoration of the electron system:

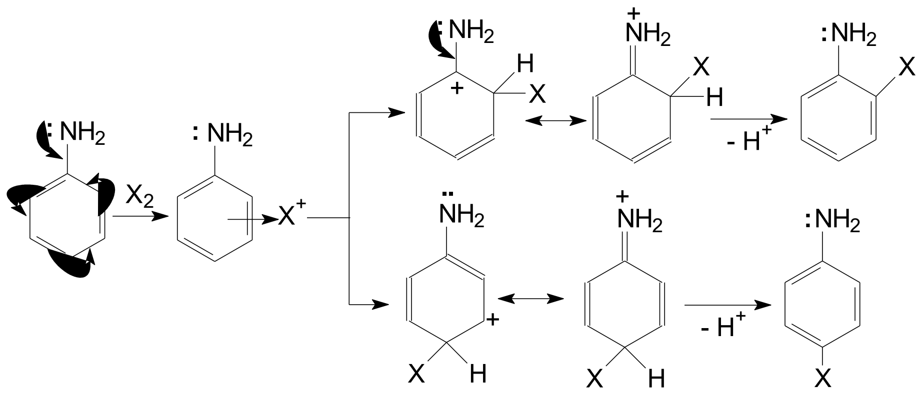


Direction of displacement. Substitution reactions in an aromatic nucleus obey the following rule:

1. The position of the incoming group in the aromatic nucleus is determined by the character of the substituent(s) in the nucleus;

2. Substituents are divided into two groups: a) first group substituents, which direct the particle entering the nucleus to the ortho- and para-states relative to itself, these are: -ON, -NR2, -NHR, - NH2, -OR, -NHCOR, CH3, -R, -Cl, -Br, -I. b) substituents of the second group, which direct the incoming particle to the meta state: -N+R3, -NO2, -CN, -SO3H, -CX3, -CHO, -COR, -COOH, -COOR

Reason for orientation:if we the reaction product in electrophilic exchangeπ- andσIf we recall the formation of -complexes and see the electron distribution in them:



σSubstituents also participate in the neutralization of the positive charge when the -complex is formed. If the substituent does not have an electron pair (CH3-, R-, etc.), then this occurs due to the inductive effect of CC bond electrons to neutralize the resulting positive charge.

Orientation effect of halogens. When the aromatic nucleus has a halogen substituent, it has a strong negative induction and a weak positive mesomeric effect. During the reaction, the mesomeric effect has a strong effect.

Meta targeting. In many of the substitutes listed aboveπthere is a garden, they have a strong negative mesomeric effect. The remaining substituents are positively charged and have a strong negative induction effect.

Control questions:

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7. Write the reaction of obtaining secondary-butylbenzene from benzene according to Friedel-KrafS reaction, explain the mechanism.
8. Explain why the reaction to get benzenesulfonyl acid.

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LECTURE No. 3

NUCLEOPHILIC EXCHANGE REACTIONS IN THE AROMATIC SERIES

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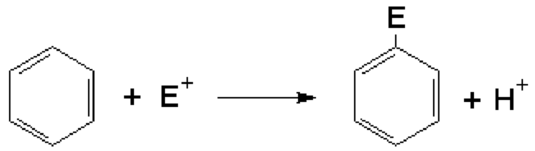
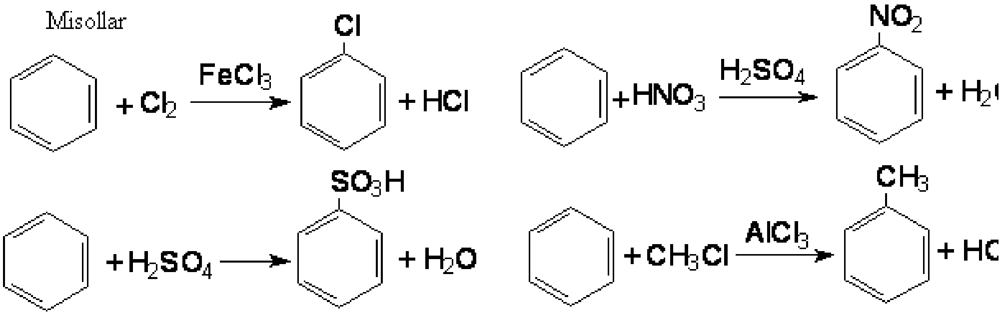


Misollar



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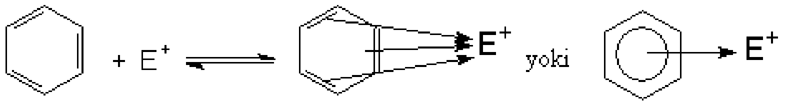

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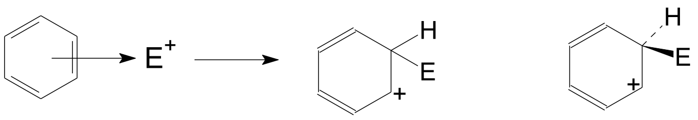

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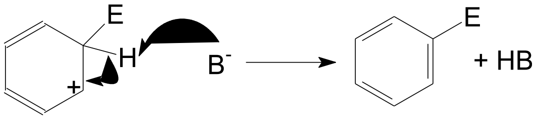

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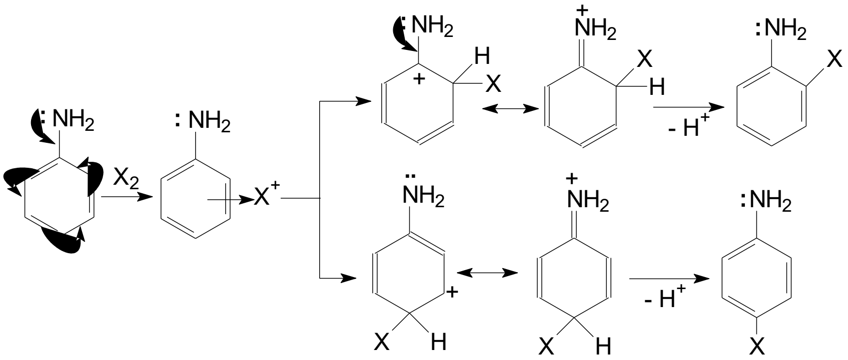

σSubstituents also participate in the neutralization of the positive charge when the -complex is formed. If the substituent does not have an electron pair (CH3-, R-, etc.), then this occurs due to the inductive effect of CC bond electrons to neutralize the resulting positive charge.

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LECTURE No. 4

AROMATIC HALLOID COMPOUNDS

Plan:

1. Halogenation of aromatic hydrocarbons, compounds with electron donor and electron acceptor substitutes in the aromatic ring.

2. Halogenation of the side chain of aromatic hydrocarbons. Reaction mechanisms.

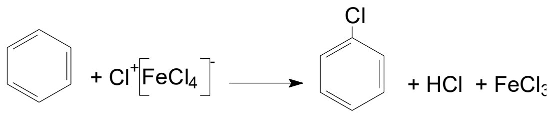
3. Nitration of aromatic hydrocarbons. Nitrifying agents.

4. Conditions and mechanism of nitration reaction

Basic phrases.*Halogenation of aromatic hydrocarbons, compounds with electron-donor and electron-acceptor substituents in the aromatic ring. Halogenation of side chains of aromatic hydrocarbons. Reaction mechanisms.*

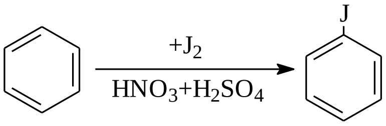
Chlorination and bromination of benzene and its homologues is easy. These reactions usually take place in the presence of catalysts FeCl3, AlCl3, ZnCl2. Catalysts form a complex with the halide:

$$Sl\text{-}Cl + FeCl3 \rightarrow Cl+[FeCL4]-$$

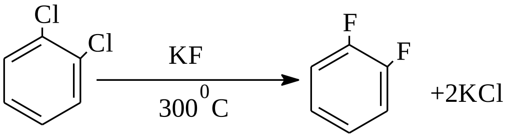


The reaction of benzene and its homologues with iodine takes place only under special conditions, because the electron affinity of the iodine atom is smaller than that of chlorine and bromine.The reaction of Mn, benzene with iodine can be carried out in the presence of oxidizing agents (HJO3, HNO3QH2SO4, H2O2). In this case, the oxidizing agent converts iodine into the iodine cation JQ:

$$J_2 \xrightarrow{HNO_3+H_2SO_4} J^+ + HSO_4^-$$



The following method is used to obtain a fluoroaromatic compound:



If the halogenation reaction is carried out in the vapor phase, the side chain of the ring can be halogenated:

$$Cl_2 \xrightarrow{h\nu} \dot{C}l + \dot{C}l$$

$$C_6H_5\text{-}CH_3 + \dot{C}l \longrightarrow C_6H_5\text{-}\dot{C}H_2 + HCl$$

$$C_6H_5\text{-}\dot{C}H_2 + Cl_2 \longrightarrow \underset{\text{benzil xlorid}}{C_6H_5CH_2Cl} + \dot{C}l$$

$$C_6H_6 + CH_2O + HCl \xrightarrow{ZnCl_2} C_6H_5CH_2Cl + H_2O$$

The last reaction is called chloromethylation.

Chemical properties. Bromo-iodobenzene reacts with Mg to form an organomagnesium compound. Halidebenzenes also readily react with Li, Na, and K:

C6H5Br + Mg→C6H5MgBr

C6H5Br + 2Li→C6H5Li + LiBr

C6H5Li + C6H5Br→C6H5-C6H5 + LiBr

The reaction of halobenzenes with alkali in the presence of copper powder produces phenol:

C6H5Cl + NaOH→C6H5OH + NaCl

Likewise, if iodobenzene is heated in the presence of copper, diphenyl is formed:

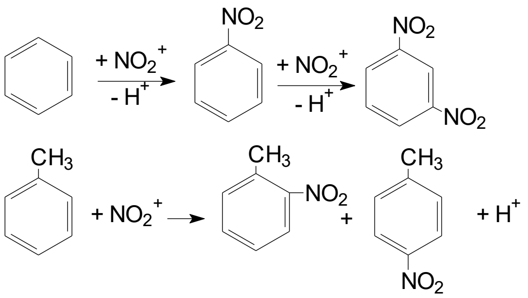
C6H5I + 2Cu→C6H5-C6H5 + 2CuI

The inertness of the halide atom in the aromatic core is that of the vinyl halide (1.44μD) similarly, the molecule has a small dipole moment (1.58μD).

Nitro compounds of the benzene series. A 1:2 mixture of nitric and sulfuric acids is used for nitration of aromatic hydrocarbons (nitrating mixture):

HNO3 + 2H2SO4→NO2+ + H3O+ + 2HSO4-

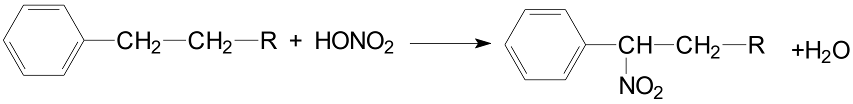
The resulting nitronium cation attacks the aromatic compound:



If toluene is exposed to dilute nitric acid at high temperature (100-1500C), side chain nitration occurs:

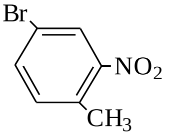
C6H5-CH3 + HNO3→C6H5-CH2NO2 + H2O.

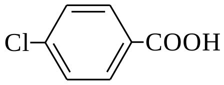
If the side chain of benzene has a long radical, itsα-state is nitrated:



Control questions:

1. Synthesize the following compounds using toluene and other necessary reagents.

1) 

2) 

2. Name the product of the iodination reaction of tert-butylbenzene in the presence of nitric acid.
3. Write the reaction mechanism for the side chain chlorination of propylbenzene.
4. Chlorobenzene conc. Write and name the reaction product(s) with sulfuric and nitric acids.

Literature:

1. О.Я. Нейланд. Органическая химия. М.: «Высшая школа». 1990. С.17-19, 212-217.

2. А. Терней. Современная органическая химия. М.: «Мир». 1981. Т.1. С.559-640.

3. Дж. Марч. Органическая химия. М.: «Мир». 1987. Т.2. С.304-407.

4. K.N.Axmedov, H.Y.Yoʻldoshev. Organik kimyo usullari. 2 qism. T.: «Universitet». 1993. 3-22 в.

LECTURE No. 5

AROMATIC NITRO COMPOUNDS.

Plan:

1. Naming of nitrocompounds of the benzene series.

2. Methods of obtaining nitrocompounds of the benzene series.

3. Physical and chemical properties of nitrocompounds of the benzene series.

4. Nitrocompounds of the benzene series are compounds that contain a nitro group in the benzene nucleus or side chain.

The names of nitrocompounds of the benzene series are formed by adding the prefix nitro to the name of benzene or its monosubstituted derivative. If necessary, the position of the substituents attached to the benzene nucleus is designated by o-, M-, p- (in rational nomenclature) or by a number (in systematic nomenclature):

nitrobenzene - nitrotoluene2,4,6 - trinitrotoluene

Sometimes the benzene ring is considered a substituent on the carbon skeleton and is denoted by the prefix phenyl:

phenylnitromethane

Aromatic nitro compounds in which the nitro group is directly attached to the carbon of the benzene ring are of great practical importance. They are widely used in the production of paints, explosives and aromatic substances, solvents and other organic compounds.

Methods of obtaining

The main method of obtaining aromatic nitro compounds is nitration:

Ar H + +N02► Ar N02 + H+

Direct replacement of the hydrogen of an aromatic compound with a nitro group is carried out using nitrating reagents. As nitrating reagents, different concentrations of nitric acid, a nitrating mixture (a mixture of concentrated nitric and sulfuric acids), nitrates of alkali metals and nitrogen oxides in the presence of sulfuric acid are used.

A nitrating mixture is often used for nitration of aromatic compounds in the laboratory and in industry.

Nitration of aromatic compounds with a nitrating compound is an electrophilic exchange reaction, the mechanism of which has been thoroughly studied.

In this reaction, the nitronium cation N02+ is an electrophilic reagent that is formed from nitric and sulfuric acids as follows:

H20 + H2S04 =* H3O + OSO3H or HSO4

HNO3 + 2H2S04N02 + H30 + 2OSO3H or 2HS04

In this reaction, strong sulfuric acid is an acid, and weak nitric acid is a base.

Some stable salts of nitronium (for example, nitronium perchlorate [N02]+CI0'4 , nitronium tetrafluoroborate [N02]+BF 4) are also nitrating agents. They nitrify aromatic compounds in nitromethane or acetic acid medium even at room temperature (G. Ola).

Since the nitro group reduces the electron density of the benzene ring (pages 53-54), the introduction of the second nitro group is carried out at high temperature in the presence of concentrated acids. The third nitro group can be introduced into the meta state with great difficulty. The fourth nitro group cannot be introduced directly.

Homologs of benzene are not easily nitrated compared to benzene itself.

Phenylnitromethane nitrolabizes toluene with dilute nitric acid at 100-150°C:

C6H5-CH3 + H0N02►C6H5-CH2N02 + H20

Phenyl nitro-methane can also be obtained by reacting silver nitrite with benzyl chloride.

C6H5-CH2C1 + AgN02 ►C6H5-CH2N02 + AgCl

Physical properties

Nitrocompounds of the benzene series are liquid, mostly yellow crystalline substances, insoluble in water, and well soluble in organic solvents.

Physical constants of nitrocompounds of the benzene series

Chemical properties

Nitroarenes undergo reduction, electrophilic substitution, and nucleophilic substitution reactions.

Reduction of the nitro group. In 1842, NN Zinin synthesized aniline by reducing nitrobenzene with ammonium sulfide in a water-alcohol solution.

The effect of the reaction medium on the reduction of nitroarenes is significant.

Nitroarenes are immediately reduced to aromatic amines in an acidic environment.

Iron, tin or zinc and hydrochloric acid are used as reducing agents in acidic environments.

In industry, nitroarenes are reduced with iron filings (for cheapness) with hydrochloric acid or with molecular hydrogen in the presence of Raney nickel.

Ammonium sulfide and zinc, as well as sodium sulfide, are used in the presence of sodium hydroxide as reducing agents in an alkaline environment.

Reducing reagents do not reduce nitrobenzene as actively in neutral and alkaline solutions as in acidic solutions.

For example, zinc reduces nitrobenzene to aniline in the presence of abundant hydrochloric acid, and to N-phenylhydroxylamine under the influence of ammonium chloride.When nitrobenzene is reduced with methanol in the presence of caustic sodium, azoxybenzene is formed.

Control questions:

1. Name the product of the iodination reaction of tert-butylbenzene in the presence of nitric acid.
2. Write the reaction mechanism of the side chain chlorination of propylbenzene.
3. Chlorobenzene conc. Write and name the reaction product(s) with sulfuric and nitric acids.

Literature:

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3. Дж. Марч. Органическая химия. М.: «Мир». 1987. Т.2. С.304-407.
4. K.N.Axmedov, H.Y.Yo‘ldoshev. Organik kimyo usullari. 2 qism. T.: «Universitet». 1993. 3-22 в.

LECTURE No. 6

HYDROXY DERIVATIVES OF AROMATIC HYDROCARBONS.

Plan:

1. Classification of phenols:
2. Methods of obtaining phenols.
3. Properties of phenolic hydroxyl group.
4. Areas of use of diatomic phenols

Basic phrases.Classification of phenols: Methods of obtaining phenols. Properties of phenol hydroxyl group. Areas of use of diatomic phenols

Aromatic compounds with an oxygen atom in their molecule can be divided into two: phenols and aromatic alcohols. Phenols are of great importance in the chemical industry.

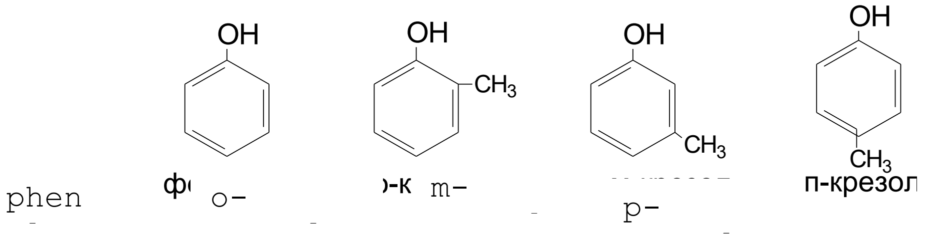
Classification of phenols: monoatomic, diatomic and polyatomic phenols. Methods of obtaining phenols. Properties of phenolic hydroxyl group.

Interaction between the aromatic nucleus and the hydroxyl group in the phenol molecule. Reactions of electrophilic substitution (halogenation, nitration, sulfation) in phenols. Phenol carboxylation, formylation (Kolbe, Reimer-Thiemann, Wilsmeyer) reactions. Phenol-formaldehyde resins. Areas of use of diatomic phenols

Aromatic compounds with an oxygen atom in their molecule can be divided into two: phenols and aromatic alcohols. Phenols are of great importance in the chemical industry.

Methods of obtaining:

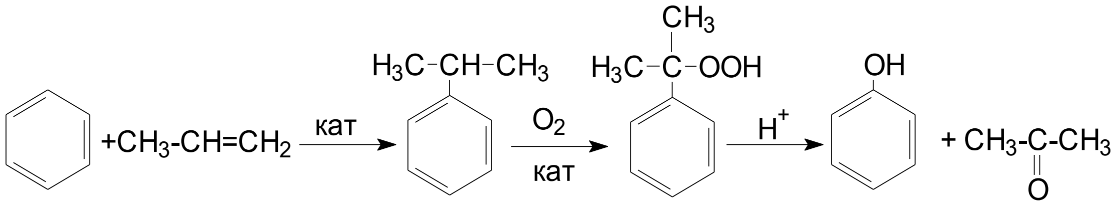
1. Phenol and o-, p-, m-cresols are extracted from the tar formed during coking from coal:



2. To obtain from benzene, it is sulfonated and heated with alkali:

C6H6 + H2SO4→C6H5-SO3H + NaOH→C6H5OH + Na2SO3 + H2O

3. Oxidation of isopropylbenzene with air oxygen:



4. Obtaining from diazocompounds:

$$C_6H_5\text{-}\overset{+}{N}{\equiv}N + H_2O \longrightarrow C_6H_5OH + N_2 + H^+$$

Properties. The OH group of the phenol molecule exhibits acidic properties:

1. Phenol is easily soluble in alkali solution:

ArOH + NaOH→ArONa + H2O

2. Simple esters are obtained from phenolates:

ArONa + RI→ArOR + NaI

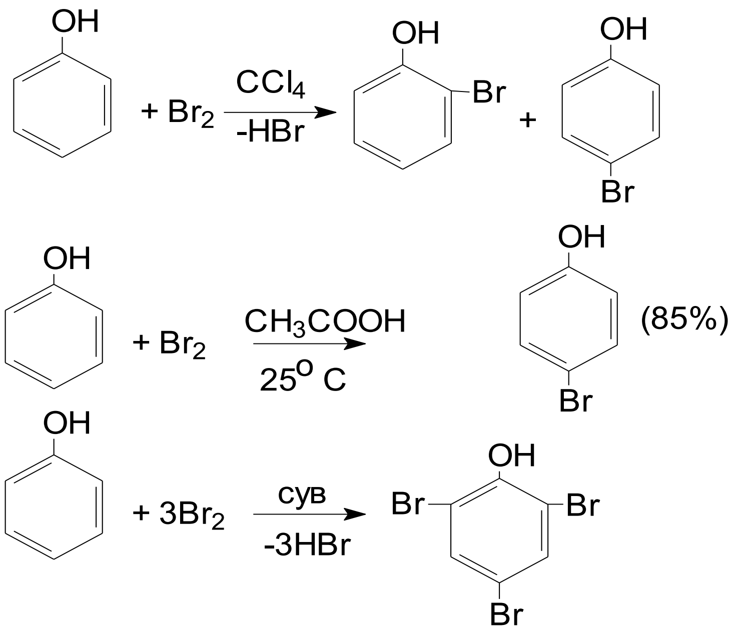
ArONa + (CH3O)2SO2→ArOCH3 + CH3OSO2ONa

3. Complex esters are obtained from phenolates:

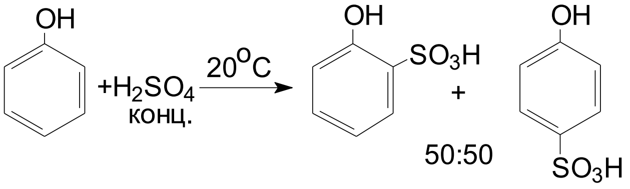
ArONa + CH3COCl→ArO-CO-CH3 + NaCl

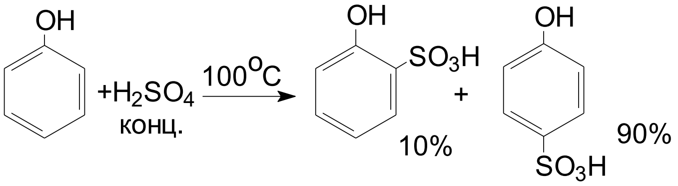
Phenol Aromatic Nucleus Reactions:

1. Halogenation:

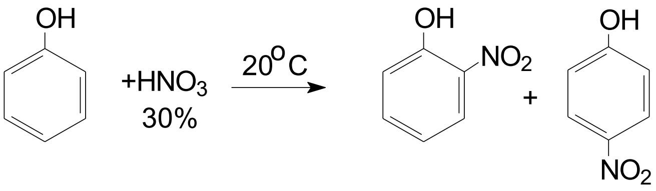


2. Sulfation:

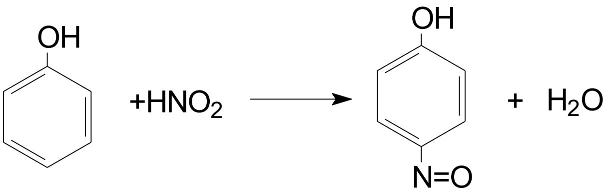




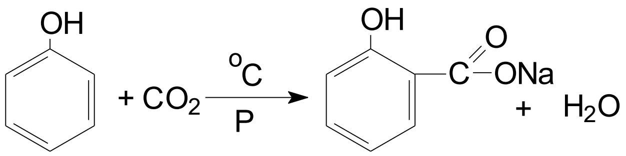
3. Nitration:



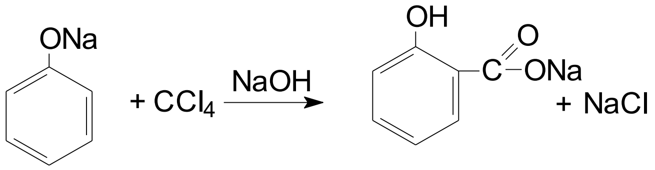
Effects of nitric acid:



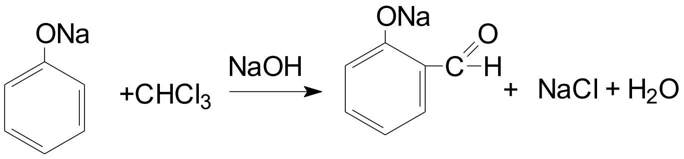
If sodium phenolate is heated under pressure in an SO2 atmosphere, salicylic acid salt is formed:



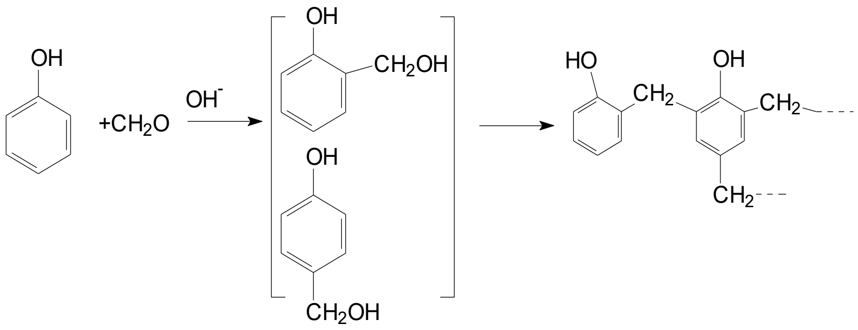
Salicylic acid can also be obtained by reacting sodium phenolate with CCl4:



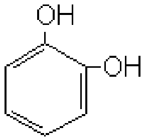
Under the influence of chloroform, salicylic aldehyde is formed (Reimer Tieman):



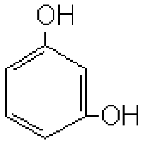
As a result of the condensation of phenol with formaldehyde, phenol-formaldehyde resins are formed:



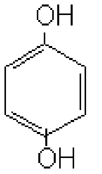
Diatomic phenols



o-dioksibenzol
pirokatexin



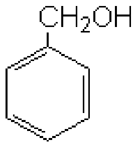
m-dioksibenzol
rezortsin



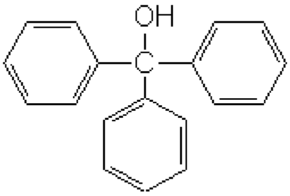
p-dioksibenzol
gidroxinon

Pyrocatechin is obtained by hydrolysis of o-dichlorobenzene, and resorcin is formed by the reaction of m-benzenedisulfoacid with alkali. Hydroquinone is converted back to p-benzoquinone. Pyrocatechin and hydroquinone are used in photography.

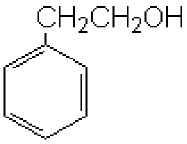
Aromatic alcohols



benzil spirti



trifenilmetanol

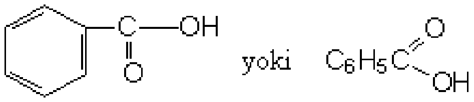


2-feniletanol

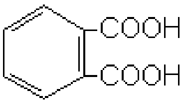
For the synthesis of aromatic alcohols, certain methods such as hydrolysis, organometallic synthesis, and reduction of the carbonyl group are used.

Aromatic carbonic acids

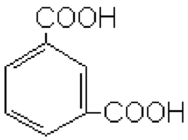
Compounds of this class are derivatives of aromatic hydrocarbons with a carboxyl group. The simplest monobasic aromatic acid is called benzoic acid:



Dibasic acids containing two carboxyl groups in the molecule are called phthalic acids:



ftal kislota



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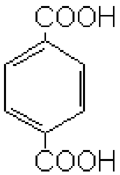
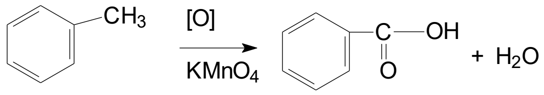
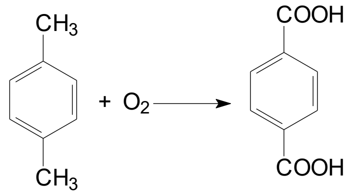


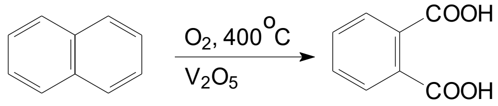
terftal kislota

Of these, o- and p- phthalic acids are of practical importance.

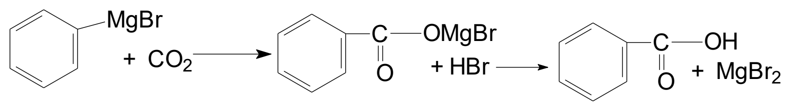
Oxidation of the side chain of aromatic hydrocarbons in the presence of KMnO4 or K2Cr2O7:

1. 

2. 

3. 

4. Grignard reaction:

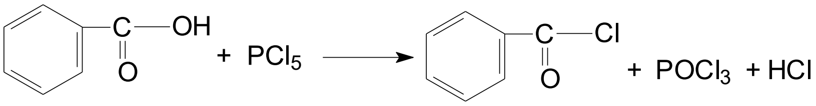
1. 

Properties

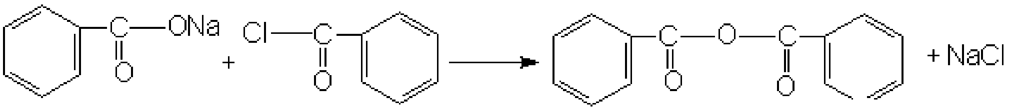
Aromatic carboxylic acids are stronger than the aliphatic series of unsaturated acids in their acid strength (pKa). Such an acid is weakened when the aromatic nucleus is removed from the carboxyl group. A substituent on an aromatic nucleus can alter the degree of solvation of the anion by altering the inductive effect of the nucleus.

1. Salt formation:

2. Formation of haloanhydrides:

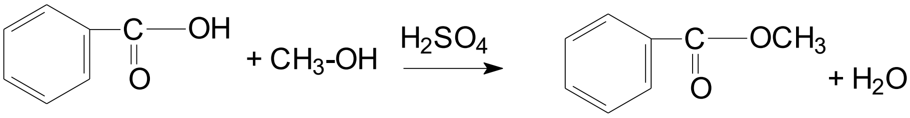


3. Formation of acid anhydrides:

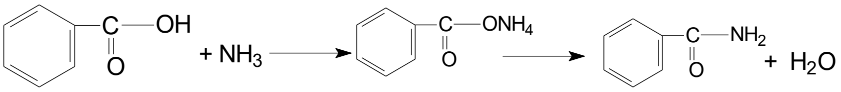


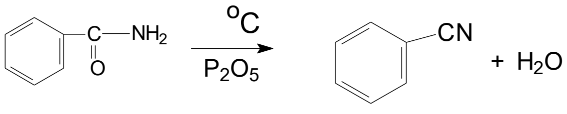
Benzov kislota angidridi

4. Etherification reaction:

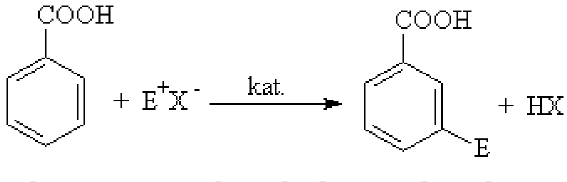


5. Formation of acid amide and nitrile:

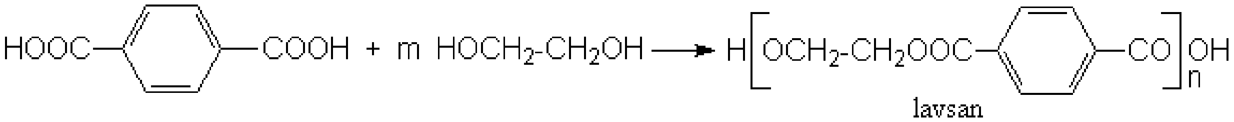




Aromatic acids undergo exchange reactions (nitration, sulfation, halogenation) with electrophilic reagents:



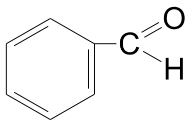
6. Terephthalic acid reacts with ethylene glycol to form polyethylene terephthalate polymer (lavsan):

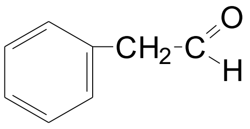


lavsan

Aromatic oxocompounds

In the aromatic aldehyde and ketone molecule, the carbonyl group is attached to the carbon of the benzene ring or to the side chain. Aromatic aldehydes are of two types:

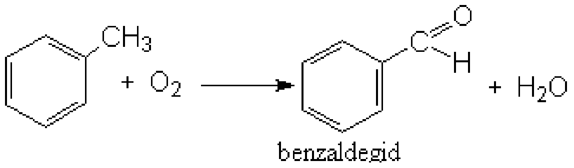
а) 

б) 

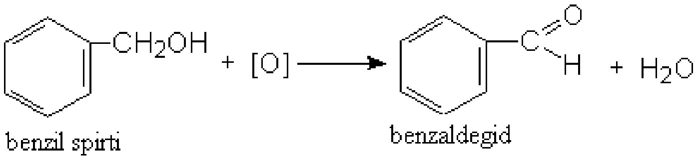
Aromatic aldehydes of the second type (b) structure differ little in their properties from aldehydes of the aliphatic series.

Methods of obtaining

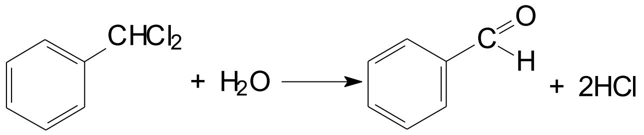
1. Oxidation of aromatic hydrocarbons with oxygen:



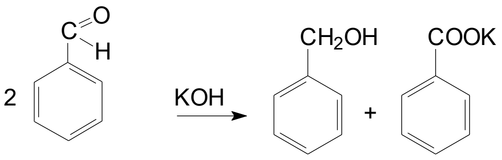
2. Oxidation of aromatic alcohols:



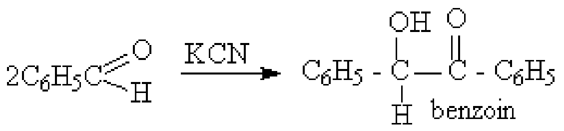
3. Hydrolysis of aromatic dihaloalkanes:



Properties. Aromatic aldehydes undergo all reactions in which aldehydes of the aliphatic series undergo. Mn, benzoic aldehyde undergoes oxidation-reduction reaction under alkaline conditions, forming benzyl alcohol and benzoic acid (Cannizzaro):



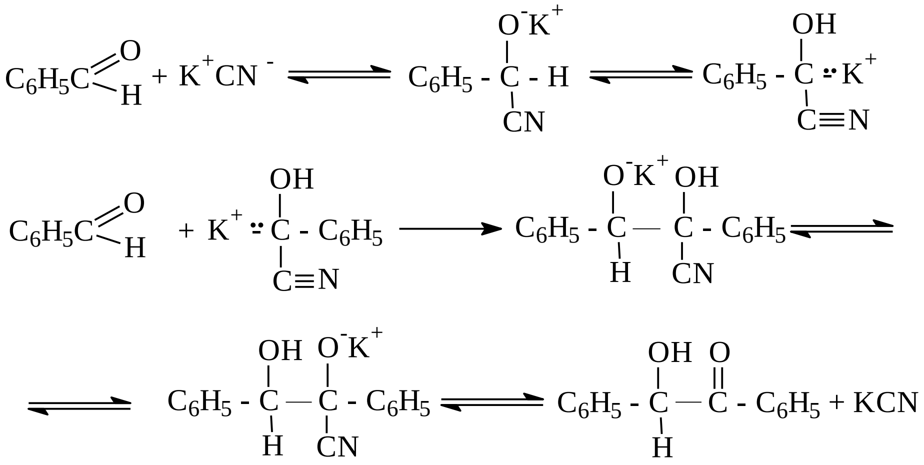
Condensation of benzaldehyde in the presence of potassium cyanide is called benzoin condensation. The resulting substance is called "benzoin":



$$2C_6H_5CHO \xrightarrow{KCN} C_6H_5-\underset{H}{\overset{OH}{C}}-\overset{O}{\overset{\|}{C}}-C_6H_5$$

benzoin

All aromatic aldehydes undergo this reaction. Mechanism of reaction:



$$C_6H_5C\overset{O}{\underset{H}{}} + K^+CN^- \rightleftharpoons C_6H_5-\overset{O^-K^+}{\underset{CN}{C}}-H \rightleftharpoons C_6H_5-\overset{OH}{\underset{C\equiv N}{C}}\colon K^+$$

$$C_6H_5C\overset{O}{\underset{H}{}} + K^+\colon\overset{OH}{\underset{C\equiv N}{C}}-C_6H_5 \longrightarrow C_6H_5-\overset{O^-K^+}{\underset{H}{C}}-\overset{OH}{\underset{CN}{C}}-C_6H_5 \rightleftharpoons$$

$$\rightleftharpoons C_6H_5-\overset{OH}{\underset{H}{C}}-\overset{O^-K^+}{\underset{CN}{C}}-C_6H_5 \rightleftharpoons C_6H_5-\overset{OH}{\underset{H}{C}}-\overset{O}{\overset{\|}{C}}-C_6H_5 + KCN$$

Control questions:

1. Write the reactions for the formation of benzaldehyde from toluene, benzylidene chloride and benzyl alcohol using appropriate reactions.
2. Write the reactions to obtain acetophenone from 1-phenyl-1,1-dichloroethane, 1-phenyl-1-ethanol and benzene using appropriate reactions.
3. Write the nitration and bromination reactions of benzaldehyde and acetophenone and state the conditions.
4. Which of the phenylacetic, n-toluyl aldehydes undergoes the Cannizzaro reaction. Write the reaction equation.
5. *n*-Write the benzoin condensation products of toluene aldehyde, n-nitrobenzaldehyde and n-methoxybenzaldehyde.

Literature:

1. О.Я. Нейланд. Органическая химия. М.: «Высшая школа». 1990. С.17-19, 212-217.

2. А. Терней. Современная органическая химия. М.: «Мир». 1981. Т.1. С.559-640.

3. Дж. Марч. Органическая химия. М.: «Мир». 1987. Т.2. С.304-407.

