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PHARMACEUTICAL CHEMISTRY

COLLECTION OF TEST TASKS

MINISTRY OF HEALTH OF UKRAINE
NATIONAL UNIVERSITY OF PHARMACY

PHARMACEUTICAL CHEMISTRY

COLLECTION OF TEST TASKS

FOR PREPARATION TO THE UNIFIED STATE QUALIFICATION EXAM

STAGE 2 "PHARMACY"

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Pharmaceutical chemistry : Collection of test tasks for preparation to the
P 56 Unified State Qualification Exam STAGE 2 «Pharmacy» / V. A. Georgiyants [et al.]. – Kharkiv : NUPh, 2024. – 92 c.

The collection of test tasks was created according to the approved program in pharmaceutical chemistry. The publication contains test tasks structured by topics and theoretical explanation of the correct answers, the study of which will allow higher education applicants to prepare for the Unified State Qualification Exam STAGE 2 "Pharmacy" in the educational component of pharmaceutical chemistry.

The collection of tests is intended for in-class and individual work of higher education applicants, specialty 226 "Pharmacy, industrial pharmacy" of the educational program "Pharmacy".

UDC 615.07:615.011:54.06(076)

CONTENT

Introduction ……..……..... 4

Module 1 «Pharmaceutical analysis» ..……..... 5

Content module 1. The system of drug quality control. Pharmacopoeial analysis. The use of physical, physico-chemical and chemical methods for identifying and establishing the purity of medicinal products 5

Content module 2. Chemical and physicochemical methods of quantitative analysis of medicinal products. Express analysis of medicines 16

Module 2 «Physicochemical aspects of pharmacokinetics and pharmacodynamics medicinal substances. Drugs affecting organs and systems» ……..... 25

Content module 3. Physicochemical aspects of pharmacokinetics and pharmacodynamics of medicinal substances. Medicines that act on the central nervous system 25

Content module 4. Medicines affecting the peripheral nervous system..... 49

Content module 5. Drugs affecting the excretory, cardiovascular and gastrointestinal systems 49

Module 3 «Drugs affecting metabolism and tissue processes. Antimicrobial drugs» 62

Content module 6. Drugs affecting metabolism and tissue processes 62

Content module 7. Antimicrobial drugs 71

Literature .....…… 88

Inroduction

Pharmaceutical chemistry is an integral educational component that summarizes the training of a pharmacy specialist in the field of chemistry. It is a fundmental educational component in the training of pharmacists, which gives future masters in pharmacy a firm background for understanding of various aspects of analysis, storage and pharmacological action of medicinal products. The rational use of medicines is based on the knowledge of chemical transformations and properties of substances. Modern methods of chemical and biochemical analysis with a high level of reliability make it possible to determine the structure of the medicinal product and its purity. The modern technologies of chemical science in pharmacy allows to identify minimal impurities in the substance, to study the ways of biotransformation and to obtain knowledge about the molecular mechanisms of drug action.

The mastering of the basics of pharmaceutical chemistry, like the key aspects of pharmaceutical analysis and properties of the most important representatives of widely used drugs form different pharmacological groups (drugs affecting organs and systems, affecting metabolism and tissue processes, antimicrobial drugs, etc.) is the basis for the higher education applicant's successful study of the educational program.

The systematization of knowledge and the effective revision of the study material are the keys to successful learning and passing exams. One of the effective forms of this type of work can be revision within the framework of the concept of question-answer, which is a recognized world practice.

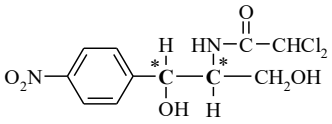
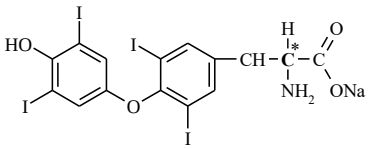
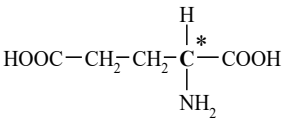
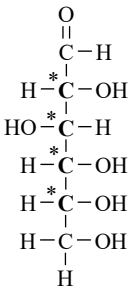
The guide systematizes the topics of the pharmaceutical chemistry educational component program by presenting the key questions and answers to them in a concise form. This will allow the student to easily and quickly revise the material. Moreover, the emphasis on the most important questions of pharmaceutical chemistry for each of the topics of the study program was made at preparation of the study manual.

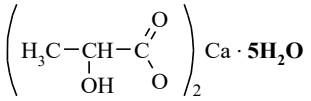
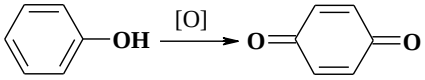
The collection of tests in pharmaceutical chemistry is intended for independent work of higher education applicants, specialty 226 "Pharmacy, industrial pharmacy" of the educational program "Pharmacy".

The presentation of materials in English is useful not only for those higher education applicants who are studying in English, but also for those who want to prepare for the English-language part of the Unified State Qualification Exam (USQE).

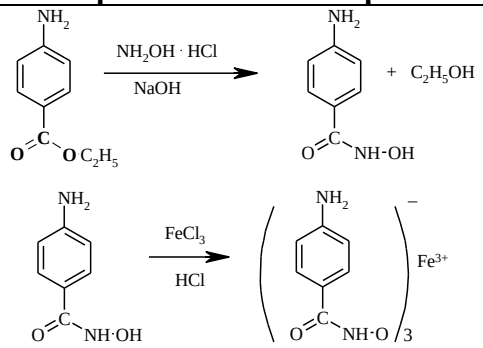
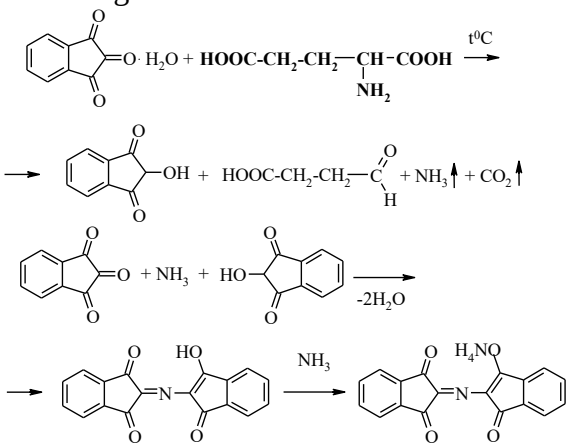
MODULE 1
Pharmaceutical analysis

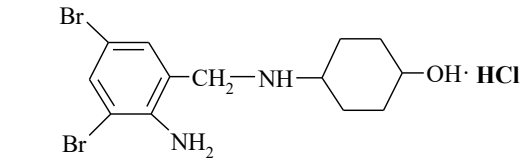
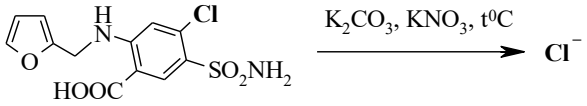
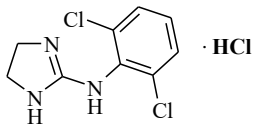
Content module 1. The system of drug quality control. Pharmacopoeial analysis. The use of physical, physico-chemical and chemical methods for identifying and establishing the purity of medicinal products

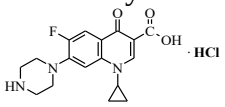
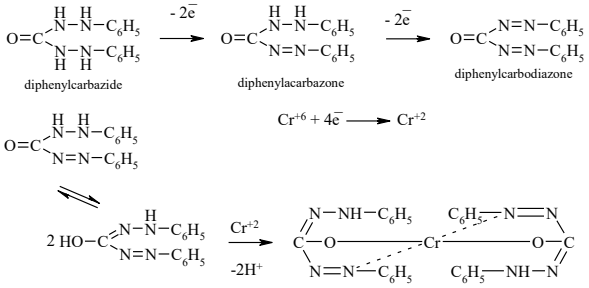
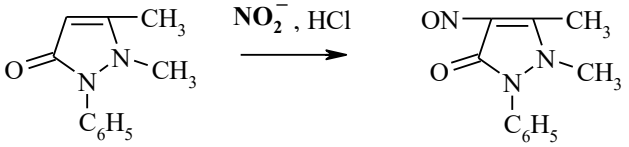
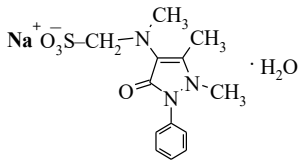
Test from «Крок-2» base	Explanation
Topic 1. Subject and objectives of pharmaceutical chemistry. General approaches to pharmaceutical analysis. Determination of fundamental physical (physicochemical) constants as quality indicators	
A quality control and analysis laboratory certifies a series of **glutamic acid**, an optically active substance. What is the identification indicator of the **polarimetry**? A. *angle of rotation B. absorbance C. refrective index D. pH of the solution E. density	    **Polarimetry** is a method based on measuring the degree of polarization of light and the angle of rotation of the plane of polarization of light when it passes through optically active substances. Measurement of the **angle of rotation** is carried out on devices - polarimeters. The angle of rotation in solutions depends on their concentration; therefore, polarimetry is widely used to measure the concentration of optically active substances. To confirm the purity and identification of the optically active substance, the value of the **specific optical rotation** is calculated $[\alpha]_D^{20}$**.**
Glucose is an optically active substance that is analysed using **polarimetry.** The specific optical rotation value is used to identify and confirm the purity of optically active drugs. This value is calculated from the measurement of: A. *angle of rotation B. absorbance C. refrective index D. retention time E. distribution coefficient	
Polarimetry is used in the pharmaceutical analysis of optically active drugs. What value is used to identify compounds by polarimetry? A. *specific optical rotation B. pH of the solution C. specific absorbance D. refrective index E. molar absorption coefficient	
The pharmacist-analyst uses a **polarimeter** to check the “Levothyroxine sodium” quality. It is used to measure: A. *angle of rotation B. refrective index C. absorbance D. melting point E. electromotive force	