LECTURE No. 7

AROMATIC CARBONYL COMPOUNDS

PLAN:

1. Chemical and physical properties
2. Acquisition and use
3. Individual representation

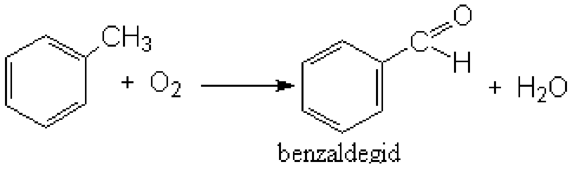
Basic phrases.*Methods for obtaining aromatic aldehydes and ketones. Specific properties of aromatic aldehydes: autoxidation, condensation. Acetophenone and Benzophenone. Electrophilic substitution in the aromatic nucleus of aromatic aldehydes and ketones*

In the aromatic aldehyde and ketone molecule, the carbonyl group is attached to the carbon of the benzene ring or to the side chain. Aromatic aldehydes are of two types:

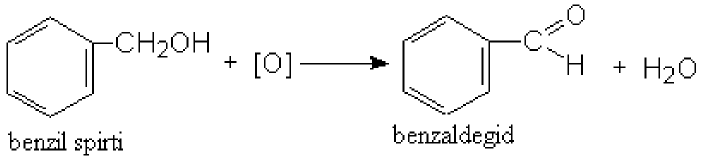
Aromatic aldehydes of the second type (b) structure differ little in their properties from aldehydes of the aliphatic series.

Methods of obtaining

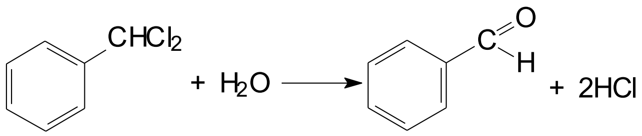
1. Oxidation of aromatic hydrocarbons with oxygen:



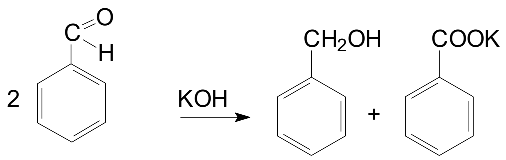
2. Oxidation of aromatic alcohols:



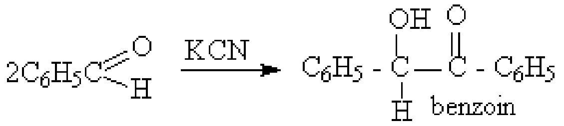
3. Hydrolysis of aromatic dihaloalkanes:



Properties. Aromatic aldehydes undergo all reactions in which aldehydes of the aliphatic series undergo. Mn, benzoic aldehyde undergoes oxidation-reduction reaction under alkaline conditions, forming benzyl alcohol and benzoic acid (Cannizzaro):



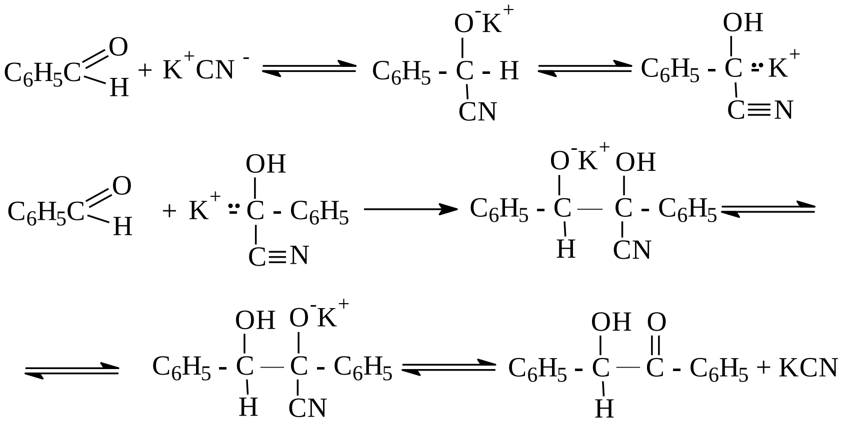
Condensation of benzaldehyde in the presence of potassium cyanide is called benzoin condensation. The resulting substance is called "benzoin":



$$2C_6H_5C\genfrac{}{}{0pt}{}{=O}{-H} \xrightarrow{KCN} C_6H_5-\underset{H}{\overset{OH}{C}}-\overset{O}{\overset{\|}{C}}-C_6H_5$$

benzoin

All aromatic aldehydes undergo this reaction. Mechanism of reaction:

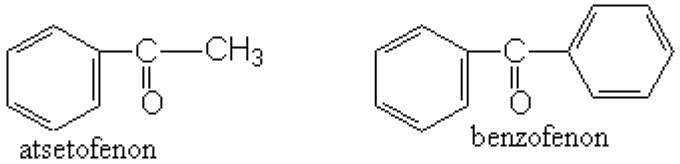


$$C_6H_5C\overset{O}{\underset{H}{<}} + K^+CN^- \rightleftharpoons C_6H_5-\overset{O^-K^+}{\underset{CN}{C}}-H \rightleftharpoons C_6H_5-\overset{OH}{\underset{C\equiv N}{C}}{:}K^+$$

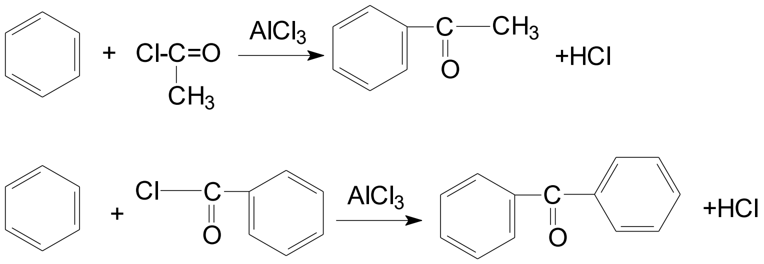
$$C_6H_5C\overset{O}{\underset{H}{<}} + K^+{:}\overset{OH}{\underset{C\equiv N}{C}}-C_6H_5 \longrightarrow C_6H_5-\overset{O^-K^+}{\underset{H}{C}}-\overset{OH}{\underset{CN}{C}}-C_6H_5 \rightleftharpoons$$

$$\rightleftharpoons C_6H_5-\overset{OH}{\underset{H}{C}}-\overset{O^-K^+}{\underset{CN}{C}}-C_6H_5 \rightleftharpoons C_6H_5-\overset{OH}{\underset{H}{C}}-\overset{O}{\overset{\|}{C}}-C_6H_5 + KCN$$

Aromatic ketones. A carbonyl in a ketone molecule>C=The O group is attached to two radicals, one of which must be an aromatic residue (radical):



Ketones of this type are mainly obtained by acylation of aromatic hydrocarbons by the Friedel-KrafS method with acid chlorides in the presence of AlCl3:



Properties. Aromatic ketones undergo all the reactions characteristic of ketones of the aliphatic series. They are oxidized (under the influence of strong oxidants), reduced, add alcohols and HCN, halogenate, replace carbonyl oxygen with halogen, undergo condensation, give oxime, hydrazone and other derivatives.

Control questions:

6. Write the reactions for the formation of benzaldehyde from toluene, benzylidene chloride and benzyl alcohol using appropriate reactions.

7. Write the reactions to obtain acetophenone from 1-phenyl-1,1-dichloroethane, 1-phenyl-1-ethanol and benzene using appropriate reactions.

8. Write the nitration and bromination reactions of benzaldehyde and acetophenone and state the conditions.

9. Which of the phenylacetic, n-toluyl aldehydes undergoes the Cannizzaro reaction. Write the reaction equation.

10. *n*-Write the benzoin condensation products of toluene aldehyde, n-nitrobenzaldehyde and n-methoxybenzaldehyde.

Literature:

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2. А. Терней. Современная органическая химия. М.: «Мир». 1981. Т.1. С.559-640.

3. Дж. Марч. Органическая химия. М.: «Мир». 1987. Т.2. С.304-407.

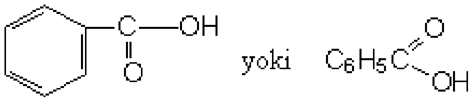
4. K.N.Axmedov, H.Y.Yo‘ldoshev. Organik kimyo usullari. 2 qism. T.: «Universitet». 1993. 3-22 в.

LECTURE No. 8
AROMATIC CARBON ACIDS
PLAN:

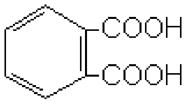
1. Chemical and physical properties
2. Acquisition and use
3. Individual representation

Basic phrases.*General methods of synthesis of aromatic acids. Benzoic acid and its derivatives: benzoyl chloride, benzoic acid esters, nitrile, amide. Phthalic acid and terephthalic acid, their derivatives*

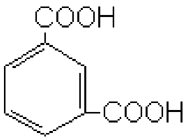
Compounds of this class are derivatives of aromatic hydrocarbons with a carboxyl group. The simplest monobasic aromatic acid is called benzoic acid:



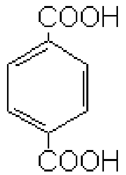
Dibasic acids containing two carboxyl groups in the molecule are called phthalic acids:



ftal kislota



izoftal kislota

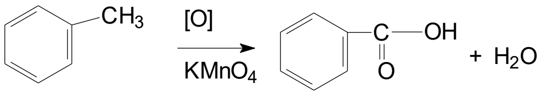


terftal kislota

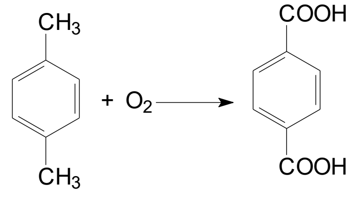
Of these, o- and p- phthalic acids are of practical importance.

Oxidation of the side chain of aromatic hydrocarbons in the presence of KMnO4 or K2Cr2O7:

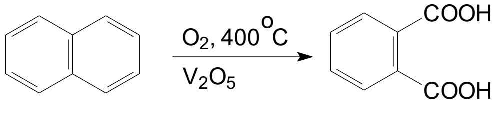
1.



2.

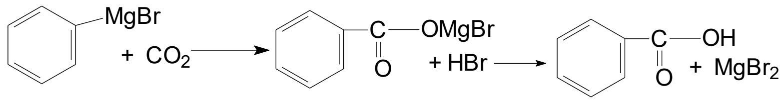


3.



4. Grignard reaction:

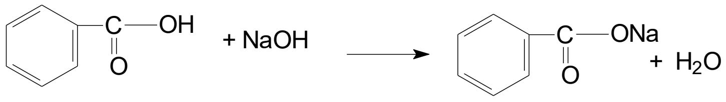
1.



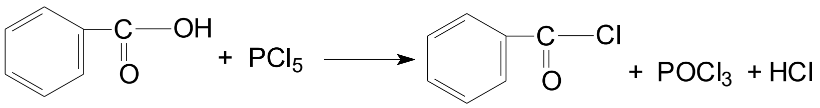
Properties

Aromatic carboxylic acids are stronger than the aliphatic series of unsaturated acids in their acid strength (pKa). Such an acid is weakened when the aromatic nucleus is removed from the carboxyl group. A substituent on an aromatic nucleus can alter the degree of solvation of the anion by altering the inductive effect of the nucleus.

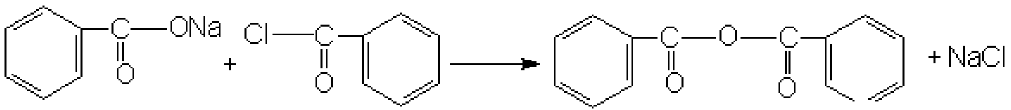
1. Salt formation:



2. Formation of haloanhydrides:

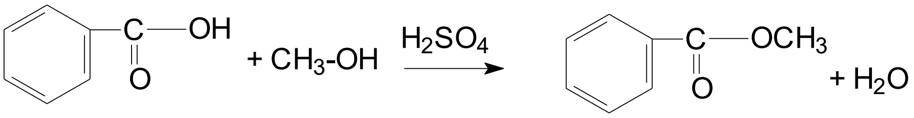


3. Formation of acid anhydrides:

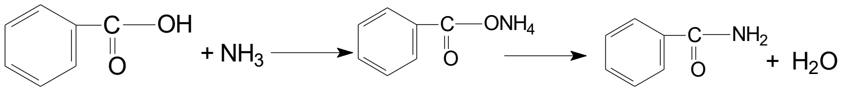


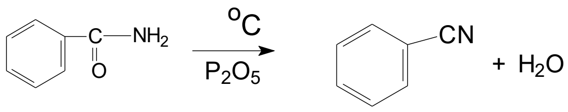
Benzoy kislota angidridi

4. Etherification reaction:

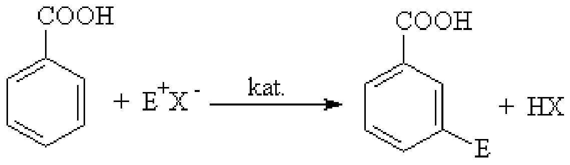


5. Formation of acid amide and nitrile:

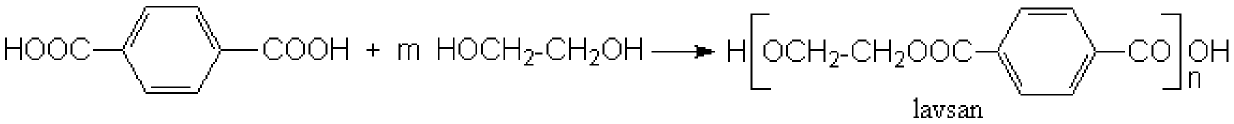




Aromatic acids undergo exchange reactions (nitration, sulfation, halogenation) with electrophilic reagents:



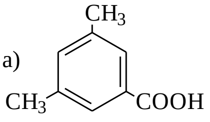
6. Terephthalic acid reacts with ethylene glycol to form polyethylene terephthalate polymer (lavsan):

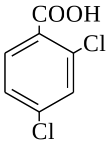


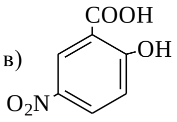
Control questions:

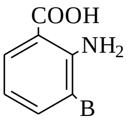
1. Write the formulas and name the isomers of the monocarbon with the composition S8N8O2 and the dicarboxylic acids with the composition C8H8O4.

2. Name the following compounds:

a) 

б) 

в) 

c) 

3. Write the structural formulas of the acid derivatives named below:

a) benzoyl chloride; b) phenylacetic acid nitrile; c) ethyl ether of n-nitrobenzoic acid; g) o-chlorobenzoic acid anhydride; d) p-Methoxybenzoic acid amide.

4. Write the reaction equations for the formation of ethyl ester of the acids named below.

a) p-nitrobenzoic acid; b) o-chlorobenzoic acid; c) p-methoxybenzoic acid; g) 2,6-difluorobenzoic acid.

5. Explain the chemical properties of aromatic acids using the example of benzoic acid.

Literature:

1. О.Я. Нейланд. Органическая химия. М.: «Высшая школа». 1990. С.17-19, 212-217.

2. А. Терней. Современная органическая химия. М.: «Мир». 1981. Т.1. С.559-640.

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4. K.N.Axmedov, H.Y.Yo‘ldoshev. Organik kimyo usullari. 2 qism. T.: «Universitet». 1993. 3-22 в.

LECTURE No. 9

AROMATIC AMINES

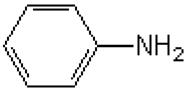
Plan:

1. Obtaining aromatic amines.
2. Intermediate products formed during the reduction process and their conversion to each other.
3. Regrouping of benzidine and semidyne.
4. Chemical properties of aromatic amines.

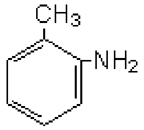
Basic phrases.*Preparation of aromatic amines by reducing aromatic nitro compounds in acidic, alkaline, neutral media and catalytically. Intermediate products formed in the process of reduction and their conversion to each other. Rearrangement of benzidine and semidyne. Chemical properties of aromatic amines.*

Compounds in which the hydrogen atom of the aromatic nucleus is replaced by an NH2 group are called aromatic amines.

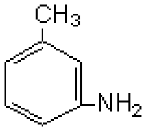
The simplest aromatic amine



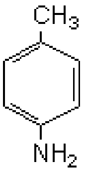
anilin deb ataladi



o-aminotoluol,
o-toluidin

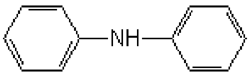


m -aminotoluol,
m -toluidin

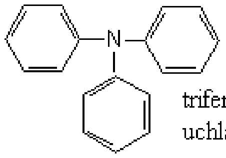


p -aminotoluol,
p -toluidin

If the nitrogen atom in the aromatic amine molecule is attached to one aromatic ring, it is called primary, if it is attached to two aromatic rings, it is called secondary, and if it is attached to three aromatic rings, it is called tertiary aromatic amine:

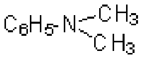


difenilamin
ikilamchi amin



trifenilamin
uchlamchi amin

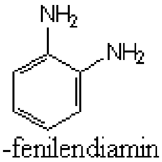
C_6H_5-NH-CH_3
metilfenilamin



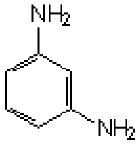
$C_6H_5\text{-}N\begin{smallmatrix}CH_3\\CH_3\end{smallmatrix}$

dimetilfenilamin

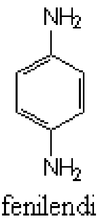
An aromatic nucleus may also contain several amino groups:



o-fenilendiamin

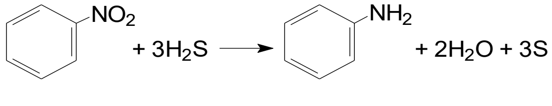


m -fenilendiamin



p -fenilendiamin

Methods of obtaining amines. NN Zinin was the first to propose the preparation of aromatic amines. He obtained aniline by reacting nitrobenzene with hydrogen sulfide:



Later, different methods of reducing nitrobenzene were developed:

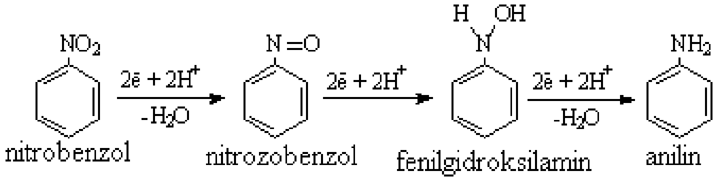
$$C_6H_5NO_2 \xrightarrow{Fe + HCl} C_6H_5NH_2 + 2H_2O$$

$$C_6H_5NO_2 + 14HCl + 3Sn \rightarrow 2C_6H_5NH_2{\cdot}HCl + 3SnCl_4 + 4H_2O$$

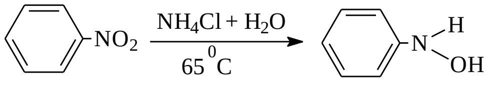
$$C_6H_5NO_2 + 3H_2 \xrightarrow{Ni} C_6H_5NH_2 + 2H_2\Theta$$

Using such methods, nitrotoluenes are returned to o-, p- and m-toluidines.

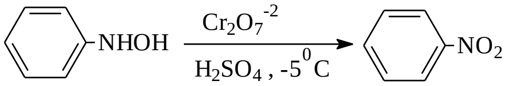
The reduction of aromatic nitro compounds is complicated, and intermediates formed in an acidic environment are rapidly reduced to aniline:



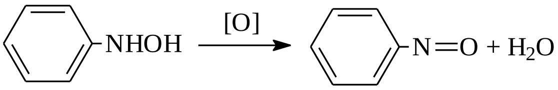
If nitrobenzene is reduced in a neutral medium, the reaction stops at the stage of formation of phenylhydroxylamine:



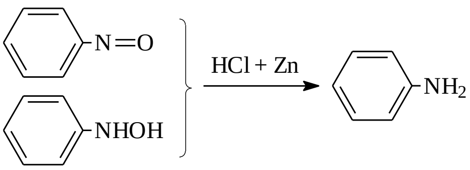
Thus, phenylhydroxylamine is an intermediate in the formation of aniline from nitrobenzene, which can be oxidized back to nitrobenzene:



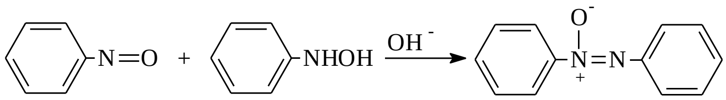
Nitrosobenzene is the first intermediate formed during the reduction of nitrobenzene, and it readily converts to phenylhydroxylamine, which can be oxidized to phenylhydroxylamine:



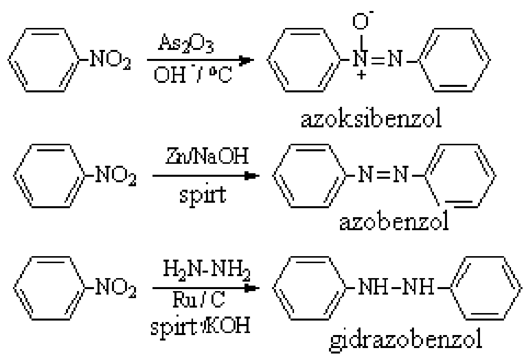
Aniline is obtained back from nitrosobenzene and phenylhydroxylamine:



In addition, azoxybenzene is formed as a result of the interaction of nitrosobenzene and phenylhydroxylamine:

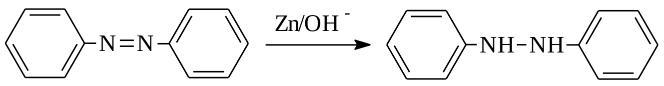


As a result of the reduction of nitrobenzene in an alkaline medium, azoxybenzene, azobenzene and hydrazobenzene can be formed:

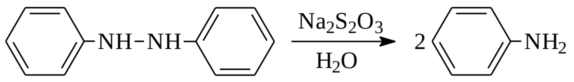


Azoxybenzene is reduced to azobenzene, and azobenzene is oxidized to azoxybenzene:

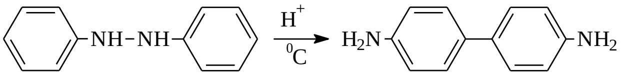
And hydrazobenzene can be reduced to azobenzene under the action of zinc and alkali:



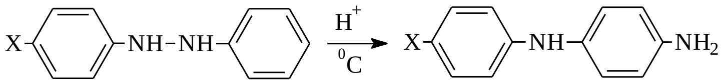
When hydrazobenzene is reduced, aniline is formed:



In an acidic environment, hydrazobenzene turns into benzidine (n,n'-diaminodiphenyl):

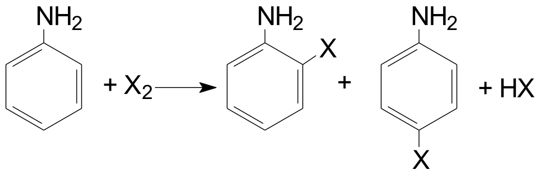


If one nucleus of this molecule is substituted in the n-position, then semidyne is formed:

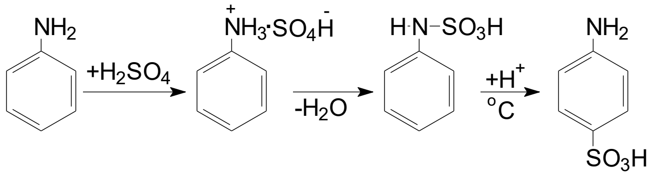


Properties of amines. Aniline differs from aliphatic amines in its properties. It is a weak base and does not form a salt with weak acids. But it gives salt with strong acids. This is because the nitrogen atom has a pair of electrons in the aromatic nucleusπ- is affected by electrons. So, the p electrons of the nitrogen atom and the aromatic ringπ-interacts with a cloud of electrons.

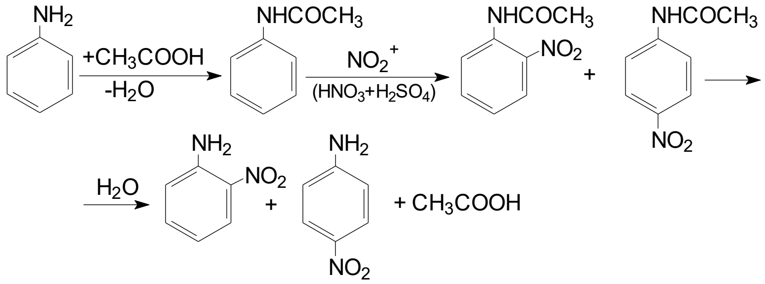
Aniline is very easily halogenated. That is NH$_2$facilitates the group reaction:



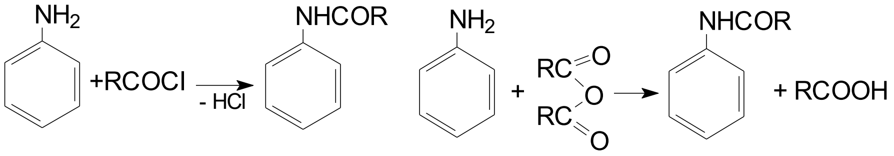
But sulfonation of aniline is carried out at high temperature. Because of this, in the first step of the reaction, the amino group is sulfonated:



For nitration of aniline, it is first acylated, then nitrated and the resulting product is hydrolyzed to form o- and p-nitroaniline:



Aromatic amines can be acylated with acid chlorides or anhydrides. The resulting substances are called anilides:



As a result of the reaction of aromatic amines with aromatic aldehydes, substances called "Schiff's bases" are synthesized:

C6H5NH2 + C6H5CHO→C6H5-N=CN-C6H5 + H2O

To obtain derivatives containing an alkyl group on the nitrogen atom, vapors of a mixture of aniline and alcohol (methanol) Al_2When transferred over O3, alkyl and dialkylanilines are formed:

$$C_6H_5NH_2 + CH_3OH \xrightarrow{Al_2O_3} C_6H_5NHCH_3 + H_2O$$
$$C_6H_5NH_2 + 2CH_3OH \xrightarrow{Al_2O_3} C_6H_5N(CH_3)_2 + 2H_2O$$

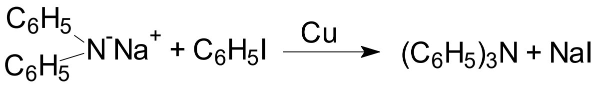
These substances are produced in large quantities because they are used as anti-detonators and in the preparation of paints.

Secondary and tertiary aromatic amines. If the HCl salt of aniline is heated, the secondary aromatic amine-diphenylamine is formed:

$$2C_6H_5N^+H_3Cl^- \xrightarrow{^oC} C_6H_5\text{-}NH\text{-}C_6H_5 + NH_4Cl + HCl$$

Diphenylamine and other secondary amines are used as antioxidants to protect plastics from oxidation.

If the sodium derivative of diphenylamine reacts with iodobenzene in the presence of copper, tertiary "triphenylamine" is formed.



$$(C_6H_5)_2N^-Na^+ + C_6H_5I \xrightarrow{Cu} (C_6H_5)_3N + NaI$$

Tertiary aromatic amines are not basic.

Control questions:

1. Why are aliphatic diazo compounds unstable and what can be done to increase their stability.
2. How to get a compound and create conditions to get diazomethane.
3. Write the equations for the reaction of anisole and methylacetate using diazomethane.
4. Write equations for the reaction of diazomethane with acetaldehyde and acetones.
5. Synthesize methyl tert-butyl ether from diazomethane.
6. Suggest a scheme for synthesizing methylcyclopropane and 1,1-dimethylcyclopropane from diazomethane.
7. Write the equation for the cycloaddition reaction of diazomethane to butyne-2.

Literature:

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3. Дж. Марч. Органическая химия. М.: «Мир». 1987. Т.2. С.304-407.
4. K.N.Axmedov, H.Y.Yo‘ldoshev. Organik kimyo usullari. 2 qism. T.: «Universitet». 1993. 3-22 в.

LECTURE No. 10

DIAZO COMPOUNDS

Plan:

1. Diazo compounds.
2. Reactions of diazopyrims that take place without nitrogen separation and dissociation.
3. Azo coupling reaction, azo dyes

Basic phrases.*Diazo compounds. Reactions of diazopyrims that take place without nitrogen release and dissociation. Azo coupling reaction, azo dyes*

Diazo compounds. Salts of aromatic amines are diazotized under the action of nitric acid in an acidic environment to form aryldiazonium salts:

C6H5-N+H3Cl- + HONO→C6H5-N+≡NCl- + 2H2O

Usually, to carry out the diazotization reaction, one amount of aromatic amine is dissolved in three amounts of mineral acid and NaNO2 is added to it at 00C.

Chemical properties. Phenyldiazonium chloride is a highly reactive compound. Reactions of phenyldiazonium chloride are of two types: nitrogen can be released or nitrogen can not be released.

I. Reactions with nitrogen release.

1. Decomposition of diazonium salts:

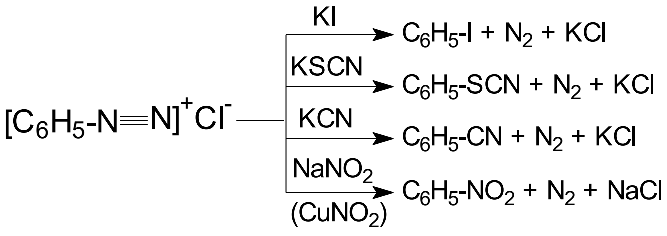
$$[C_6H_5\text{-}N\equiv N]^+Cl^- + H_2O \xrightarrow{100^\circ C} C_6H_5OH + N_2 + HCl$$

2. Synthesis of organometallic compounds, ANNesmeyanov reaction:

$$[C_6H_5\text{-}N\equiv N]^+Cl^-\cdot HgCl_2 + Cu \longrightarrow C_6H_5\text{-}HgCl + N_2 + Cu_2Cl_2$$

3. Gatterman-Zandmeyer reactions:

$$[C_6H_5\text{-}N\equiv N]^+Cl^- + Cu_2Cl_2 \xrightarrow{^\circ C} C_6H_5Cl + N_2$$



4. Meyerwein reaction:

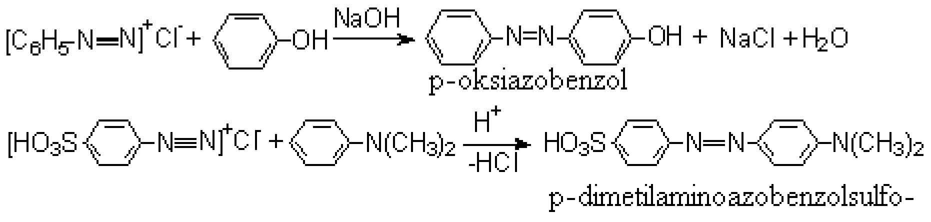
C6H5N2Cl + CH2=CH-COOH→C6H5-CH2-CHCl-COOH + N2

II. Reactions that take place without nitrogen release.

1. Formation of phenylhydrazines (reduction of diazonium salts):

$$[C_6H_5\text{-}N\equiv N]^+Cl^- \xrightarrow{4H} C_6H_5\text{-}NH\text{-}NH_2\cdot HCl$$

2. Suffering reaction. As a result of this reaction, important azo dyes are obtained. Diazonium salts react with phenols in a weakly alkaline environment, and with aromatic amines in an acidic environment:



Azo coupling reactions always go to the p-state, and if it is occupied, to the o-state.

Aliphatic diazo compounds

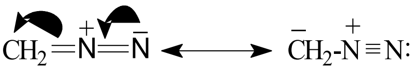
Diazo compounds are compounds that contain 2 nitrogens in their molecule, one of which is ammonium nitrogen.

Aliphatic diazo compounds can be of two types: 1) diazonium salts, 2) diazoalkanes. Diazonium salts are very stable salts because there is no factor that increases the resolution of the positive charge on the ammonium nitrogen:

$$\left[CH_3-\overset{+}{N}\equiv N\right]X^- \xrightarrow{HX} CH_2=\overset{+}{N}=N^- \longleftrightarrow \overset{-}{C}H_2-\overset{+}{N}\equiv N$$

Compared to the diazonium salt, diazomethane is more stable, because it is, firstly, an internal salt, and secondly, negatively charged nitrogen electrons or negatively charged carbon electrons bind due to mesomerism. The diagram above shows the structure of diazomethane in its diazonium salt. Diazoalkanes have a linear structure.

The structure of Mn, diazomethane is as follows: CH2=NQ=N-. Diazomethane can also exist in mesomeric form as follows:



It is a linear molecule and is an almost non-polar and unstable substance. Diazomethane is obtained by the following methods:

CH3-NH2 + HONO→CH2=N+=N- + 2N2O

CH3-NH-CONH2 + HNO2 + N2O→CH2=N+=N- + NH3 + CO2

CH3-NH-COOC2H5 + HNO2 + N2O→CH2=N+=N-+ CO2 + C2H5OH

In practice, the following two methods are used. It is known that as a result of the first reaction, alcohol is formed and nitrogen is released. In fact, this reaction goes through the following steps:

CH3NH2.HCl + HONO→[CH3-N^{+}≡N]Cl-+ 2H2O

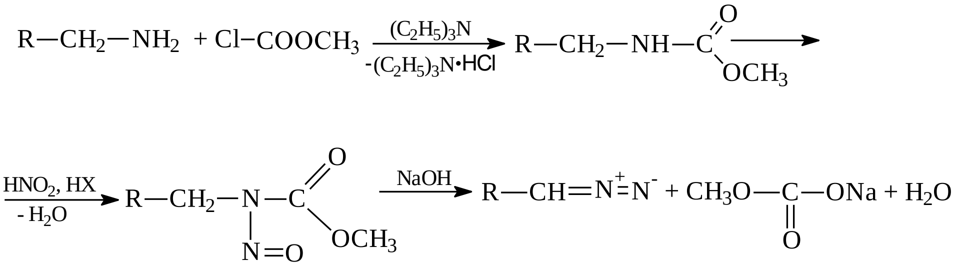
CH3-N+≡N + N2O→CH3OH + N2 + H+

CH3-N+≡N→[CH2^{-}—N+≡N↔CH2=N+qN-]+H+

Because the resulting methyldiazonium cation is unstable, an alcohol is formed. To increase the resolution of diazomethane, hydrogen atoms in the CH2 group must be exchanged for electron-withdrawing groups. Diazo compounds formed from Mn, glycine ethyl ether, 2,2.2-triftorethylamine include:

N-=N+=CH-COOC2H5 N^{-}=N+=CH-CF3

When diazomethane itself needs to be obtained from alkylamines, first the alkylamine is acylated, the obtained product is diazotized, and then the acyl group is removed by hydrolysis with alkali. This can be shown by the following scheme:

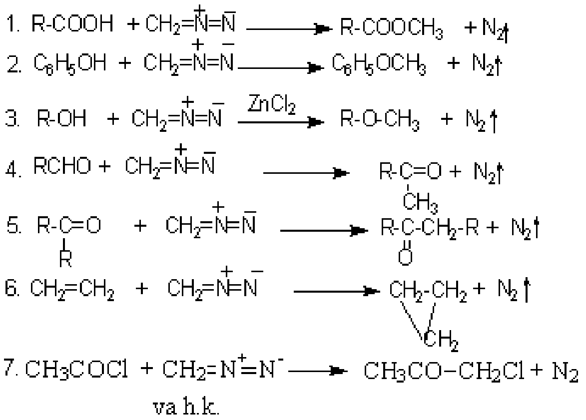


$$R-CH_2-NH_2 + Cl-COOCH_3 \xrightarrow[-(C_2H_5)_3N\cdot HCl]{(C_2H_5)_3N} R-CH_2-NH-C(=O)OCH_3 \longrightarrow$$

$$\xrightarrow[-H_2O]{HNO_2,\ HX} R-CH_2-N(N{=}O)-C(=O)OCH_3 \xrightarrow{NaOH} R-CH=\overset{+}{N}=N^- + CH_3O-C(=O)-ONa + H_2O$$

Diazomethane is a yellow-green, poisonous gas. The ability to react is high. Easily reacts with acids, alcohols, phenols, aldehydes. Resistant to alkalis.

Esterification of carboxylic acids under the action of diazomethane is the easiest way to obtain methyl ester of carboxylic acids.Below are some reactions of diazomethane:



If an excess of diazomethane is obtained in the acylation reaction, the hydrogen in the methylene group is exchanged for an acyl group, and the released hydrogen chloride forms methyl chloride with excess diazomethane:

$$CH_3COCl + 2\,CH_2=\overset{+}{N}=N^- \longrightarrow CH_3CO-CH=\overset{+}{N}=N^- + N_2 + CH_3Cl$$

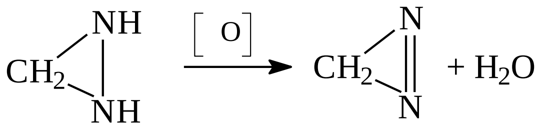
Thus, diazoketone is obtained from diazomethane. This reaction shows that the hydrogens in the diazomethane molecule are mobile. This is also proven by obtaining metal derivatives of diazomethane:

$$CH_2=\overset{+}{N}=N^- + (C_6H_5)_3CNa \longrightarrow NaCH=\overset{+}{N}=N^- + (C_6H_5)_3CH$$

Diazomethane undergoes photochemical decomposition and polymerizes:

$$nCH_2=\overset{+}{N}=N^- \xrightarrow{h\nu} \left[CH_2\right]_n + N_2$$

SchmitS performed the synthesis of diazomethane isomer-cyclic diazomethane:



Cyclic diazomethane is partially isomerized to open-chain diazomethane on heating.

Control questions:

Why are aliphatic diazo compounds unstable and what can be done to increase their stability.

How to get a compound and create conditions to get diazomethane.

Write the equations for the reaction of anisole and methylacetate using diazomethane.

Write equations for the reaction of diazomethane with acetaldehyde and acetones.

Synthesize methyl tert-butyl ether from diazomethane.

Suggest a scheme for synthesizing methylcyclopropane and 1,1-dimethylcyclopropane from diazomethane.

Write the equation for the cycloaddition reaction of diazomethane to butyne-2.

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LECTURE No. 11

ONE FIVE MEMBERED HETERATOM CONTAINS HETEROCYCLIC COMPOUNDS

Plan:

1. Heterocyclic compounds
2. Five-membered aromatic compounds containing one heteroatom: pyrrole, thiophene, furan. 3. Structure, aromatic properties
4. Chemical properties.
5. Electrophilic exchange reactions

Basic phrases.*Diazo compounds. Reactions of diazopyrims that take place without nitrogen release and dissociation. Azo coupling reaction, azo dyes*

Heterocyclic compounds are compounds whose ring consists of carbon and a hetero atom.

Oxygen, nitrogen and sulfur atoms are mainly involved as heteroatoms in the composition of compounds found in nature.

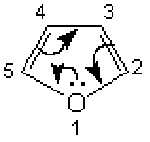
The total number of atoms in heterocyclic compounds can be three, four, five, six and more. But the most stable heterocyclic compounds are five- and six-membered, which are common among natural compounds.

Heterocyclic compounds 1) by the total number of atoms; 2) to the number of heteroatoms; 3) classified according to the number of rings.

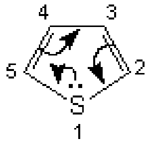
When naming heterocyclic compounds, the numbering of the atoms of the molecule forming the ring begins with the heteroatom.

Five-membered heterocyclic compounds

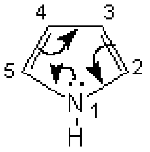
The most important five-membered heterocyclic compounds are furan, thiophene, and pyrrole, which have oxygen, sulfur, and nitrogen atoms in the ring, respectively:



furan

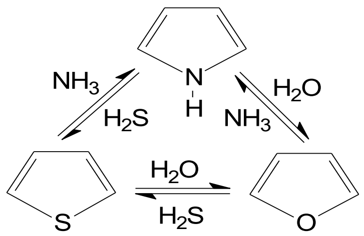


tiofen

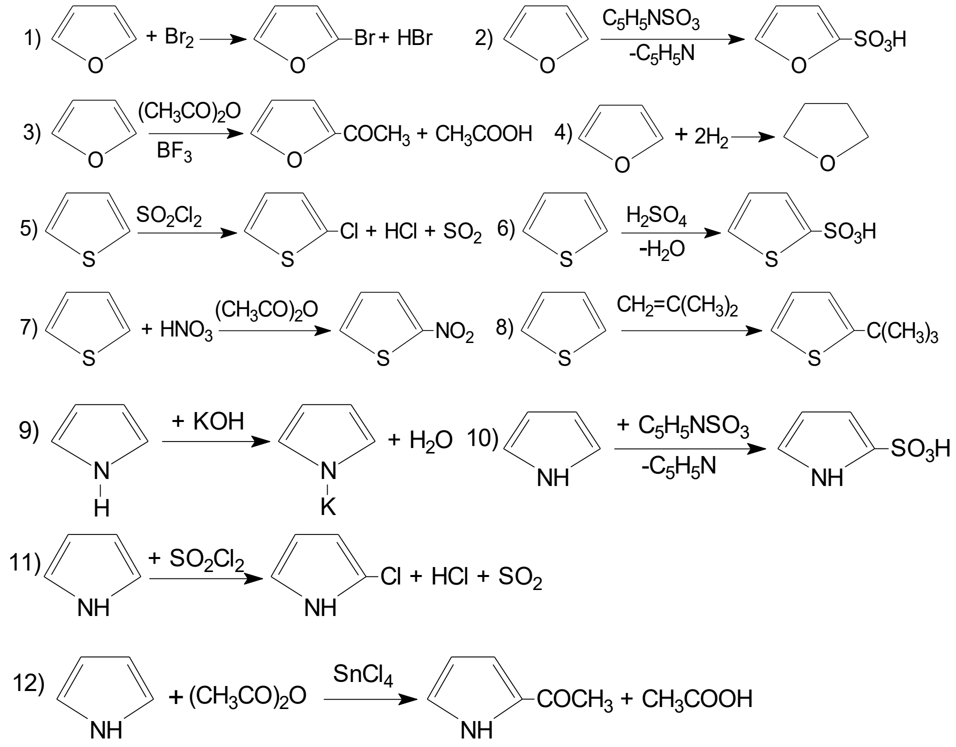


pirrol

This shows that the structure of compounds is close to each other. In fact, YU.K. Yuryev showed that they can turn into each other. For this, he showed that thiophene or pyrrole is formed by passing a mixture of furan vapors with hydrogen sulfide or ammonia over Al2O3 at 400-450oS:



Electrons of double bonds of furan, thiophene and pyrrole interact with p-electrons of heteroatoms and become singleπ- forms a system of electrons. As a result, these substances exhibit aromatic properties. Therefore, they easily undergo electrophilic substitution reactions (nitration, halogenation and sulfation) and give the corresponding derivatives:



Control questions:

1. Write the structural formulas of the compounds named below.

a)α-methylfuran b) 2-bromo-4-methylfuran

c) furfurol g) 5-nitrofurfurol

d) N-methylpyrrole e)α-thiophenesulfonic acid

2. Explain the aromatic properties of pyrrole, thiophene, and furan.

3. Write the hydrogenation reactions of pyrrole, thiophene and furan.

4. Write the nitration, acetylation and bromination reactions of furan, pyrrole and thiophene.

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LECTURE No. 12

SIX MEMBER HETEROCYCLIC COMPOUNDS

Plan:

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2. Five-membered aromatic compounds containing one heteroatom: pyrrole, thiophene, furan. 3. Structure, aromatic properties
4. Chemical properties.

Basic phrases. *Diazo compounds. Reactions of diazopyrims that take place without nitrogen release and dissociation. Azo coupling reaction, azo dyes*

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The total number of atoms in heterocyclic compounds can be three, four, five, six and more. But the most stable heterocyclic compounds are five- and six-membered, which are common among natural compounds.

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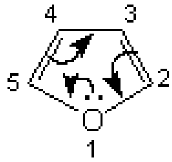
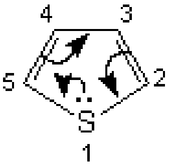
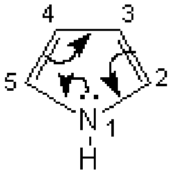

furan


tiofen


pirrol

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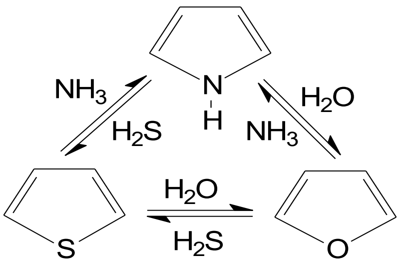

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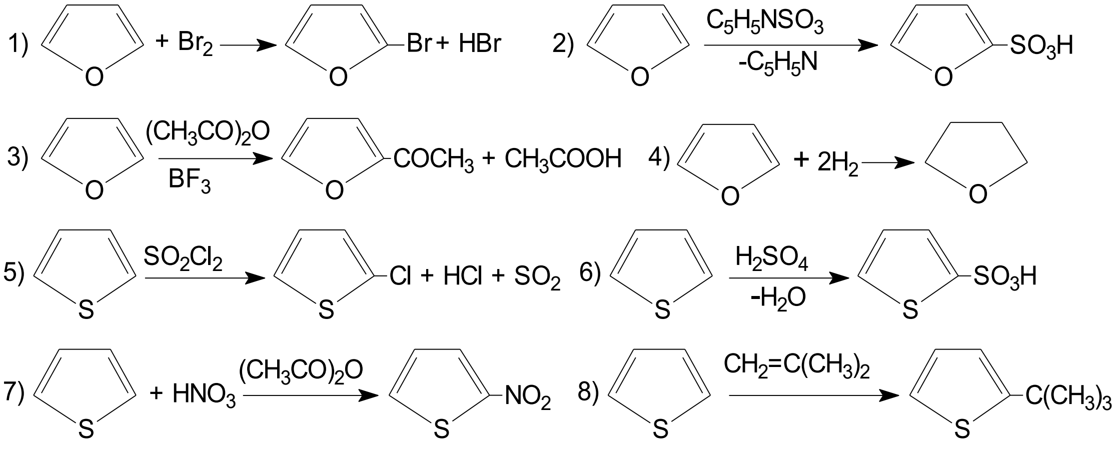
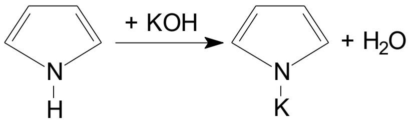


9)



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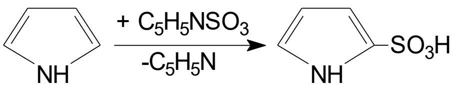

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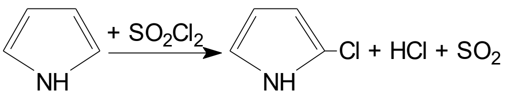

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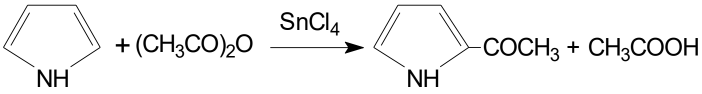

Control questions:

1. Write the structural formulas of the compounds named below.

a)α-methylfuran	b) 2-bromo-4-methylfuran
c) furfurol	g) 5-nitrofurfurol
d) N-methylpyrrole	e)α-thiophenesulfonic acid

2. Explain the aromatic properties of pyrrole, thiophene, and furan.
3. Write the hydrogenation reactions of pyrrole, thiophene and furan.
4. Write the nitration, acetylation and bromination reactions of furan, pyrrole and thiophene.

Literature:

1. O.YA.Neyland Organic chemistry. M.: "Viysshaya Shkola", 1990. P.166-172, 658-681.
2. A.N. Nesmeyanov, N.A. Nesmeyanov Nachala organic chemistry. M.: "Chemistry". 1970. Book 2. P.288-376.
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LECTURE No. 13

ORGANIC METALLIC COMPOUNDS

Plan:

1. Organometallic compounds
2. Silica compounds
3. Organolithium compounds

Basic phrases.*Organometallic compounds and their structure. Organosilicon compounds, organolithium compounds*

Organometallic compounds— organic compounds with a metal-carbon bond in the molecule. The term "organometallic compounds" is somewhat arbitrary. Cyanides, carbides, and in some cases carbonyls of metals (even if they contain the Me-S bond) are inorganic compounds. Organic compounds of boron, phosphorus, silicon, magnesium and other non-metals are included in the category of organometallic compounds. Therefore, the general name "organoelement compounds" is used more often. For the first time organometallic compounds were synthesized in 1827 by V. Seize (Seize salt K[PtCl3(CH2=CH2)]H2O). Later, after R. Bunsen obtained iron organic compounds (1839), English chemist E. Frankland obtained diethyl zinc (1849), the chemistry of organometallic compounds was founded. Li, Na, K, Rb, Cs, Be, Mg, Ca, Sr, Ba, Zn, Organometallic compounds of metals such as Cd, Hg, B, Al, Ga, In, Tl, Si, Sn, Pb, As, Sb, Bi are well studied. They are liquid and solid substances. Most are soluble in organic solvents. Organometallic compounds, especially mercury, tin, and lead compounds are very toxic. Most organometallic compounds actively react with water and oxygen. Some ignite spontaneously in air, in a carbon dioxide environment. Intermediate metals — organic compounds of Ti, Zr, Y, Nb, Ta, Cr, Mo, U, Re, Fe, Ru, Os, Rh, Ir, Co and Ni are of great practical importance. Organometallic compounds are used in the production of medicinal substances, pure metals, metal coatings, and in the synthesis of organic substances (again, Q. Grinyar's reaction, Kucherev's reaction, Polymerization).

Silica compounds- organic compounds containing silicon (Si-S) in the molecule. Goho includes all organic compounds containing silicon in the series of organosilicon compounds. Organosilicon compounds are divided into "monomers" and organosilicon polymers, which contain one or more silicon atoms. Organohalosilanes RnSiX4 n (where — X — halogen, p=1+3) and RnSiHmX4 (n and t=1,2; t+p=2,3); Alkoxysilanes and Aroxysilanes Si(OR)4, Rn Si(OR)4 m; organohydrosilanes Rn SiH4 n; organoaminosilanes Rn Si(NRj)4_n; organosilanols RnSi(OH)4m; organocyclosilanes RnSi(OCOR')4_ n (n=1+3); silatranes and others; Si-O-Si organosiloxanes, organosilazanes with Si-N-Si bonds, compounds containing several silicon atoms; Silatians with Si—S—Si bonds; Polyorganosilanes with Si—Si bonds and others are well studied. Also, the organic radical contains halogen, amino-, hydroxy-, alkoxy-, epoxy group and others; SiM, SiOM or SiRM (M-metal or non-metal atom, mas, Li, Na, K, V, A1, Sn, Ti, P, Fe) group called carbofunctional organosilicon compounds also represent a large group. In addition, there are also heterocyclic compounds with one or more silicon atoms in the ring (dimethylsilacyclobutane, dihydrofevanthrene or "oxaphene", etc.). According to the international nomenclature, organosilicon compounds containing one atom of silicon are considered derivatives of silane (SiH4). Most organosilicon compounds are colorless liquids, some [cyclosiloxanes (R2SiO3)] are crystalline solids. Generally, organosilicon compounds are well soluble in thermally stable substances, carbohydrates, chlorinated carbohydrates, ethers and other organic solvents; does not mix with water, is easily hydrolyzed. Formed organohydroxysilanes undergo intermolecular condensation to give organosiloxanes, polycondensate under the influence of released or added acid and turn into organosilicon polymers. Monomer organosilicon compounds are mainly used in the production of organosilicon polymers, mono- and di-functional organosilicon compounds are used in the production of organosilicon water-charges, difunctional organosilicon compounds are used in the production of organosilicon rubbers, di-, tri-, tetra and polyfunctional organosilicon compounds are used in the production of resins and varnishes. . Organosilicon compounds are also used in the production of hydrophobizers, antiadhesives, fillers in the plastic industry, microelectronic devices, fillers for special ceramics, and other productions.

As the electronegativity of the metal increases, the polarity of M - C bonds decreases, and compounds of metals such as Hg, Sn, Sb, etc. are mainly covalent. These are distilled liquids or crystalline substances that are resistant to oxygen and water. When heated, they decompose to form metal and free organic radicals, for example:

(C2H5)4Pb ® Pb + 4C2H5.

M. s. It can be obtained as a result of the interaction of group 1 metals with halogenated (or halogenated):

n-C4H9Br + 2Li ® n-C4H9Li + LiBr

addition of hydrides or metal salts to multiple chains:

3CH2 = CH2 + AlH3 ® (C2H5) 3Al

interaction of diazo components with metal salts:

2CH2N2 + HgCl2 ® ClCH2HgCH2Cl + 2N2

The interaction of M. metal halides, metals and with each other:

3C6H5Li + SbCl3 ® (C6H5) 3Sb + 3LiCl

(C2H5) 2Hg + Mg ® (C2H5) 2Mg + Hg

(CH2 = CH) 4Sn + 4C6H5Li ® (C6H5) 4Sb + 4CH2 = CHLi.

M. s. Transition metals belonging to group 1 are prone to homolytic decomposition (alkyl derivatives of Ag, Cu and Au), aryl and alkenyl compounds of these elements are more stable, acetylenides are very strong, as well as platinum methyl compounds, for example (CH3) 3PtI and (CH3) 4Pt.

In M. s. A metal atom from group 2 interacts with all carbon atoms in the p-electron system. Typical representatives of this class are M. s. - ferrocene, dibenzenechrome, butadiene-iron-tricarbonyl. Recently, the classical theory of valence has been invalidated for compounds of this type (for the electronic structure, see Valence).

M. s. played a major role in the development of ideas about the nature of chemical bonds. They are used in organic synthesis, especially organolithium compounds and organomagnesium compounds. Many M. s. antiseptics, medicinal and physiological active substances, antiknock agents (for example, tetraethyl lead), antioxidants, stabilizers for polymers, etc. It is very important to obtain pure metals through carbonyl and M. s. in the production of semiconductors and metal coatings. M. s. - intermediates in a number of important industrial processes catalyzed by metals, their salts and complex organometallic catalysts (for example, hydration and cyclopolymerization of acetylene, anionic, including stereospheric, polymerization of olefins and dienes, carbonylation of unsaturated compounds). See also Organoaluminum compounds, Arsenic compounds, Organosulfur compounds, Antimony compounds, Organozinc compounds, Grignard reaction, Nesmeyanova reaction, Kucherova reaction, Würz reaction, Transition elements, Ferrocene, Polymerization

Control questions:

1. Tell about organometallic compounds?
2. Write typical reactions of organosilicon compounds?
3. The use of organic lithium compounds?

Literature:

1. О.Я. Нейланд. Органическая химия. М.: «Высшая школа». 1990. С.17-19, 212-217.

2. А. Терней. Современная органическая химия. М.: «Мир». 1981. Т.1. С.559-640.

3. Дж. Марч. Органическая химия. М.: «Мир». 1987. Т.2. С.304-407.

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LECTURE No. 14

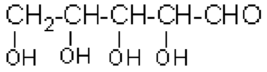
CARBOHYDRATES.

Plan:

1. Types of carbohydrates.
2. Monoses and their types.
3. Structure and properties of monoses.
4. Di- and polysaccharides

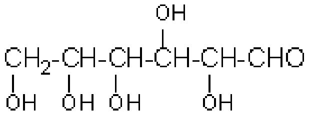
Basic phrases.*Types of carbohydrates. Monoses and their types. Structure and properties of monoses. Di- and polysaccharides*

Carbohydrates are common substances in nature and are found in plants and fruits. Monosaccharides are non-hydrolyzable sugars. Pentoses and hexoses are the most common five- and six-carbon monosaccharides in nature. Mn, pentoses-xylose, arabinose, ribose, etc. Hexoses-glucose, fructose, mannose, etc. 1 carbon contains an aldehyde or ketone group, and the remaining carbon atoms have 4 or 5 hydroxyl groups. The structural formula of Mn, ribose is as follows:



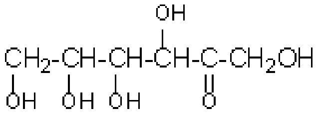
$$\underset{OH}{CH_2}-\underset{OH}{CH}-\underset{OH}{CH}-\underset{OH}{CH}-CHO$$

riboza



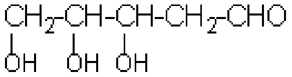
$$\underset{OH}{CH_2}-\underset{OH}{CH}-\underset{OH}{CH}-\overset{OH}{CH}-\underset{OH}{CH}-CHO$$

glyukoza



$$\underset{OH}{CH_2}-\underset{OH}{CH}-\underset{OH}{CH}-\overset{OH}{CH}-\underset{\|}{\underset{O}{C}}-CH_2OH$$

fruktoza

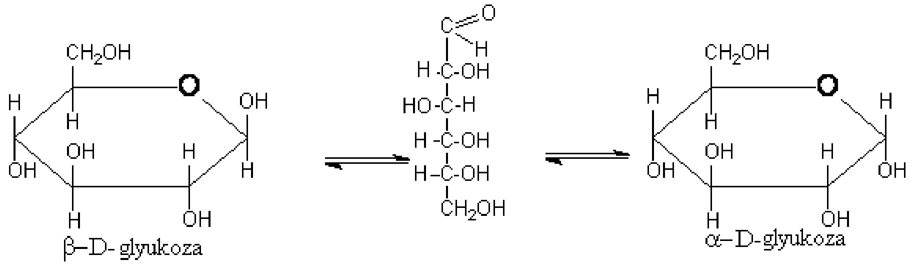


$$\underset{OH}{CH_2}-\underset{OH}{CH}-\underset{OH}{CH}-CH_2-CHO$$

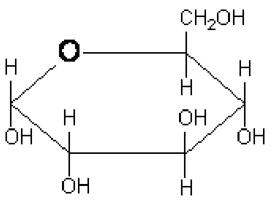
2-dezoksiriboza

Among the mentioned compounds are ribose, 2-des-oxyribose, glucose-aldoses. And fructose is -ketose. They are sweet-tasting substances and are abundant in grapes and sweet fruits.

Monosaccharides have an open carbon chain and a closed (cyclic) chain structure.This can be seen in the example of D glucose:

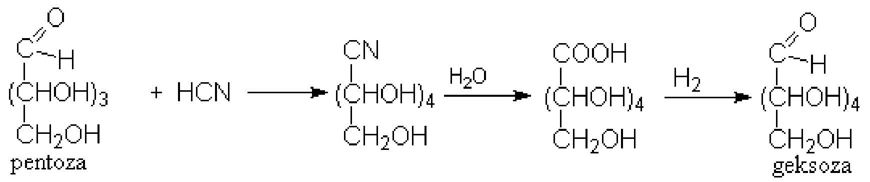


L-series glucose and its isomers can also be obtained, mn,αThe formula of -L(-)-glucopyranose is shown as follows:



α–L (-)glyukopiranoza

D-series monosaccharides D (+) from glycerol aldehyde, L-series monosaccharides L (+) can be obtained from glycerol aldehyde by oxynitrile synthesis. For example, this can be seen in the following example:



Monosaccharides can be obtained by hydrolysis of di- and polysaccharides under the catalysis of acids or enzymes or oxidation of polyhydric alcohols:

(C6H10O5)n + nH2O→nC6H12O6

Monosaccharides are crystalline substances that dissolve well in water and have a sweet taste. Because they contain asymmetric carbon atoms, they are optically active compounds. Mn, glucose exists in the form of 16 optical isomers in the open form, and 32 in the closed form. Chemically, monosaccharides exhibit both aldehyde (or ketone) and polyhydric alcohol properties. A polyatomic alcohol can be obtained by reducing the aldehyde group in Mn monosaccharides:

$$\underset{\text{D- glyukoza}}{CH_2OH[CHOH]_4-CHO} + H_2 \xrightarrow{Ni} \underset{\text{D- sorbit}}{CH_2OH[CHOH]_4-CH_2OH}$$

When oxidized, gluconic acid is formed:

$$\underset{\text{D- glyukoza}}{CH_2OH[CHOH]_4-CHO} + [O] \xrightarrow{Br_2+H_2O} \underset{\text{glyukon kislota}}{CH_2OH[CHOH]_4-COOH}$$

Glucose forms phenylhydrazone and ozazone due to aldehyde group with phenylhydrazine.

Glucose can be methylated with methyl iodide to get pentamethylglucose (pentamethyl simple ether due to 5 hydroxyl groups), and pentaacetylglucose can be obtained by acetylation with acetic anhydride:

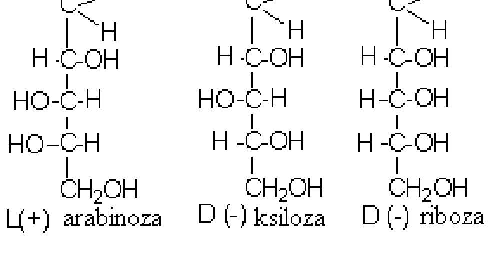
$$CH_2OH\ (CHOH)_4\ CHO + 5\ (CH_3CO)_2O \longrightarrow CH_2OCOCH_3\ (CHOCOCH_3)_4\ CHO + 5\ CH_3COOH$$

Glucose or other hexoses form ethyl alcohol under the action of the enzyme zymase:

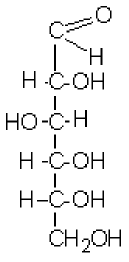
$$C_6H_{12}O_6 \xrightarrow{\text{bijg'ish}} 2C_2H_5OH + 2CO_2$$

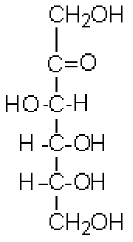
In addition to alcoholic fermentation, hexoses can also be oxidized by forming acetone, butanol, citric acid, lactic acid, butyric acid. A separate enzyme is used for each process.

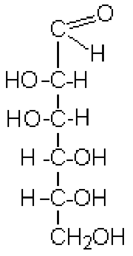
Among the pentoses, we present the structure of beet sugar arabinose, xylose found in straw and shul, and ribose found in the cell nucleus, which are of great biological importance:



Here are the formulas of D-glucose, D-fructose, and D-mannose from hexoses:


D (+) glyukoza


D (-) fruktoza

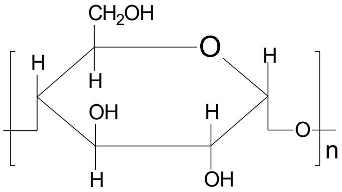

D (+) mannoza

Glucose and fructose are found in grapes and other sweet fruits, while mannose is found in barley and orange peel. Glucose and fructose are important nutrients.

Disaccharides contain 2 monosaccharide residues, which, when hydrolyzed, form 2 monosaccharides. Mn, when sucrose is hydrolyzed, glucose and fructose monosaccharides are formed. Monosaccharides exhibit the chemical properties of aldehydes or ketones and alcohols. Disaccharides have similar properties to polyhydric alcohols.

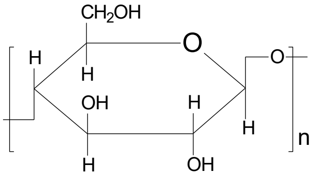
Polysaccharides. Polysaccharides are carbohydrates that produce large amounts of monosaccharides when hydrolyzed. Examples of such polysaccharides include starch, cellulose, and inulin.

Starch is an important food productα- is a high molecular compound consisting of D-glucose residues. Its formula can be shown as follows:



Therefore, when starch is hydrolyzedα-D glucose is formed.

Cellulose is a component of woodβ- is a high molecular compound consisting of D-glucose residues. So, in its elemental linkβ-D-glucose residue is present:



The molecular mass of cellulose is higher than 20000000, its macromolecule has a linear structure. The molecular mass of starch is smaller than that of cellulose and the structure is branched.

Starch is 74% in it, 78% in rice, 16% in potatoes. Glucose is obtained by hydrolysis of both starch and cellulose, and ethanol is obtained from glucose by fermentation:

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

D-fructose residue is present in the basic unit of the polysaccharide called inulin. It is abundant in the root of Jerusalem artichoke.

Control questions:

1. What compounds are carbohydrates and how many different types are there.
2. Give examples of threose and tetrose from monosaccharides. How many spatial isomers are there?
3. D (+) using oxynitrile synthesis from glycerol aldehyde D (+) create a scheme for glucose synthesis.
4. Draw up a scheme of lactic acid oxidation of glucose.
5. Write the reaction equations for the production of fructose from glucose using phenylhydrazine
6. D (+) write the closed-chain formulas of glucose and D (-) ribose.
7. Write the 5- and 6-membered ring formulas of D (-) fructose.
8. How to get carboxymethylcellulose from cellulose. Write the reaction equation.

Literature:

1. О.Я. Нейланд. Органическая химия. М.: «Высшая школа». 1990. С.17-19, 212-217.

2. А. Терней. Современная органическая химия. М.: «Мир». 1981. Т.1. С.559-640.

LECTURE No. 15

AMINO ACIDS AND PROTEINS.

Plan:

1. Types of amino acids, structure of amino acids

2. α-amino acids and proteins

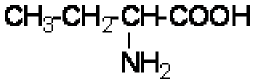
3. Irreplaceableα- amino acids

4. Structure, properties and importance of proteins

Basic phrases.*Types of amino acids, structure of amino acids,α- amino acids and proteins, irreplaceableα- amino acids, structure, properties and importance of proteins*

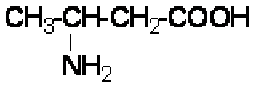
Amino acids are substances whose molecule contains both amino-(NH2) and carboxyl -(COOH) groups. Proteins are differentα- are high-molecular polypeptide compounds consisting of amino acid residues. Proteins are the basis of living life and have a complex structure.

Depending on the position of the 2 functional groups in the amino acids relative to each other□-,□- andThere will be □-amino acids. Mn:



$CH_3\text{-}CH_2\text{-}\underset{NH_2}{\underset{|}{CH}}\text{-}COOH$

α-aminobutyric acid, 2-aminobutanoic acid



$CH_3\text{-}\underset{NH_2}{\underset{|}{CH}}\text{-}CH_2\text{-}COOH$

β-aminobutyric acid, 3-aminobutanoic acid

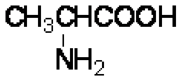
$H_2N-CH_2\text{-}CH_2\text{-}CH_2\text{-}COOH$

γ-aminobutyric acid, 4-aminobutanoic acid

Since amino acids contain an asymmetric carbon atom, they also have optical isomerism. They also bend the polarized light to the right (Q) or to the left (-). D ââ L is divided into rows.

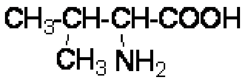
Included in the proteinα-amino acids have unique names. Mn:

NH2-CH2-COOH glycocol, glycine



$CH_3\underset{NH_2}{\underset{|}{C}}HCOOH$

alanin



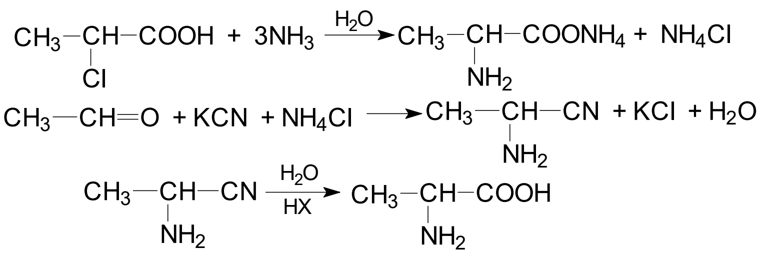
$CH_3\text{-}\underset{CH_3}{\underset{|}{CH}}\text{-}\underset{NH_2}{\underset{|}{CH}}\text{-}COOH$

valin va h.k

Amino acids have properties of both amines and carboxylic acids. They are usually in the form of an internal salt and are therefore water-soluble, crystalline substances.

It contains about 20 proteinsα-amino acids are included. Some of these amino acids are synthesized in the body, and some must enter the body with food. Necessary for the body, but cannot be synthesized in the bodyα-amino acids are called non-essential amino acids.

The methods of obtaining amino acids are similar to the methods of obtaining amino compounds and carboxylic acids. Mrα- amino acidsα- can be obtained from halogen acids and aldehydes using the following reactions:

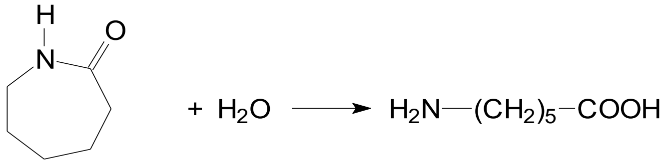


$$CH_3-\underset{Cl}{\underset{|}{CH}}-COOH + 3NH_3 \xrightarrow{H_2O} CH_3-\underset{NH_2}{\underset{|}{CH}}-COONH_4 + NH_4Cl$$

$$CH_3-CH{=}O + KCN + NH_4Cl \longrightarrow CH_3-\underset{NH_2}{\underset{|}{CH}}-CN + KCl + H_2O$$

$$CH_3-\underset{NH_2}{\underset{|}{CH}}-CN \xrightarrow[HX]{H_2O} CH_3-\underset{NH_2}{\underset{|}{CH}}-COOH$$

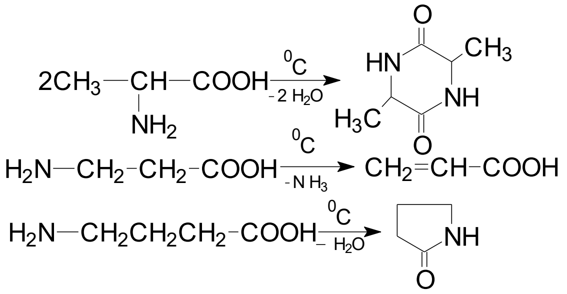
ϖ-Aminocaproic acid is obtained by hydrolysis of caprolactam:



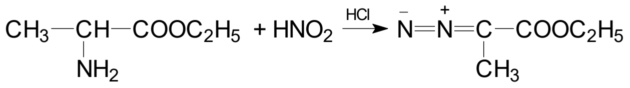
βAmino acids are obtained by adding ammonia to unsaturated acids:

$$CH_2{=}CH-COOH + NH_3 \longrightarrow H_2N-CH_2-CH_2-COOH$$

α-,β-andγ-amino acids differ from each other in what substances they turn into during heating. In thisα- amino acids diketopiperazines,β- amino acids - unsaturated acids andγ-amino acids form lactams:

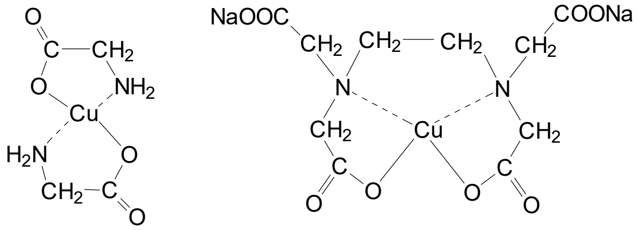


α-When amino acids are heated, open-chain oligopeptides or polypeptides can be formed. In general, amino acids are amphoteric compounds, reacting with both bases and acids to form salts. They undergo separate reactions at the expense of the amino group and at the expense of the carboxyl group. Mn, under the action of nitric acidα-amino acids are converted into diazo compounds. Amino acid ester is usually used in this reaction:



$$CH_3-\underset{NH_2}{CH}-COOC_2H_5 + HNO_2 \xrightarrow{HCl} \overset{-}{N}{=}\overset{+}{N}{=}\underset{CH_3}{C}-COOC_2H_5$$

Amino acids form complex compounds with ions of heavy metals, Mn:



Amino acids that form water-soluble complexes are called complexons. One of the most important complexes is ethylenediaminetetraacetic acid (trilonB):

$$(HOOC-CH_2)_2NCH_2CH_2N(CH_2-COOH)_2$$

Proteins are also amphoteric and have primary, secondary and tertiary structures.In the polypeptide molecule of proteinsα-the sequence of amino acid residues is called their primary structure. Internal of proteins (α-) and intermolecular (β-) helical structure due to the formation of hydrogen bonds is called their secondary structure. Cylindricalα-different arrangement of helices in space and formation of SS disulfide bridges in different parts of the macromolecule is called the tertiary structure of proteins. The combination of several polypeptide chains by forming hydrogen bonds and ion pairs is called the quaternary structure of proteins.

Proteins are characterized by biuret, xanthoprotein, Millon and ninhydrin reactions. Proteins play an important vital role in the body.

Control questions:

1. How many different amino acids are there? Give examples.
2. α-,β-andγ-amino acids differ from each other by which reaction.
3. What amino acids are called non-essential amino acids? Give them examples.
4. According to the Shtrekker-Zelinsky methodα-how amino acids are obtained. Write the reaction equation.
5. Write the equation for the reaction of di- and tripeptide from glycine.
6. Alanine a) hydrochloric acid; b) methylamine; c) what compounds are formed when exposed to ammonia.
7. Write down the structural formulas of complex compounds formed by zinc chloride with sodium salts of alanine and trilon-Blar.
8. Explain biuret and xanthoprotein reactions of proteins. What external changes will occur.

Literature:

1. О.Я. Нейланд. Органическая химия. М.: «Высшая школа». 1990. С.17-19, 212-217.

2. А. Терней. Современная органическая химия. М.: «Мир». 1981. Т.1. С.559-640.

LECTURE No. 16

BIOLOGICAL ACTIVITY OF ORGANIC COMPOUNDS.

Plan:

1. Classification of pesticides.
2. Herbicides.
3. Fungicides.
4. Insecticides.
5. Attractants (pheromones).

Basic phrases.*Classification of pesticides. Herbicides. Fungicides.*

Insecticides. Compounds that control plant growth. Defoliants. Repellents. Attractants (pheromones). Hemosterilizers. Prostaglandins. Natural pesticides.

Pesticides [lat. pestis - disease, caedo - I kill], toxic chemicals - chemicals used to fight against plant pests and diseases, weeds, as well as wood, cotton fiber products, wool, skin pests, and the causative agents of dangerous diseases of domestic animals. Also, proteins, gibberellins, defoliants, descants, retardants are included in pesticides. Pesticides enter the cells of living organisms and change their physical and chemical properties. Entering into a chemical reaction with the protein and other substances of the cell, it precipitates them, weakens the activity of enzymes, disrupts the process of metabolism and causes the cell to die.

Pesticides are classified according to the object of use, route of entry into the body, nature of action and chemical composition. Pesticides are divided into the following types depending on the object of use against harmful organisms: insecticides - means that repel insects; antifeedants - substances that protect plants and materials from pests; acaricides - for plant-eating mites; nematicides - for plant nematodes; limaticides - slime worms; rodenticides - for rodents; fungicides - against diseases caused by fungi: bactericides - against bacteria; herbicides - for weeds among agricultural crops; arboricides - tools used against shrubs and small shrubs; attractants - attract insects, repellents - substances that scare away insects and flies, algicides - drugs used against algae, etc. There are also pesticides with a complex effect. For example, pesticides used in seed treatments may have fungicidal, bactericidal, insecticidal, and other function(s).

Pesticides are one of the most effective ways to control weeds, diseases and pests. Pesticides belong to different classes of organic and inorganic compounds. Most of them are obtained artificially. The most effective pesticides include organochlorine and organophosphorus compounds, carbamic acid compounds, plant extracts (pyrethroids), triazines. Inorganic pesticides include compounds of copper, sulfur and other elements. Organochlorine pesticides are preferred by universality. They kill many types of pests, have a long-lasting effect, and are less dangerous for pets. The disadvantage of organochlorine pesticides is their chemical stability in the external environment, soil, plants and water, that is, they remain for a long time without decomposition. This can lead to the accumulation of drug residues in plant products and animal organisms. The use of highly stable chemicals such as DDT has been avoided. Organophosphorus pesticides have high biological activity. These compounds are distinguished from others by the property of being absorbed into the plant and maintaining the poison power for a long time. Some are absorbed through the leaves or roots and spread along the plant's vascular system along with the nutrient solution. Pests that feed on plant sap are poisoned and die from it; these compounds are called internally acting drugs. Substances of another group are absorbed on the surface of plant tissues and do not spread through the veins and are called partially absorbed drugs. These are more stable inside the organism than on the surface of the body and also kill the pests on the untreated back of the leaf. Organophosphorus pesticides include insecticides, fungicides, nematocides and herbicides. In agriculture, such insecticides and acaricides as phosphamide (BI-58), phazolon, karbofos, zolon and other(s) are widely used.

Control questions:

1. Write the structural formulas of the compounds named below.

a)α-methylfuran
b) 2-bromo-4-methylfuran
c) furfurol
g) 5-nitrofurfurol
d) N-methylpyrrole
e)α-thiophenesulfonic acid

Literature:

1. О.Я. Нейланд. Органическая химия. М.: «Высшая школа». 1990. С.17-19, 212-217.

2. А. Терней. Современная органическая химия. М.: «Мир». 1981. Т.1. С.559-640.

LECTURE No. 17

IN ORGANIC REACTIONS ADDITIONAL PROCEEDINGS

Plan:

1. Alternative conditions of reactions.
2. Effect of substrate and reagent structure, solvent nature and various factors on the direction of reaction.
3. Use of organic compounds in industry, agriculture, medicine and other fields.
4. Contributions of Uzbek scientists to organic chemistry.

Basic phrases.*Alternative reaction conditions. The effect of the structure of the substrate and reagent, the nature of the solvent and various factors on the course of the reaction. Application of organic compounds in industry, agriculture, medicine and other fields. Contributions of Uzbek scientists to organic chemistry.*

Heterocyclic compounds are compounds whose ring consists of carbon and a hetero atom.

Oxygen, nitrogen and sulfur atoms are mainly involved as heteroatoms in the composition of compounds found in nature.

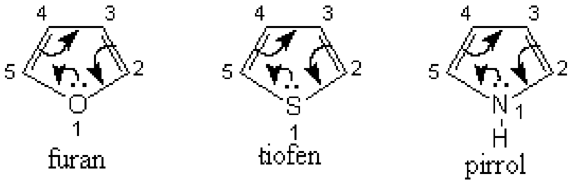
The total number of atoms in heterocyclic compounds can be three, four, five, six and more. But the most stable heterocyclic compounds are five- and six-membered, which are common among natural compounds.

Heterocyclic compounds 1) by the total number of atoms; 2) to the number of heteroatoms; 3) classified according to the number of rings.