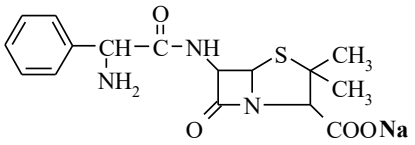
Loss of crystallisation water may occur if the storage conditions for calcium lactate pentahydrate are not followed. What is the name of this process? A. *weathering B. oxidation C. reduction D. hydrolysis E. polymerisation	 **Weathering** is the loss of water by crystalline crystal hydrates occurs at elevated temperatures and in a dry atmosphere. When the water of crystallization is lost, the transparent crystals lose part of the water and become opaque as a result.
Phenol changes colour under the influence of moisture and light if it is stored in improper conditions. The discolouration is a result of the process of: A. *oxidation B. weathering C. reduction D. hydrolysis E. polymerisation	Phenol is colorless, needle-like crystals that turn pink in air due to oxidation, which leads to the formation of a complex mixture of colored substances (this is due to the intermediate formation of quinones). 
An analyst in a pharmaceutical company's laboratory is responsible for the quality control of injectable solutions. To determine the **pH** of the solution, he must use: A. *potentiometer B. refractometer C. spectrophotometer D. polarimeter E. viscosimeter	In the practice of chemical analysis, the acidity or alkalinity of a solution is characterized by the decimal logarithm of the concentration of hydrogen ions with a negative sign - the **hydrogen index (pH)**. **Potentiometers** of various systems or **pH meters**, the scale of which is graduated in pH units, are used to measure pH. The potentiometric determination of pH is based on the measurement of the electromotive force of a galvanic cell consisting of two electrodes: the indicator, the potential of which depends on the activity of hydrogen ions, and the reference electrode - a standard electrode with a known potential value.
A **refractometer** is used to identify and test glycerol substances. What indicator does it measure? A. *refrective index B. melting point C. dynamic viscosity D. absorbance E. angle of rotation	**Refractometry** is an optical method of analysis, which is based on measuring the index of refraction of light by the tested substance. Refractometry is used to identify and establish the purity of certain substances, as well as to determine the concentration of a substance in a solution (quantification). Devices used to determine the refractive index are called refractometers.
Photometric methods are widely used in pharmaceutical analysis to control the quality of medicinal products. They are based on the ability of the substance to: A. *selectively absorb electromagnetic radiation B. shift the plane of light polarization C. selectively distribute between two phases D. affect the potential of the indicator electrode E. change the aggregate state under the influence of temperature	**Photometric analysis** methods are a group of methods based on measuring the transmission, **absorption**, or scattering of **electromagnetic radiation** by the analysed substance. These methods are divided into several groups: colorimetry, photocolorimetry; spectrophotometry; fluorimetry; turbidimetry; nephelometry.

Various physicochemical methods are used in pharmaceutical analysis. What method is based on measuring the **absorption** of **monochromatic radiation** by a medicinal substance? A. *spectrophotometry B. fluorimetry C. refractometry D. polarimetry E. potentiometr	**Spectrophotometry** is based on measuring the absorption of a substance by monochromatic radiation. Absorption spectrophotometry in the ultraviolet and visible regions of the spectrum can be used for drug identification, purity testing, and quantification. To calculate the quantitative content, it is necessary to measure the **optical density** of the solution of the substance under investigation on a spectrophotometer and calculate the content using the specific absorption index or by the standard method

Test from «Крок-2» base	Explanation
Topics 2-3. General principles of drug identification. Use of spectral and chromatographic methods for drug identification. Standard samples and reference spectra	
Local anesthetic **benzocaine** can be identified using the reaction of **iron(III) hydroxamate formation.** What makes possible this reaction? A. *esther group B. sulfamide group C. carboxylic group D. ketone group E. aldehyde group	 Benzocaine is an **ester** of p-aminobenzoic acid and ethanol. During the reaction of benzocaine with hydroxylamine in an alkaline environment, hydroxamic acid is formed, which with a solution of iron (III) chloride produces a cherry-red iron hydroxamate.
At the laboratory of pharmacopoeial analysis, **glutamic acid** is being identified using the method of thin-layer chromatography. What reagent is used to develop a chromatogram? A. *ninhydrin B. aniline C. pyridine D. cyanogen bromide E. diphenylamine	To determine **α-amino acids**, a reaction with ninhydrin is used. At heating a **blue-violet** color is formed: 
What solution should be used by an expert at the laboratory of the pharmaceutical product certification center to identify the medicines that contain **potassium ions**? A. *sodium cobaltinitrite B. magnesium sulfate C. ammonium oxalate D. sodium hydroxide E. barium chloride	Reaction of **potassium ion** with **sodium cobaltinitrite** solution is carried out in the presence of diluted acetic acid. **A yellow or orange-yellow precipitate is formed**: 

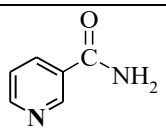
A lab technician at the pharmaceutical certification centre prepares reagents. To identify medicines containing **potassium ions,** they use a solution of A. *sodium cobaltinitrite B. ammonium oxalate C. barium chloride D. sodium hydroxide E. magnesium sulfate	
The drug quality control laboratory has received a mucolytic preparation containing ambroxol hydrochloride. A solution which has to be used for the **chloride ions** identification is A. *silver nitrate B. barium sulfate C. glyoxal-hydroxyanil D. potassium ferrocyanide E. diphenylamine	   Ca**Cl**$_2$ **Cl^- + $AgNO_3$ → AgCl↓ + NO_3^-** **$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$** At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.
The test substance is sintered with a mixture of potassium carbonate and potassium nitrate to confirm the presence of covalently bound chlorine in the diuretic "Furosemide" structure. The resulting chloride ions are identified by the solution of: A. *silver nitrate B. ammonium oxalate C. potassium iodide D. sodium sulfide E. calcium chloride	
A pharmacist-analyst performs an express analysis of a liquid dosage form containing **calcium chloride**. He identifies the **chloride ion** by reaction with the solution: A. *silver nitrate B. potassium pyroantimonate C. sodium tetraphenylborate D. ammonium oxalate E. barium chloride	
Chromatographic methods are used in pharmaceutical analysis. What type of chromatography is based on **reversible chemisorption of the ions of the analyte solution by the ionogenic groups of the sorbent**? A. *ion-exchange chromatography B. thin layer chromatography C. adsorption chromatography D. gas chromatography E. paper chromatography	**Ion exchange chromatography** is a method of liquid chromatography based on the different ability of separated ions to ion exchange with a stationary phase (ionite).

Various chromatographic methods are used to check the quality of medicines. Indicate the type of chromatography that takes place on a sheet of filter paper as the mobile liquid phase moves through its capillaries and surface. A. *paper B. adsorption C. gas D. thinlayer E. ion-exchange	**Paper chromatography** is a type of partition chromatography, where the stationary phase is special types of chromatographic paper, and the mobile phase is a solvent or a mixture of solvents. Separation of substances occurs as a result of their distribution between cellulose fibers (stationary phase) and solvent (mobile phase).
The drug quality control laboratory has received the antimicrobial ciprofloxacin hydrochloride. The pharmacist-analyst determines the **chloride ion** in the presence of **sulfuric acid** concentrated with the following reagent: A. *potassium dichromate B. sodium hydroxide C. magnesium sulfate D. potassium chloride E. zinc oxide	Ciprofloxacin hydrochloride (Ciprofloxacini hydrochloridum)  $4Cl^- + K_2Cr_2O_7 + 3H_2SO_4 \rightarrow 2CrO_2Cl_2\uparrow + K_2SO_4 + 3H_2O + 2SO_4^{2-}$  When **chloride ions** interact with **potassium dichromate** in a sulfuric acid environment, chromyl chloride is formed, which reacts with diphenylcarbazide to form a **purple-red** complex compound.
A reaction with **antipyrine** (**phenazone**) in the presence of dilute **hydrochloric acid** was carried out during the pharmaceutical analysis of the drug substance. The appearance of **a green colour** allows identifying: A. *nitrites B. sulfates C. fluorides D. bromides E. iodides	 To identify the **nitrite ion**, a reaction with antipyrine (phenazone) is carried out in an acidic environment, where **green nitrosoantipyrine** is formed.
A white precipitate was formed due to the analgesic **Metamizole sodium** monohydrate reaction with **potassium pyroantimonate solution.** This confirms the presence in the structure of the medicinal substance of: A. *sodium ions B. covalently bonded sulphur C. methyl group D. phenyl redical E. keto groups	 $\mathbf{Na^+ + K[Sb(OH)_6] \rightarrow Na[Sb(OH)_6]\downarrow + K^+}$ When **sodium ions** interact with a solution of **potassium pyroantimonate** at heating with further cooling in ice water and rubbing with a glass rod, a thick white precipitate is formed.