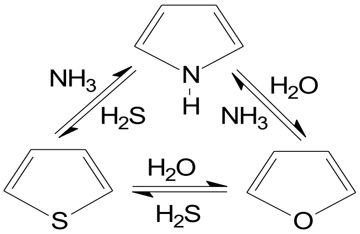
When naming heterocyclic compounds, the numbering of the atoms of the molecule forming the ring begins with the heteroatom.

Five-membered heterocyclic compounds

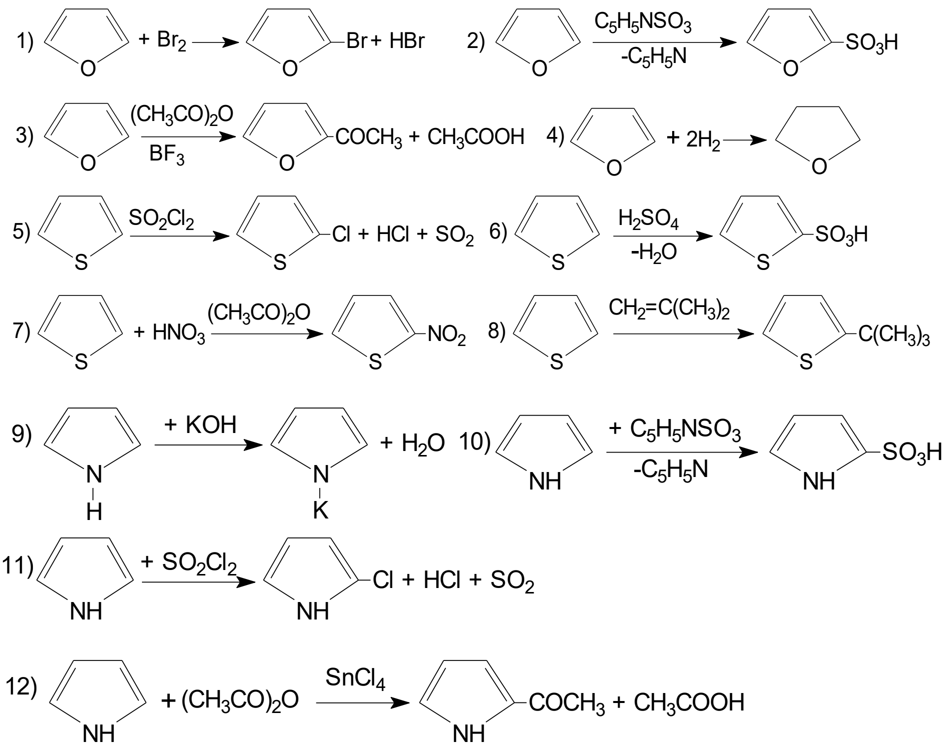
The most important five-membered heterocyclic compounds are furan, thiophene, and pyrrole, which have oxygen, sulfur, and nitrogen atoms in the ring, respectively:



This shows that the structure of compounds is close to each other. In fact, YU.K. Yuryev showed that they can turn into each other. For this, he showed that thiophene or pyrrole is formed by passing a mixture of furan vapors with hydrogen sulfide or ammonia over Al2O3 at 400-450oS:



Electrons of double bonds of furan, thiophene and pyrrole interact with p-electrons of heteroatoms and become singleπ- forms a system of electrons. As a result, these substances exhibit aromatic properties. Therefore, they easily undergo electrophilic substitution reactions (nitration, halogenation and sulfation) and give the corresponding derivatives:



Control questions:

1. Write the structural formulas of the compounds named below.

a)α-methylfuran	b) 2-bromo-4-methylfuran
c) furfurol	g) 5-nitrofurfurol
d) N-methylpyrrole	e)α-thiophenesulfonic acid

2. Explain the aromatic properties of pyrrole, thiophene, and furan.
3. Write the hydrogenation reactions of pyrrole, thiophene and furan.
4. Write the nitration, acetylation and bromination reactions of furan, pyrrole and thiophene.

Literature:

1. О.Я. Нейланд. Органическая химия. М.: «Высшая школа». 1990. С.17-19, 212-217.

2. А. Терней. Современная органическая химия. М.: «Мир». 1981. Т.1. С.559-640.

LABORATORY WORK

Laboratory work-1

ELECTROPHILIC REPLACEMENT REACTIONS IN THE AROMATIC SERIES.

NITROBENZENE

$$C_6H_6 + HONO_2 \xrightarrow[H_2SO_4]{} C_6H_5NO_2 + H_2O$$

Reagents.

Benzene	18 ml or 15.6 g (0.2 mol)
Nitric acid (dq1.4)	20 ml (0.29 mol)
Sulfuric acid (d q1.84)	25 ml (0.45 mol)

Sodium carbonate; calcium chloride.

The experiment is carried out under the hood.

200*ml*in a volumetric, round-bottomed flask, the nitric and sulfuric acids are mixed gently while being cooled. An air cooler is installed in the flask, and benzene is poured little by little (2-3 ml) into the mixture cooled to room temperature while shaking. Lower the temperature to 50°Cthe flask is lowered into a water bath to hold the seedling. After pouring the specified amount of benzene, the temperature of the water bath is raised to 60°C, and the reaction is continued for 45 minutes with stirring. During the reaction, it is necessary to keep the temperature at the same level so that m-dinitrobenzene does not form.

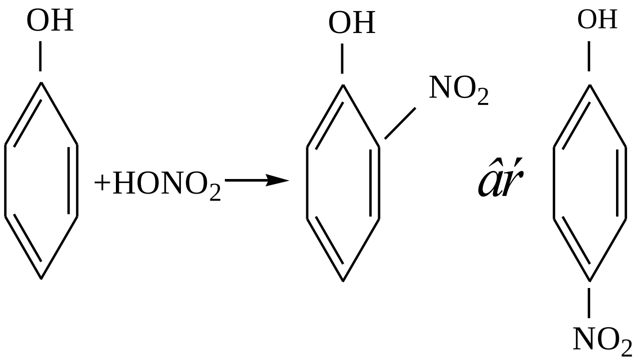
The reaction mixture is then cooled, poured into a separatory funnel, and the acidic layer is separated from the nitrobenzene layer.wished Nitrobenzene is first washed with water, then with a 3-5% soda solution until carbon dioxide gas escapes (in this case, the upper mouth of the separatory funnel should be open). The nitrobenzene is separated from the aqueous portion, dried in a flask containing calcium chloride and equipped with an air cooler, and heated on a water bath until the milky product becomes clear.

Dry nitrobenzene is poured into a smaller Wurtz flask, driven through an air cooler, and the fraction at 207-211°C is collected and the drive is stopped. It is dangerous to carry the drive all the way to the end, because an explosion can occur if nitrobenzene is mixed with dinitrobenzene.

The boiling point of pure nitrobenzene is 210.9°C;$d_{20}^{20} = 1,2055$; $n_D^{20} = 1,5525$.

The amount is around 21 g.

o-and p-NITROPHENOL



Reagents.

Phenol	28.2 g (0.3 mol)
Nitric acid (dq1,11)	185 ml (0.62 mol)

Methyl alcohol; caustic soda; activated carbon; hydrochloric acid.

28.2 g of phenol obtained in a conical flask is heated until it liquefies by adding 3-4 ml of water, and after cooling, it is slowly poured into 185 ml of nitric acid in a round-bottomed flask with shaking. The flask is cooled with water so that the temperature of the reaction mixture does not exceed 20°C. The brownish mixture is left in cold water for two hours, shaking from time to time. Then it is mixed with twice as much water, and an oily liquid separates from it and is stored until it sinks to the bottom of the flask. The aqueous part of the mixture is slowly poured out, and the oily part is washed with water 2-3 times and it is driven with water vapor. In this case, o-nitrophenol with a yellow tint is expelled, and p-nitrophenol remains in the flask.

The collected o-nitrophenol was filtered using a Buchner funnel, and the obtained substance was filtered through layers of filter paper. compressed and then air-dried.

o-The amount of nitrophenol is around 10 g.

The liquefaction temperature of pure o-nitrophenol is 45°C.

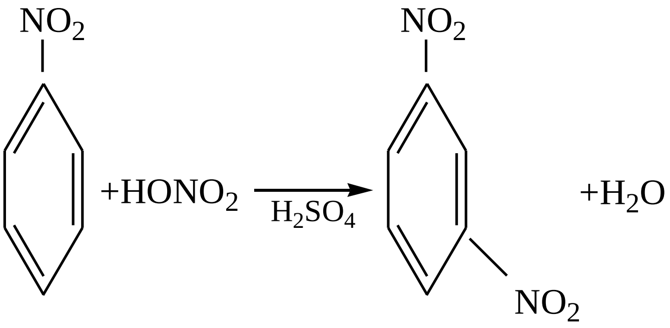
If the liquid temperature of the obtained substance is below 45°C, it is recrystallized in methyl alcohol.

In order to isolate the remaining p-nitrophenol in the reaction flask, the flask is cooled and placed in an ice bath for 30 minutes, and the p-nitrophenol separated is filtered in a Buchner funnel. Then, to clean it, it is heated to boiling with 250 ml of 2% hydrochloric acid and a spoonful of activated charcoal for 10-15 minutes, and it is filtered in a preheated Buechner funnel while boiling. The filtrate is left overnight and the p-nitrophenol separated is filtered off and dried between filter papers. A small amount of p-nitrophenol can be obtained by evaporating the filtrate.

The amount is around 4 g.

The obtained product is an odorless and colorless crystal, liquidniche temperature 11Z,6°C; boiling point 279°C (with decomposition). Soluble in hot water, alcohol and ether.

m-DINITROBENZOL



Reagents.

Nitrobenzene	12.3 g or 10.2 ml (0.1 mol)
Nitric acid (d q1.4)	10*ml*(0.14 mol')
Sulfuric acid (d q1.84)	30 ml (0.53 mol)

Sodium carbonate; alcohol.

200*ml*12.3 g of nitrobenzene is placed in a volumetric flask, heated in a fume hood on a water bath, and the nitrifying mixture is added little by little with good stirring. After all of the nitrifying mixture has been poured, heating and stirring are continued for another 30 minutes. The completion of the reaction is known as follows: when a drop of the solution is placed in a test tube with water, dinitrobenzene should precipitate, forming a white-yellow crystal; if this does not happen, heating is continued for another 10-15 minutes.

After that, the mixture is cooled and poured into 300 ml of ice water with good stirring.

The precipitated dinitrobenzene is filtered in a Buchner funnel, washed with cold water, and the filter is crushed and dried between layers of paper.

Quantity 4*g*.

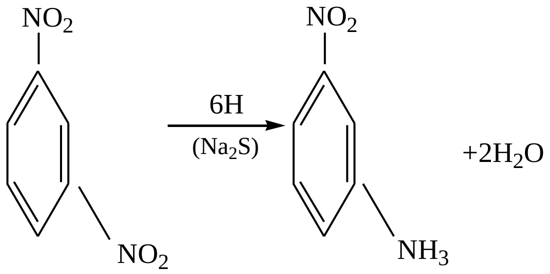
To obtain pure dinitrobenzene, it is recrystallized in ethyl alcohol.

m-Dinitrobenzene is a colorless needle-like pure crystal. Liquefaction temperature is 89.8°C.

Laboratory work-2

ALKYLATION AND ACYLATION OF AROMATIC COMPOUNDS.

m-NITROANILINE



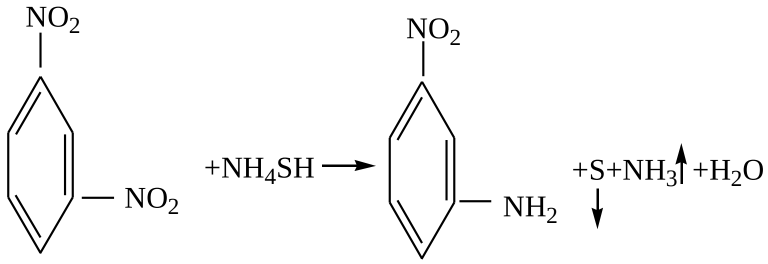
Reagents:

m-Dinitrobenzene	10 g (0.06 mol)
Sodium sulphide	25 g (0.32 mol)

500*ml*10 g of dinitrobenzene is placed in a conical flask with a capacity, heated to boiling with 200 ml of water, and a solution of sodium sulphide in 100 ml of water is slowly poured into the boiling solution. Then the reaction mixture is heated to boiling for another 10-15 minutes. The flask is cooled with cold water, after settling, the nitroaniline is filtered in a Buchner funnel, washed 2-3 times with cold water and dried in air. The resulting nitroaniline is recrystallized in water.

The amount is around 5 g.

m-Nitroaniline is a pure, yellow needle-like crystalline substance with a melting point of 114°C.



$$NH_4OH+H_2S \longrightarrow NH_4SH+H_2O$$

Reagents.

m-Dinitrobenzene 10 g (0.06 mol)

Hydrogen sulfide (produced by the action of hydrochloric acid on iron (P)-sulfide) Ammonia (d q0.910) 5.5 ml (0.16 mol)

Ethyl alcohol 40 ml

10 g of m-dinitrobenzene and 40 ml of alcohol are placed in a 200 ml round bottom flask, the flask is connected to a reflux condenser and heated until

the mixture is completely dissolved. The mixture in the flask is then cooled with water while stirring, and 5.5 ml of concentrated ammonia is added to it, and hydrogen sulfide is injected into the mixture in a fume hood for 60 minutes from a Kipp apparatus. Then the flask is heated a little in a water bath, then cooled, and hydrogen sulfide is injected into it for another 30 minutes. This case will be returned once more.

After that, the flask is slightly heated in a water bath, then cooled and 170 ml of water is added to it. A yellow-brown precipitate is formed. It is filtered in a Buechner funnel and washed with water.

To remove sulfur residues, nitroaniline is treated with double diluted hydrochloric acid in a crucible and filtered in a Buechner funnel.

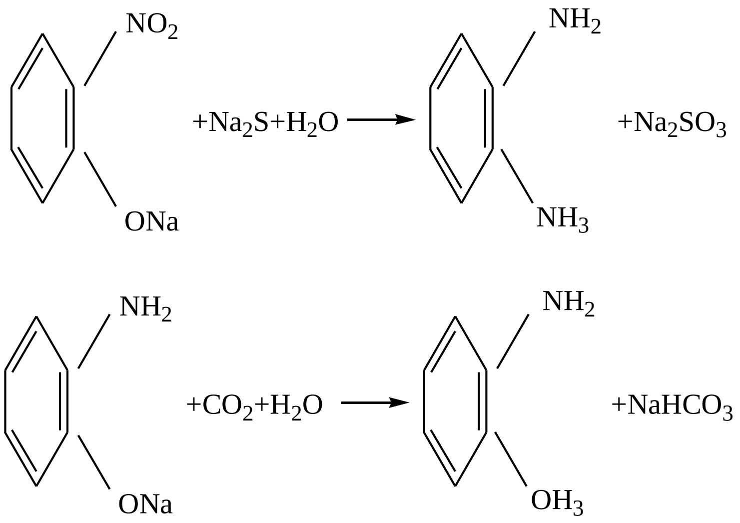
The dissolved nitroaniline hydrochloride is slightly evaporatedAfter it is condensed and cooled, concentrated ammonia is applied to it, and nitroaniline is precipitated.

The precipitate is filtered, washed with cold water and recrystallized in boiling water. Then the crystals are dried.

Pure yellow needle-like m-nitroaniline has a melting point of 114°C.

The amount is around 6 g.

o-AMINOPHENOL



$$Na_2S + H_2O \rightarrow NaHS + NaOH$$

$$NaHS + CO_2 + H_2O \rightarrow H_2S + NaHCO_3$$

Reagents.

o-Nitrophenol	20 g (0.14 mol)
Engraver, sodium	5.75 g (0.14 mol)
Sodium sulphide	100*g*(1.2 moles)
Carbon dioxide gas (from cylinder)	
Sodium bisulphite (40% li)	10 ml

The work should be completed in one day

100*g*sodium sulphide crystal is liquefied in a porcelain bowl over an open flame at 110-115°C, while stirring, 20 g of o-nitrophenol and an equivalent amount of pure caustic sodium (5.75 g) of sodium o-nitrophenolate are added little by little. will be added. After adding sodium o-nitrophenolate, the reaction mixture is stirred for 45 minutes at a temperature of 125-130°C.

After the reaction is over (a drop of the obtained sample should dissolve in water), the heating is stopped and the alloy is poured into 300 ml of water. After filtering the aqueous solution, carbon dioxide gas is injected into the filtrate, which has not yet cooled, to neutralize the alkali and separate o-aminophenol. After a while o-aminophenol begins to precipitate as small white shiny crystals. The flask is cooled to room temperature, the precipitated substance is filtered in a Buchner funnel, sodium bisulfite solution (3 ml) is added to 25-30 ml of ice water, 10-15 ml of water andat the end, it is washed with 10-15 ml of alcohol and dried at 100-110°C.

The liquefaction temperature of pure ortho-aminophenol is 174°C1

The amount is 12-14 g.

HYDRAZOBENZOL AND BENZIDINE

Extraction of hydrazobenzene

$$2C_6H_5 - \mathrm{NO_2} + 5\mathrm{Zn} + 10\mathrm{NaOH} \rightarrow C_6H_5 - \mathrm{NH} - \mathrm{NH} - C_6H_5 + 5\mathrm{Zn(ONa)_2} + 4H_2O$$

Reagents.

Nitrobenzene	10 ml or 12.3 g (0.1 mol)
Zinc powder	30 g (0.45 gram atom)

Caustic sodium; alcohol.

A reflux condenser is connected to one mouth of a flask with a capacity of half a liter, with a round bottom and two mouths, and the other mouth is closed with a stopper.

A solution of 14 g of caustic soda in 50 ml of water, 10 ml of nitrobenzene and 25 ml of alcohol is poured into the flask, then zinc powder is added little by little (from 2-3 g) while shaking. When zinc powder is added, the reaction is rapid. That is why the later parts of the zinc powder slow down the reactionis then inserted. If the reaction stops, the mixture is heated in a water bath. The flask should be shaken throughout the reaction so that the zinc powder does not settle to the bottom of the flask.

The liquid in the flask is first red (azobenzene), then pale yellowas soon as color is obtained, 150 ml of alcohol is poured in, heated to boiling in a water bath and quickly filtered in a Buechner funnel. The flask is shaken with 25 ml of hot alcohol and the zinc powder remaining in the filter is washed. After cooling the filtrate in a mixture of ice and salt for 1 hour, the precipitated hydrazobenzene crystals are filtered off, and the filtrate is washed with 30% alcohol until it comes from an alkaline environment to a neutral environment, and the obtained colorless crystalline substance is dried in a calcium chloride vacuum desiccator. is dried.

The liquefaction temperature of pure hydrazobenzene is 125°C.

The amount is 7 g.

Laboratory work-3

NUCLEOPHILIC REPLACEMENT REACTIONS IN THE AROMATIC SERIES.

n-CRESOL

$$[CH_3 - C_6H_5 - NH_3]SO_4H \xrightarrow[(HCl+NaNO_2)]{+HNO_2} [CH_3 - C_6H_5 - N_2]SO_4H + 2H_2O$$

$$[CH_3 - C_6H_5 - N_2]SO_4H + H_2O \rightarrow CH_3 - C_6H_4 - OH + N_2 + H_2SO_4$$

Reagents.

n-Toluidine 10.7 *g*(0.1 mol')

Sulfuric acid (dq1.84)10 *ml*(0.18 mol')

Sodium nitrite 7 *g*(0.1 mol')

Sodium chloride; ether; calcium chloride.

Mix 10 ml of sulfuric acid with 75 ml of water in a half-liter beaker and slowly add toluidine while shaking. Then the mixture is cooled, 120 g of ice is added to it, and the rest of the work is carried out as in the synthesis of phenol.

The fraction of the formed n-cresol at 195-200°C is removed.

The amount is 5-6 g.

The liquefaction temperature of pure n-cresol is 35°C.

Boiling temperature is 202.5°C.

m-NITROCHLORBENZOL

$$O_2N - C_6H_4 - NH_2 \xrightarrow[(HCl+NaNO_2)]{+HNO_2} [O_2N - C_6H_4 - N_2]Cl + 2H_2O$$

$$[O_2N - C_6H_4 - N_2]Cl \xrightarrow{Cu_2Cl_2} O_2N - C_6H_4 - Cl + N_2$$

Reagents.

m-Nitroaniline10 *g*(0.07 mol')

Hydrochloric acid (dq1,19) 28 *ml*(0.35 mol)Sodium nitrite 5.5

g(0.08 mol')

Copper chloride (prepared before work); benzene; caustic soda; calcium chloride.

28*ml*hydrochloric acid is diluted with 20 ml of water, heated, and 10 g of nitroaniline is dissolved in it; the solution is cooled to 1°C with ice, a solution of 5.5 g of sodium nitrite in 15 ml of water is added little by little while stirring, and the reaction product is checked with iodine paper (see page 172).

The resulting precipitate is filtered, and the filtrate is poured into a suspension of copper chloride (copper chloride is obtained by the method of synthesizing chlorobenzene) in a flask with stirring. The mixture is stirred occasionally for 1 hour, then connected to a reflux condenser and heated in a water bath until nitrogen evolution is complete.

The mixture in the flask is then extracted with benzene, and the benzene solution is washed with water, dilute caustic soda solution, and again with water and dried with calcium chloride. Benzene is then removed under normal conditions and chlorochlorobenzene in vacuo.

m- Boiling temperature of nitrochlorobenzene is 124-125°C (18 mm wire) or 116-117 °C (12 mm wire). It forms pale yellow crystals that liquefy at 44-45°C.

The amount is 7 g. around.

Laboratory work-4

DIAZO AND AZO COMPOUNDS.

PHENOL

$$C_6H_5NH_2 + H_2SO_4 \rightarrow [C_6H_5NH_3]SO_4H$$

$$2NaNO_2 + H_2SO_4 \rightarrow 2HNO_2 + Na_2SO_4$$

$$[C_6H_5 - NH_3]SO_4H + HNO_2 \rightarrow [C_6H_5 - N_2]SO_4H + 2H_2O$$

$$[C_6H_5 - N_2]SO_4H + H_2O \rightarrow C_6H_5OH + N_2 + H_2SO_4$$

Reagents.

Aniline9,3	*g*(0.1 mol')
Sulfuric acid 10	*ml*(dq1.84) (0.18 mol')
Sodium nitrite 7.5	*g*(0.1 mol')

Sodium chloride; ether; calcium chloride.

300Take 50 ml of water in a glass with a capacity of ml and pour sulfuric acid while stirring. Then the freshly distilled aniline is slowly poured into the dilute acid while stirring. the solution is cooled to room temperature and 70 g of crushed ice is added little by little. aniline sulfate precipitates as the solution cools.

0A solution of sodium nitrite in 30 ml of water is poured little by little into the solution cooled to °C with good stirring. After most of the sodium nitrite solution has been poured off, check whether the reaction is complete with iodine paper. If a drop of the solution on the starch paper turns blue after the last part of the solution has been poured, the reaction is complete. If there is no change in the starch paper, a little more of the sodium nitrite solution is added. The reaction medium should be acidic.

The obtained phenyldiazonium salt is placed in a 500 ml round-bottomed flask and heated in a water bath (until nitrogen is exhausted) at 40-50°C for 15-20 minutes. The resulting phenol is driven off with steam. Stirring is continued until a sample of the distillate forms a pale turbidity of tribromophenol with bromine water.

The distillate is saturated with ground table salt and transferred to the phenol ether layer in a separatory funnel. After that, the ether layer is separated, dried with calcium chloride, and the ether is evaporated in a water bath. Then the water cooler is replaced by an air cooler and fired in a phenol gas flame. In the collecting flask, the phenol rapidly solidifies as a resin-free crystal.

The amount is 6-7 g.

The liquefaction temperature of pure phenol is 42-43°C.

Boiling temperature is 182°C.

n-CRESOL

$$[\mathrm{CH_3} - C_6H_5 - \mathrm{NH_3}]\mathrm{SO_4}H \xrightarrow[\mathrm{(HCl+NaNO_2)}]{\mathrm{+HNO_2}} [\mathrm{CH_3} - C_6H_5 - N_2]\mathrm{SO_4}H + 2H_2O$$

$$[\mathrm{CH_3} - C_6H_5 - N_2]\mathrm{SO_4}H + H_2O \rightarrow \mathrm{CH_3} - C_6H_4 - \mathrm{OH} + N_2 + H_2\mathrm{SO_4}$$

Reagents.

n-Toluidine 10.7	*g*(0.1 mol')
Sulfuric acid (dq1.84)10	*ml*(0.18 mol')
Sodium nitrite 7	*g*(0.1 mol')

Sodium chloride; ether; calcium chloride.

Mix 10 ml of sulfuric acid with 75 ml of water in a half-liter beaker and slowly add toluidine while shaking. Then the mixture is cooled, 120 g of ice is added to it, and the rest of the work is carried out as in the synthesis of phenol.

The fraction of the formed n-cresol at 195-200°C is removed.

The amount is 5-6 g.

The liquefaction temperature of pure n-cresol is 35°C.

Boiling temperature is 202.5°C.

m-NITROCHLORBENZOL

$$O_2N - C_6H_4 - NH_2 \xrightarrow[(HCl+NaNO_2)]{+HNO_2} [O_2N - C_6H_4 - N_2]Cl + 2H_2O$$

$$[O_2N - C_6H_4 - N_2]Cl \xrightarrow{Cu_2Cl_2} O_2N - C_6H_4 - Cl + N_2$$

Reagents.

m-Nitroaniline10 *g*(0.07 mol')

Hydrochloric acid (dq1,19) 28 *ml*(0.35 mol)Sodium nitrite 5.5

g(0.08 mol')

Copper chloride (prepared before work); benzene; caustic soda; calcium chloride.

28*ml*hydrochloric acid is diluted with 20 ml of water, heated, and 10 g of nitroaniline is dissolved in it; the solution is cooled to 1°C with ice, a solution of 5.5 g of sodium nitrite in 15 ml of water is added little by little while stirring, and the reaction product is checked with iodine paper (see page 172).

The resulting precipitate is filtered, and the filtrate is poured into a suspension of copper chloride (copper chloride is obtained by the method of synthesizing chlorobenzene) in a flask with stirring. The mixture is stirred occasionally for 1 hour, then connected to a reflux condenser and heated in a water bath until nitrogen evolution is complete.

The mixture in the flask is then extracted with benzene, and the benzene solution is washed with water, dilute caustic soda solution, and again with water and dried with calcium chloride. Benzene is then removed under normal conditions and chlorochlorobenzene in vacuo.

m- Boiling temperature of nitrochlorobenzene is 124-125°C (18 mm wire) or 116-117 °C (12 mm wire). It forms pale yellow crystals that liquefy at 44-45°C.

The amount is 7 g. around.

Laboratory work-5

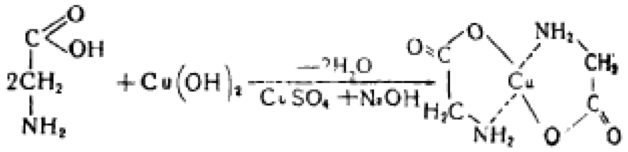
SYNTHESIS OF HETEROCYCLIC COMPOUNDS.

Extraction of glycocol salt

Reagents:glycocol, 5% solution of copper sulfate, 10% solution of caustic soda.

0.2 g of glycocol, 3 ml of copper sulfate solution, 1 ml of caustic sodium solution are put into the test tube, the mixture is thoroughly shaken and heated.

In this case, the precipitate dissolves and a light blue solution is formed:



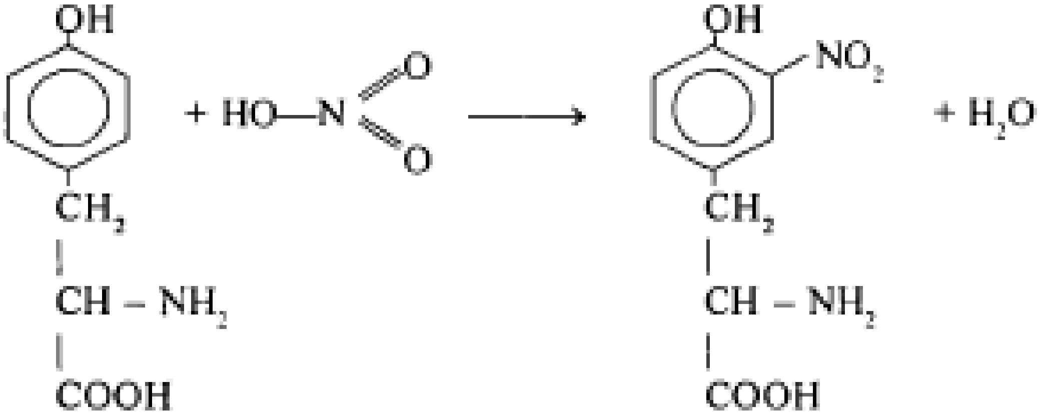
As an α-amino acid, glycocol forms a blue complex cyclic compound with copper. Such compounds are called chelates.

Xanthoprotein reaction

Reagents:phenylalanine, tryptophan, tyrosine solutions, concentrated nitric acid, concentrated sodium alkali solution.

If concentrated nitric acid is applied to a protein solution containing tyrosine, tryptophan and phenylalanine amino acids or molecules containing these amino acids, a yellow nitrocompound of these amino acids is formed and the solution is colored yellow. After the yellow color is formed, if a slightly concentrated sodium alkali or ammonia solution is added to the solution, the solution turns orange.

Pour 1 ml of phenylalanine, tyrosine or tryptophan solution and 0.2 - 0.3 ml of concentrated nitric acid into a test tube and boil for 1 - 2 minutes.
The solution turns yellow.

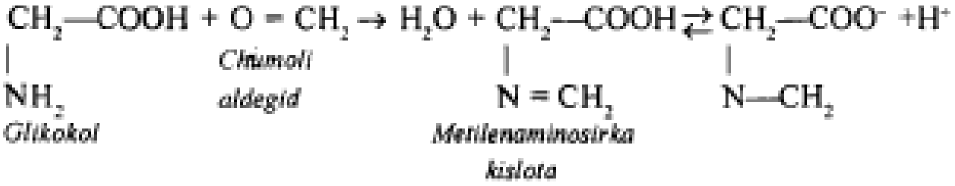


Reaction of glycocol with formaldehyde

Reagents1% solution of glycocol, formalin, 10% solution of caustic sodium, 1% solution of phenolphthalein in alcohol.

4 ml of glycocol solution is poured into the test tube, 1-2 drops of phenolphthalein solution are added to it, and alkali solution is added drop by drop until the mixture turns red. Then 2 ml of neutralized formalin is added to the alkaline solution. In this case, as a result of binding of the amino group to

formaldehyde, the environment of the solution becomes acidic and becomes discolored:



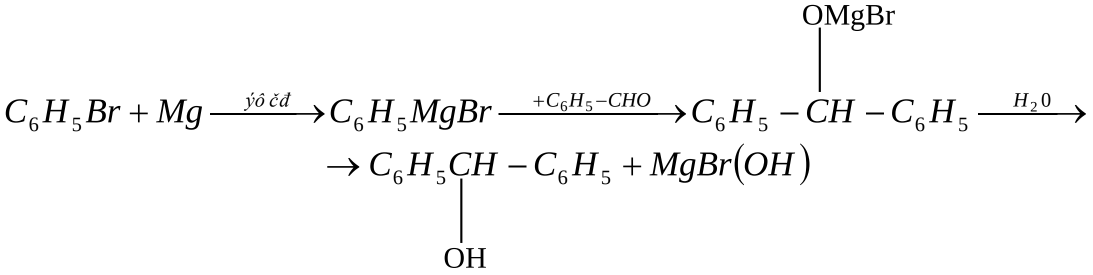
$$CH_2(NH_2){-}COOH + O{=}CH_2 \rightarrow H_2O + CH_2(N{=}CH_2){-}COOH \rightleftarrows CH_2(N{-}CH_2){-}COO^- + H^+$$

Amino acids have a neutral reaction and exist as amphoteric ions in aqueous solutions. If an amino group binds to a substance, amino acids react acidic in aqueous solutions.

Laboratory work-6

SYNTHESES WITH THE HELP OF ORGANIC METALLIC COMPOUNDS

BENZHYDROL (DIPHENYLCARBINOL)



$$C_6H_5Br + Mg \xrightarrow{\text{ýô čđ}} C_6H_5MgBr \xrightarrow{+C_6H_5-CHO} C_6H_5-\overset{\displaystyle OMgBr}{\overset{|}{CH}}-C_6H_5 \xrightarrow{H_20}$$

$$\rightarrow C_6H_5\underset{\displaystyle OH}{\underset{|}{CH}}-C_6H_5 + MgBr(OH)$$

Reagents.

Bromobenzene23.5 *g*or 16 ml (0.15 mol)
Magnesium metal slag 3.6 *g*(0.15 gram atom)
Benzaldegide 11.9 *g*or 11 ml (0.11 mol)
Absolute diethyl ether110 *ml*
Chloride cyst 12 *ml*
Diethyl ether 40 *ml*
of sodium bisulphite

10 ml of 40% solution of iodine crystal; soda solution; calcium chloride; naphtha.

Before synthesizing benzhydrol, metal-organic compound-magnesium bromophenyl is taken and its cooled solution is treated with a solution of benzaldehyde in absolute ether.

500*ml*capacity, equipped with a three-mouth, round-bottom beaker mixer, a dropping funnel, a reflux condenser with a calcium chloride tube, 3.6 g of magnesium powder, 30 ml of absolute ether are added to it, and a large iodine crystal is thrown into it. Then 4-5 ml of a solution of 16 ml of bromobenzene in 50 ml of absolute vphire is poured through the dropper funnel.

If the reaction does not start after a few minutes (the ether does not become cloudy and boils), the flask is placed in a hot water bath and heated slightly until the reaction begins.

After the reaction has started, the water bath is removed and the ethereal solution of bromobenzene is added dropwise in such a way that the ether should boil uniformly.

After the bromobenzene is poured, the reaction flask is heated in a water bath for 1-1.5 hours until the magnesium in it dissolves. Then the magnesium bromophenyl in the flask is cooled with ice, and a solution of 11 ml of freshly distilled benzaldehyde in 30 ml of absolute ether is added dropwise with stirring.

30after a minute, the flask is removed from the ice and the reaction mixture is brought to room temperature.

The reaction mixture is cooled again with ice, 30-40 g of ice is added little by little, and a solution of 12 ml of concentrated hydrochloric acid (dq1.19) in 12 ml of water is added little by little (dissolving with hydrochloric acid is carried out until the solution becomes clear).

The ethereal solution is separated, and the aqueous part is extracted twice (from 15-20 ml) with ether.

To remove unreacted benzaldehyde, the ethereal solutions are shaken with 10 ml of 40% sodium bisulfite solution in a separatory funnel. It is then washed with soda solution and then water until it is alkaline, and then dried with calcium chloride.

After the ether is driven off, the oily residue begins to crystallize on cooling.

Thus, the obtained benzhydrol is recrystallized in petroleum ether or naphtha, the liquefaction temperaturerasi 68-69°S.

The amount is 15 g

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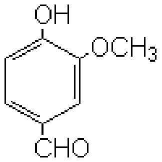
PRACTICAL TRAINING

PRACTICAL EXERCISE No. 1

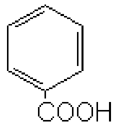
AROMATICITY. AROMATIC SYSTEMS WITHOUT BENZENE RING. ELECTROPHILIC EXCHANGE IN AROMATIC COMPOUNDS.

Aromatic hydrocarbons are compounds rich in carbon, having a molecular ring structure, specific chemical bonds, and physical and chemical properties.

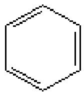
The first representatives of aromatic hydrocarbons were isolated from naturally occurring compounds known as aromatics, which have a characteristic long-lasting smell. Mn, one such compound is vanillin, which has a similar structure to benzoic acid:



vanilin



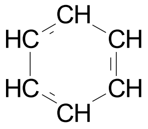
benzoy kislota



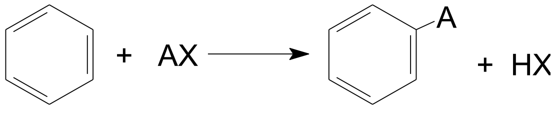
benzol

If we compare these two substances with the benzene molecule, the similarity between them and the connection between "aromaticity" is obvious. Currently, when using the term "aromaticity", it is understood that some unsaturated compounds undergo exchange reactions rather than coupling reactions, and are resistant to temperature and oxidants.

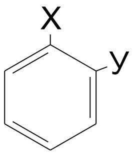
Benzene, the first representative of aromatic hydrocarbons, was synthesized by Faraday in 1825. Kekule determined the structure of benzene in 1865, showed that it consists of six carbons and six hydrogens, and proposed the following formula:

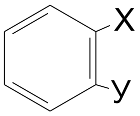


Benzene and its homologues can be represented by the formula CHH2n-6. Based on this formula, benzene should undergo the same coupling reaction as alkenes. But under normal conditions, the benzene molecule is resistant to bromine or oxidizing agents. In a benzene molecule, all carbon and hydrogen atoms are equivalent. If one hydrogen atom is replaced by another group, one derivative is obtained:

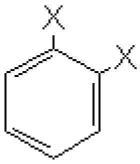


The given formula does not fully reflect the structure of the benzene molecule. Mn, the following two substituted derivatives of the benzene molecule should be two different substances:

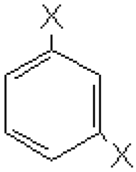




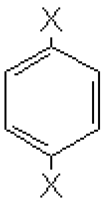
But it is known that there are no such isomers, and both formulas represent the same substance. If there are two substituents and their position on the benzene ring is different, then there are three benzene derivatives:



orto-



meta-



para-

The peculiar nature of the benzene molecule has attracted the attention of chemists for more than 100 years. Finally, in the 1930s, the most modern physical methods and mathematical calculations were used to develop the currently accepted explanations.X-ray structure analysis showed that the length of the CC bond in the benzene molecule is 0.139 nm, the value of the angles is 1200, and the molecule lies in one plane.

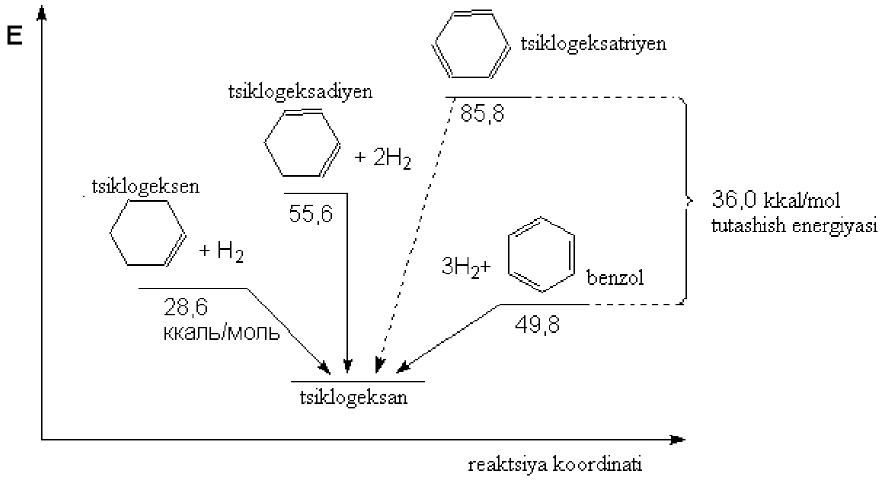
CC bonds in the molecule have an equivalent value. Due to the symmetry of the molecule, the r-orbital of each carbon is covered with the same probability as the r-orbitals of neighboring carbon atoms on both sides. This leads to the formation of a cloud of p-electrons above and below the plane of the benzene ring and their bonding. These electrons are not localized between carbon atoms, but above and below the plane of the benzene moleculeπ-electrons are delocalized in their orbitals.

The fact that each C-C bond consists of three electrons causes the electron clouds to overlap, and as a result, the benzene ring is attached at the top and bottom of the plane.π- causes a cloud of electrons to form and the molecule to remain stable.

The following examples show that the benzene molecule is energetically stable. When a cyclohexane molecule becomes saturated with hydrogen, heat is released because a saturated hydrocarbon is more stable than an unsaturated hydrocarbon.

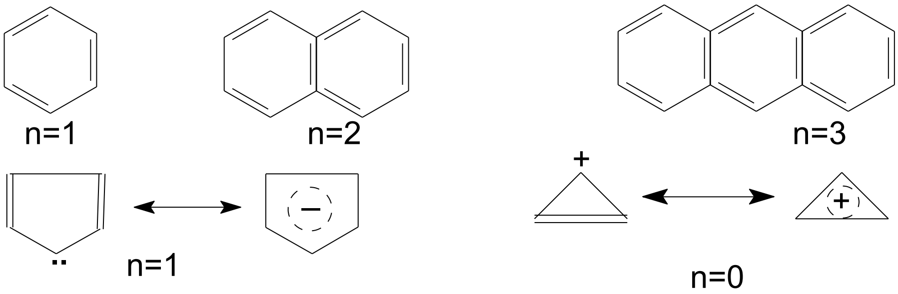
So, the double bond and single bond electrons are connectedπ-organization of the electron system stabilizes the molecule.

In addition, in order for the benzene molecule to react like alkenes, it is necessary to spend additional energy (usually high temperature), which localizes the delocalized electron clouds.



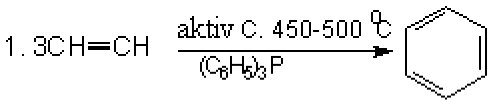
Thus, the simplest concept of aromaticity is systemπ- is the lowest energy of the molecule due to delocalization of electrons.

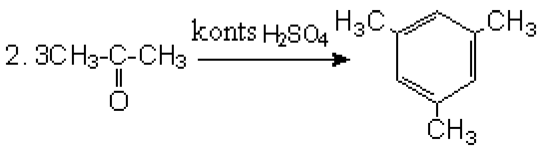
In 1931, as a result of quantum-mechanical calculations, Hückel found a closed-chain, plane-lying generalized 4n+2πconcluded that a molecule with -electron will have aromatic properties (n=0,1,2,3):



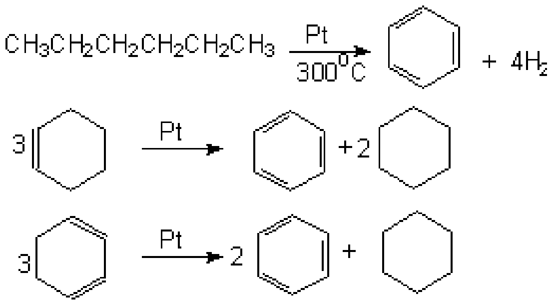
Methods for obtaining aromatic hydrocarbons. Aromatic hydrocarbons such as benzene are found in some oils. Therefore, they can be obtained from oil. Benzene and its homologues can be obtained from the tar produced during coal coking. Dry burning of coal (pyrolysis) is carried out in airless conditions at 10000C. 75-80% of coke (for the metallurgical industry) and coke gas are obtained (consisting of benzene, toluene, xylenes and methane, hydrogen, CO2, ethylene and acetylene). Coal tar: consists of benzene, toluene, xylenes, ethylbenzene, etc. The heavy fraction is a mixture of naphthalene, anthracene, phenanthrene and their derivatives, which is processed and separated into components.

Aromatic hydrocarbons can be synthesized using the following methods:

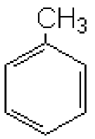


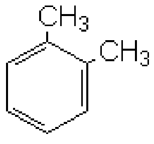


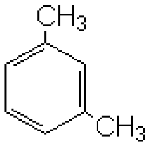
3. Dehydrogenation and cyclization

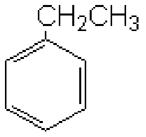


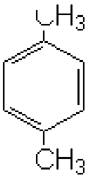
Isomerization and naming

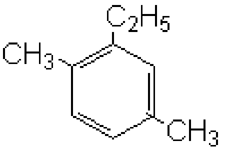

metilbenzol
toluol

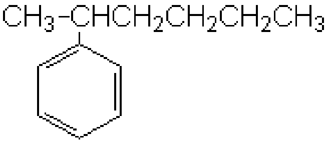

1,2-dimetilbenzol
o-ksilol


1,3 -dimetilbenzol
m-ksilol

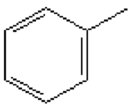

etilbenzol

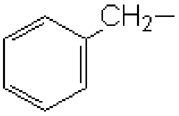

1,4 -dimetilbenzol
p-ksilol


1,4-dimetil-2-etilbenzol


2-fenilgeksan

Radikallar:


fenil-


benzil

PRACTICAL EXERCISE No. 2
ELECTROPHILIC AND NUCLEOPHILIC EXCHANGE REACTIONS IN AROMATIC HYDROCARBONS.

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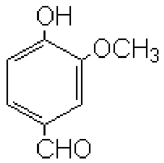
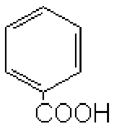
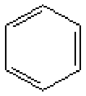


vanilin



benzoy kislota



benzol

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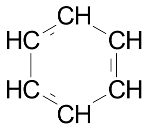

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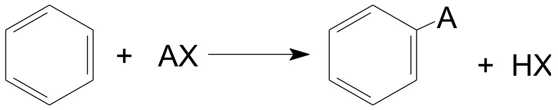

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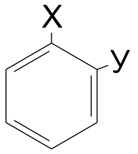

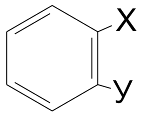

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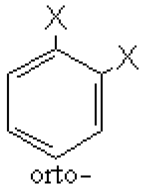
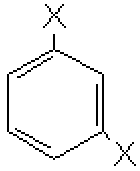
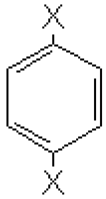


orto-



meta-



para-

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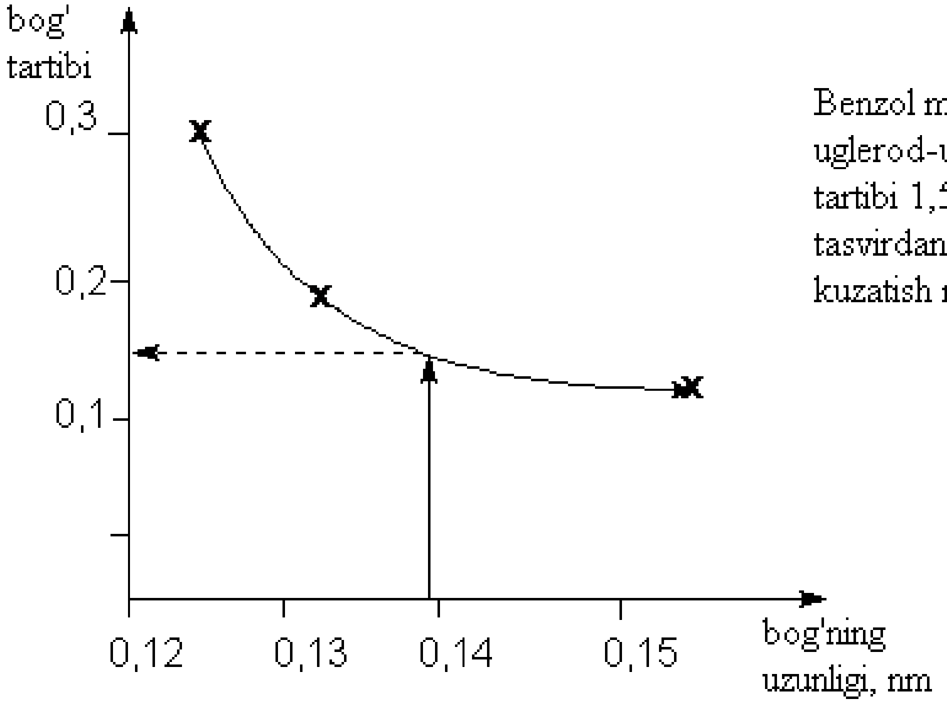
CC bonds in the molecule have an equivalent value. Carbon atoms have 6 sp2 bonds that form a regular hexagon. Due to the symmetry of the molecule, the r-orbital of each carbon is covered with the same probability as the r-orbitals of neighboring carbon atoms on both sides. This leads to the formation of a cloud of p-electrons above and below the plane of the benzene ring and their bonding. These electrons are not localized between carbon atoms, but above and below the plane of the benzene moleculeπ-electrons are delocalized in their orbitals. Each SS bond is a pair of □- electrons andπConsidering that the -bond consists of 1.6 electrons, it can be seen that this bond consists of three electrons, and it becomes clear that the order of the bond is 1.5.



Benzol molekulasida uglerod-uglerod bog'ining tartibi 1,5 ekanligini grafik tasvirdan ham yaqqol kuzatish mumkin

The fact that each C-C bond consists of three electrons causes the electron clouds to overlap, and as a result, the benzene ring is attached at the top and bottom of the plane.π- causes a cloud of electrons to form and the molecule to remain stable.

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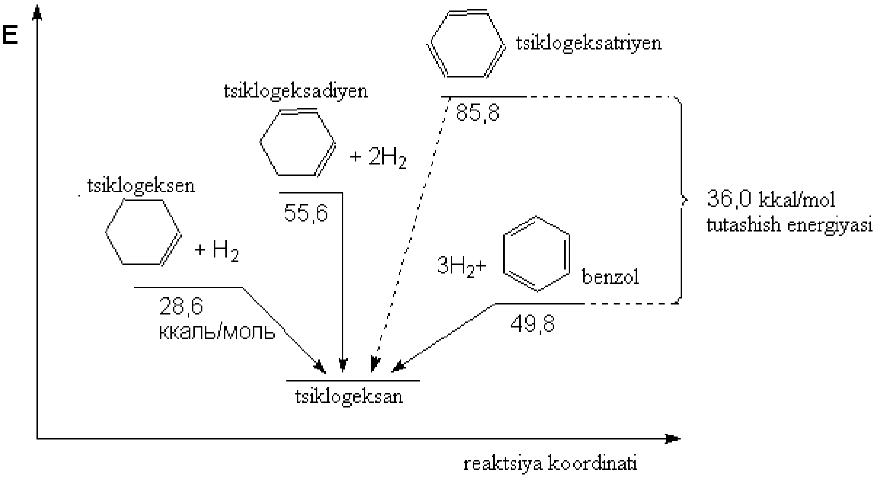

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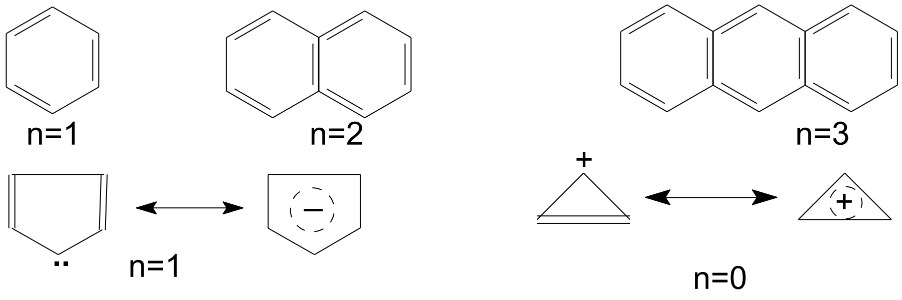

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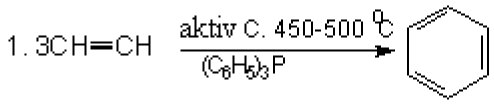
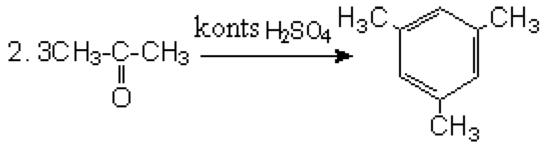
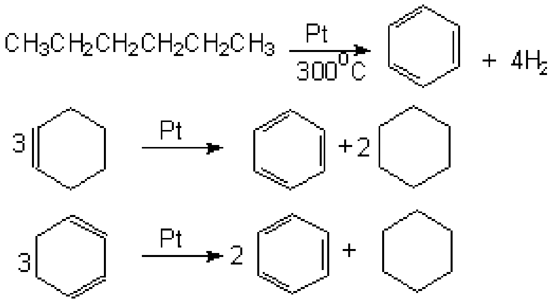
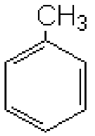




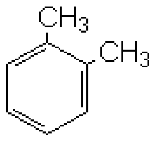
3. Dehydrogenation and cyclization



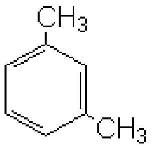
Isomerization and naming



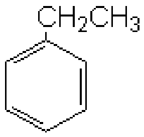
metilbenzol
toluol



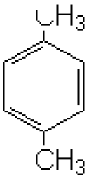
1,2-dimetilbenzol
o-ksilol



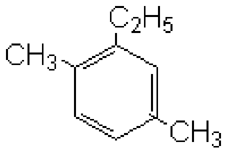
1,3 -dimetilbenzol
m-ksilol



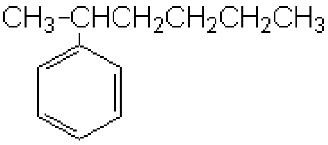
etilbenzol



1,4 -dimetilbenzol
p-ksilol

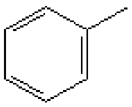


1,4-dimetil-2-etilbenzol

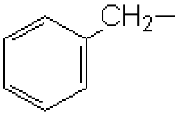


2-fenilgeksan

Radikallar:



fenil-



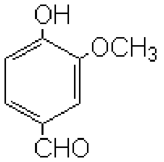
benzil

PRACTICAL EXERCISE No. 3

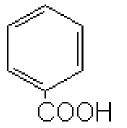
PHENOLS AND PHENOL DERIVATIVES. THEIR USE IN AGRICULTURE AND MEDICINE.

Aromatic hydrocarbons are compounds rich in carbon, having a molecular ring structure, specific chemical bonds, and physical and chemical properties.

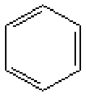
The first representatives of aromatic hydrocarbons were isolated from naturally occurring compounds known as aromatics, which have a characteristic long-lasting smell. Mn, one such compound is vanillin, which has a similar structure to benzoic acid:



vanilin



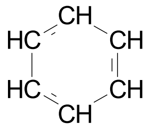
benzoy kislota



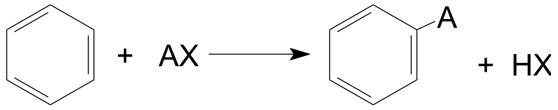
benzol

If we compare these two substances with the benzene molecule, the similarity between them and the connection between "aromaticity" is obvious. Currently, when using the term "aromaticity", it is understood that some unsaturated compounds undergo exchange reactions rather than coupling reactions, and are resistant to temperature and oxidants.

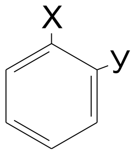
Benzene, the first representative of aromatic hydrocarbons, was synthesized by Faraday in 1825. Kekule determined the structure of benzene in 1865, showed that it consists of six carbons and six hydrogens, and proposed the following formula:

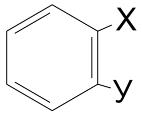


Benzene and its homologues can be represented by the formula CHH2n-6. Based on this formula, benzene should undergo the same coupling reaction as alkenes. But under normal conditions, the benzene molecule is resistant to bromine or oxidizing agents. In a benzene molecule, all carbon and hydrogen atoms are equivalent. If one hydrogen atom is replaced by another group, one derivative is obtained:

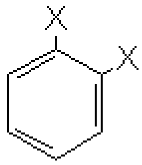


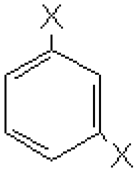
The given formula does not fully reflect the structure of the benzene molecule. Mn, the following two substituted derivatives of the benzene molecule should be two different substances:

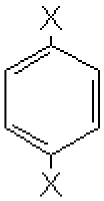




But it is known that there are no such isomers, and both formulas represent the same substance. If there are two substituents and their position on the benzene ring is different, then there are three benzene derivatives:

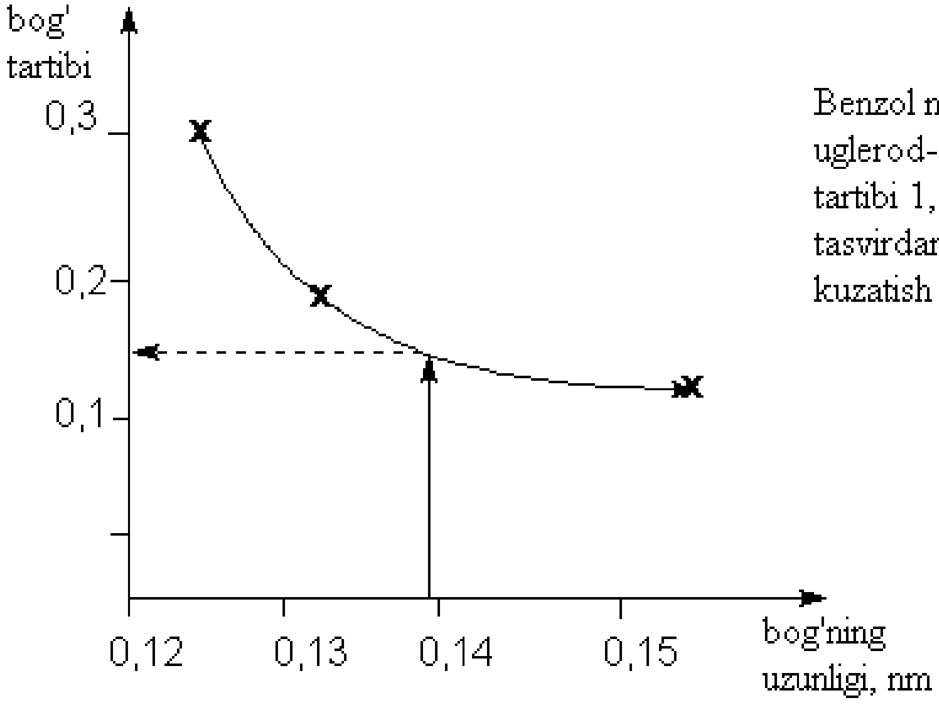

orto-


meta-


para-

The peculiar nature of the benzene molecule has attracted the attention of chemists for more than 100 years. Finally, in the 1930s, the most modern physical methods and mathematical calculations were used to develop the currently accepted explanations.X-ray structure analysis showed that the length of the CC bond in the benzene molecule is 0.139 nm, the value of the angles is 1200, and the molecule lies in one plane.

CC bonds in the molecule have an equivalent value. Carbon atoms have 6 sp2 bonds that form a regular hexagon. Due to the symmetry of the molecule, the r-orbital of each carbon is covered with the same probability as the r-orbitals of neighboring carbon atoms on both sides. This leads to the formation of a cloud of p-electrons above and below the plane of the benzene ring and their bonding. These electrons are not localized between carbon atoms, but above and below the plane of the benzene moleculeπ-electrons are delocalized in their orbitals. Each SS bond is a pair of □- electrons andπConsidering that the -bond consists of 1.6 electrons, it can be seen that this bond consists of three electrons, and it becomes clear that the order of the bond is 1.5.



Benzol molekulasida uglerod-uglerod bog'ining tartibi 1,5 ekanligini grafik tasvirdan ham yaqqol kuzatish mumkin

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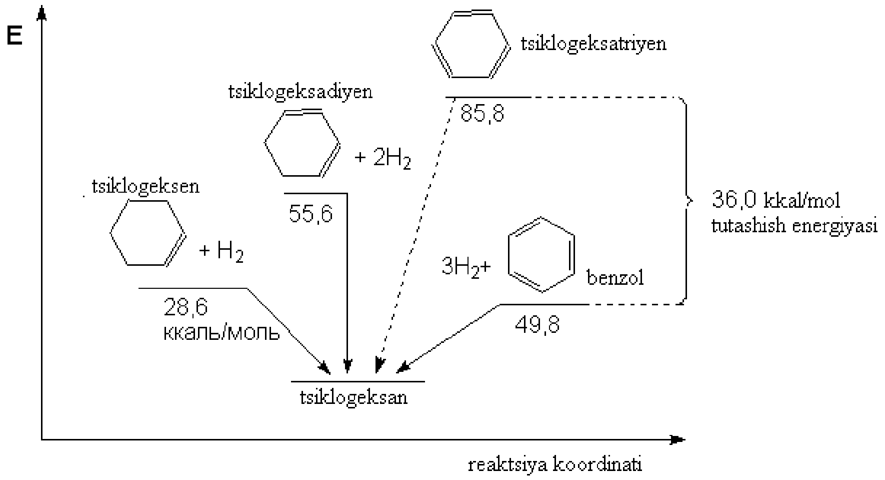

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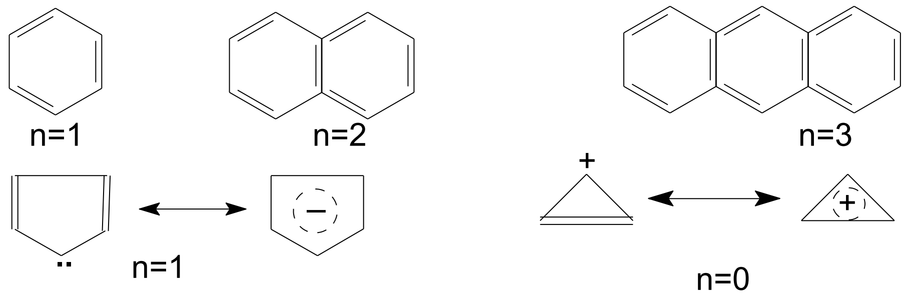

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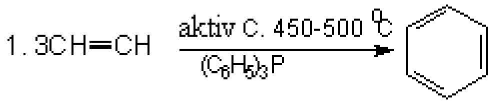

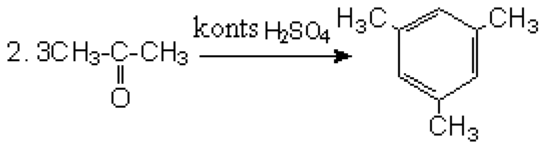

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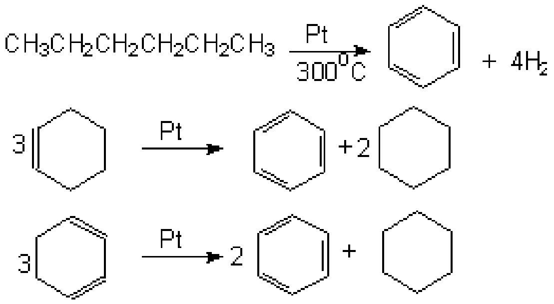
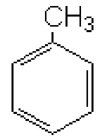
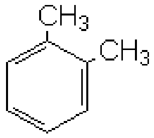


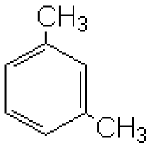
Isomerization and naming



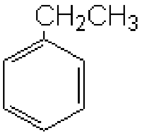
metilbenzol
toluol



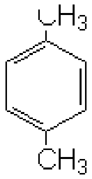
1,2-dimetilbenzol
o-ksilol



1,3 -dimetilbenzol
m-ksilol



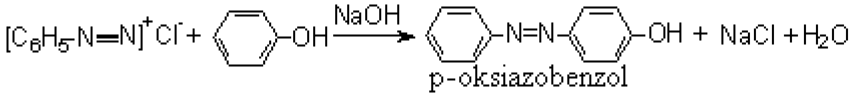
etilbenzol



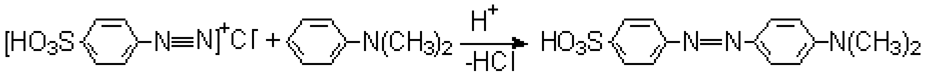
1,4 -dimetilbenzol
p-ksilol

PRACTICAL EXERCISE No.4
AROMATIC AMINES AND DIAZO COMPOUNDS.

Aggregation reaction. As a result of this reaction, important azo dyes are obtained. Diazonium salts react with phenols in a weakly alkaline environment, and with aromatic amines in an acidic environment:



p-oksiazobenzol



p-dimetilaminoazobenzolsulfo-
kislota, metiloranj, bo'yoq

Azo coupling reactions always go to the p-state, and if it is occupied, to the o-state.

Aliphatic diazo compounds

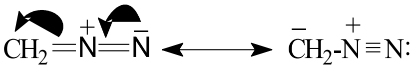
Diazo compounds are compounds that contain 2 nitrogens in their molecule, one of which is ammonium nitrogen.

Aliphatic diazo compounds can be of two types: 1) diazonium salts, 2) diazoalkanes. Diazonium salts are very stable salts because there is no factor that increases the resolution of the positive charge on the ammonium nitrogen:

$$\left[CH_3-\overset{+}{N}\equiv N\right]X^- \xrightarrow{HX} CH_2=\overset{+}{N}=N^- \longleftrightarrow \overset{-}{C}H_2-\overset{+}{N}\equiv N$$

Compared to the diazonium salt, diazomethane is more stable, because it is, firstly, an internal salt, and secondly, negatively charged nitrogen electrons or negatively charged carbon electrons bind due to mesomerism. The diagram above shows the structure of diazomethane in its diazonium salt. Diazoalkanes have a linear structure.

The structure of Mn, diazomethane is as follows: CH2=NQ=N-. Diazomethane can also exist in mesomeric form as follows:



$$CH_2=\overset{+}{N}=\overset{-}{N} \longleftrightarrow \overset{-}{C}H_2\text{-}\overset{+}{N}\equiv N:$$

It is a linear molecule and is an almost non-polar and unstable substance. Diazomethane is obtained by the following methods:

$$CH3\text{-}NH2 + HONO \rightarrow CH2=N+=N- + 2N2O$$

$$CH3\text{-}NH\text{-}CONH2 + HNO2 + N2O \rightarrow CH2=N+=N- + NH3 + CO2$$

$$CH3\text{-}NH\text{-}COOC2H5 + HNO2 + N2O \rightarrow CH2=N+=N-+ CO2 + C2H5OH$$

In practice, the following two methods are used. It is known that as a result of the first reaction, alcohol is formed and nitrogen is released. In fact, this reaction goes through the following steps:

$$CH3NH2.HCl + HONO \rightarrow [CH3\text{-}N^+\equiv N]Cl\text{-}+ 2H2O$$

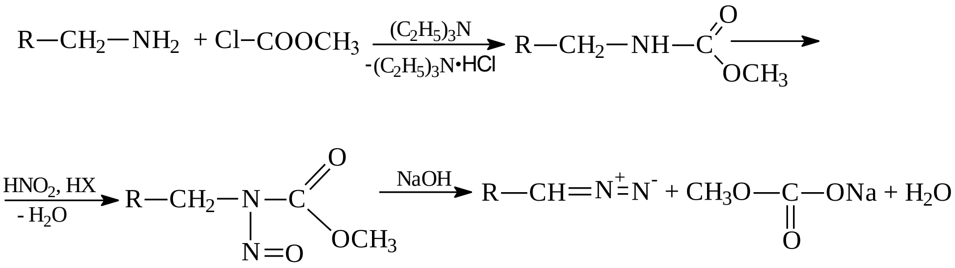
$$CH3\text{-}N+\equiv N + N2O \rightarrow CH3OH + N2 + H+$$

$$CH3\text{-}N+\equiv N \rightarrow [CH2^- — N+\equiv N \leftrightarrow CH2=N+qN\text{-}]+H+$$

Because the resulting methyldiazonium cation is unstable, an alcohol is formed. To increase the resolution of diazomethane, hydrogen atoms in the CH2 group must be exchanged for electron-withdrawing groups. Diazo compounds formed from Mn, glycine ethyl ether, 2,2.2-triftorethylamine include:

N-=N+=CH-COOC2H5 N^-=N+=CH-CF3

When diazomethane itself needs to be obtained from alkylamines, first the alkylamine is acylated, the obtained product is diazotized, and then the acyl group is removed by hydrolysis with alkali. This can be shown by the following scheme:

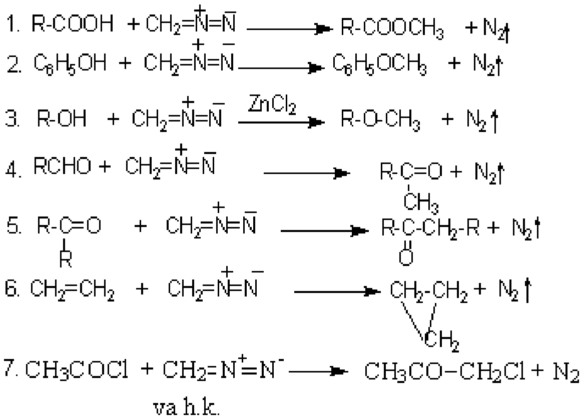


$$R-CH_2-NH_2 + Cl-COOCH_3 \xrightarrow[-(C_2H_5)_3N\cdot HCl]{(C_2H_5)_3N} R-CH_2-NH-C(=O)OCH_3 \longrightarrow$$

$$\xrightarrow[-H_2O]{HNO_2,\ HX} R-CH_2-N(N{=}O)-C(=O)OCH_3 \xrightarrow{NaOH} R-CH=\overset{+}{N}=N^- + CH_3O-C(=O)-ONa + H_2O$$

Diazomethane is a yellow-green, poisonous gas. The ability to react is high. Easily reacts with acids, alcohols, phenols, aldehydes. Resistant to alkalis.

Esterification of carboxylic acids under the action of diazomethane is the easiest way to obtain methyl ester of carboxylic acids.Below are some reactions of diazomethane:



1. $R-COOH + CH_2=\overset{+}{N}=\overset{-}{N} \longrightarrow R-COOCH_3 + N_2\uparrow$
2. $C_6H_5OH + CH_2=\overset{+}{N}=\overset{-}{N} \longrightarrow C_6H_5OCH_3 + N_2\uparrow$
3. $R-OH + CH_2=\overset{+}{N}=\overset{-}{N} \xrightarrow{ZnCl_2} R-O-CH_3 + N_2\uparrow$
4. $RCHO + CH_2=\overset{+}{N}=\overset{-}{N} \longrightarrow R-C(CH_3)=O + N_2\uparrow$
5. $R_2C=O + CH_2=\overset{+}{N}=\overset{-}{N} \longrightarrow R-C(=O)-CH_2-R + N_2\uparrow$
6. $CH_2=CH_2 + CH_2=\overset{+}{N}=\overset{-}{N} \longrightarrow$ cyclo-$(CH_2-CH_2-CH_2)$ $+ N_2\uparrow$
7. $CH_3COCl + CH_2=\overset{+}{N}=N^- \longrightarrow CH_3CO-CH_2Cl + N_2$

va h.k.

If an excess of diazomethane is obtained in the acylation reaction, the hydrogen in the methylene group is exchanged for an acyl group, and the released hydrogen chloride forms methyl chloride with excess diazomethane:

$$CH_3COCl + 2\,CH_2=\overset{+}{N}=N^- \longrightarrow CH_3CO-CH=\overset{+}{N}=N^- + N_2 + CH_3Cl$$

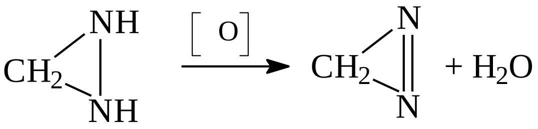
Thus, diazoketone is obtained from diazomethane. This reaction shows that the hydrogens in the diazomethane molecule are mobile. This is also proven by obtaining metal derivatives of diazomethane:

$$CH_2=\overset{+}{N}=N^- + (C_6H_5)_3CNa \longrightarrow NaCH=\overset{+}{N}=N^- + (C_6H_5)_3CH$$

Diazomethane undergoes photochemical decomposition and polymerizes:

$$nCH_2=\overset{+}{N}=N^- \xrightarrow{h\nu} \left[CH_2\right]_n + N_2$$

SchmitS performed the synthesis of diazomethane isomer-cyclic diazomethane:



Cyclic diazomethane is partially isomerized to open-chain diazomethane on heating.

PRACTICAL EXERCISE No.5
HETEROGENEOUS COMPOUNDS, NOMENCLATURE, HANCH-WIDEMANN SYSTEM.

Heterocyclic compounds are compounds whose ring consists of carbon and a hetero atom.

Oxygen, nitrogen and sulfur atoms are mainly involved as heteroatoms in the composition of compounds found in nature.

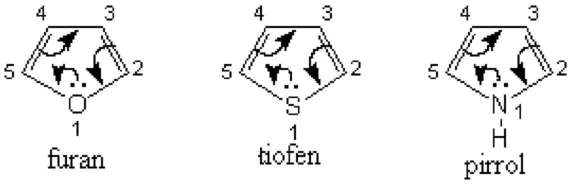
The total number of atoms in heterocyclic compounds can be three, four, five, six and more. But the most stable heterocyclic compounds are five- and six-membered, which are common among natural compounds.

Heterocyclic compounds 1) by the total number of atoms; 2) to the number of heteroatoms; 3) classified according to the number of rings.

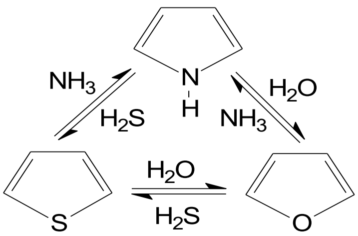
When naming heterocyclic compounds, the numbering of the atoms of the molecule forming the ring begins with the heteroatom.

Five-membered heterocyclic compounds

The most important five-membered heterocyclic compounds are furan, thiophene, and pyrrole, which have oxygen, sulfur, and nitrogen atoms in the ring, respectively:

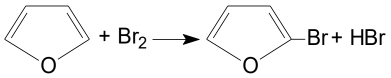


This shows that the structure of compounds is close to each other. In fact, YU.K. Yuryev showed that they can turn into each other. For this, he showed that thiophene or pyrrole is formed by passing a mixture of furan vapors with hydrogen sulfide or ammonia over Al2O3 at 400-450oS:



Electrons of double bonds of furan, thiophene and pyrrole interact with p-electrons of heteroatoms and become singleπ- forms a system of electrons. As a result, these substances exhibit aromatic properties. Therefore, they easily undergo electrophilic substitution reactions (nitration, halogenation and sulfation) and give the corresponding derivatives:

1)



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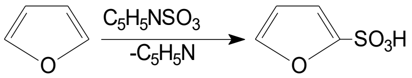

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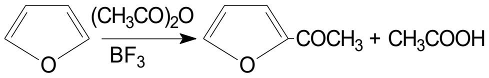

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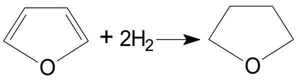

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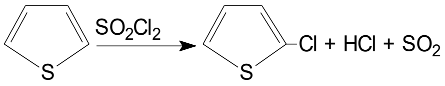

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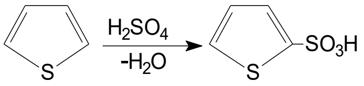

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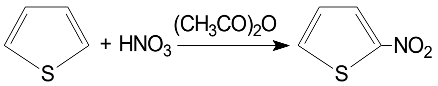

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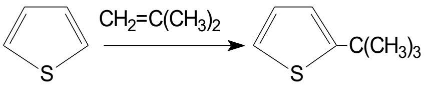

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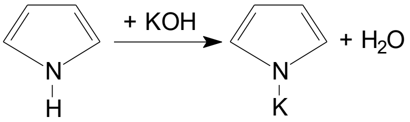

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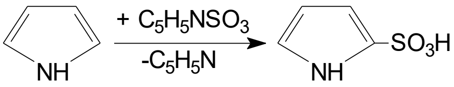

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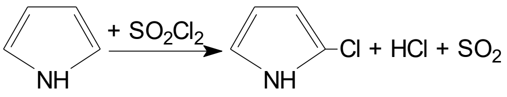

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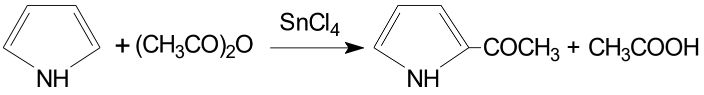

INDEPENDENT WORK TOPICS

No	**Subject Name**	**Hour**
	V semester	
11	Glycol, milk, apple, wine, citric acid.	15
12	Acetoacetic ester, its acidity and tautomerism, formation of compounds with metals, their structure.	15
13	Mspatial isomers of onosaccharides, configurational series. Ring-chain tautomerization, mutarotation.	15
14	Mreactions used to determine the structure and spatial isomers of onosaccharides.	15
15	The occurrence of di- and polysaccharides, carbohydrates in nature and their importance.	15
16	Acid-base properties of amino acids and dependence of their structure on pH. Understanding Peptide Synthesis.	15
17	Diphenyl, triphenylmethane, anthracene, phenanthrene. Ways to get them.	15
18	Diazo and nitrogen compounds, conditions of azo coupling.	15
19	Pyrazole, imidazole, triazole, tetrazole, oxazole, thiazole.	15
20	Pyridine, pyrimidine and quinoline.	15
	V semester	**150**

O‘ZBEKISTON RESPUBLIKASI
OLIY TA’LIM, FAN VA INNOVATSIYALAR VAZIRLIGI

NAMANGAN DAVLAT UNIVERSITETI

O‘QUV-USLUBIY BOSHQARMA

«TASDIQLAYMAN»
O‘quv ishlari bo‘yicha prorektor
_____________ D.Xolmatov
«___» _____________ 2023-yil

ORGANIK KIMYO
FANINING

O‘QUV DASTURI

3-kurs, kunduzgi ta’lim shakli (iqtidorli guruh) uchun

Bilim sohasi: 500000-Tabiiy fanlar, matematika va statistika
Ta’lim sohasi: 530000-Fizika va tabiiy fanlar
Bakalavriat ta’lim yo’nalishi: 60530100-Kimyo (kunduzgi)

NAMANGAN – 2023

<table>
<tr><td colspan="2">**Fan/Modul kodi**
OrK 1518</td><td>**O’quv yili**
2023-2024</td><td>**Semestr**
3-4-5</td><td colspan="2">**ECST-Kreditlar**
18 (2/8/**8**)</td></tr>
<tr><td colspan="2">**Fan/Modul turi**
Majburiy</td><td colspan="2">**Ta’lim tili**
O’zbek</td><td colspan="2">**Xaftadagi dars soatlari**
2/8/**6**</td></tr>
<tr><td rowspan="2">**1**</td><td colspan="2">**Fanning nomi**</td><td>**Auditoriya mashg'ulotlari (soat)**</td><td>**Mustaqil ta’lim (soat)**</td><td>**Jami yuklama (soat)**</td></tr>
<tr><td colspan="2">**Organik kimyo**</td><td>240</td><td>300</td><td>540</td></tr>
</table>

I. FANNING MAZMUNI

Fanning mazmuni. Fanni o’qitishdan maqsad talabalarga organik kimyo asoslarini, organik birikmalarning tuzilishi bilan fizik-kimyoviy xossalarini bog’laydigan umumiy qonunlarni, organik birikmalarni sintez qilishning zamonaviy usullarini, kimyoviy xossalarini nazariy asoslashni, ularning sanoatda, qishloq xo’jaligida, tibbiyotda va boshqa sohalarda qo’llashni o’rgatishdan iborat.