The drug quality control laboratory received a substance of antibiotic "**Ampicillin sodium**". The sodium ion was identified by reacting with **potassium pyroantimonate** solution to form a precipitate of the following colour: A. *white B. blue C. yellow D. red E. green	 $Na^+ + K[Sb(OH)_6] \rightarrow Na[Sb(OH)_6]\downarrow + K^+$ When **sodium ions** interact with a solution of **potassium pyroantimonate** at heating with further cooling in ice water and rubbing with a glass rod, a thick white precipitate is formed.
A reaction with a **sodium hydroxide** solution was carried out under heating during the pharmaceutical analysis of a medicinal substance. This reaction produced **a gas with a characteristic odour,** turning **a wet red litmus paper blue.** Which cation was identified in the drug? A. *ammonium B. magnesium C. calcium D. sodium E. potassium	$NH_4^+ + NaOH \xrightarrow{t^0C} NH_3\uparrow + H_2O + Na^+$ When ammonium salts are heated with a solution of sodium hydroxide, gaseous ammonia is released, which is detected by its **characteristic odour** and alkaline reaction.
In pharmaceutical analysis, a sample of a substance moistened with **dilute hydrochloric acid** is placed in a colourless flame. The appearance of an **orange-red colour** allows identifying the cation of: A. *calcium B. sodium C. potassium D. ammonium E. barium	**Calcium salt**, moistened with hydrochloric acid and placed into a **colorless flame**, colors it in an **orange-red color**.
The **ferric (II) ion** was identified in the anti anaemic medication ferrous sulphate heptahydrate by forming a blue precipitate in dilute hydrochloric acid. What reagent was used in this test? A. *potassium ferricyanide B. silver nitrate C. tartaric acid D. antipyrine E. glyoxal-hydroxyanil	$Fe^{2+} + K_3[Fe(CN)_6] \rightarrow KFe[Fe(CN)_6]\downarrow + 2K^+$ During the interaction of **iron (II) ions** with a solution of **potassium ferricyanide**, a **blue precipitate** is formed, which does not dissolve when hydrochloric acid is added.

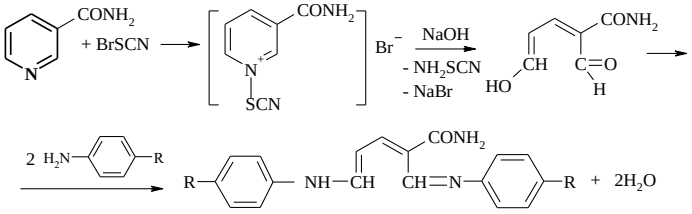
A pharmacist-analyst is analysing the medicinal substance **nicotinamide.** The pharmacopoeial reaction with a solution of cyanobromide and aniline produces a yellow colour. To which functional group is the reaction performed?

A. *pyridine cycle
B. amide group
C. caroxylic group
D. phenol hydroxide group
E. ester group



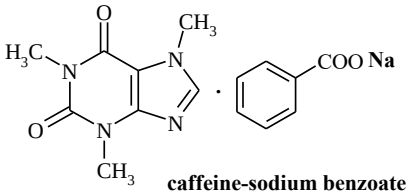
Nicotinamide is a vitamin, which belongs to derivatives of **pyridine**. Nicotinamide gives a reaction to the pyridine **cycle** with cyanobmide reagent and aniline, a yellow color appears.

$$Br_2 + NH_4SCN \rightarrow BrSCN + NH_4Br$$

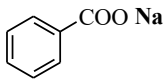


Salts of benzoic acid are used in medical practice. According to the requirements of the SPhU, which reagent is involved in a qualitative reaction with **benzoate ion** to form a pale yellow precipitate?

A. *ferric (III) chloride solution
B. sodium hydrogen carbonate solution
C. potassium permanganate solution
D. magnesium sulfate solution
E. sodium nitrite solution



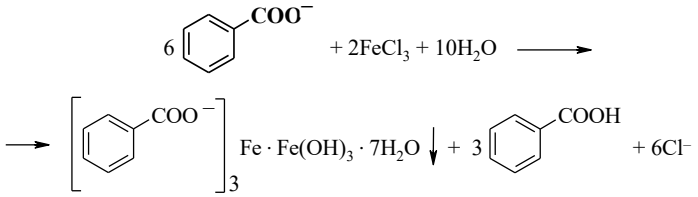
caffeine-sodium benzoate



sodium benzoate

A pharmacist-analyst conducts an express analysis of an extemporaneous mixture. He identifies sodium benzoate in the composition of the mixture by the reaction with the solution of:

A. *iron (III) chloride
B. sodium bicarbonate
C. ammonium oxalate
D. sodium acetate
E. magnesium sulfate

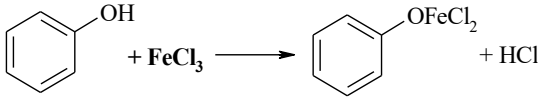


When **benzoate ions** interact with a solution of ferric chloride, a **pale yellow** precipitate is formed, which is soluble in ether.

A pharmacist-analyst is testing for **phenol** in an antiseptic medicine. The presence of the **phenolic hydroxyl** is determined through reaction with a solution of:

A. *ferric (III) chloride
B. ninhydrin
C. barium chloride
D. potassium permanganate
E. silver nitrate

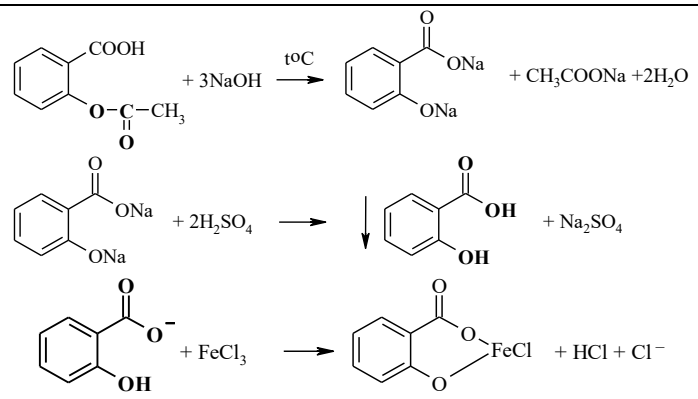
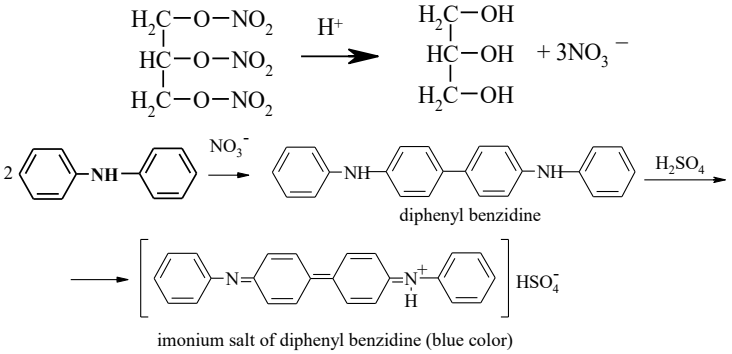
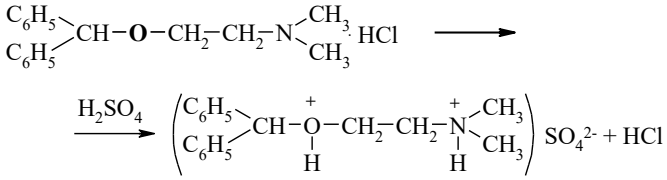
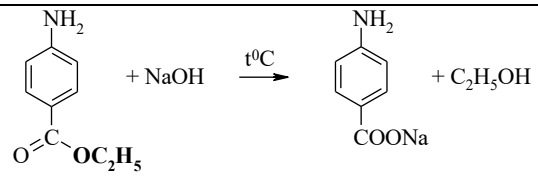
A phenol solution (1:100) forms a blue-violet color with a neutral $FeCl_3$ solution. When a drop of alkali or acid is added, the color disappears (unlike salicylic acid):



The identification of acetylsalicylic acid involves alkaline hydrolysis. After acidifying the reaction medium, a crystalline precipitate is formed, which reacts with the salicylates in the solution of:

A. *ferric (III) chloride
B. sodium hydrotartrate
C. magnesium sulfate

After boiling of **acetylsalicylic acid** with sodium hydroxide solution and subsequent acidification of the reaction mixture, a precipitate of salicylic acid is formed. For its identification, a reaction with a solution of **iron (III) chloride** is carried out (a **purple color** appears).