Fanning vazifasi- organik birikmalarning sinflari orasidagi genetik bog’lanishlar, gomologik qatorlarini, izomerlarini, nomlanishini, fizik xossalarini, kimyoviy xossalarining ularning tarkibi, tuzilishi va funksional guruhlarning tabiatiga molekulada joylashish tartibiga, kimyoviy, elektron, fazoviy tuzilishi, muxit va sharoitga bog’liqligini talabalarga o’rgatishdan iborat. Organik kimyo fani xalq xo’jaligi uchun yangi turdagi maxsulotlarni tibbiyot, qishloq xo’jaligi extiyoji uchun biologik faol moddalarni sintez qilishning eng qulay usullarini ishlab chiqishda muxim ro’l o’ynashini talabalarga o’rgatadi.

II. ASOSIY NAZARIY QISM (MA’RUZA MASHG’ULOTLARI)

II.I. Fan tarkibiga quyidagi mavzular kiradi:

1-mavzu. Organik kimyo faniga kirish.

Organik kimyo fanining predmeti va uning rivojlanish tarixi.

2-mavzu. Organik birikmalar tuzilish nazariyasi.

Radikallar, tiplar va boshqa nazariyalar. Butlerovning kimyoviy tuzilish nazariyasi.

3-mavzu. Organik birikmalarning nomlanishi va izomeriyasi.

Organik birikmalarning nomlanishi: Ratsional, tarixiy va sistematik nomenklatura. Organik birikmalarda izomeriya.

4-mavzu. Organik birikmalarning reaksion qobiliyati.

Organik birikmalarda boradigan reaksiyalar. Reaksiya mexanizmlari. Atomlarning o’zaro (mezomer va induksion) ta’siri.

5-mavzu. Organik birikmalarda kimyoviy bog’lanish va uning turlari.

Kimyoviy bog’ va uning turlari. Elementlarning nisbiy elektromanfiyligi. Ion, kovalent va vodorod bog‘lar. Bog‘ning xususiyatlari.

6-mavzu. Organik birikmalarning tuzilishini aniqlash usullari.

Organik birikmalarning sinflanishi. Organik birikmalarning tuzilishini aniqlash usullari.

7-mavzu. Alkanlar.

Alkanlarning gomologik qatori, nomlanishi va izomeriyasi. Alkil radikallar. Alkanlarni olish usullari. Alkanlarning ishlatilishi.

8-mavzu. Alkanlarning kimyoviy xossalari.

Alkanlardagi radikal-zanjir almashinish reaksiyasi mexanizmlari haqida umumiy tushunchalar: galogenlash, sulfoxlorlash, sulfooksidlash, nitrolash, oksidlash reaksiyalari. Kori-Xaus, kross-birikish reaksiyalari. Alkanlarda boradigan elektrofil almashinish reaksiyalari.

9-mavzu. Alkenlar.

Alkenlarning nomlanishi, izomeriyasi. Olinish usullari. Qo'sh bog’ni hosil qilish usullari.

Alkenlarning ishlatilishi.

10-mavzu. Alkenlarning kimyoviy xossalari.

Alkenlarni geterogen va gomogen gidrogenlash. Qo’sh bog’ga kislotalar, galogenvodorodlar, suv va galogenlarning elektrofil birikishi. Markovnikov qoidasi va uning tushuntirish. Elektrofil birikishning fazoviy kechishi. Alkenlarga radikal birikish. Metatezis reaksiyasi. Vodorod bromidning (Karash bo’yicha) birikish yo’nalishining o’zgarishi. Allil tipidagi galogenlash reaksiyalari. Radikal almashinish mexanizmlari.

11-mavzu. Alkinlar.

Alkinlarning nomlanishi va izomeriyasi. Asetilen va uning gomologlarining olinish usullari. sp- gibridlanish tushunchasi asosida uch bog’ning tuzilishini tushuntirish. Alkinlarning ishlatilishi.

12-mavzu. Alkinlarning kimyoviy xossalari.

Kucherov reaksiyasi, spirtlar, karbon kislotalar, karbonil birikmalar, galogenvodorodlar va sianid kislotaning birikishi. Alkinlarning elektrofil va nukleofil birikish reaksiyalari. Alkinlarning kross-birikish reaksiyalari. Vinil boranlar va ular asosida sintezlar.

13-mavzu. Alkadienlar.

Alkadienlarning tuzilishi, nomlanishi, turlari va izomeriyasi. Muhim 1,3-dienlar va ularni degidrogenlash, degidroxlorlash, degidratlash reaksiyalari yordamida olish. Konyugirlangan qo'sh bog’li dienlarning elektron tuzilishi. Kumulenlar. Elektron va fazoviy tuzilishi.

14-mavzu. Alkadienlarning kimyoviy xossalari.

1,3-dienlarning kimyoviy xossalari: katalitik gidrogenlash, galogenlarning va galogenvodorodlarning elektrofil birikishi, bu reaksiyalarning kinetik va termodinamik nazorat sharoitidagi yo’nalishi mahsulotlari.

15-mavzu. Sikloalkanlar.

Nomlanishi va turlari, tuzilishi, izomeriyasi. Siklik birikmalarning sintezi. Sikloalkanlar ishlatilishi.

16-mavzu. Sikloalkanlar kimyoviy xossalari.

Birikish, o’rin olish va oksidlanish-qaytarilish reaksiyalari.

17-mavzu. Monogalogen alkanlar.

Ularning nomlanishi, izomeriyasi. Hosil qilish usullari: to’yingan uglevodoroddagi vodorod atomining almashinishi, qo’sh bog’ga birikish reaksiyalari, spirtlarning gidroksil-guruhini galogenga almashtirish.

18-mavzu. Monogalogen alkanlarning kimyoviy xossalari.

Galogen atomlarining nukleofil almashinish va degidrogalogenlash reaksiyalari. Reaksiya mahsulotlari nisbatining nukleofil va asosning tabiatiga, konsentratsiyasiga, galogenalkanning tuzilishiga, erituvchining tabiatiga bog’liqligi. Galogenalkanlarni vodorod bilan qaytarish, ularning metallar bilan reaksiyasi: metallorganik birikmalar olish. To'yinmagan galogenbirikmalar.

19-mavzu. Bir atomli spirtlar.

Bir atomli to'yingan spirtlar. Spirtlarni olish usullari. Oddiy alifatik spirtlarning sanoatda olinishi. Spirtlarning kimyoviy xossalari: gidroksil guruhining sulfat kislota, galogenovodorodlar, mineral kislotalarning galogenangidridlari ta'sirida almashinishi, degidratlanishi. Spirtlarning oksidlanish-qaytarilish reaksiyalari. Spirtlarning ishlatilishi.

20-mavzu. Ko'p atomli spirtlar va to’yinmagan spirtlar.

Glikollar. Glikollarni olish usullari, kimyoviy xossalari. Di- va polietilenglikollar. Glitserin. Xossalari. Glitserinni sintez qilish usullari. Spirtlarda nukleofil almashinish reaksiyalari. To'yinmagan spirtlar. Allil spirti. Allil spirtining olinish usullari, kimyoviy xossalari.

21-mavzu. Oddiy efirlar va tiollar.

Oddiy efirlarning tuzilishi va nomlanishi. Turlari. Oksiranlar va kraun efirlar. Dialkil efirlarini olish usullari. Tiollarning olinishi.

22-mavzu. Karbonil birikmalar.

Tuzilishi va nomlanishi, turlari. Karbonil guruhini xosil qilish usullari. Aldegidlar va ketonlar.

23-mavzu. Karbonil birikmalarning kimyoviy xossalari.

Karbonil birikmalarda nukleofil birikish va almashinish reaksiyalari. Kondensatsiya reaksiyalari. Keto- enol tautomeriya. Aldol-kroton kondensatsiya reaksiyalari, uning kislotali va asos muhitdagi mexanizmi. Aldegid va ketonlarning oksidlanish-qaytarilish reaksiyalari.

24-mavzu. Karbon kislotalar va ularning hosilalari.

Tuzilishi, turlari va nomlanishi. Olinish usullari. Karbon kislotalarning xossalari va tabiiy manbalari. Karbon kislota hosilalari.

25-mavzu. Dikarbon kislotalar.

Nomlanishi, turlari va tuzilishi. Sintez usullari: Sikloalkanlarni, alisiklik spirtlarni va ketonlarni oksidlash, mono- va dinitrillarning gidrolizi, malon va asetosirka efirlari yordamida sintezlar. Bitta va ikkita karboksil guruhlari bo'yicha hosilalar olish, aralash hosilalar. To'yinmagan monokarbon kislotalar. To'yinmagan dikarbon kislotalar.

26-mavzu. Nitrobirikmalar.

Nomlanishi, turlari va tuzilishi. Nitrobirik-malarni olish usullari. Asi-shakli. Alkanlarni nitrolash (Konovalov reaksiyasi), galogen atomini nitro- guruqga almashtirish, aminlarni oksidlash. Kimyoviy xossalari.

27-mavzu. Aminlar.

Nomlanishi. Turlari. Alifatik uglevodorodlarning galogen-, gidroksi- va amino-hosilalaridan, amidlardan, azidlardan, karbon kislota gidrazidlari va gidroksam kislotalaridan olish usullari. Kimyoviy xossalari.

28-mavzu. Aromatik uglevodorodlar.

Benzol va uning gomologlari, nomlanishi, izomeriyasi. Aromatik uglevodorodlarning manbalari va olish usullari. Benzol halqasining elektron tuzilishi va benzolning kimyoviy xossalari. Aromatiklik haqida tushuncha. Aromatiklikning belgilari. Xyukkel qoidasi. Nobenzoid aromatik sistemalar. Siklopropenil- va tropiliy kationlari. Siklopentadienil-anioni, azulen, annulenlar.

29-mavzu. Aromatik qatordagi elektrofil almashinish reaksiyalari.

Sulfolash, nitrolash, galogenlash, alkillash, atsillash. Bu reaksiyalarning aromatik uglevodorodlarni qayta ishlashdagi ahamiyati, mexanizmlari haqida tushuncha va ularni tajribada asoslash. s- va p-komplekslar. Benzol halqasidagi o'rinbosarlarning reaksiya mahsulotlarining izomer tarkibiga va reaksiya tezligiga ta'siri.

Aromatik uglevodorodlarda halqaga va yon zanjirga boradigan radikal, elektrofil va nukleofil reaksiyalar mexanizmlari. Reaksiyalarning energetik tasviri. Reaksiya tezligini belgilovchi bosqich.

30-mavzu. Aromatik qatorda nukleofil almashinish reaksiyalari.

Aromatik uglevodorodlarda boradigan nukleofil reaksiyalar mexanizmlari. Reaksiyalarning energetik tasviri. Reaksiya tezligini belgilovchi bosqich.

31-mavzu. Aromatik galoidbirikmalar.

Olinish usullari. Aromatik uglevodorodlarni galogenlash, diazoniy tuzlaridan olish. Galogen-uglerod bog’i uzilishi hisobiga ketadigan reaksiyalar. Aromatik galoidbirikmalarning metallar bilan ta'sirlanishi: metallorganik birikmalarni olish. Kross-birikish reaksiyalari. Elektrofil almashinish reaksiyalari. O'rinbosarlarning induksion va mezomer ta'siri haqida tushuncha. Galogen atomlarining o'rinbosar sifatida ta'siri. Galogen atomi tutgan aromatik uglevodorodlarda nukleofil almashinish reaksiyalari mexanizmlari.

32-mavzu. Aromatik nitrobirikmalar.

Aromatik nitrobirikmalarning olinishi va xossalari. Nitrolovchi reagentlar. Nitro-guruhning elektrofil almashinish reaksiyasi tezligiga va yo'nalishiga ta'siri. Nitrobirikmalarning qisman qaytarilish mahsulotlari. Nitro-birikmalarning tautomerlanishi, dimerlanish, kondensatsiya reaksiyalari.

33-mavzu. Aromatik uglevodorodlarning gidroksilli hosilalari.

Nomlanishi. Fenol va uning gomologlari. Olinish usullari va fizik-kimyoviy xossalari. Naftollar. Aromatik yadroga gidroksil- guruhi kiritish usullari. Fenollarning kislotalik xususiyatlari. Fenollarning o'ziga xos reaksiyalari. Gidroksil- guruhni himoyalash. Aromatik spirtlar. Aromatik uglevodorodlar va ular hosilarining qo'llanilishi.

34-mavzu. Aromatik karbonil birikmalar.

Aromatik aldegidlarga xos xususiyatlar. Aromatik-alifatik qator ketonlari, ularni olish va kimyoviy xossalari. Ularning oksimlari va fazoviy tuzilishi. Bekman qayta guruhlanishi.

35-mavzu. Aromatik karbon kislotalar.

Almashingan benzoy kislotalarning dissotsiyalanish konstantasiga o'rinbosarlarning ta'siri. Aromatik karbon kislotalar sintez qilishning umumiy usullari. Benzoy kislotasi va uning hosilalari. Salitsil va sulfosalitsil kislotalar. Dolchin kislotasi, olinishi va xossalari. Antranil kislotasi, olinishi va uning ishlatilishi.

36-mavzu. Aromatik aminlar.

Aromatik aminlarning turlari. Aromatik yadrodagi o'rinbosarlar tabiati va joylashishining aminlar asosligiga ta'siri. Amino- guruhning benzol yadrosiga ta'siri: Elektrofil almashinish reaksiyalari. Amino- guruhni himoyalash. Aromatik aminlarning qo'llanilishi.

37-mavzu. Diazobirikmalar.

Alifatik va aromatik diazobirikmalar. Diazotirlash reaksiyasi, uni amalga oshirish sharoitining amin tuzilishiga bog’liqligi. Diazotirlovchi agentlar va reaksiya sharoitlari. Diazobirikmalarning azot chiqishi bilan boradigan reaksiyalari: diazoguruhni vodorodga, galogenlarga, gidroksil-, sian- va nitro- guruhlariga almashtirish. Diazobirikmalarning azot chiqmasdan boradigan reaksiyalari. Azobo'yoqlar sintezi. Qaytarish reaksiyalari, triazenlar hosil bo'lishi. Diazobirikmalarning qo'llanish sohalari.

38-mavzu. Geterofunksional birikmalar.

Gidroksikislotalar. Aldegido- va ketokislotalar. Nomlanishi va turlari. Alifatik gidroksikislotalar olishning umumiy usullari. Reformaskiy reaksiyasi asosida β-gidroksikislotalarni sintez qilish. Gidroksikislotalarning tabiiy manbalari va asosiy vakillari. Kimyoviy xossalari.

39-mavzu. Besh a’zoli geterosiklik birikmalar.

(furan, tiofen, pirrol), ular sintezining umumiy usuli va o'zaro aylanishlari (Yurev). Furan, tiofen, pirrol va benzolning fizik-kimyoviy xossalarini taqqoslash. Olinishi, fizik va kimyoviy xossalari. Azot, kislorod va oltingugurt tutgan besh a'zoli geterosiklik birikmalar.

40-mavzu. Olti a’zoli geterosiklik birikmalar.

Olti a'zoli geterosiklik birikmalarning aromatikligi. Piridin olinish usullari. Geterosiklik birikmalarda elektrofil, nukleofil almashinish, yon zanjirda radikal almashinish reaksiyalari. Piridin xosilalarini ishlatilishi.

41-mavzu. Metalorganik birikmalar. Magniy-, litiy-, natriy-, rux- va misorganik.

Kimyoviy xossalari. Misorganik birikmalarning olinishi va organik sintezda qo’llanilishi. Kross-birikish reaksiyalari. Xek reaksiyasi. Palladiyorganik birikmalar asosida allillash reaksiyalari.

42-mavzu. Uglevodlar.

Klassifikatsiyasi va tuzilishi. Monosaxaridlar. Aldozalar. Izomeriyasi, konfiguratsiyasi, genetik qatorlari. Monosaxaridlarning yopiq zanjirli shakllari. Tautomeriya. Mutarotatsiya. Ketozalar. Monosaxaridlarning xossalari. Glikozidlar. Monosaxaridlar tuzilishini aniqlash. Di- va oligosaxaridlar. Polisaxaridlar. Kraxmal. Glikogen. Inulin. Sellyuloza. Geteropolisaxaridlar. Ligninlar.

43-mavzu. Aminokislotalar va oqsillar.

Nomlanishi va turlari. Tabiiy α-aminokislotalarning tuzilishlari bo'yicha xillari. Sintez qilish usullari. Oqsillar. Turlari. Polipeptidning tuzilishi, aminokislota tarkibini aniqlash va polipeptid zanjiridagi aminokislota qoldiqlarining tarkibini aniqlash usullari haqida tushuncha. Oqsillarning tuzilishi. Oqsillar denaturatsiyasi.

44-mavzu. Organik birikmalarning biologik faolligi.

Pestitsidlarning klassifikatsiyasi. Gerbitsidlar. Fungitsidlar. Insektitsidlar. O‘simlik o‘sishini boshqaruvchi birikmalar. Defoliantlar. Repellentlar. Attraktantlar (feromonlar). Xemosterilizatorlar. Prostaglandinlar. Tabiiy pestitsidlar.

45-mavzu. Organik reaksiyalarda boradigan qo'shimcha jarayonlar.

Reaksiyalarning muqobil sharoitlari. Reaksiya yo'nalishiga substrat va reagent tuzilishi, erituvchi tabiati va turli omillarning ta'siri. Organik birikmalarning sanoat, qishloq xo’jaligi, tibbiyot va boshqa sohalarda qo’llanilishi. O’zbekiston olimlarining organik kimyo faniga qo’shgan xissalari.

II.2. MA’RUZA MAVZULARINING TAQSIMLANISHI

№	Mavzular	Soati
	III semestr	
1	Organik kimyo faniga kirish.	2
2	Organik birikmalar tuzilish nazariyasi.	2
3	Organik birikmalarning nomlanishi va izomeriyasi.	2
4	Organik birikmalarning reaksion qobiliyati.	2
5	Organik birikmalarda kimyoviy bog’lanish va uning turlari.	2
6	Organik birikmalarning tuzilishini aniqlash usullari.	2
	III semestr bo’yicha	**12**
	IV semestr	
7	Alkanlar.	2
8	Alkanlarning kimyoviy xossalari.	2
9	Alkenlar.	2
10	Alkenlarning kimyoviy xossalari.	2
11	Alkinlar.	2
12	Alkinlarning kimyoviy xossalari.	2
13	Alkadienlar.	2
14	Alkadienlarning kimyoviy xossalari.	2
15	Sikloalkanlar.	2
16	Sikloalkanlar kimyoviy xossalari.	2
17	Monogalogen alkanlar.	2
18	Monogalogen alkanlarning kimyoviy xossalari.	2
19	Bir atomli spirtlar.	2
20	Ko'p atomli spirtlar va to’yinmagan spirtlar.	2
21	Oddiy efirlar va tiollar.	2
22	Karbonil birikmalar.	2
23	Karbonil birikmalarning kimyoviy xossalari.	2
24	Karbon kislotalar.	2
25	Dikarbon kislotalar.	2
26	Nitrobirikmalar.	2
27	Aminlar.	2
28	Geterofunksional birikmalar.	2
	IV semestr bo’yicha	**44**
	V semestr	
29	Aromatik uglevodorodlar.	2
30	Aromatik qatordagi elektrofil almashinish reaksiyalari.	2
31	Aromatik qatorda nukleofil almashinish reaksiyalari.	2
32	Aromatik galloidbirikmalar.	2

33	Aromatik nitrobirikmalar.	2
34	Aromatik uglevodorodlarning gidroksilli hosilalari.	2
35	Aromatik karbonil birikmalar.	2
36	Aromatik karbon kislotalar.	2
37	Aromatik aminlar.	2
38	Diazobirikmalar.	2
39	Besh a’zoli geterosiklik birikmalar.	2
40	Olti a’zoli geterosiklik birikmalar.	2
41	Metalorganik birikmalar.	2
42	Uglevodlar.	2
43	Aminokislotalar va oqsillar.	2
44	Organik birikmalarning biologik faolligi.	2
45	Organik reaksiyalarda boradigan qo'shimcha jarayonlar.	2
	V semestr bo’yicha	**34 soat**
	Umumiy soat:	**90 soat**

III.1. AMALIY MASHG‘ULOT MAVZULARI

1-amaliy mashg‘ulot. Organik birikmalarda kislota va asoslilik.

Louri-Brensted nazariyasi, L’yuis nazariyasi, kuchli kislota, anionlarning asosli xususiyati, Organik moddalarning kislotali yoki asosli xususiyatlari, Kislotalilik yoki asoslilik tushunchalari

2-amaliy mashg‘ulot. Induksion va mezomer ta’sir.

Organik birikmalarda boradigan reaksiyalar. Reaksiya mexanizmlari. Atomlarning o’zaro (mezomer va induksion) ta’siri. Induktsion ta`sir va uning xos xususiyatlari. Induktsion ta`sirning ishorasi (yo`nalishi) va kuchini aniqlash usullari, Mezomer ta`sir va uning o`ziga xos xususiyatlari. mezomeriya momenti.

3-amaliy mashg‘ulot. Radikal almashinish reaksiyalari.

Ma’lum bo‘lgan organik birikmalarning turli-tumanligi va ko‘pligi, Organik birikmalarning tez o‘zgaruvchanligi. Ular harorat ta’sirida suyuqlanadi, parchalanadi va oson yonadi, Organik birikmalar tarkibining murakkabligi, Organik birikmalar dissotsiyalanmaydi, chunki uglerod-uglerod orasidagi bog‘ kovalent bog‘dir, Organik birikmalarning reaksiyalari sekin vaqtning o‘tishi bilan boradi. Organik birikmalarda izomeriya hodisasi mavjud.

4-amaliy To’yinmagan uglevodorodlarda boradigan radikal birikish reaksiyalari va mexanizmlari.

Organik birikmalarda boradigan reaksiyalar. Reaksiya mexanizmlari. Atomlarning o’zaro (mezomer va induksion) ta’siri. Induktsion ta`sir va uning xos xususiyatlari. Induktsion ta`sirning ishorasi (yo`nalishi) va kuchini aniqlash usullari, Mezomer ta`sir va uning o`ziga xos xususiyatlari. mezomeriya momenti.

5-amaliy mashg‘ulot. Etilen uglevodorodlarida radikal almashinish reaksiyalari.

Organik birikmalarning tez o‘zgaruvchanligi. Ular harorat ta’sirida suyuqlanadi, parchalanadi va oson yonadi, Organik birikmalar tarkibining murakkabligi, Organik birikmalar dissotsiyalanmaydi, chunki uglerod-uglerod orasidagi bog‘ kovalent bog‘dir,

Organik birikmalarning reaksiyalari sekin vaqtning o‘tishi bilan boradi. Organik birikmalarda izomeriya hodisasi mavjud.

6-amaliy mashg‘ulot. Olefinlarda boradigan metatezis reaksiyalari.

Organik birikmalarda boradigan reaksiyalar. Reaksiya mexanizmlari. Atomlarning o’zaro (mezomer va induksion) ta’siri. Induktsion ta`sir va uning xos xususiyatlari. Induktsion ta`sirning ishorasi (yo`nalishi) va kuchini aniqlash usullari, Mezomer ta`sir va uning o`ziga xos xususiyatlari. mezomeriya momenti

7-amaliy mashg‘ulot. Galloidbirikmalar. Elimirlanish reaksiyalari. E1 va E2 reaksiya mexanizmlari. Galloidbirikmalar asosida metallorganik birikmalarni sintez

qilish.

Organik birikmalarning tez o‘zgaruvchanligi. Ular harorat ta’sirida suyuqlanadi, parchalanadi va oson yonadi, Organik birikmalar tarkibining murakkabligi, Organik birikmalar dissotsiyalanmaydi, chunki uglerod-uglerod orasidagi bog‘ kovalent bog‘dir,

Organik birikmalarning reaksiyalari sekin vaqtning o‘tishi bilan boradi. Organik birikmalarda izomeriya hodisasi mavjud.

8-amaliy mashg‘ulot. Bir, ikki va ko’p atomli spirtlar. Mukoyama, mitsunobu reaksiyalari.

Organik birikmalarda boradigan reaksiyalar. Reaksiya mexanizmlari. Atomlarning o’zaro (mezomer va induksion) ta’siri. Induktsion ta`sir va uning xos xususiyatlari. Induktsion ta`sirning ishorasi (yo`nalishi) va kuchini aniqlash usullari, Mezomer ta`sir va uning o`ziga xos xususiyatlari. mezomeriya momenti

9-amaliy mashg‘ulot. Aldegid va ketonlar. Kondensatsiya reaksiyalari.

Organik birikmalarning tez o‘zgaruvchanligi. Ular harorat ta’sirida suyuqlanadi, parchalanadi va oson yonadi, Organik birikmalar tarkibining murakkabligi, Organik birikmalar dissotsiyalanmaydi, chunki uglerod-uglerod orasidagi bog‘ kovalent bog‘dir,

Organik birikmalarning reaksiyalari sekin vaqtning o‘tishi bilan boradi. Organik birikmalarda izomeriya hodisasi mavjud.

10-amaliy mashg‘ulot. Vittig, Mixail reaksiyalari. Perisiklik reaksiyalar.

Organik birikmalarda boradigan reaksiyalar. Reaksiya mexanizmlari. Atomlarning o’zaro (mezomer va induksion) ta’siri. Induktsion ta`sir va uning xos xususiyatlari. Induktsion ta`sirning ishorasi (yo`nalishi) va kuchini aniqlash usullari, Mezomer ta`sir va uning o`ziga xos xususiyatlari. mezomeriya momenti

11-amaliy mashg‘ulot. Aromatiklik. Benzol halqasi tutmagan aromatik sistemalar. Aromatik birikmalarda elektrofil almashinish.

Organik birikmalarning tez o‘zgaruvchanligi. Ular harorat ta’sirida suyuqlanadi, parchalanadi va oson yonadi, Organik birikmalar tarkibining murakkabligi, Organik birikmalar dissotsiyalanmaydi, chunki uglerod-uglerod orasidagi bog‘ kovalent bog‘dir,

Organik birikmalarning reaksiyalari sekin vaqtning o‘tishi bilan boradi. Organik birikmalarda izomeriya hodisasi mavjud.

12-amaliy mashg‘ulot. Aromatik uglevodorodlarda boradigan elektrofil va nukleofil almashinish reaksiyalari.

Organik birikmalarda boradigan reaksiyalar. Reaksiya mexanizmlari. Atomlarning o’zaro (mezomer va induksion) ta’siri. Induktsion ta`sir va uning xos xususiyatlari. Induktsion ta`sirning ishorasi (yo`nalishi) va kuchini aniqlash usullari, Mezomer ta`sir va uning o`ziga xos xususiyatlari. mezomeriya momenti

13-amaliy mashg‘ulot. Fenollar va fenollarning xosilalari. Ularning qishloq xo’jaligida va tibbiyotda ishlatilishi.

Organik birikmalarning tez o‘zgaruvchanligi. Ular harorat ta’sirida suyuqlanadi, parchalanadi va oson yonadi, Organik birikmalar tarkibining murakkabligi, Organik birikmalar dissotsiyalanmaydi, chunki uglerod-uglerod orasidagi bog‘ kovalent bog‘dir,

Organik birikmalarning reaksiyalari sekin vaqtning o‘tishi bilan boradi. Organik birikmalarda izomeriya hodisasi mavjud.

14-amaliy mashg‘ulot. Aromatik aminlar va diazobirikmalar.

Organik birikmalarda boradigan reaksiyalar. Reaksiya mexanizmlari. Atomlarning o’zaro (mezomer va induksion) ta’siri. Induktsion ta`sir va uning xos xususiyatlari. Induktsion ta`sirning ishorasi (yo`nalishi) va kuchini aniqlash usullari, Mezomer ta`sir va uning o`ziga xos xususiyatlari. mezomeriya momenti.

15-amaliy mashg‘ulot. Geteroxalqali birikmalar, nomlanishi, Ganch-Videman sistemasi.

Organik birikmalar tarkibining murakkabligi, Organik birikmalar dissotsiyalanmaydi, chunki uglerod-uglerod orasidagi bog‘ kovalent bog‘dir, Organik birikmalarning reaksiyalari sekin vaqtning o‘tishi bilan boradi. Organik birikmalarda izomeriya hodisasi mavjud.

III.2. AMALIY MASHG‘ULOT MAVZULARINI TAQSIMLANISHI

№	Amaliy mashg‘ulot mavzulari	Soati
	III semestr	
1	Organik birikmalarda kislota va asoslilik.	2
2	Induksion va mezomer ta’sir.	2
	III semestr bo’yicha	**4**
	IV semestr	
3	Radikal almashinish reaksiyalari.	2
4	To’yinmagan uglevodorodlarda boradigan radikal birikish reaksiyalari va mexanizmlari.	2
5	Etilen uglevodorodlarida radikal almashinish reaksiyalari.	2
6	Olefinlarda boradigan metatezis reaksiyalari.	2
7	Galloidbirikmalar. Elimirlanish reaksiyalari. E_1 va E_2 reaksiya mexanizmlari. Galloidbirikmalar asosida metallorganik birikmalarni sintez qilish.	2
8	Bir, ikki va ko’p atomli spirtlar. Mukoyama, mitsunobu reaksiyalari.	2
9	Aldegid va ketonlar. Kondensatsiya reaksiyalari.	2
10	Vittig, Mixail reaksiyalari. Perisiklik reaksiyalar.	2
	IV semestr bo’yicha	**16**
	V semestr	
11	Aromatiklik. Benzol halqasi tutmagan aromatik sistemalar. Aromatik birikmalarda elektrofil almashinish.	2
12	Aromatik uglevodorodlarda boradigan elektrofil va nukleofil almashinish reaksiyalari.	2
13	Fenollar va fenollarning xosilalari. Ularning qishloq xo’jaligida va tibbiyotda ishlatilishi.	2
14	Aromatik aminlar va diazobirikmalar.	2
15	Geteroxalqali birikmalar, nomlanishi, Ganch-Videman sistemasi.	2
	V semestr bo’yicha	**10**
	Umumiy jami:	**30**

IV.1. LABORATORIYA MASHG’ULOTLAR MAVZULARI

1-laboratoriya mashg’uloti. Texnika xavfsizlik qoidalari. Kimyoviy idishlar.

Texnika xavfsizlig, Kimyo laboratoru=iya mashg’ulotlarini olib borish qoidalari.Yonuvchi, portlovchi va zaharli moddalar bilan ishlash qoidalari. Kuyganda va zaharlanganda ko‘rsatiladigan birinchi yordam. Kimyo laboratoriyada qo’llaniladigan idishlar va jihozlar

2-laboratoriya mashg’uloti. Organik moddalarni tozalash va ularning fizik doimiyliklarini aniqlash.

Ikkita suyuq modda aralashmasini atmosfera bosimida haydash uchun tajribalar: benzol-anilin, aseton-toluol, benzol-ksilol, xloroform-toluol. Erituvchilardan qayta kristallash va suyuqlanish temperaturalarini aniqlash uchun tajribalar: benzoy kislota, gidroxinon,rezorSin, asetanilid. Mikrohaydash usuli bilan tozalash. Sublimasiya usulida naftalin, benzoy kislota, xinon, saliSil kislotalarni tozalash. Xromatografiya. Yupqa qatlam xromatografiyasi-adsorbentning aktivligini Brokman bo’yicha aniqlash. Ikki komponentli aralashmani analiz qilish uchun aralashmalar: nitroanilinlar, nitrofenollar. Ikki komponentli aralashmani xromatografik kolonkada ajratish. Qog’oz xromatografiyasi yordamida o,p-nitroanilinlar, o,m-nitroanilinlar, izomer nitrofenollar, aminokislatalar aralashmalarini ajratish uchun tajribalar.

3-laboratoriya mashg’uloti. Alifatik qatoridagi adikal almashinish reaksiyalari.

Radikallarni xosil bo’lishi, reaksiyaning tartibi, reaksiyaning molekulyarligi, zanjir reaksiyalari. Ikki komponentli aralashmani xromatografik kolonkada ajratish. Qog’oz xromatografiyasi yordamida o,p-nitroanilinlar, o,m-nitroanilinlar, izomer nitrofenollar, aminokislatalar aralashmalarini ajratish uchun tajribalar.

4-laboratoriya mashg’uloti. To’yingan uglerod atomida boradigan elektrofil almashinish reaksiyalari.

Elektrofil almashinish mexanizmi haqidagi umumiy tushunchalar. va komplekslar.

5-laboratoriya mashg’uloti. To’yingan uglerod atomida boradigan nukleofil almashinish reaksiyalari.

Galloid alkillardagi galogen almashinish reaksiyalari. va mexanizmi. Spirtlarni, nitrillarni, nitrobirikmalarni, aminlarni, oddiy efirlarni, fenollarni (Vilyamson reaksiyasi), tio efirlarni, merkaptanlarni, kislota efirlarini galloid alkillardan olinishi. Bu reaksiyalardagi fazalararo katalizi haqidagi tushuncha. Galoid hosilalar tuzilishining reaksiya borishiga almashinish mexanizmiga tasiri. Reagentlarning nukleofilligiga, asosliligiga, qutblanganligiga, solvataSiyasiga bog’liqligi. Ambident nukleofillar, Kornblyum koidasi.

6-laboratoriya mashg’uloti. Elektrofil birikish reaksiyalari.

Elektrofil tasir mexanizmlari, reaksiya bosqichlari, peroksidlar ishtirokidagi reaksiyalar. Spirtlarni, nitrillarni, nitrobirikmalarni, aminlarni, oddiy efirlarni, fenollarni (Vilyamson reaksiyasi), tio efirlarni, merkaptanlarni, kislota efirlarini galloid alkillardan olinishi. Bu reaksiyalardagi fazalararo katalizi haqidagi tushuncha. Galoid hosilalar tuzilishining reaksiya borishiga almashinish mexanizmiga tasiri.

7-laboratoriya mashg’uloti. To’yinmagan uglerod atomidagi nukleofil almashinish reaksiyalari.

Eterifikasiya va pereeterifikasiya reaksiyalari. Murakkab efirlarning diazometan yordamida karbon kislotalarning tuzlari yordamida olinishi,kislota hosilalari va ularning nukleofil reagentlar bilan ta'sirlashuvi. Murakkab efirlarning kislotali va ishqorli gidrolizi.

sp2-gibridlangan uglerod atomida boradigan nukleofil almashinish reaksiyalari bo’yicha bajariladigan sintezlar: etilasetat, butilasetat, etilbenzoat, benzanilid, amilasetat, izoamilasetat, propilasetat, (-naftilasetat, (-naftilbenzoat, asetanilid.

8-laboratoriya mashg’uloti. Spirtlarda boradigan nukleofil almashinish reaksiyalari.

Spirtlardagi gidroksilni nukleofil almashinish reaksiyasi. Spirtlardan galoid hosilalarni, oddiy efirlarni mineral kislota efirlarni olinishi. Bu reaksiyalarning kislotali katalizi. Oddiy efirlarning galoid vodorod kislotalari tasirida parchalanishi.

sp3-gibridlangan uglerod atomida boradigan nukleofil almashinish reaksiyalari bo’yicha bajariladigan sintezlar etilbromid, n-propilbromid, n-butilbromid, etil yodid, yodoform, xlorsiklogeksan, uchl.- butilxlorid, dibutil efir, diizoamil efir, dioksan-1,4, etilyodid.

9-laboratoriya mashg’uloti. Karbonil birikmalarning kondensasiya va tautomeriya reaksiyalari.

Aldol va kroton kondensasiyasi. Bu reaksiyada karbonil birikmalarning tuzilishi va reaksion qobiliyatiga bog’liqligi. Asosli va kislotali katalizning roli. Aldegid va ketonlarning o’zaro kondensasiyasi, asetosirka efiri bilan malon efiri bilan, nitrobirikmalari bilan kondensasiyalari. Knovengel va Perkin reaksiyalari. Yuqoridagi reaksiya mexanizmidagi umumiylik. Murakkab efir kondensasiyasi. Diefirlarning (Dikman reaksiyasi) ichki molekulyar kondensaSiyasi. Mannix reaksiyasi (aminoasillash). Keto-enol tautomeriyasi. Enolizasiya vaktida kislotali, asosli katalizning roli. Tiol formalarining mustahkamligi. Natriy aSetosirka efiri Ikkilamchi reaksion qobiliyati, asetosirka va malon efiri yordamidagi sintezlar.

Karbonil birikmalarning kondensasiya va tautomeriya reaksiyalari bo’yicha bajariladigan sintezlar benzalaseton, dibenzalaseton, asetosirka efiri, benzoilaseton, benzalasetofenon, 1,3,5-trifenilbenzol, dolchin kislota, benzalanilin, fenolftalein, pentaeritrit.

10-laboratoriya mashg’uloti. Organik birikmalarning oksidlanish reaksiyalari.

Oksidlanish. Organik kimyodagi oksidlanish reaksiyalarining o’ziga xosligi. Etilen bog’ining oksidlanishi: - oksidlarni olinishi (Prilijaeva reaksiyasi) 1,2-diollarni olinishi. Vagner reaksiyasi. Vodorod peroksidi yordamida gidroksillash. Ozonlash reaksiyasi. Qo’shbog’ o’rnini aniqlash uchun oksidlash reaksiyasini qo’llash. Aktivlantirilgan metil va metilen gruppasini oksidlash: aromatik karbon kislotalarini, aldegidlarni, ketonlarni alkilbenzoldan olish. Fenol va aSetonni sintezlashda kumol prosessi. Amil tipidagi spirtni olish. Spirtni oksidlash:degidrogenlash, Openauor reaksiyasi, spirtlardan aldegid, keton va dikarbon kislotalarni olish, aldegid va ketonlarni oksidlash. -dikarbonilli birikmalarni selen oksidi yordamida sintezi(-metilen zanjirini oksidlash). Aromatik yadroni oksidlash:xinonlar sintezi, malein va ftal angidridini olinishi, ozonlash. Oksidlash reaksiyalarida funksional gruppalarni himoyalash usullari (karbonil,amin,gidroksil gruppalari)

11-laboratoriya mashg’uloti. Organik birikmalarning qaytarilish reaksiyalari.

Qaytarish reaksiyalari. Asetilen va etilen bog’li uglevodorodlarni suyuq ammiak eki spirtda metallar yordamida qaytarish.

Qo’shbog’larni katalitik gidrogenlash. Spirtlarni va fenollarni uglevodorodlarni olish, spirtlarni olish alyumogidrid litiy, natriy borgidrid), Meerveyn-Pandorf, KoniSarro, Tishenko reaksiyalari, ketonlardan pinakondlarni olish, pinakolin qayta taqsimlanishi. Qaytarilish reaksiyasining elektron mexanizmi. Kislota va uning hosilalarini qaytarish: aldegidlarning Rozenkund buyicha olinishi, spirtlarning olinishi (alyumogidrid litiy. Buvo-Blan metodi) Amid, nitril, oksimlarni qaytarib aminlarni olish. Ketonlarni qaytarib aminlash (Leykart reaksiyasi). Gidrogenlash katalizatorlari va ularni tayerlash usullari. Siklogeksan katoridagi moddalarni olishda aromatik uglevodorodlarni katalitik gidrogenlash.

Organik birikmalarning oksidlanish-qaytarilish reaksiyalari bo’yicha bajariladigan sintezlar benzoy kislota, izoftal kislota, tereftal kislota, butanol-2, benzgidrol, antron, aseton, adipin kislota, antraxinon, benzaldegid, toluxinon, benzil spirti, ftal kislota, xinon, gidrodolchin kislota, siklogeksanol, siklogeksan, metilfenilkarbinol.

12-laboratoriya mashg’uloti. Organik birikmalarni aniqlash reaksiyalari.

Organik birikmalarning funkSional guruhlarini va moddalarning bir xilligini aniqlash.

Fizik usullar. IQ-spektroskopiya. To’lqin spektrlar. Valent va defarmaSion tebranish. Xarakteristik, tavsif chastotalar haqida tushuncha. IQ-spektroskopiya bajaraoladigan vazifalar va Yo’nalishlar: moddaning spektri va tuzilishini solishtirish, aniqlash (identifikaSiya), funkSional tahlil.

Elektron spektroskopiya. UB-spektr tabiati. Elektron utishlar ultrabinafsha va kuriladigan (vidimiy)spektr kismida paydo bo’lganlari. Polosalar klassifikaSiyasi. UB-spektroskopiyasi bajaraoladigan vazifalar va Yo’nalishlar: aniqlash va mikdoriy tahlil. Tutashish (sopryajenie) tasirini aniqlash. YMR spektrlari. Magnit maydonida protonning o’zini tutishi. RelaksaSiya vakti.

- Molekulada proton xolatini xarakterlaydigan belgi kimyoviy siljish. Teng bo’lmagan protonlar tasirida piklarning parchalanishi. PMR spektriga qarab organi modda tuzilishi haqida fikr yuritish. Qog’oz, yupqa qavatli, gazsuyuqliklik xromatografiyalarni va monoforezni moddalarni aniqlashda qo’llanishi.

Organik moddalarda funksional gruppalarni aniqlashda kimyoviy usullar. Spirtlar. Ksantogenat va gidraksam sinovi. Lukas sinovi, mis tuzlari ishqorli eritmalarining tasiri. Ayrim hosilalari: uretanlar, benzoy, p-nitrobenzoy, 3,5-dinitrobenzoy va 3-nitroftal kislotali murakkab efirlar, xlorli benziltiuroniy bilan tuzlari. Gidroksilli birikmalar IK-spektrlari. Fenollar. Temir xlorid bilan sinov, brom, ishqor tasiri. Hosilalari: uretanlar, difeniluretanlar, 3,5-dinitrobenzoy kislota efirlari, bromlash maxsulotlari. Aldegid va ketonlar. feling reaktivi bilan sinov. Benedikt. Tollens reaktivlari. Fuksinsernistaya kislota, yodoform bilan sinovlar. Aldegid va ketonlarning hosilalari: 2,4-dinitrofenilgidrazonlar, semikarbazonlar, oksimlar, dimedon hosilalari. IQ va UB spektrlarda CO-polosasi. Kislotalar. Suyultirilgan natriy asosi, bikarbonat va karbonat natriy eritmalaridagi eruvchanlik, gidroksam sinovi, kumush va kurgoshin tuzlarini chuktirish. Hosilari: amidlar, anilidlar, toluididlar, benziltiuroniytuzlari, nitro benzil va fenaSilefirlari. Aminlar. Suyultirilgan kislotalarda eruvchanligi,karbilamin sinovi, diazolash va azobirikish. Hosilalar: mochevina va tiomochevina almashinganlari, amidlar, ftalamin kislotalari, to’rtlamchi ammoniy tuzlari, pikratlar, pikrolanatlar. Ionoforez va qog’oz xromotogrammasi orqali aminokislotalarni aniqlash. Aminlar va amidlarning IQ-spektrlari. Nitro birikmalar gidrat zakis temir bilan sinov, nitrit kislotaning birlamchi vaikkilamchi alifatik nitrobirikmalarga tasiri. Konovalov reaksiyasi (temir xlorid bilan sinov). Nitrogruppaning spektrlardagi ko'rinishi. Galogen hosilalar. Belshteyn sinovi, kumush nitrat bilan sinov. Aril galogenidlar, galloidalmashgan nitro hosilalar va arilsulfamidli hosilalar. Qo'shbog'li moddalar. Uglerod to'rt xlorid eritmasiga brom tasiri, kaliy permanganat eritmasini rangsizlantirish.

13-laboratoriya mashg'uloti. Aromatik qatordagi elektrofil o'rin almashinish reaksiyalari.

Elektrofil almashinish mexanizmi haqidagi umumiy tushunchalar. va komplekslar. O'rinbosarlarning xalqaning reaksion qobiliyatiga tasiri va orentaSiya yo'naltirish koydalari. Elektrodonor va elektronoakseptor o'rinbosarlar, ularning yo'naltirish qobiliyati. Galogenlar yo'naltirish qobiliyatining o'ziga xos tomonlari. Kelishilgan va kelishilmagan yo'naltirish (orentaSiya).

C-X bog' hosil bo'lish reaksiyalari. Benzol va uning gomologlari, naftalinni nitrolash sharoitlari. Nitroniy kationi roli. Nitrat kislotaning oksidlash qobiliyati natijasidagi qo'shimcha maxsulotlar. Aromatik aminlar va fenollarni nitrolashdagi maxsus sharoitlar. Benzol va uning gomologlarini, naftalin, antraxinon, fenol va naftollarni, anilinni sulfolash sharoitlari. Sulfolash reaksiyasining qaytarligi. Sulfokislotalarni ajratish va ularni aniqlash. Sulfokislotalarning funksional hosilalari. Sulfogruppani elektrofil va nukleofil almashinish. Galogenni aromatik xalqaga va en zanjirga kiritish shart sharoitlari. Ikkala reaksiya mexanizmlarining farqlari, xamda bu galogenhosilalarning hosilalarining farqi Galogenlovchi agentlar.

C - C bog'larning hosil bo'lishi bilan boradigan reaksiyalar. Fridel-Krafs reaksiyasi orqali uglevodorod va ketonlarning sintezlari. Alkillovchi (galloid alkillar, olefinlar, spirtlar) va asillovchi (galoidangidridlar va kislota angidridlari) reagentlar. Katalizatorlar va ular ta'sirining mexanizmi. Fridel-Krafs buyicha alkillash prosessidagi qo'shimcha prosesslar-izomerlanish, polialkillash, dezalkillash. Fris qayta taqsimlanishi (peregruppirovkasi). Aromatik aldegidlar sintezi. Gatterman, Vilsmeyer, Reymer-Timan reaksiyalari.

14-laboratoriya mashg'uloti. Aromatik birikmalarni alkillash va atsillash.

Aromatik qatordagi elektrofil o'rin almashinish reaksiyalari. Nitrolash bo'yicha bajariladigan sintezlar nitrobenzol, dinitrobenzol, m-nitrobenzoy kislota, o- va p-nitrofenol, p-nitroanilin, (-nitronaftalin, pikrin kislota, m-nitrobenzaldegid, o- va p-nitrotoluol, p-nitroasetanilid. Galoidlash bo'yicha bajariladigan sintezlar brombenzol, p-bromtoluol, 2,4,6-tribromfenol, p-bromasetanilid, p-bromanilin, 2,4,6-tribromanilin, p-yodanilin, p-bromanizol, (-bromnaftalin. Alkillash va asillash bo'yicha bajariladigan sintezlar o- va p-benzilfenol, izopropilbenzol, asetofenon, benzofenon, o- va p-Siklogeksilfenol, difenilmetan, 1-ikilamchi-butil-4-metilbenzol, 1-metil-4-izopropilbenzol, o- va p-benziltoluol, o- va p-benziletilbenzol, 2-benzil-p-ksilol, 2-benzoil-p-ksilol, p-asetilanizol, 4-metilbenzofenon. Sulfolash bo'yicha bajariladigan sintezlar p-toluolsulfokislota, sulfanil kislota, benzolsulfoxlorid, naftion kislotaning natriyli tuzi, (-naftalinsulfokislota (natriyli tuzi), 4-fenolsulfokislota.

15-laboratoriya mashg'uloti. Aromatik qatordagi nukleofil o'rin almashinish reaksiyalari.

Nukleofil almashinish reaksiyalari. Elektroakseptor o'rinbosar tutgan galoidarillardagi galogenni nukleofil almashinish reaksiyalari. Sulfogruppani gidroksil va sian gruppasiga almashtirish. Elektronoakseptor o'rinbosar tutgan aromatik xalqaning vodorodini gidroksil va aminogruppaga almashtirish. Bu reaksiyalardagi orientasiya koidalari P-Nitrozodialalkilanilinlardan ikkilamchi aminlarnining sintezi. Degidrobenzol hosil bo'lish boskichi orqali boradigan nukleofil almashinish reaksiyalari.

16-laboratoriya mashg'uloti. Diazo- va azobirikmalar.

Diazolash reaksiyasi. Diazolash agentlari. Diazolash sharoiti va bu reaksiyaning borishi ustidan kontrol. Diazolashda qo'shimcha jarayonlar va uni oldini olish. Diaminlar va aminofenollar diazolash. Aromatik diazobirikmalar, ularning tuzilishi va tautomer shakllari. Diazobirikmalarning geterolitik va gomolitik parchalanishi. Diazobirikmani gidroksilga, alkoksil va vodorodga, galloidga va sianogruppaga (Zandmyer), arilradikallarga (Gatterman, Gomberg) almashinish reaksiyalari. To'yinmagan birikmalarni galloidarillash (Meerveyn), Nesmeyanov reaksiyasi. Diazobirikmalarni arilgidrozinlargacha qaytarish.Azobirikish reaksiyalari va uning mexanizmi.

Fenollar va aminlar bilan birikish sharoiti. Azobo'yoqlar. Geleantin va p-nitro anilin kizilining tuzilishi.

Diazo- va azobirikmalar. Diazobirikmalarda azot chiqishi bilan boradigan reaksiyalar bo’yicha bajariladigan sintezlar fenol, p-krezol, p-bromtoluol, m-nitroxlorbenzol, m-krezol, yodbenzol, 2,4,6-tribrombenzol, xlorbenzol, 2-yodtoluol, p-dinitrobenzol. Diazobirikmalarda azot chiqmasdan boradigan reaksiyalar bo’yicha bajariladigan sintezlar (-naftoloranj, p-nitroanilin, diazoaminobenzol, geliantin, qizil kongo, metil qizili, barqaror qizil bo’yoq, diazoaminobenzol, p-aminoazobenzol

17-laboratoriya mashg’uloti. Geterosiklik birikmalar sintezi.

Tiofen, furan, pirrol, piridin katoridagi moddalarni bifunkSional hosilalaridan:diollarda, dikarbonil birikmalardan, dikarbon kislotalar va ularning hosilalaridan, xamda aldegid va ammiakdan (Chichibabin), aSetouksus efiri, aldigidlar va ammiak (Ganch) olish. Kodensirlangan geterosiklik sistemalarni sintezi: aromatik amin va gliSerindan xinolin katoridagi (SkrauS), aromatik amin va alifatik aldegidlardan xinolin katoridagi (Debner-Miller), Fisher buyicha indol sintezi. Kumarin, indigo benzimidazol olishda orta-dialmashgan benzol hosilalarini qo’llash, furan, tiofen va pirrollarning bir-biriga utkazish (Yurev).

Oddiy geterosiklik sistemalarning aromatik xossalari, aromatikligining sababi. Piridin va pirroldagi geteroatom xossalari. Furan, tiofen, pirrol, piridin katoridagi eliktrofil almashinish reaksiyalari. Benzol katoridagi birikmalar bilan solishtiring.

Piridin va xinolindagi nukleofil almashinish reaksiyalari: amid natriy bilan reaksiya (Chichibabin), ishqorli kaliy va fenillitiy ta'siri.

18-laboratoriya mashg’uloti. Metallorganik birikmalar yordamida sintezlar

Magniyorganik birikmalarning hosil bo’lish sharoiti. Magniyni aktivlashtirish, erituvchining reaksiya borishiga tasiri. Erituvchi bo’lmagan sharoitda Shorigin usuli buyicha magniyorganik birikmani olish. Magniyorganik birikmalar olishdagi qo’shimcha reaksiyalar: to’yingan va to’yinmagan uglevodorodlarning hosil bo’lishi. Bu reaksiyalarga galogenning tabiati va radikallar tuzilishining tasiri. Magniyorganik birikmalarning galogen bilan,aktiv vodorod atomi tutgan birikmalar bilan (suv, spirt, fenol, asetilen) reaksiyalari. Iosich kompleksi. Magniy organik birikmalarni spirtlar olinishida (bu sintezdagi qo’shimcha reaksiyalar), aldegidlar, ketonlar, karbon kislotalar olishda qo’llanilishi. Magniy organik birikmalarni to’yinmagan uglevodorodlar bilan reaksiyalarning o’ziga xosligi. Rux organik birikmalarning oksi kislotalar efirlari va to’yinmagan kislotalar (ReformaSkiy reaksiyasi) sintez uchun qo’llanilishi. Litiy organik birikmalar uchun magniy organik birikmalarga karaganda yaxshi va yomon tomonlari, xususiyatlari Natriyorganik birikmalar, ular yordamida alifatik (Vyurs reaksiyasi) va to’yingan aromatik uglevodorodlar (Vyurs- Fittiga reaksiyasi) sintezi. Reaksiya sharoiti va mexanizmi. Bu sintezlardagi qo’shimcha maxsulotlar.

Metallorganik birikmalar yordamida sintezlar: n-oktan, n-dekan, dibenzil, propilbenzol, benzoy kislota, benzgidrol, difeniletan, n-butilbenzol, dietilmetilkarbinol, trifenilkarbinol.

IV.2.LABORATORIYA MASHG‘ULOTI MAVZULARINI TAQSIMLANISHI

№	Laboratoriya mashg‘uloti mavzular	Soat
	III semester	
1	Texnika xavfsizlik qoidalari. Kimyoviy idishlar.	6
2	Organik moddalarni tozalash va ularning fizik doimiyliklarini aniqlash.	8
	III semestr bo’yicha	**14**
	IV semestr	
3	Alifatik qatoridagi adikal almashinish reaksiyalari.	6
4	To’yingan uglerod atomida boradigan elektrofil almashinish reaksiyalari.	6
5	To’yingan uglerod atomida boradigan nukleofil almashinish reaksiyalari.	6
6	Elektrofil birikish reaksiyalari.	6
7	To’yinmagan uglerod atomidagi nukleofil almashinish reaksiyalari.	6
8	Spirtlarda boradigan nukleofil almashinish reaksiyalari.	6
9	Karbonil birikmalarning kondensasiya va tautomeriya reaksiyalari.	6
10	Organik birikmalarning oksidlanish reaksiyalari.	6
11	Organik birikmalarning qaytarilish reaksiyalari.	6
12	Organik birikmalarni aniqlash reaksiyalari.	6

	IV semestr bo'yicha	**60**
	V semestr	
13	Aromatik qatordagi elektrofil o'rin almashinish reaksiyalari.	8
14	Aromatik birikmalarni alkillash va atsillash.	8
15	Aromatik qatordagi nukleofil o'rin almashinish reaksiyalari.	8
16	Diazo- va azobirikmalar.	8
17	Geterosiklik birikmalar sintezi.	8
18	Metallorganik birikmalar yordamida sintezlar	6
	V semestr bo'yicha	**46**
	Jami	**120**

V. MUSTAQIL TA'LIM VA MUSTAQIL ISHLAR

№	Mustaqil ta'lim mavzusi
	III semestr
1	Organik birikmalarning nomenklaturasi va izomeriyasi
2	Organik birikmalarning fazoviy tuzilishi va gibritlanish.
	IV semestr
3	Alkenlarning elektron tuzilishi va geometrik izomeriya.
	Gidroborlash (Braun reaksiyasi) va uning qo'sh bog'ni gidrogenlash va gidratlash mahsulotlarini olishda ishlatilishi.
5	Alkenlarni epoksidlash, sis- va trans-gidroksillash (Vagner reaksiyasi), ozonlash, 1,3-butadienni n-butandan, etil spirtidan, izopropenni atseton va atsetilendan, 2-metilbutandan olish.
6	Metatezis va kross-birikish reaksiyalari.
7	Dikarbonil birikmalarni olish.
8	Malon kislota. Asetosirka va malon efirining xossalari va undan sintezlarda foydalanish.
9	Akril, metakril kislotalar va ular xosilalarining olinishi va ishlatilishi.
10	Nitrobirikmalarning tautomeriyasi va atsi- shaklining reaksiyalari.
	V semestr
11	Glikol, sut, olma, vino, limon kislota.
12	Atsetosirka efiri uning kislotaliligi va tautomeriyasi, metallar bilan birikmalar xosil qilishi, ularning tuzilishi.
13	Monosaxaridlarning fazoviy izomerlari, konfiguratsion qatorlar. Halqa-zanjirli tautomerlanish, mutarotasiya.
14	Monosaxaridlarning tuzilishi va fazoviy izomerlarni aniqlashda ishlatiladigan reaksiyalar.
15	Di- va polisaxaridlar, uglevodlarning tabiatda uchrashi va ularning ahamiyati.
16	Aminokislotalrning kislota-asoslik xossalari va ularning tuzilishini pH ga bog'liqligi. Peptid sintezi haqida tushuncha.
17	Difenil, trifenilmetan, antrasen, fenantren. Ularni olish usullari.
18	Diazo- va azotuzuvchilar, azobirikish sharoitlari.
19	Pirazol, imidazole, triazol, tetrazol, oksazol, tiazol.
20	Piridin, pirimidin va xinolin.

VI.1.KURS ISHI MAVZULARI BANKI

(Kurs ishi mavzulari banki talaba sonidan 15-20% ga ortiqcha bo'ladi)

Organik birikmalarning kislota va asas xossalari.	Bimolekulyar nukleofil o'rin olish reaksiyasi (S_n2)
Karbazol.	Dekarboksillash
Organik birikmalarda sp2-gibridlanish	Diazobirikmalar
iroksin	Etil spirti va uning axamiyati
To'yinmagan ikki asosli karbon kislotalar	Fazoviy izomerlar (stereoizomerlar)

Galloidalkanlar	Fenollar
Oddiy terpen va terpenoidlar	Fosfororganik birikmalar
To’yinmagan ketonlar	Funksional guruh
Indol	Galloidalk nlar va galloidarenlar
Organik birikmalarda kimyoviy bog’lanish	Galloidkarbon kislotalar
Izomeriya	Gistidin
Organik birikmalarda mezomer effekt	Glikozidlar
Organik reaktsiyalar	Imidazol.
Ketonlar	Izoxinolin
Konfiguratsiya	Karotinoidlar
Pikolin	Kauchuklar
Konformatsiya	Kraun efirlari
Pirazol	Kremniyorganik birikmalar
Ko’p atomli spirtlar	Lakton
Piridin	Lipidlar
Ko’p yadroli aromatik uglevodorodlar	Merkaptanlar
Pirimidin	Monokarbon kislotalar
Organik birikmalar tuzilishini aniqlashning fizik-kimyoviy usullari	Monomolekulyar nukleofil o’rin olish reaksiyasi (S_n1)
Laktam	Mutarotatsiya
Pirrol	Nikotin
Litiyorganik birikmalar	Noorganik kislotalarning murakkab yefirlari
Pirrolidin	Nukleofil
Magniyorganik birikmalar	Oltingugurtorganik birikmalar
Pirrolin	Optik izomeriya
Steroidlar	Organik birikmalarda induktiv effekt
Markovnikov qoidasi	Organik birikmalarda sp3-gibridlanish
Purin	Organik birikmalarda sp-gibridlanish
Aminokislotalar	Organik birikmalarning biologik faolligi
Monosaxaridlar	Pikolin kislota.
Sulfolan	Piperidin.
Murakkab efirlar	Piroksin
Tiazol	Pirosliz kislota
Nikotin kislota	Poliprenollar
Tiofen	Polisaxardlar
Geterofunksional birikmalar	Sikloalkanlar
Oksazol	Sikloalkenlar
Nitrolash	Sulfolash
Nomenkdatura	To’yingan spirtlar
To’yinmagan bir asosli karbon kislotalar	To’yinmagan aldegadlar
Oddiy efirlar	To’yinmagan spirtlar
Karboksillash	Yelektrofil (elektronni yoqtiraman)
Organik kimyoning rivojlanish tarixi	Yenantiomerlar
Bororganik birikmalar	Yepimerlar
Boshlang’ich struktura	Zaytsev qoidasi
Degidrogalogenlash	Aldegidlar
Degitratlanish	Alifatik aminlar
Geterohalqali birikmalar	Alkadienlar
Oraliq metallarning organik birikmalari	Alkanlar
Diastereomerlar	Alkenlar

Dikarbon kislotalar	Alkinlar
Disaxaridlar	Alyuminiyorganik birikmalar
Gibridlanish	Amidlar
Fenilalanin	Aromatik aminlar
Fenilpiridin	Aromatik bo’lmagan geterohalqali birikmalar
Furan	Aromatik uglevodorodlar (arenlar)
Guanin	Aromatiklik
Furfurol	Azobirikmalar

Kafedrada kurs ishini tashkil etish bo’yicha uslubiy ko’rsatma ishlab chiqiladi va talabalarga yetkaziladi. Shu uslubiy ko’rsatma asosida kurs ishlarini qabul qilinadi va baholanadi.

VII. FAN O‘QITILISHINING NATIJALARI (SHAKLLANADIGAN KOMPETENTSIYALAR)

Fanni o’zlashtirish natijasida talaba:

“Organik kimyo” fanini o’zlashtirish jarayonida amalga oshiriladigan masalalar doirasida bakalavr:

- organik birikmalarni nomlash usullarini bilish kerak;
- organik sinf birikmalarining zamonaviy sintez usullarini bilishi shart;
- organik birikmalarning fizik va kimyoviy xossalarni ularning tarkibi, kimyoviy tuzilishi va molekulaning fazoda joylashishiga bog’liqligini bilishi kerak;
- reaksiya mexanizmlarni yozib atroflicha tushuntirib berishni, organik moddalarni tibbiyotda, qishloq xo’jaligi, mudofaa va boshqa sohalarda qo’llash ko’nikmasiga ega bo’lishi kerak.

VIII. TA’LIM TEXNOLOGIYALARI VA METODLARI

- ✓ ma’ruzalar;
- ✓ interfaol keys-stadilar;
- ✓ mantiqiy fikrlash, tezkor savol-javoblar;
- ✓ guruhlarda ishlash;
- ✓ taqdimotlarni tayyorlash;
- ✓ individual loyihalar;
- ✓ jamoa bo’lib ishlash va ximoya qilish uchun loyihalar

IX. KREDITLARNI OLISH UCHUN TALABLAR

Fanga ajratilgan kreditlar talabalarga har bir semestr bo’yicha nazorat turlaridan ijobiy natijalarga erishilgan taqdirda taqdim etiladi.

Fan bo’yicha talabalar bilimini baholashda oraliq (ON) va yakuniy (YaN) nazorat turlari qo’llaniladi. Nazorat turlari bo’yicha baholash: 5 – “a’lo”, 4 – “yaxshi”, 3 – “qoniqarli”, 2 – “qoniqarsiz” baho mezonlarida amalga oshiriladi.

Oraliq nazorat har semestrda bir marta og’zaki yoki yozma ish shaklida o’tkaziladi.

Talabalar semestrlar davomida fanga ajratilgan amaliy (seminar) mashg’ulotlarda muntazam, har bir mavzu bo’yicha baholanib boriladi va o’rtachalanadi. Bunda talabaning amaliy (laboratoriya) mashg’ulot hamda mustaqil ta’lim topshiriqlarini o’z vaqtida, to’laqonli bajarganligi, mashg’ulotlardagi faolligi inobatga olinadi.

Shuningdek, amaliy (laboratoriya) mashg’ulot va mustaqil ta’lim topshiriqlari bo’yicha olgan baholari oraliq nazorat turi bo’yicha baholashda inobatga olinadi. Bunda har bir oraliq nazorat turi davrida olingan baholar o’rtachasi oraliq nazorat turidan olingan baho bilan **qayta o’rtachalanadi**.

O’tkazilgan oraliq nazoratlardan olingan baho **oraliq nazorat natijasi** sifatida qaydnomaga rasmiylashtiriladi.

Yakuniy nazorat turi semestrlar yakunida tasdiqlangan grafik bo’yicha **o’g’zaki** yoki **yozma ish** shaklida o’tkaziladi.

Oraliq (ON) va yakuniy (YaN) nazorat turlarida:

Talaba mustaqil xulosa va qaror qabul qiladi, ijodiy fikrlay oladi, mustaqil mushohada yuritadi, olgan bilimini amalda qo'llay oladi, fanning (mavzuning) mohiyatini tushunadi, biladi, ifodalay oladi, aytib beradi hamda fan (mavzu) bo'yicha tasavvurga ega deb topilganda – **5 (a'lo) baho**;

Talaba mustaqil mushohada yuritadi, olgan bilimini amalda qo'llay oladi, fanning (mavzuning) mohiyatini tushunadi, biladi, ifodalay oladi, aytib beradi hamda fan (mavzu) bo'yicha tasavvurga ega deb topilganda – **4 (yaxshi) baho**;

Talaba olgan bilimini amalda qo'llay oladi, fanning (mavzuning) mohiyatini tushunadi, biladi, ifodalay oladi, aytib beradi hamda fan (mavzu) bo'yicha tasavvurga ega deb topilganda – **3 (qoniqarli) baho**;

Talaba fan dasturini o'zlashtirmagan, fanning (mavzuning) mohiyatini tushunmaydi hamda fan (mavzu) bo'yicha tasavvurga ega emas, deb topilganda – **2 (qoniqarsiz) baho** bilan baholanadi.

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GLOSSARY

Term	Review in Uzbek	In Russian review	Commentary in English
Organic chemistry	chemistry of carbon-containing compounds	**Organic chemistry-** chemistry soedinenium carbon	**Organic chemistry**the study of carbon compounds.
Homologous	representative of the homologous series	**Homologous-** a representative homologous series	**Homologous**a member of homologous series
Homologous series	A series of compounds that differ by a few CH2 groups	**Homologichesky ryad-** ryad soedineniy, v kotorom kajdyy posleduyushchi predstavitel otlichaetsya ot predydushchego na gruppuSN2.	**Homologous series**a family of compounds in which each member differs from the next by one methylene group
Radical	a group without one electron (atom)	**Radical-** a group of atoms with an atom without one electron	**Radical**a species that has an odd number of electrons
Isomers	compounds having the same composition qualitatively and	**Isomerism**– soedineniya s odinakovym elementnym	**Isomers**compounds that have the same molecular formula

	quantitatively, differing only in their chemical or spatial structure, and accordingly having different properties	sostavom, molecular massoy, no otlichayushchiesya stroeniem.	but different structures.
Spatial isomers(stereoisomers)	Compounds with the same composition and chemical structure, differing only in the arrangement of atoms in space	**Prostranstvennye isomeri**(stereoisomery) - soedineniya s odinakovym sostavom i khimicheskim stroeniem, no otlichayushchiesya po popolojeniyu atomov v prostanstve.	**Stereoisomers**isomers that have their atoms connected in the same order but have different three-dimensional arrangements.
Configuration	arrangement of atoms in a molecule in a certain order in space	**Configuration –**to ili inoe otnositelnoe raspolozhenie atomov molekuly in space.	**Configuration**the three-dimensional arrangement of atoms bonded to a chirality center.
Conformation	a state formed by the rotation of atoms or groups of atoms around one or more σ-bonds within a molecule of a certain configuration	**Conformation-** different spatial arrangement of atoms ili atomic group and molecular specific configuration, obuslovlennoe vrascheniem vokrugs-svyazey.	**Conformations**the three-dimensional shape of a molecule at any given instant, assuming that rotation around single bonds are frozen.
Primary structure	the part of the compound with the largest number of characteristic groups	**Rodonachalnaya structure-**structural fragment molecular, lezhashchii в основе названия.	**Skeletal structures**a shorthand way of writing structures in which carbon atoms are assumed

			to be at each intersection of two lines (bonds) and at the end of each line.
Functional group	a characteristic group that gives the chemical properties of a compound	**Functional group** - structural fragment molecular, defining and chemical properties.	**Functional**an atom or group of atoms that is part of a larger molecule and has a characteristic chemical reactivity.
Covalent bond	a bond between nonmetals formed on the basis of shared electron pairs.	**Covalent bond-** svyaz, obrazovannaya za schet obshchikh elektronnykh par.	**Covalent bond**a bond formed by sharing electrons between atoms.
Ionic bonding	a bond formed by electrostatic attraction	**Ionnaya svyaz-** svyaz, obrazovannaya za schet electrostatic attraction of atoms	**Ionic bond**the electrostatic attraction between ions of unlike charge.
Inductive effect	of electron cloudsσ-shift in garden	**Inductive effect-** smeshchenie electronov poσ-swyazi	**Inductive effect**the electron-attracting or electron-withdrawing effect transmitted through s bonds.
Nitrification	the reaction of introducing a nitro group (-NO2) into an organic substance	**Nitrogen -**vvedenie nitrogruppy (-NO2) v sostav organicheskogo soedineniya	**Nitration**the substitution of a nitro group onto an aromatic ring.
Sulfation	the reaction of introducing a sulfo group (–SO3H) into an organic	**Sulfurization-** vvedenie sulfogruppy (–SO3H) and composition of	**Sulfonation**the substitution of a sulfonic acid group (-SO3H)

	substance	organic compounds	onto an aromatic ring.
Oxidation	interaction of a compound molecule with an oxygen atom	**Oxidation-** the reaction of molecular soedineniya i oxygrona s umensheniem stepi oxysleniya carbona.	**Oxidation**a reaction that causes a decrease in electron ownership by carbon, either by bond formation between carbon and a more electronegative atom (usually oxygen, nitrogen, or a halogen) or by bond-breaking between carbon and a less electronegative atom (usually hydrogen).
Carboxylation	Interaction with CO2	**Karboxilirova-nie**– reaction s SO2	**Carboxylation**the addition of CO2 to a molecule.
Decarboxylation	A reaction with the release of CO2	**Decarboxylation-** reaction otshchepleniya SO2	**Decarboxylation**t he loss of carbon dioxide from a molecule.β-keto acids decarboxylate readily on heating.
Dehydration	A reaction with the release of H2O	**Dehydration-** reaction s otshchepleniem N2O	**Dehydration**the loss of water from an alcohol to yield an alkene.
Dehydrohalogenation	reaction with the separation of hydrogen and halogen	**Dehydrohalogenation-** reaction s otshchepleniem hydrogen and	**Dehydrohalogenation**the loss of HX from an alkyl halide.

		halogen	Alkyl halides undergo dehydrohalogenation to yield alkenes on treatment with strong base.
sp3-hybridization	hybridization of the orbitals of one s- and three p-electrons and the formation of four new hybridized clouds	**sr^3-Hybridization-** obrazovanie iz odnoys-i trexr-orbitaley chetyre kachetstvenno novye, ravnotsennye orbitali	**sp^{3}hybrid orbitals**hhybrid orbitals derived by combination of an s atomic orbital with three p atomic orbitals.
sp2-hybridization	on the carbon atom in the double bond, one s- and two p-orbitals hybridize to form three equal orbitals	**sr^2-Hybridization-** obrazovanie iz odnoys-and twor-orbitalei tri kachestvenno novye, ravnotsennye orbitali	**sp^{2}hybrid orbitals**hhybrid orbitals derived by combination of an s atomic orbital with two p atomic orbitals.
sp-hybridization	one s- and one p-orbital "mix" with each other to form two hybridized orbitals	**sr-Hybridization-** obrazovanie iz odnoys-it's simpler-orbitali dve kachetstvenno novye, ravnotsennye orbitali	**sphybrid orbitals**hybrid orbitals derived from the combination of an s and ap atomic orbital.
Homolytic cleavage	if we assume that the constituents of the molecule are A and B, then the pair of electrons participating in the formation of a bond between them is divided between the two constituents (molecules).	**Homoliticheskу razryv-** razryvyazy v hode, which every atom has one electron A: B→A· + B·	**Homolytic bond breakage**the kind of bondbreaking that occurs in radical reactions when each fragment leaves with one bonding electron: A:B→A· + B·

	A: B→A· + B·		
Heterolytic cleavage	In this case, the shared electron pair between A and B constituents is taken by one of these constituents. A: B→A+ + :B-	**Heterolitichesky razryv-** razryv svyazii in which the first atom has a pair of electrons, what does the second atom have A: B→A+ + :B-	**Heterolytic bond breakage**the kind of bondbreaking that occurs in polar reactions when one fragment leaves with both of the bonding electrons: A: B→A+ + :B-
Electrophile (I like electrons)	positively charged ion.	**Electrophile**("love electron") is a positively charged ion	**Electrophile**an "electron-lover," or substance that accepts an electron pair from a nucleophile in a polar bond formation reaction.
Nucleophile	a negatively charged ion	**Nucleophile**("lovely nucleon") is a negatively charged ion	**Nucleophile**an electron-rich species that donates an electron pair to an electrophile in a polar bond-forming reaction. Nucleophiles are also Lewis bases.
Alkanes	hydrocarbons with the general formula CnH2n+2 containing simple s-bonds	**Alkane-** hydrocarbons, and molecules that are atomic Covalent bonds with carbons-	**Alkanes**a class of compounds of carbon and hydrogen that contains only single bonds.

		svyazyami.CnH2n+2	CnH2n+2
Cycloalkanes	closed-ring hydrocarbons with the general formula SnH2n, the chain of which consists only of carbon atoms	**Alkane-** hydrocarbons, and molecules that are atomic Covalent bonds with carbons-svyazyami.CnH2n+2	**Cycloalkane**an alkane that contains a ring of carbons.
Alkenes	unsaturated hydrocarbons that contain a single double bond and have the general formula CnH2n that undergo coupling reactions	**Alkene-** hydrocarbons, and molecules that are atomic Carbon fiber double connection.CnH2n	**Alkene**a hydrocarbon that contains a carbon–carbon double bond, R2C=CR2 CnH2n
Markovnikov's rule	When hydrogen halides are added to symmetrically unsaturated hydrocarbons, the hydrogen is attached to the most hydrogen-bearing carbon atom.	**Rule Markovnikova -** pri vzaimodeystvii halogenovodorodov s non-symmetrical alkenami atom hydrogen prisoednyaetsya k bolee hydrogenizovannomu atomu carbona, to est atomu ugleroda, soderjashchemu bolshee chislo atomov vodoroda.	**Markovnikov's rule**in the addition of HX to an alkene, the hydrogen atom bonds to the alkene carbon that has fewer alkyl substituents.
Zaitsev's rule	in dehydrogenation reactions, hydrogen leaves the less hydrogenated carbon atom	**Zaitseva rule**- in the reaction of fire-fighting water and hydrogenation of hydrogen in the hydroxyl atom zirovannogo sosednego atoma korbona.	**Zaitsev's rule**a rule stating that E2 elimination reactions normally yield the more highly substituted alkene as major product.

Alkynes	unsaturated hydrocarbons with the general formula CnH2n-2 containing one triple bond	**Alkin-** hydrocarbons, and molecules that are atomic Carbon fiber triple bond.CnH2n-2	**Alkyne**ahydrocarbon that contains a carbon–carbon triple bond, RC≡CR. CnH2n-2
Aromatic hydrocarbons (arenes)	carbocyclic compounds with a benzene ring in the molecule.	**Areny-** soedinenia, soderjashchie benzene	**Arena**an alkyl-substituted benzene.
Aromaticity	compounds with a ring are difficult to undergo coupling reactions and easy to undergo exchange reactions, the number of electrons corresponds to the formula 4n + 2	**Aromatics** - sovokupnost spe-tsificheskix svoystv benzene, i.e. high stability, inertness and reactivity addition and reactivity reaction, the number of r-electron sootvet-stvuet formula 4n + 2	**Aromaticity** the special characteristics of cyclic conjugated molecules, including unusual stability and a tendency to undergo substitution reactions rather than addition reactions on treatment with electrophiles. Aromatic molecules are planar, cyclic, conjugated species with 4n + 2p electrons.
Alkylhalogen derivatives	Compounds formed by the replacement of one or more hydrogen atoms in an aliphatic hydrocarbon molecule with a	**Alkyl halide-** aliphatic compounds, in which a few hydrogen atoms are combined with a halogen atom.	**Alkyl halide**acompound with a halogen atom bonded to a saturated, sp3-hybridized carbon atom.

	halogen		
Bimolecular nucleophilic substitution reaction (SN2)	a reaction that proceeds in one step with the formation of an intermediate active complex, and the rate of the reaction depends on the concentration of two particles: the halogen derivative and the nucleophile	**The reaction is SN2-** the reaction occurs in one stage through the formation of a transitional state, в postroenii kotorogo prinimaet uchastie kak molecule haloalkane, tak and nucleophilic reagent.	**SN2 reaction**a bimolecular nucleophilic substitution reaction.
Monomolecular nucleophilic substitution reaction (SN1)	a two-step reaction in which the rate of the reaction depends only on the concentration of the halogen derivative and in which the dissociation of the halogen derivative takes place	**Reaction SN1-** reactiongde razryv svyazi C-Hal predshestvuet obrazovaniyu svyazi C-Nu.	**SN1 reaction**a unimolecular nucleophilic substitution reaction.
Alcohols	Hydroxyl compounds of one or more hydrogen atoms in hydrocarbons.	**Spirty-** production of aliphatic hydrocarbons, in which only a few hydrogen atoms are replaced by the -ON group	**Alcohols**a class of compounds with -OH group bonded to a saturated, sp3-hybridized carbon, SPIRIT.
Phenols	Compounds formed by replacing one or more hydrogen atoms in the benzene ring with a hydroxyl group	**Phenol-**proizvodnye aromaticheskikh glevohydrodorov, v kotyrykh odni ili skolkol atomov hydrogen zameshcheny na -ON group	**Phenols**a class of compounds with an -OH group directly bonded to an aromatic ring, ArOH.