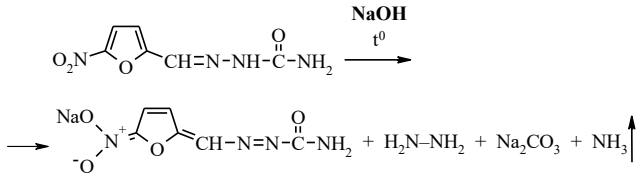
D. ammonium oxalate E. sodium hydrocarbonate	
An analytical chemist is analysing the anti-anginal drug glycerol trisodium (nitroglycerin). To identify the nitrate ions formed after hydrolysis, he uses a solution of: A. *diphenylamine B. lanthanum (III) nitrate C. thiourea D. chloramine E. glyoxalhydroxyanile	Glycerol trinitrate (ester) undergoes hydrolysis with the formation of the corresponding alcohol (glycerol) and acid (nitric) or its salt. The reaction to the residue of nitric acid formed as a result of ester hydrolysis - the appearance of a blue color when interacting with **diphenylamine** in the presence of concentrated sulfuric acid: 
The antihistamine "Diphenhydramine hydrochloride" is an ester by structure. A pharmacist-analyst identifies the compound by the formation of an oxonium salt upon addition of: A. *concentrated sulfuric acid B. hydroxylamine hydrochloride solution C. ferric (III) chloride solution D. dilute nitric acid E. potassium pyroantimonate solution	Due to the presence of an ether group for diphenhydramine, the reaction of the formation of an **oxonium salt** when interacting with concentrated sulfuric acid is characteristic - an intense yellow color appears, which changes to red when concentrated nitric acid is added. 
Ethanol is formed by alkali hydrolysis of local anaesthetic Benzocaine. The pharmacist-analyst confirms the reaction product by performing: A. *iodoform test B. murexide test C. thiochrome test D. ninhydrine test E. hydroxamic test	 **$C_2H_5OH + 4I_2 + 6NaOH \rightarrow$** **$\rightarrow CHI_3\downarrow + 5NaI + HCOONa + 5H_2O$** The ether group of anesthesin is hydrolyzed when heated with a sodium hydroxide solution, as a result of which **ethyl alcohol** is released, which can be detected by the reaction of the formation of **iodoform** (the appearance of a yellow precipitate or turbidity and a **characteristic odour**)

A pharmacist-analyst identifies the aromatic nitro group in the antibacterial agent Nitrofural (furacilin) structure. What reagent do they use?

A. *sodium hydroxide
B. magnesium sulfate
C. ammonium oxalate
D. calcium chloride
E. ferric (III) chloride

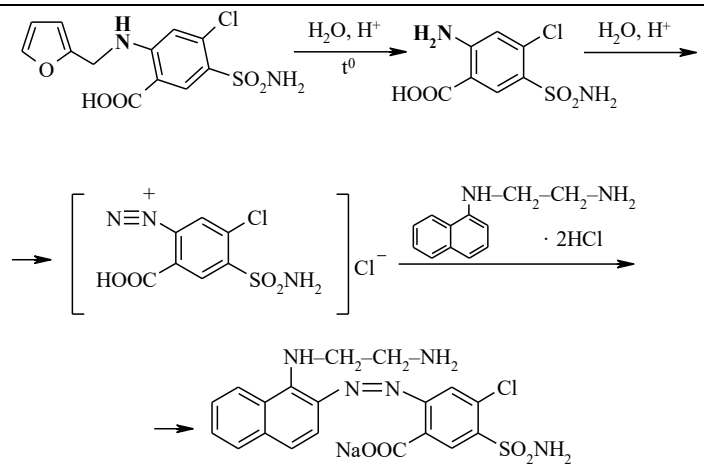
When Nitrofural (Furacilin) is dissolved in dimethylformamide and the subsequent addition of an alcoholic **potassium hydroxide solution**, a purple-red color appears:

When dissolving a portion of the substance in a mixture of equal volumes of water and **alkali solution**, an orange-red color appears, which can be explained by the formation of an acinitroform salt.
Heating the resulting alkaline solution of nitrofural leads to the release of ammonia, which is detected by the smell or by the bluing of wet red litmus paper:



As a result of acid hydrolysis of the diuretic Furosemide, a product containing a primary aromatic amino group is formed. This makes it possible to carry out a further formation reaction of:

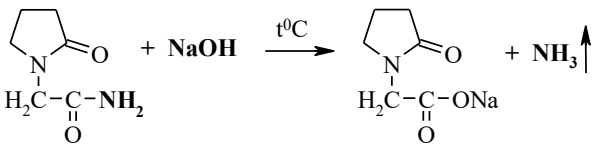
A. *azo dye
B. thiochrome
C. iodoform
D. thaleoquine
E. murexide



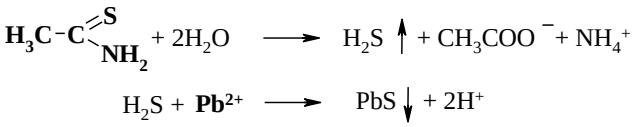
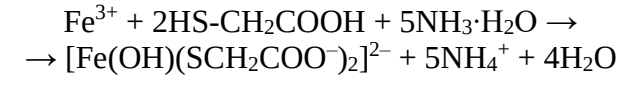
As a result of furosemide hydrolysis, a derivative containing a primary **aromatic amino group** is formed. Its presence is confirmed by the reaction of the formation of a **violet-red azo dye**.

A reaction that produces ammonia when heated is used to identify the nootropic drug "Piracetam". What reagent is used in this reaction?

A. *sodium hydroxide solution
B. magnesium sulphate solution
C. potassium thiocyanate solution
D. barium chloride solution
E. ammonium oxalate solution

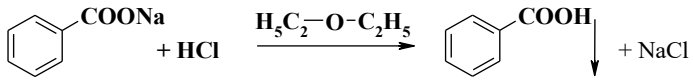
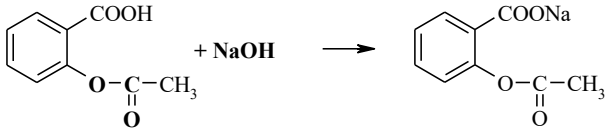


When piracetam is heated with a **solution of sodium hydroxide**, **ammonia** is formed, which is determined by the smell or the change of the colour of the wet red litmus paper.

Test from «Крок-2» base	Explanation
Topics 4-5. Test for purity of medicinal products. Pharmacopoeial requirements for the determination of impurities by chemical methods. Tests for purity of medicinal products. Use of physical constants and physico-chemical methods in purity testingy	
What reagent is used to test diltiazem hydrochloride for heavy metal impurities? A. *thioacetamide B. copper-tartrate C. molybdenum-vanadium D. sulfomolybdenum E. cyanobromide	The test for heavy metals is carried out using the **thioacetamide reagent** in the presence of a buffer solution (pH 3.5). A **brown color** is formed: 
A pharmacist-analyst in a drug quality control laboratory is testing a substance of procaine hydrochloride with a thioacetamide reagent. What impurities are indicated by the formation of a brown colour during this test? A. *heavy metals B. potassium C. aluminium D. magnesium E. calcium	In parallel, in addition to the reference and test solutions, a blank solution is prepared using a mixture of 10 ml of water and 2 ml of the test solution. The brown color of the test solution should not be more intense than the brown color of the reference solution.
The test for calcium lactate pentahydrate involves a reaction with a solution of thioglycolic acid in the presence of citric acid and ammonia. This reaction is used to determine the presence of such an impurity as: A. *iron B. potassium C. chlorides D. sulphates E. ammonium salts	The test for iron is prerformed by the reaction with a solution of thioglycolic acid in the presence of citric acid and an ammonia solution:  The pink color of the tested solution should not be more intense than the color of the standard.
A pharmaceutical company is developing a method for controlling the purity of a new drug using thin sorbent chromatography. It should be borne in mind that for the effective separation of substances mixture by adsorption chromatography, the following is crucial A. *selection of a combination of mobile and stationary phases B. chromatographic column diameter C. height of the chromatographic column D. room temperature E. room humidity	**Thin-layer chromatography** is a method of separation and analysis of mixtures of substances based on their different sorption by a thin layer of sorbent (stationary phase) when the solvent (mobile phase) moves over it.

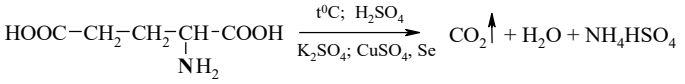
A pharmaceutical company is developing a method for controlling the purity of a new drug using thin sorbent chromatography. It should be borne in mind that for the effective separation of a substance mixture by adsorption chromatography, the following are crucial: A. *properties of the compounds under study B. concentrations of the solutions under study C. temperature at which the determination is performed D. height of the chromatographic column E. diameter of the chromatographic column	
Furosemide is a loop diuretic. When testing this drug, a reaction was carried out with silver nitrate in dilute nitric acid. The appearance of white opalescence indicates the presence of an impurity: A. *chlorides B. calcium C. magnesium D. heavy metals E. ammonium salts	Test for **chlorides:** $\mathbf{Cl^-} + \mathbf{AgNO_3} \xrightarrow{HNO_3} \underset{\text{white cudled precipitate}}{AgCl\downarrow} + NO_3^-$ The solution is neutralaized, then nitric acid is added and this mixture is poured into a solution of silver nitrate, agitated and compared with the refence after 5 minutes, The opalescence of the tested solution should not be more than of the reference solutions. Acidification with other acids is not allowed, as in this case insoluble silver salts may be formed
Quality control of substances for pharmaceutical use involves determining the residual amounts content of volatile organic solvents. For this purpose, the SPhU recommends using this type of chromatography: A. *gas B. paper C. liquid D. ion exchange E. thin-layer	**Gas chromatography** is a physicochemical method for the patrition of substances, based on the distribution of the components of the analyzed mixture between stationary and mobile phases relative to each other. The mobile phase is a **gas (carrier gas)**, and the stationary phase is a solid sorbent or a liquid applied to inert solid media or the inner walls of the column.

Content module 2. Chemical and physicochemical methods of quantitative analysis of medicinal products. Express analysis of medicines

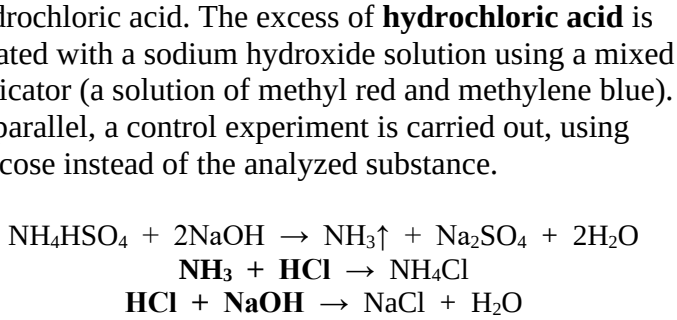
Test from «Крок-2» base	Explanation
Topic 6. Quantitative determination of medicinal products. Titrimetric methods	
An analytical pharmacist conducts a quantitative analysis- of sodium benzoate and uses a hydrochloric acid solution as a titrant. What method of quantification is being used in this case? A. *acidimetry B. bromatometry C. nitritometry D. complexometry E. iodometry	 **Acidimetric** titration of **sodium benzoate** is carried out in the presence of **diethyl ether**, since benzoic acid is released, which changes the pH of the aqueous solution to 2.5-3.0. This leads to a change in the color of the solution to the equivalence point. **Diethyl ether** is used to extract the benzoic acid that has formed.
A pharmacist-analyst performs quantitative determination of the expectorant 'Sodium benzoate' by the method of acidimetry. To eliminate the influence of benzoic acid on the indicator, the titration should be carried out in the presence of: A. *diethyl ether B. manittol C. mercury (II) acetate D. hydrochloric acid E. sodium hydroxide	
The quantification of acetylsalicylic acid using the method of direct alkalimetry is recommended to be carried out at the temperature no higher than 20ºC to prevent a certain process form occurring. What process is it? A. *hydrolysis of the ester group B. decarboxylation of the medicinal substance C. oxidation of the medicinal substance D. reduction of the medicinal substance E. precipitation of the formed salt	 To determine the content of acetylsalicylic acid, one can use direct alkalimetric titration of an alcoholic solution of the substance (alcohol is pre-neutralized and cooled to 8-10ºC), the indicator is phenolphthalein. Acetylsalicylic acid is an ester and is easily hydrolyzed to form salicylic and acetic acids. Therefore, the titration temperature should not exceed 20° C to **avoid hydrolysis of the ester group.**
The chemical laboratory checks the quality of medicines. Specify the substance whose quantitative analysis can be carried out by the method of nitrogen determination after mineralization: A. *glutamic acid B. salicylic acid C. calcium gluconate D. ascorbic acid E. sodium benzoate	The method of determining nitrogen after digestion with sulfuric acid (Kjeldahl method) is used for the quantitative analysis of nitrogen-containing organic compounds, for example, amines, amides and compounds with heterocyclic nitrogen. The method is based on the combination of mineralization of organic matter followed by acid-base titration. First, the substance is decomposed at heating with concentrated sulfuric acid (in the presence of catalysts – potassium sulfate, copper sulfate, and selenium):

Quantitative analysis of glutamic acid is carried out in the laboratory of the pharmaceutical product certification center by the method of nitrogen determination after mineralization with sulfuric acid. The use of this method is associated with the presence of a functional group in the structure of the medicinal substance:

A. *amino group
B. carboxylic group
C. alkyl radical
D. alcohol hydroxyl
E. sulfogroup



Then a concentrated solution of sodium hydroxide is added and the released ammonia is distilled off in a flask containing an excess of a titrated solution of hydrochloric acid. The excess of **hydrochloric acid** is titrated with a sodium hydroxide solution using a mixed indicator (a solution of methyl red and methylene blue). In parallel, a control experiment is carried out, using glucose instead of the analyzed substance.



Pharmaceutical analysis of glutamic acid involves the determination of nitrogen after mineralization with concentrated sulfuric acid. Ammonia formed during the test is distilled into a receiving flask, which should contain:

A. *titrated solution of hydrochloric acid
B. saturated sodium chloride solution
C. titrated sodium edetate solution
D. freshly prepared tannin solution
E. iodized potassium iodide solution

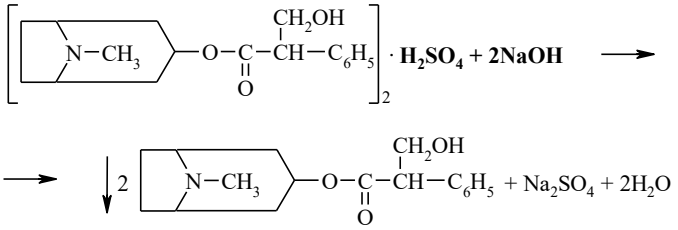
Psychotropic medicine Phenobarbital belongs to acid forms of barbiturates. This allows the analytical chemist to carry out its quantitative determination by the method:

A. *alkalimetry in a non-aqueous environment
B. acidimetry in a non-aqueous medium
C. reverse iodometry
D. reverse cerimetry
E. direct bromatometry

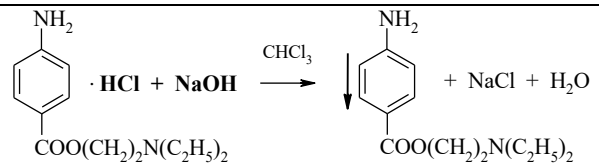
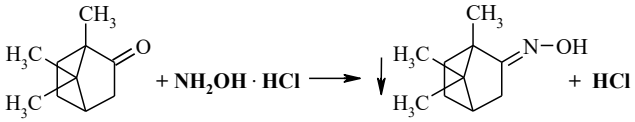
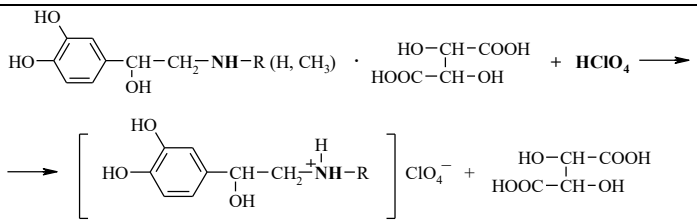
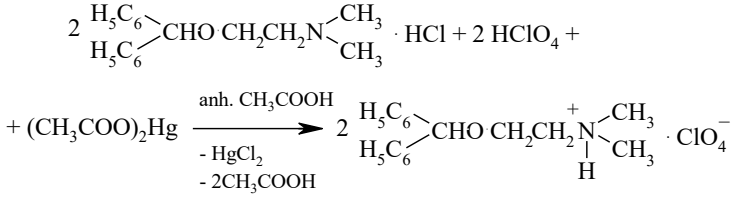
For the assay of phenobarbital **alkalimetry in a non-aqueous medium of dimethylformamide** (**DMF**) or a mixture of dimethylformamide and benzene is used the indicator is thymol blue

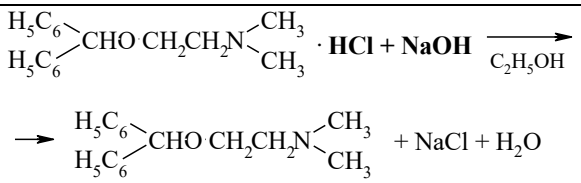
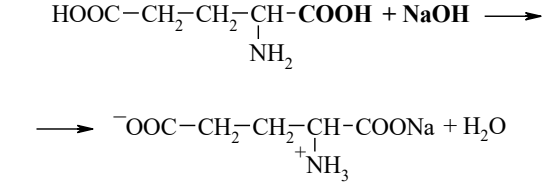
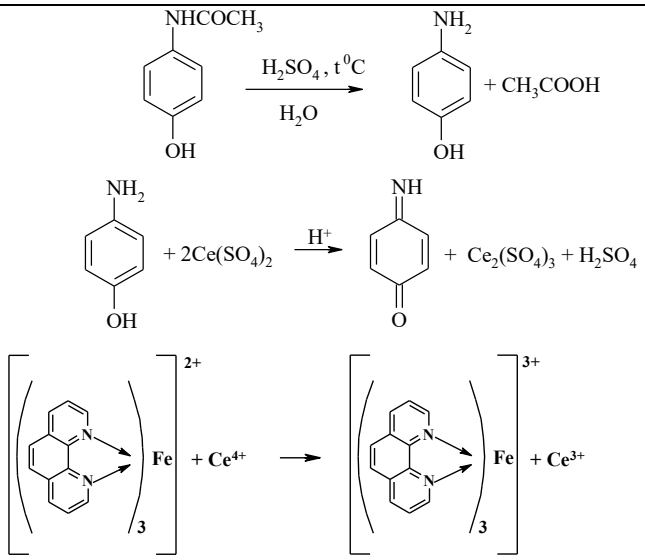
Atropine sulfate is a medicine that has a cholinolytic effect. Quantitative determination of atropine sulfate by the method of alkalimetry in an alcohol-chloroform environment is possible due to the presence of the following substance in its structure:

A. *bound sulfuric acid
B. tertiary nitrogen atom
C. alcohol hydroxyl
D. phenyl radical
E. ester group



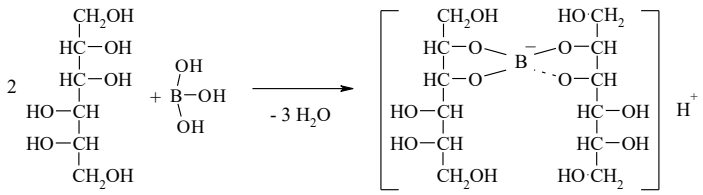
The assay for atropine sulfate can be carried out by the method of alkalimetry based on **bound sulfuric acid** in the presence of an alcohol-chloroform mixture neutralized with phenolphthalein

In the quality control laboratory, quantitative determination of the local anesthetic Procaine hydrochloride is carried out. The method of its alkalimetric titration is based on the presence in the structure of: A. *bound hydrochloric acid B. diethylamino groups C. ester bond D. unsubstituted aromatic cycle E. residue of p-aminobenzoic acid	 The assay for procaine hydrochloride can be carried out by the method of alkalimetry based on **bound hydrochloric acid**. The titration is carried out in the presence of chloroform, which extracts the released base, the indicator is phenolphthalein.
Racemic camphor is used externally as an irritant and antiseptic. The quantitative content of the substance is determined by the method of alkalimetry after the release of an equivalent amount of hydrochloric acid as a result of previous interaction with the reagent: A. *hydroxylamine hydrochloride B. p-dimethylaminobenzaldehyde C. 2,4-dinitrophenylhydrazine D. chloramine E. furfural	 **HCl + NaOH → NaCl + H_2O** A reaction with hydroxylamine hydrochloride can be used for the assay of camphor. In this reaction, ketoxime and hydrochloric acid are formed, which is titrated with sodium hydroxide solution, the indicator is bromothymol blue
Quantitative determination of the substance adrenaline tartrate is carried out by the method of acidimetry in a non-aqueous environment. As a titrant, a solution is used: A. *chloric acid B. sodium hydroxide C. potassium bromate D. iodine E. sodium nitrite	 The assay of adrenaline tartrate (epinephrine tartrate) is carried out by the method of acidimetry in the medium of anhydrous acetic acid; titrant – **perchloric acid solution**, indicator – **crystal violet**.
A pharmacist-analyst performs the quantitative determination of the antihistamine 'Diphenhydramine hydrochloride' by the method of acidimetry in a non-aqueous environment. For what purpose does he add a solution of mercury (II) acetate? A. *to bind chloride ions into a slightly dissociated compound B. to enhance the hydrolysis of diphenhydramine hydrochloride C. to change the density of the solution D. to create the optimal pH value of the solution E. to accelerate precipitation of diphenhydramine bas	 Assay of diphenhydramine hydrochloride is carried out by the method of **acidimetry in a non-aqueous media**: the solvent is anhydrous acetic acid, the titrant is a solution of perchloric acid, the indicator is crystal violet. Titration is carried out in the presence of a mercury (II) acetate solution, which binds the chloride ion into a slightly dissociated compound ($HgCl_2$), thus preventing the formation of hydrogen halides (hydrogen chloride), which even in the environment of anhydrous acetic acid have a degree of dissociation sufficient to lead to a change in the color of the indicator.

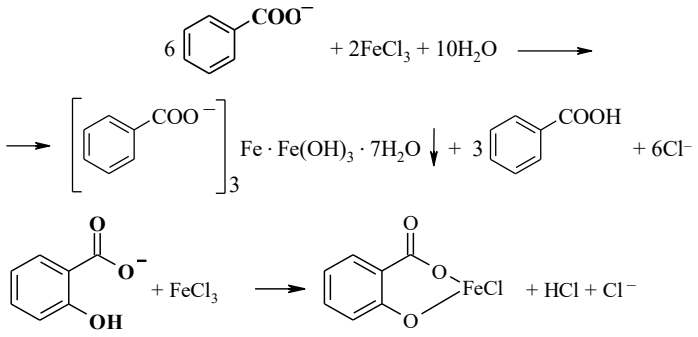
The quantitative content of the antihistamine 'Diphenhydramine hydrochloride' is determined by the method of alkalimetry. As a titrant, a solution is used: A. *sodium hydroxide B. potassium bromate C. sodium thiosulfate D. potassium permanganate E. hydrochloric acid	 The assay of Diphenhydramine hydrochloride is carried out by direct alkalimetry in a mixture of alcohol and 0.01 M hydrochloric acid solution. The and point is determined potentiometrically. The titrant volume between two points of inflection on the titration curve is used for calculations.
According to its chemical structure, glutamic acid belongs to the amino acids of the aliphatic series. What method is used for its quantitative determination? A. *alkalimetry B. nitritometry C. bromatometry D. argentometry E. complexonometry	 Glutamic acid has pronounced acidic properties (one NH_2 group and two COOH groups). Therefore, the assay can be carried out by the method of alkalimetry, titrating with sodium hydroxide solution and using bromothymol blue as an indicator.
Paracetamol is a medicine with an analgesic, antipyretic and anti-inflammatory effect. When quantifying the active substance by the cerimetric method, the indicator is used: A. *ferroin B. sodium eosinate C. phenolphthalein D. starch E. potassium chromate	 One of the methods of paracetamol assay is cerimetry. After acid hydrolysis of paracetamol p-aminophenol is formed, which is oxidized to quinonimine with a titrated solution of cerium sulfate (IV) (the indicator is **ferroin**).

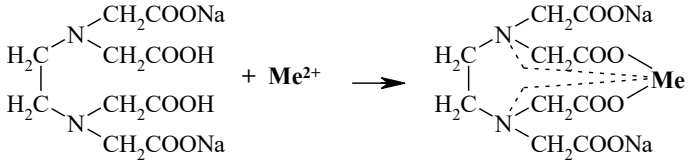
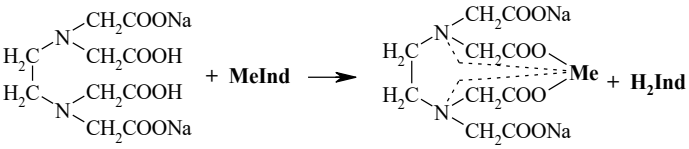
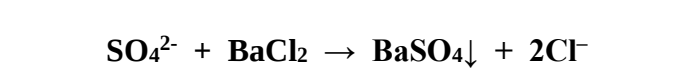
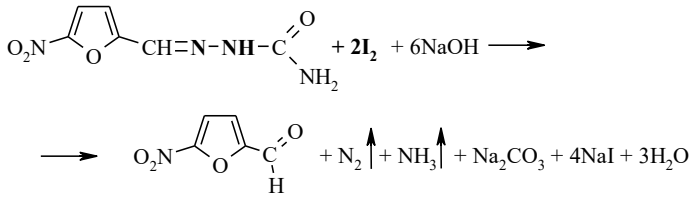
Test from «Крок-2» base	Explanation
Topic 7. Quantitative determination of medicinal products. Polarimetry, refractometry, spectrophotometry, photometry, chromatographic methods for determining the quantitative content of medicinal products	
Photometric methods are widely used in pharmaceutical analysis to control the quality of medicinal products. They are based on the ability of the substance to: A. *selectively absorb electromagnetic radiation B. shift the plane of light polarization C. selectively distribute between two phases D. affect the potential of the indicator electrode E. change the aggregate state under the influence of temperature	**Photometric analysis** methods are a group of methods based on measuring the transmission, **absorption**, or scattering of **electromagnetic radiation** by the analysed substance. These methods are divided into several groups: colorimetry, photocolorimetry; spectrophotometry; fluorimetry; turbidimetry; nephelometry.
Various physicochemical methods are used in pharmaceutical analysis. What method is based on measuring the **absorption** of **monochromatic radiation** by a medicinal substance? A. *spectrophotometry B. fluorimetry C. refractometry D. polarimetry E. potentiometry	**Spectrophotometry** is based on measuring the absorption of a substance by monochromatic radiation. Absorption spectrophotometry in the ultraviolet and visible regions of the spectrum can be used for drug identification, purity testing, and quantification. To calculate the quantitative content, it is necessary to measure the **optical density** of the solution of the substance under investigation on a spectrophotometer and calculate the content using the specific absorption index or by the standard method
A pharmacist-analyst, when determining the quantitative content of hydrocortisone acetate, measures the **optical density** of the solution. What device does he use? A. *spectrophotometer B. polarograph C. polarimeter D. pH-meter E. refractometer	
For an express analysis of a 10% glucose solution, it is necessary to determine its **refractive index.** What device should a pharmacist-analyst use for this? A. *refractometer B. photo colorimeter C. potentiometer D. polarimeter E. spectrophotometer	**Refractometry** is an optical method of analysis, which is based on measuring the index of refraction of light by the tested substance. Refractometry is used to identify and establish the purity of certain substances, as well as to determine the concentration of a substance in a solution (quantification). Devices used to determine the refractive index are called **refractometers**.