Normal broadcasts	compounds formed by the replacement of a hydrogen atom in the hydroxyl of an alcohol with another radical	**Simple air-** production alcohols, in which hydrogen hydroxyl groups are replaced by radicals	**Ethers**a class of compounds that has two organic substituents bonded to the same oxygen atom, ROR
Aldehydes	oxocompounds containing an aldehyde group in its molecule	**Aldehyde-** soedinenia, soderjashchie carbonyl group and hydrogen	**Aldehydes**a class of compounds with organic substituents bonded to a carbonyl group. RCON
Ketones	oxo compounds containing a keto group (RC=O) in its molecule	**Ketone-** soedineniya, soderjashchie two radicals and carbonyl group	**Ketones**a class of compounds with two organic substituents bonded to a carbonyl group, R2C=O.
Amen	organic compounds formed by the exchange of one or more hydrogen atoms of ammonia to hydrocarbon radicals RNH2, R2NH, R3N.	**Amen-** production ammonia, which contains only a few hydrogen atoms and radicals RNH2, R2NH, R3N.	**Amines** a class of compounds containing one or more organic substituents bonded to a nitrogen atom, RNH2, R2NH, or R3N.
Diazo compounds	organic compounds that contain interconnected nitrogen atoms, and one of these nitrogen atoms is a	**Diazoodenine-** soedineniya obshchey formula RN2X.	**Diazo compounds**a class of compounds with the general structure RN2X.

	hydrocarbon radical, and the other is a mineral acid residue		
Sufferings	organic compounds containing the azo group -N=N- and nitrogen atoms of this group are connected with aromatic hydrocarbon radicals	**Azosoedinenia-** common formula RN=NR	**Azo compounds** a class of compounds with the general structure RN=NR.
Carbonic acids	compounds containing a carboxyl group (-COOH).	**Carbonic acid-** soedinenia, soderzhashchie carboxyl group	**Carboxylic acids, RCO2H** compounds containing the -CO2H functional group.
Amino acids	organic compounds containing carboxyl and amino groups	**Amino acids-** soedinenia, soderjashchie i carboxyl i amino group	**Amino acids** a type of difunctional compound with an amino group on the carbon atom next to a carboxyl group, RCH(NH2)CO2H.
Lactam	cyclic amide	**Lactam-** cyclic amide	**Lactams**cyclic amides.
Lactone	cyclic ether	**Lactone-** cyclic ether	**Lactones**cyclic esters.
Amides	carboxylic acid derivatives in which the hydroxyl group in the carboxyl group is replaced by an amino group.	**Amidy** –Proizvodnye carbonovykh kislot, imeyushchie gruppu - CONR2	**Amides** a class of compounds containing the -CONR2 functional group.

Heterocyclic compounds	closed chain compounds in which the ring contains an atom of an element other than carbon atoms.	**Heterocyclic**- a cyclic, carbon-containing atom in its own composition	**Heterocycle**a cyclic molecule whose ring contains more than one kind of atom.
Enantiomers	mirror image stereoisomers.	**Enantiomery**– stereoisomery, yavlyayushchiesya zerkalnym autobrazheniem drug druga	**Enantiomers**stereoisomers of a chiral substance that have a mirror-image relationship. Enantiomers have opposite configurations at all chirality centers.
Diastereomers	stereoisomers that do not give a mirror image.	**Diastereomerism** - stereoisomery, ne yavlyayushchiesya zerkalnym autobrazheniem drug druga	**Diastereomers**non-mirror-image stereoisomers; diastereomers have the same configuration at one or more chirality centers but differ at other chirality centers.

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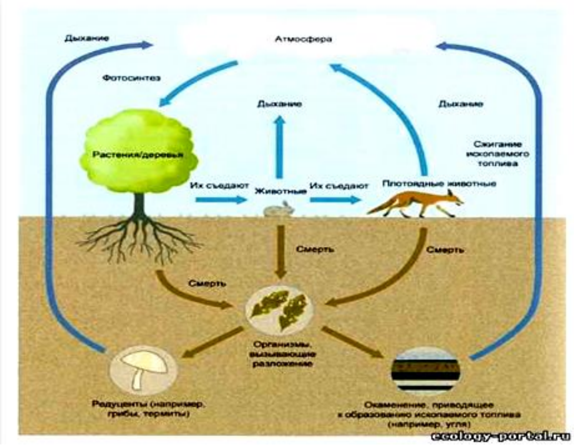

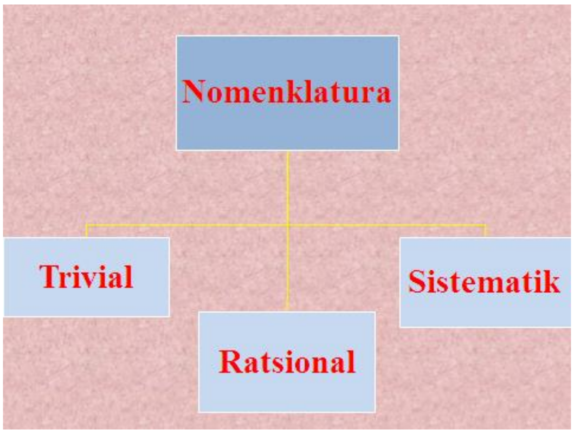
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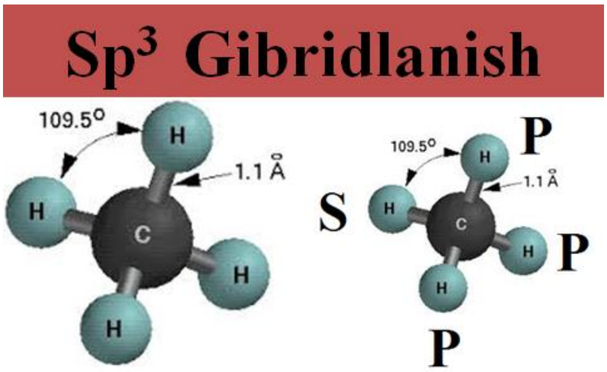
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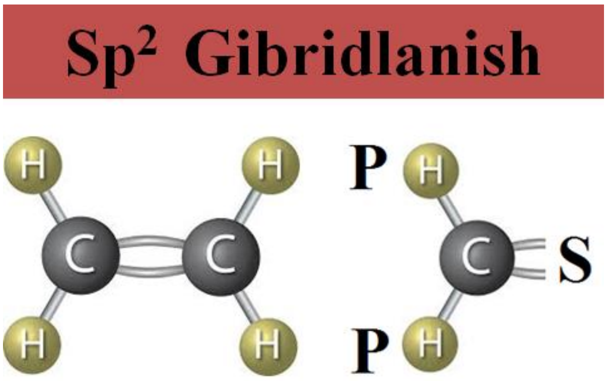
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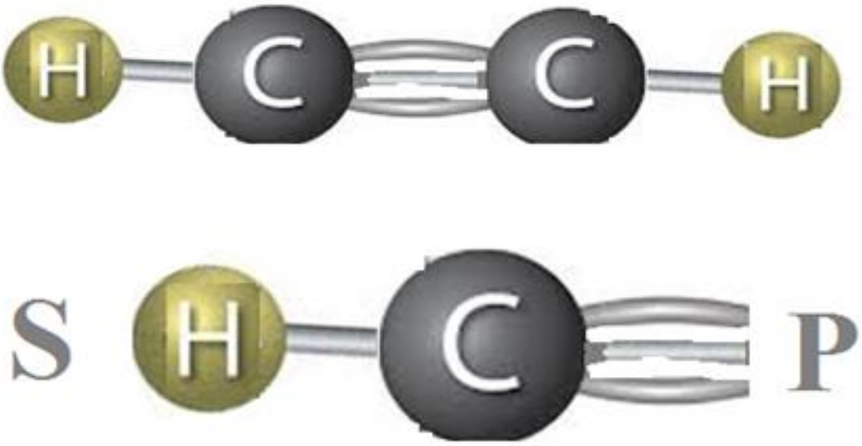
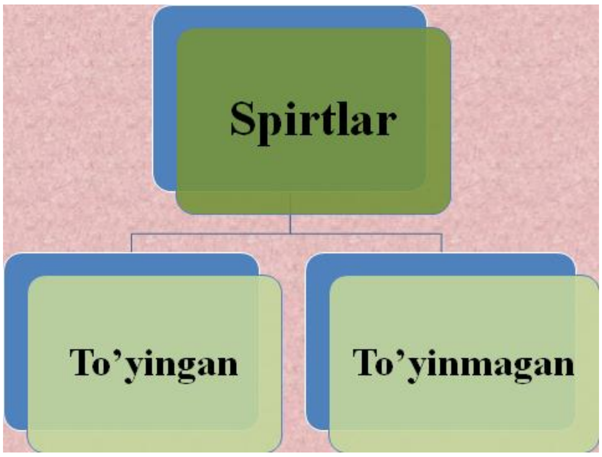




Spirtlar

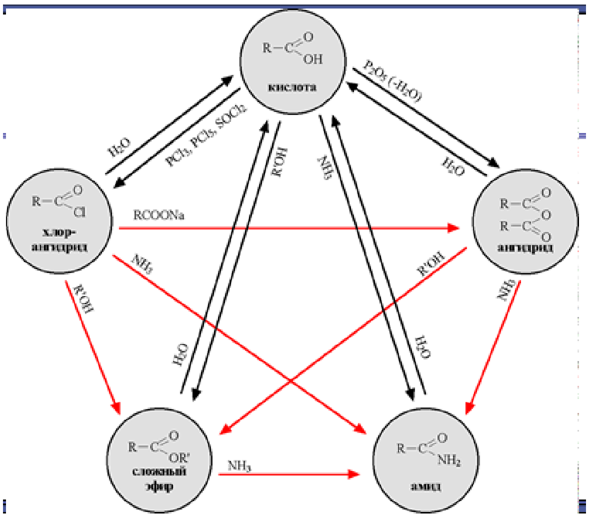
To’yingan

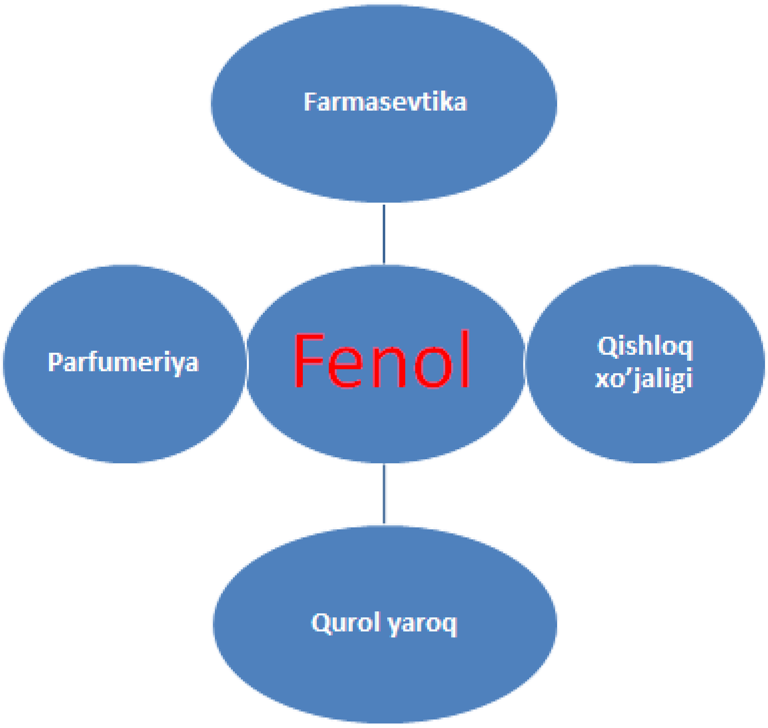
To’yinmagan

To’yingan spirtlar

Bir atomli	**Ikki atomli**	**Uch atomli**	**Ko’p atomli**
R-OH	R-(OH)$_2$	R-(OH)$_3$	R(OH)$_n$

КАРБОН КИСЛОТАЛАР

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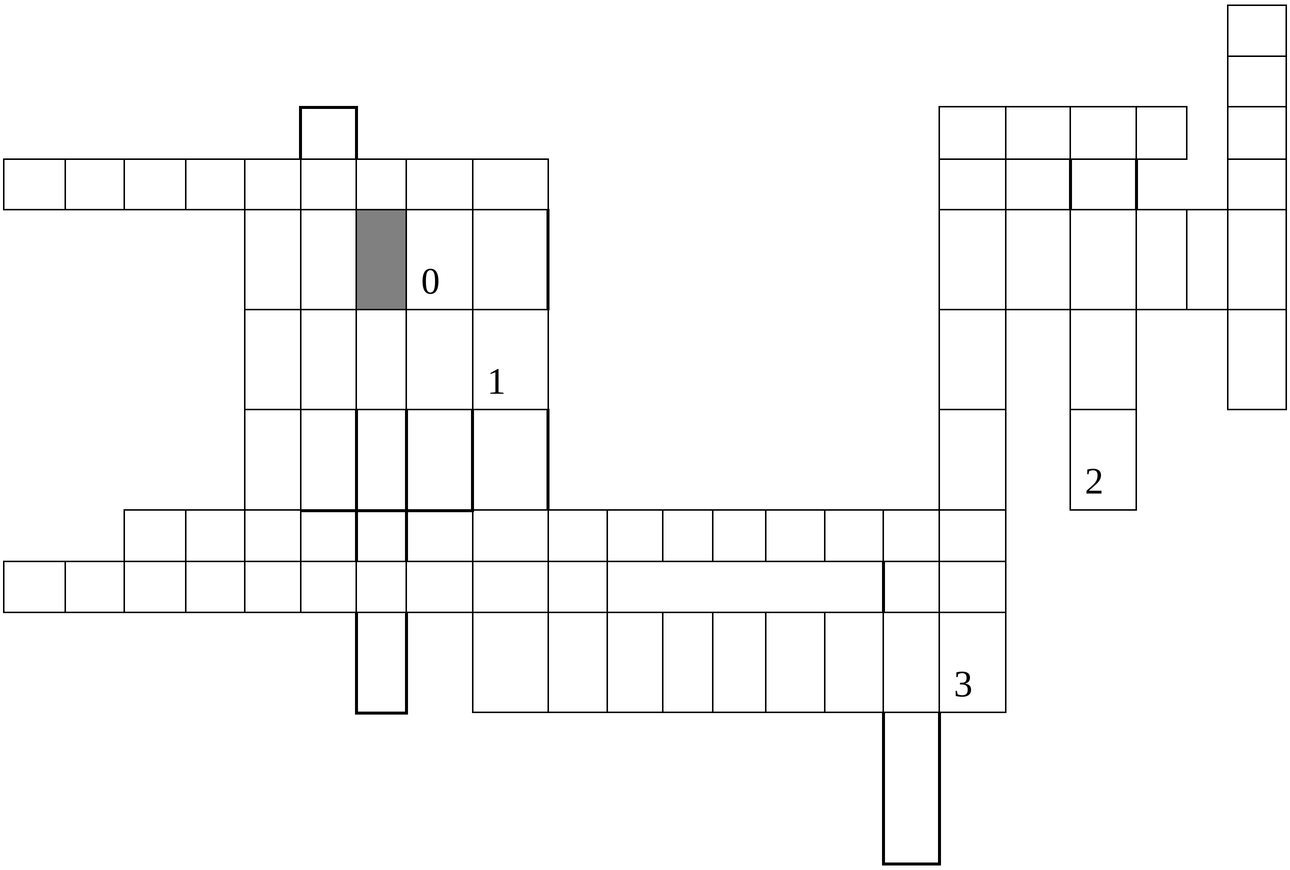
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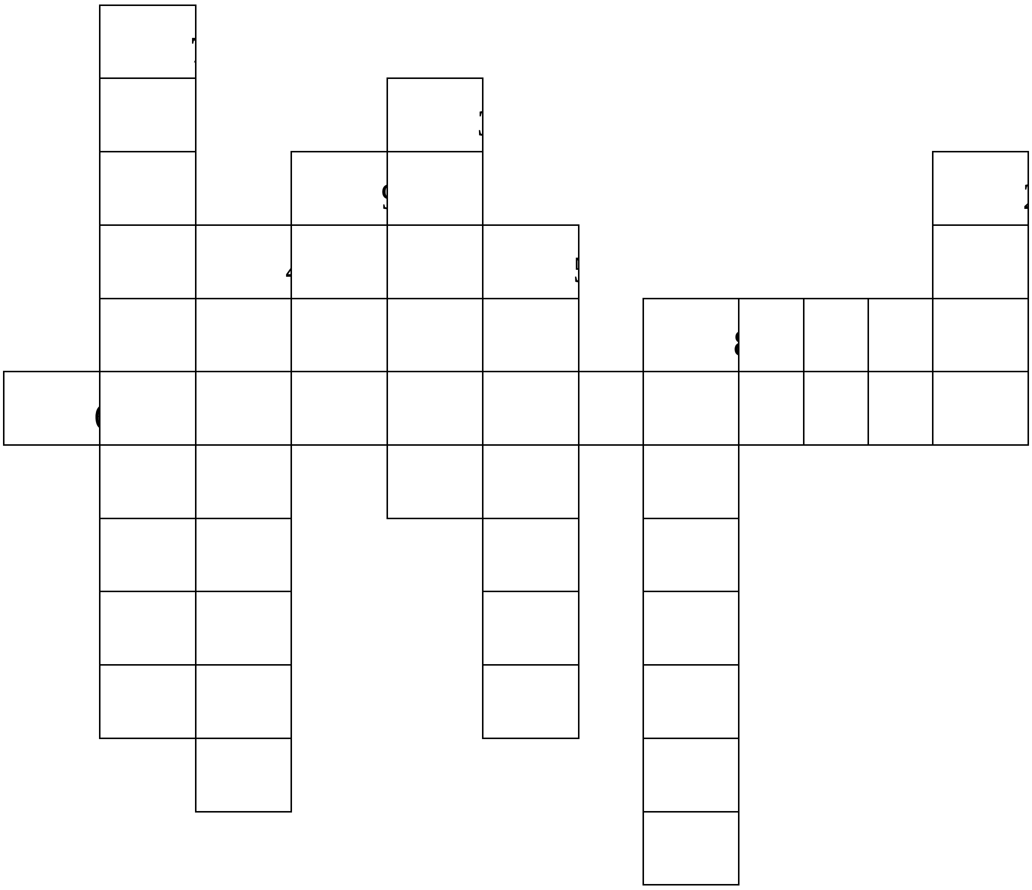
Width:
1. CH_4

2. the name of mixed Mg organic compounds.
3. a metal-organic compound used in the synthesis of polymers.
4. CHCI3
13. A scientist who obtained organic compound Zn.
11. C6H5OH

1 metal per height

5. I-Mg CC-Mg……….. reactive4i
8. In what atmosphere is Zn in the synthesis of organic compounds.
9. Ether used in Griniyar's reagent
10. Zn is obtained from the synthesis of organic compounds.
12. What group does C2H5OH belong to?

"GLYCOL" CROSSWORD



To the height

2. Unsaturated sprites.

3. What is the oxidizing substance in Volner's reaction?

4. Under the influence of Sn (ON)2 on ethylene glycolha substance that becomes fertile?

5. Adjacent compounds of size C in the atom (ON)?

7. Name SN3-SN (ON)-SN(ON)SN2(ON) by rational nomenclature?

8. Fashion using antifreeze and medicine?

9. Is the formula SnN2n unique to ice sprites?

Width:

1. What is the chemical formula of alcohol-specific rice?

6. DioxaneQfrom alcoholhwill be fertile?

8.QThe name of this substance is Greek and means "sweet"?

TEST TASKS

1. List the series of compounds containing one heteroatom in a five-membered heteroring.

A) Benzofuran, benzthiophene, pyrazole. B) Indole, indazole, oxazole.

C) Furan, thiophene, pyrrole. D) Pyridine, quinoline, pyrazine

E) Carbazole, thietin, oxirane

2. List the series of compounds containing two heteroatoms in a five-membered heteroring.

A) Pyrazole, imidazole, oxazole. B) Benzimidazole, indazole, benzoxazole.

C) Thiophene, benzthiazole, thiazoline. D) Pyridine, piperidine, pyrimidine

E) Dibenzofuran, dibenzothiophene, benzothiophene

3. List the heterocyclic compounds containing only the nitrogen atom.

A) Pyrrole, pyrazole, indole, indazole.

B) Thiophene, thiazole, thiazoline, dithiol.

C) Oxazole, isoxazole, furan, benzoxazole.

D) Pyridine, quinoline, benzthiazole, indazole.

E) Piperidine, pyridazine, dibenzthiophene, pyrazole

4. Show the series of compounds containing one heteroatom in a six-membered heteroring.

A) β-picoline, piperidine, pyrrolidine.

B) Pyridine, tetrahydropyran, α-picoline.

C) 2,3-dihydropyrrole, indole, quinoline.

D) Pyridazine, pyrazine, piperidine

E) Quinazoline, pyridine, indazole

5. List the compounds that have aromatic properties.

A) Cyclohexane, benzene, furan, phenol.

B) Benzene, furan, thiophene, pyrrole.

C) Benzene, phenol, pyrrole, cyclopentane.

D) Carbazole, indole, tetrahydropyran, benzene.

E) Pyrrole, pyridine, quinoline, cyclopentadiene.

6. Show the series of compounds whose total number of p and r electrons corresponds to Hueckel's formula 4n + 2.

A) Quinoline, benzene, aniline, cyclopentene.

B) Pyridine, furan, thiophene, benzene.

C) Cyclohexadiene, pyrrole, benzene, thiophene.

D) Furan, benzene, cyclopentadiene, phenol.

E) Thiophene, pyridine, benzene, cyclohexene.

7. In which row does the degree of delocalization of p-electrons increase?

A) Benzene > thiophene > pyrrole > furan > butadiene.

B) Butadiene > thiophene > pyrrole > furan > benzene.

C) Furan > benzene > thiophene > butadiene > pyrrole.

D) Thiophene > benzene > furan > pyrrole > butadiene.

E) Pyrrole > thiophene > butadiene > benzene > furan.

8. What intermediate product is formed when furan is synthesized from aldopentoses in acidic medium?

A) Pyrolytic acid. B) Furfural. C) Mucilage acid.

D) 2-Furanocarboxylic acid. E) 5-Hydroxymethylfurfural.

9) If 2 moles of acetylene is exposed to ammonia at a temperature of 300-4000C, what heterocyclic compound is formed?

A) Furan. B) Thiophene. C) Pyrrole. D) Pyridine. E) Pyrazole.

10. If 2 moles of acetylene are exposed to H2S and Al2O3 at a temperature of 400-5000C, what heterocyclic compound is formed?

A) Thiophene. B) Furan. C) Benzene. D) Pyrazole. E) Tetrahydrofuran.

11. Yu.K. What reagent is used to synthesize pyrrole from furan using the Yurev reaction?

A) Ammonia and temperature. B) NH4Cl. C) HNO3.

D) Pyridine. E) ROOM.

12). Show the correct series of decreasing ionization energy?

A) Furan>thiophene>pyrrole>benzene

B) Benzene>thiophene>furan>pyrrole

C) thiophene>pyrrole>furan>benzene

D)pyrrole>benzene>thiophene>furan

E) Thiophene>furan>benzene>pyrrole

13). What intermediate product is formed in the production of furan from mucilage?

A) Adipic acid

B) Cyclopentanone

C) Pyrolytic acid

D) Tartaric acid

E) Butadiene-1,3

14) Pyrrole nitration is carried out in the presence of what reagent and under what conditions?

A) using HNO3 B) in a mixture of HNO3 and H2SO4

C) using acetylnitrate at 5-100C

D) KNO3 + H2SO4 at 1000C E) using nitrogen oxides

15) What sulfonating agent is used in sulfonation of pyrrole?

A) conc. H2SO4, B) mixture of SO3 and oleum.

C) Pyridine sulfotrioxide. D) mixture of SO3 and H2SO4.

E) Dilute H2SO4

16) What brominating agent is used in the synthesis of a-bromofuran?

A) Bromine water. B) Dioxanedibromide.

C) Bromine and FeBr3. D) Bromine solution in SSl4.

E) Salts of bromine.

17) Name the nitrating agent used in the preparation of α-nitrofuran.

A) conc. Nitric acid. B) HNO3 and H2SO4.

C) Acetyl nitrate and pyridine. D) Dilute HNO3

E) Potassium nitrate.

18) Under what conditions is acetylfuran obtained from furan?

A) Under the influence of acetyl chloride. B) Under the influence of acetic acid.

C) (SN3SO)2O and SnCl4 D) SH3COONa + SH3COOH

E) SH3COOS2N5

19) Show the series of substances involved in the Reimer-Thiemann reaction.

A) Phenol, cresol, indoxyl, α-naphthol.

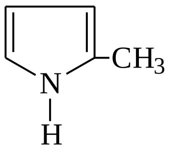
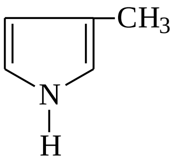
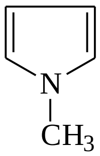
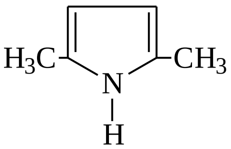
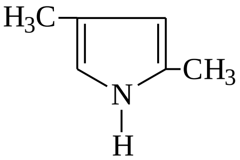
B) Phenol, pyrrole, cresol, indole.

C) Pyrrole, indole, β-naphthol, benzene.

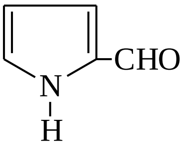
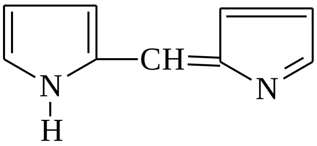
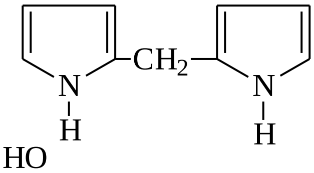
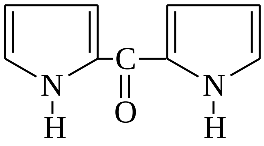
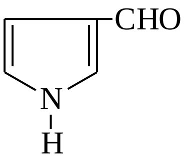
D) Benzene, pyridine, tetrahydrofuran, pyrrole

E) Furan, indoxyl, benzene.

20) What product is formed when pyrylmagnesium iodide is alkylated with SN3I at a temperature below 00C?

A) 
B) 
C) 
D) 
E) 

21 What compound does pyrrole react with formaldehyde to form?

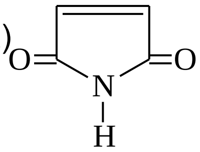
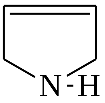
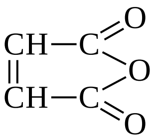
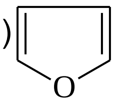
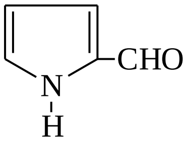
A) 
B) 
C) 
D) 
E) 

22) What reaction is carried out to change from pyrrole to pyrroline?

A) Oxidation. B) Full refund. C) Premature return. D) Acylation.

E) Heating.

23) What compound is formed when pyrrole is oxidized with an alkaline solution of KMnO4?

A) 
B) 
C) 
D) 
E) 

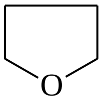
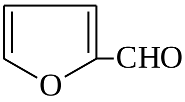
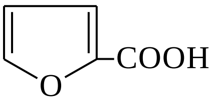
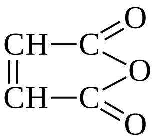
24) The stability of the furan molecule is broken under the influence of which reagent?

A) Under the influence of alkalis. B) Under the influence of mineral acids HCl, H2SO4.

C) Under the influence of sodium acetate. D) Under the influence of potassium cyanide.

E) Under the influence of acetic anhydride.

25) What product is formed when furan is oxidized with oxygen at high temperature in the presence of V2O5?

A) 
B) 
C) 
D) 
E) $CH_3CH_2CH_2COOH$

26) Which of these substances is simultaneously oxidized and reduced under the influence of KON?

A) Furan. B) Furfural. C) Tetrahydrofuran. D) Pyrrole. E) Pyrroline.

27) What products are formed when furfural undergoes the Cannizzaro reaction?

A) Furan. B) Furoin. C) Furfuryl alcohol and pyrolysis acid.

D) α-Acetylfuran. E) Maleic anhydride.

28) What product is formed when furan is completely reduced with N2 in the presence of a Ni catalyst?

A) Maleic anhydride. B) Furfural. C) Tetrahydrofuran.

D) Furfuryl alcohol. E) Pyrolytic acid.

29) Name a compound with chemical properties close to benzene.

A) Furan. B) Pyrrole. C) Thiophene. D) Pyrrolidine. E) Pyridine.

30) Show the series of substances involved in the azo-combination reaction.

A) Aniline, pyrrole, indole, p-toluidine.

B) o-Nitroaniline, aniline, benzene, o-toluidine.

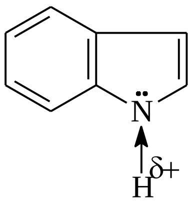
C) Pyrrole, toluene, α-picoline, quinoline.

D) Indole, piperidine, quinoline, o-xylol.

E) Ethylbenzene, pyridine, pyrrole, β-picoline.

31) In which formula is the displacement of electrons in indole correct?

A)



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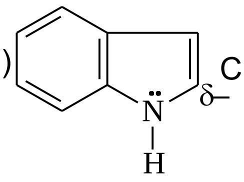

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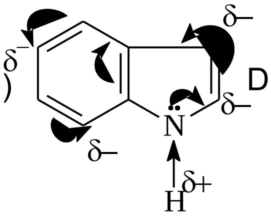

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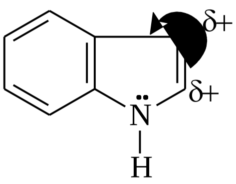

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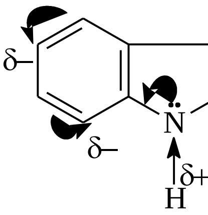
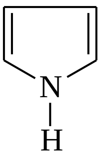


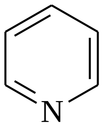
32) What product is formed when carbazole reacts with acetylene under pressure in the presence of alkaline catalysts?

A) N-vinylcarbazole. B) S-vinylcarbazole. C) 3-methylcarbazole.

D) 6-vinylcarbazole. E) 3-vinylcarbazole.

33) What product is formed when 2 moles of acetylene is cyclized with NCN at high temperature?

A)


Â)


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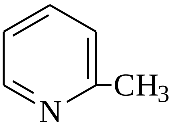

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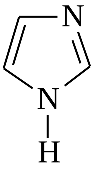

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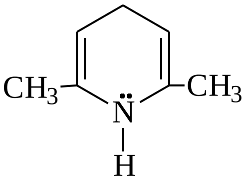
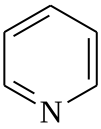


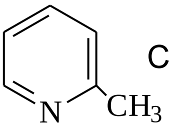
34) What products are formed if acetaldehyde NH3 is heated to 4000C in the presence of Al2O3:

A) pyridine; B) α-picoline; C) β-picoline; D) α and γ-picolins;

E) piperidine

35) When 2 moles of acrolein undergoes a condensation reaction under the catalysis of ammonia, a substance with what structure is formed;

A)


Â)


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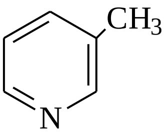

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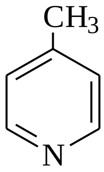
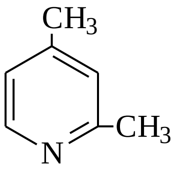


E)


36) α-picoline is obtained from butadiene-1,3 by diene synthesis, what compound can be used as a dienophile?

A) C2H5-CN. B) CH3CºN. C) HCºSN. D) NºC-CºN. E) CH2=CH-CHO.

37) How do protonating agents affect the reactivity of pyridine?

A) Increases the ability to start a reaction.

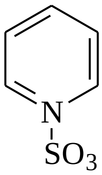
B) Does not affect

C) Entering into the reactionsignificantly increases the ability.

D) Reduces the activity of the aromatic ring.

E) Increases the activity of the aromatic ring.

38) What compound is formed when pyridine is sulfonated using oleum and HgSO4 at 230-2500C?

A)


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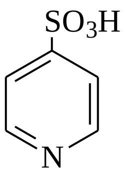

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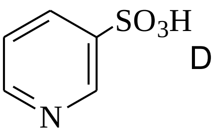

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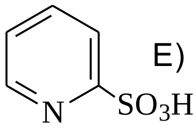

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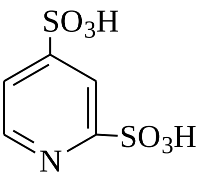
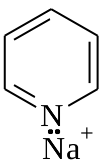
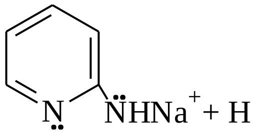
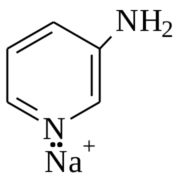
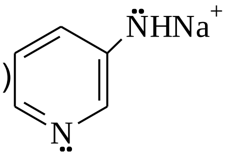
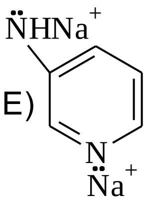


39) What intermediate products are formed when pyridine reacts with sodium amide?

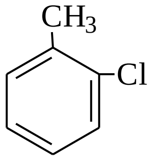
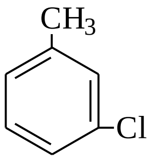
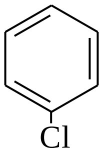
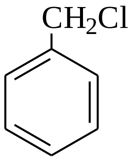
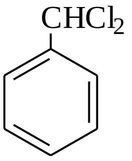
A)  Â)  Ñ)  Д)  E) 

40) Arrange in descending order of validity:

1) aniline; 2) pyridine; 3) α-picoline; 4) γ-picoline; 5) α-aminopyridine

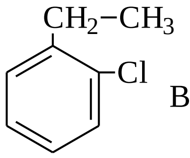
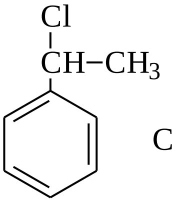
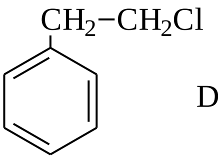
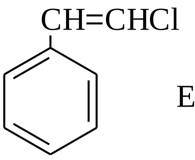
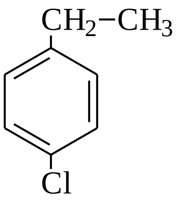
A) 4>5>3>2>1 B) 5>4>3>2>1 C) 1>2>3>4>5 D) 2>1>4>3>5 E) 3>4>5>1>2

41) Which of the following is benzyl chloride?

1)  2)  3)  4)  5) 

A) 1. B) 2. C) 3. D) 4. E) 5.

42) Show 1-Phenyl-2-chloroethane.

A)  B)  C)  D)  E) 

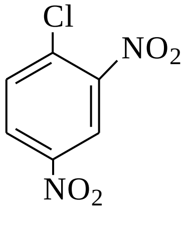
43) How many isomers of the S7N7Cl substance belonging to the aromatic series?

A) 2. B) 3. C) 1. D) 4. E) 5.

44) How many isomers of S6N4Br2 are there?

A) 5. B) 3. C) 2. D) 4. E) 1.

45) What is the correct name for a substance with the following structure?

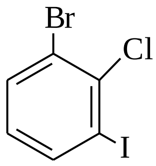


1) 2,4-Dinitrochlorobenzene

2) 1,3-Dinitro-5-chlorobenzene
3) 3-Nitro-6-chloro-1-nitrobenzene
4) 2-Chloro-1,5-dinitrobenzene
5) 1-Chloro-4,6-dinitrobenzene

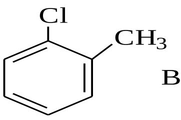
A) 1. B) 2. C) 3. D) 4. E) 5.

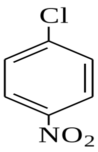
46) Which name is correct for the substance below?

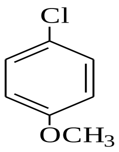


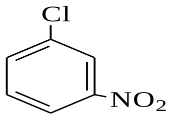
A) 1,2,3-Chloroiodobenzene
C) 1-Bromo-3-iodo-2-chlorobenzene
C) 1-Iodo-3-Bromo-2-chlorobenzene
D) 1-Chloro-2-iodo-6-bromobenzene
E) 1-Chloro-2-bromo-6-iodobenzene

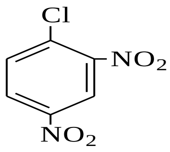
47) In which of the following compounds does chlorine atom have high activity?

A)


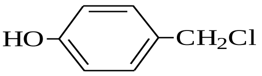
B)


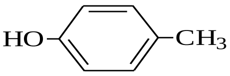
C)


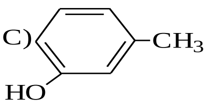
D)


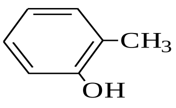
E)


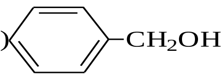
48) If an aqueous solution of alkali is added to a compound containing S7N7Cl and boiled, which of the following compounds is formed?

A)


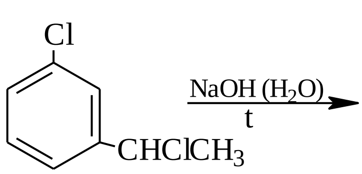
B)


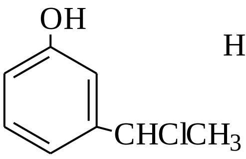
C)


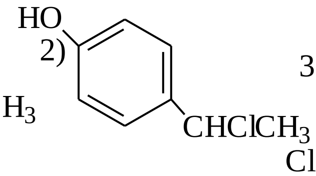
D)


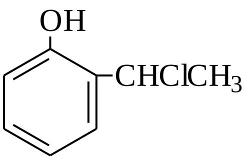
E)


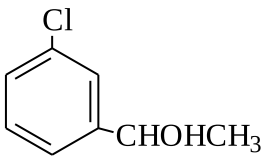
49) Which substance is formed in the following reaction?

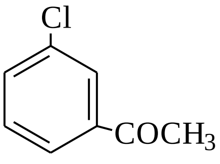


1)


2)


3)


4)


5)


A) 1. B) 2. C) 3. D) 4. E) 5.