A pharmacist-analyst conducts an express analysis of medicines manufactured in a pharmacy. He can use the **refractometric** method for: A. *quantitative determination B. determination of the distribution coefficient C. determination of the physiological action of substances D. determination of the angle of rotation E. determination of relative density	

Test from «Крок-2» base	Explanation
Topic 8. Quality control of medicinal products of extemporaneous manufacture. Regulatory documentation. Express analysis of mono- and multi-component medicines	
Dosage forms containing potassium bromide are used to treat insomnia. What solution should be used to identify the potassium cation in them? A. *sodium cobalt nitrite B. potassium pyroantimonate C. silver nitrate D. barium chloride E. potassium ferrocyanide	$2K^+ + Na_3[Co(NO_2)_6] \rightarrow K_2Na[Co(NO_2)_6]\downarrow + 2Na^+$ When **potassium ions** interact with a solution of **sodium cobaltinitrite, a yellow or orange-yellow precipitate** is formed.
An analytical pharmacist conducts an express analysis of a 2% of boric acid solution. What method must be used in this case to quantify the active ingredient? A. *alkalimetry B. argentometry C. nitritometry D. complexonometry E. acidimetry	 The aasy of boric acid is carried out by the method of alkalimetry in the presence of mannitol. Boric acid belongs to very weak acids. When it is titrated with a solution of sodium hydroxide, metaboric acid (HBO_2) salts are formed, which are strongly hydrolyzed $H_3BO_3 + NaOH \leftrightarrow NaBO_2 + 2H_2O$ To increase the acidic properties of boric acid, its ability to react with polyatomic alcohols or sugars (mannitol, sorbitol, glycerin, glucose, etc.) is used. In these reactions, coordinative compounds with stronger acidic properties than boric acid are formed. These compounds can be titrated with the required accuracy with sodium hydroxide solution in the presence of phenolphthalein.

A pharmacist-analyst conducts photo-colorimetric quantitative determination of a 0.02 % solution of nitrofural. For this he measures: A. *optical density of the solution B. pH of the studied solution C. index of refraction of the solution D. angle of rotation of the solution E. boiling temperature of the solution	**Photometric analysis** methods are a group of methods based on measuring the transmission, **absorption**, or scattering of **electromagnetic radiation** by the analysed substance. These methods are divided into several groups: colorimetry, photocolorimetry; spectrophotometry; fluorimetry; turbidimetry; nephelometry. To calculate the quantitative content, it is necessary to measure the **optical density of the solution** of the substance under investigation on a spectrophotometer and calculate the content using the specific absorption index or by the standard method
An express analysis of the antitussive mixture, which includes sodium hydrogen carbonate and thermopsis grass extract, is being conducted. The quantitative content of sodium bicarbonate in this mixture can be determined by the method: A. *acidimetry B. nitritometry C. cerimetry D. permanganatometry E. argentometry	**$NaHCO_3$ + HCl** → NaCl + CO_2↑ + H_2O Assay of sodium bicarbonate in the presence of iodides and chlorides is possible using the method of acidimetry, since this salt is formed by a strong base and a weak acid.
The composition of the expectorant mixture includes sodium bicarbonate, potassium iodide and ammonium chloride. During the express analysis of this dosage form, the quantitative determination of sodium bicarbonate can be determined by the following method: A. *acidimetry B. alkalimetry C. argentometry D. complexonometry E. nitritometry	
An express analysis of the mixture containing calcium chloride and sodium bromide is carried out. What method should be used for total quantitative determination of the ingredients of this dosage form? A. *argentometry B. complexonometry C. alkalimetry D. polarimetry E. nitritometry	Methods of **argentometry** are used for the assay of alkaline metal halides. The cvontent of sodium bromide and calcium chloride can be determined by argentometry (Mohr's method, direct titration): **NaBr(Cl) + $AgNO_3$** → AgBr(AgCl)↓ + $NaNO_3$ $AgNO_3$ + NH_4CNS → AgCNS ↓ + NH_4NO_3 3 NH_4CNS + $Fe(NH_4)(SO_4)_2$ → → $Fe(CNS)_3$ ↓ + 2 $(NH_4)_2(SO_4)$ (Mohr's method, direct titration): **NaBr(Cl) + $AgNO_3$** → AgBr(AgCl)↓ + $NaNO_3$ K_2CrO_4 + 2 $AgNO_3$ → Ag_2CrO_4↓ + 2KNO_3
A pharmacist-analyst conducts an express analysis of a sedative mixture with sodium bromide. What method is used to quantify sodium bromide? A. *argentometry B. complexonometry C. alkalimetry D. acidimetry E. nitritometry	

0.9% sodium chloride solution is widely used in hospital practice. What method can be used to quantitatively determine its active substance? A. *argentometry B. nitritometry C. complexonometry D. acidimetry E. alkalimetry	
An express analysis of a liquid dosage form containing sodium salicylate and sodium benzoate is carried out. To detect salicylate and benzoate ions in their simultaneous presence, it is necessary to use the solution of: A. *iron (III) chloride B. potassium iodide C. sodium nitrite D. ammonium chloride E. aluminum sulfate	To distingush **salicylate** and **benzoate ions** in their simultaneous presence, the following reaction is used: a drop of **iron (III) chloride** solution is applied to the filter paper; a drop of the tested solution under is added to the center of the resulting spot, a **pinkish-yellow spot (benzoate ion)** is formed, bordered by a **purple ring (salicylate ion)**. 
A pharmacist-analyst performs an express analysis of anti-inflammatory eye drops containing potassium iodide. Quantitative determination of the active substance is carried out by the method: A. *argentometry B. complexonometry C. nitritometry D. acidimetry E. alkalimetry	Argentometric methods are used for the assay of alkali metal halides. The quantitative content of potassium iodide can be determined by the method of argentometry (Fajan's method), with sodium eosinate as the indicator. $KI + AgNO_3 \rightarrow AgI\downarrow + KNO_3$
A pharmacist-analyst analyzes an extemporaneous mixture containing calcium chloride. Quantitative determination of the active substance is carried out by the method: A. *complexonometry B. alkalimetry C. nitritometry D. acidimetry E. permanganatometry	For the assay of inorganic and organic substances, which include metal cations (calcium, magnesium, zinc, bismuth, lead, aluminum), the method of complexonometry is used. In the process of assay, a small amount of metal indicator is added to the substance solution, which at a certain pH value forms an intensely colored complex with metal ions. The appropriate pH value is adjusted by the addition of auxiliary reagents (determination of zinc salts with xylenol orange in the presence of hexamethylenetetramine; determination of calcium salts with chalcone carboxylic acid in the presence of sodium hydroxide solution. A relatively stable, well-soluble compound in water is formed: $Me^{2+} + H_2Ind \leftrightarrow MeInd + 2H^+$

	During titration with sodium edetate, a complex with free metal ions is first formed.  A free indicator is released at the equivalence point. 
A pharmacist-analyst performs an express analysis of eye drops containing zinc sulfate. He identifies sulfates by reaction with a solution of: A. *barium chloride B. ammonium oxalate C. potassium nitrate D. sodium nitrite E. iron (III) chloride	**$ZnSO_4$**  When **sulfate ions** interact with a **barium chloride** solution in the presence of diluted hydrochloric acid, a **white precipitate** is formed.
A pharmacist-analyst performs an express analysis of a mixture containing calcium chloride. He identifies the calcium cation by reaction with a solution of: A. *ammonium oxalate B. potassium pyroantimonate C. sodium tetraphenylborate D. copper II sulfate E. barium chloride	**$Ca^{2+} + (NH_4)_2C_2O_4 \rightarrow CaC_2O_4\downarrow + 2NH_4^+$** When **calcium ions** interact with **ammonium oxalate** solution, a **white precipitate** is formed, which is insoluble in diluted acetic acid and ammonia solution.
A pharmacist-analyst performs a quantitative determination of a 0.02% nitrofural solution using the iodometric method. What indicator does he use? A. *starch B. potassium chromate C. methyl red D. phenolphthalein E. crystal violet	Assay of nitrofural is carried out by iodometry in an alkaline medium (back titration) with the starch as indicator.  $I_2 + 2NaOH \rightarrow NaI + NaOI + H_2O$ $NaI + NaOI + H_2SO_4 \rightarrow I_2 + Na_2SO_4 + H_2O$ **$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$**

MODULE 2

Physicochemical aspects of pharmacokinetics and pharmacodynamics medicinal substances. Drugs affecting organs and systems

Content module 3. Physicochemical aspects of pharmacokinetics and pharmacodynamics of medicinal substances. Medicines that act on the central nervous system

<table>
<tr><th>Test from «Крок-2» base</th><th>Explanation</th></tr>
<tr><td colspan="2">Topic 9. Chemical basis of drug action (general principles). Chemical reactions underlying metabolic transformations</td></tr>
<tr><td>Lipophilicity is an important characteristic of a drug. To experimentally determine the lipophilicity of the substance investigate its distribution between:
A. *water and octanol
B. ethanol and acetone
C. isopropanol and hexane
D. methanol and benzene
E. ethyl acetate and dichloroethane</td><td rowspan="3">The ratio of lipophilic and hydrophilic properties is characterized by the lipophilicity coefficient or partition coefficient.
The distribution coefficient (P, log P) is the ratio of concentrations in the aqueous and organic phases. Usually, for its experimental determination, the distribution between octanol and water is used as an organic phase.
$$P = \frac{C_{oct}}{C_{water}}$$
In practice, the logarithmic value of this indicator is usually used, which is the lipophilicity coefficient.
$$\log P = \log \frac{C_{oct}}{C_{water}}$$
The optimal value of the lipophilicity coefficient for absorption and penetration through membranes is considered to be in the range of 2-5.
For the ability of substances to penetrate through the blood-brain barrier, they must be lipophilic. Increasing lipophilicity usually leads to increased activity and protein binding.</td></tr>
<tr><td>Lipophilicity affects the bioavailability of drugs. This indicator characterizes the ability of a substance to dissolve in:
A. *lipids
B. water
C. acetone
D. acids
E. basics</td></tr>
<tr><td>Lipophilicity is one of the factors influencing the bioavailability of drugs. It can be determined experimentally by the nature of the distribution of substance in the system:
A. *n-octanol-water
B. hexane-chloroform
C. chloroform-glycerin
D. acetonitrile-water
E. ethanol-paraffin</td></tr>
<tr><td>Lipophilicity is a very important factor characterising the bioavailability of a substance. The numerical indicator that characterizes lipophilicity is called:
A. *distribution coefficient
B. stoichiometric ratio
C. correction factor
D. viscosity coefficient
E. surface tension coefficient</td><td>The ratio of lipophilic and hydrophilic properties is characterized by the lipophilicity coefficient or partition coefficient.
The distribution coefficient (P, log P) is the ratio of concentrations in the aqueous and organic phases. Usually, for its experimental determination, the distribution between octanol and water is used as an organic phase.</td></tr>
</table>

Lipophilicity is one of the factors influencing the distribution of molecules of biologically active substances in the body. The numerical indicator of this factor is:

A. *distribution coefficient
B. angle of rotation
C. absorbance
D. melting point
E. refractive index

$$P = \frac{C_{oct}}{C_{water}}$$

In practice, the logarithmic value of this indicator is usually used, which is the lipophilicity coefficient.

$$\log P = \log \frac{C_{oct}}{C_{water}}$$

The optimal value of the lipophilicity coefficient for absorption and penetration through membranes is considered to be in the range of 2-5.
For the ability of substances to penetrate through the blood-brain barrier, they must be lipophilic. Increasing lipophilicity usually leads to increased activity and protein binding.

The second phase of drug metabolism (conjugation phase) involves the reaction of xenobiotics or their metabolites, which have active functional groups, with hydrophilic endogenous molecules. This phase includes the process of:

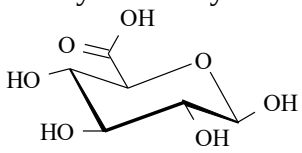
A. *glucuronidation
B. S-oxidation
C. hydroxylation
D. reduction
E. hydrolysis

Metabolism is a chemical biotransformation of a molecule under the action of various enzyme systems in the body.
The **functionalization phase** consists of oxidation, reduction, hydroxylation and hydrolysis processes. At the same time, new functional groups appear in the molecule or those present in the molecule are modified. As a result, the compounds become **more polar, hydrophilic**, that is, they can be more easily removed from the body

The metabolism of drugs occurs in several stages. The phase of metabolism during which the functional groups in the drug molecule undergo biochemical transformation is called:

A. *phase of functionalization
B. conjugation phase
C. secretion phase
D. phase of mitosis
E. phase of depolarization

The **conjugation phase** includes reactions of the interaction of xenobiotics or their metabolites, which have active functional groups, with hydrophilic endogenous molecules (glucuronic, sulfate, acetic acids, amino acids, etc.). This further increases the hydrophilicity of the xenobiotic, and facilitates its excretion by the kidneys.

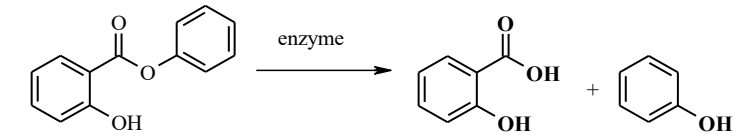


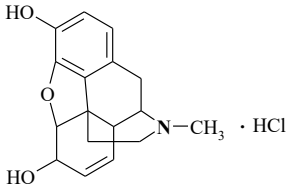
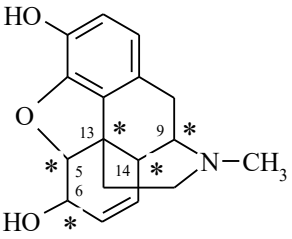
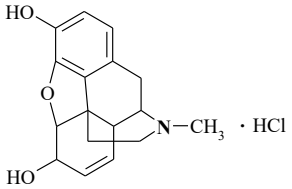
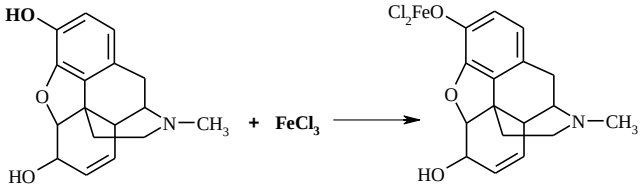
glucuronic acid

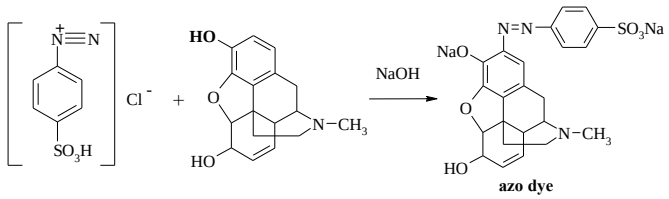
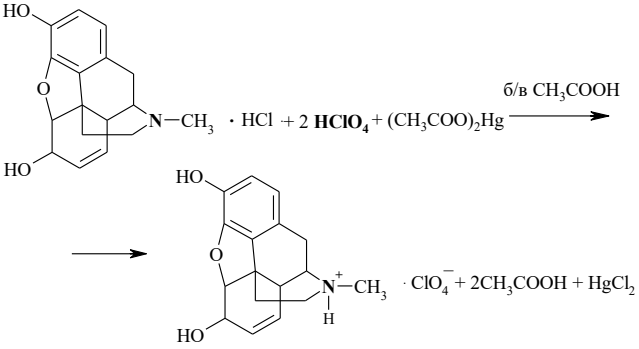
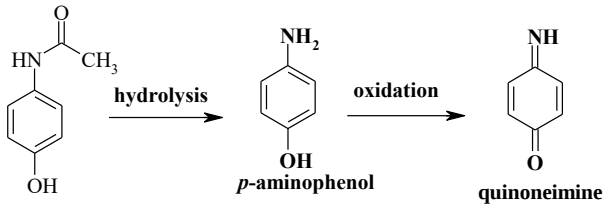
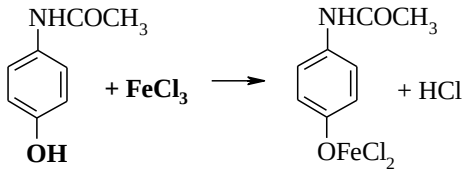
The metabolism of drugs occurs in several stages. The phase of drug metabolism, during which there is a biochemical conjugation of functional groups of the molecule with acid residues, such as glucuronic and sulfuric, or glycine, is called:

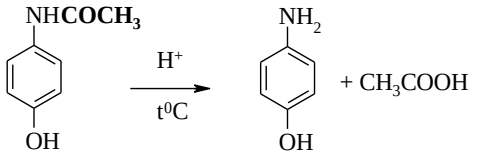
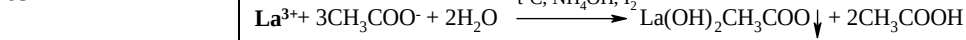
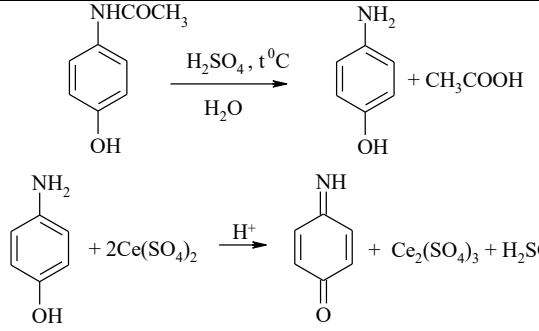
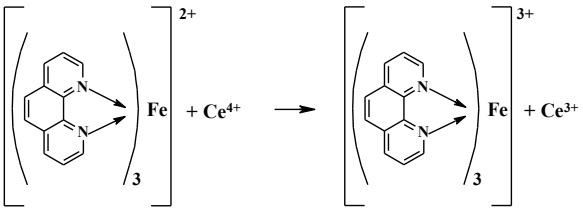
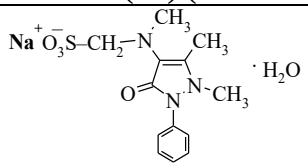
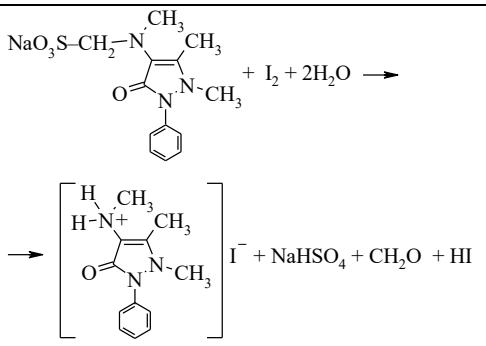
A. *conjugation phase
B. phase of functionalization
C. secretion phase
D. phase of mitosis
E. phase of depolarization

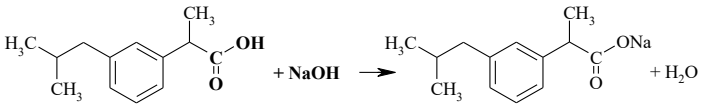
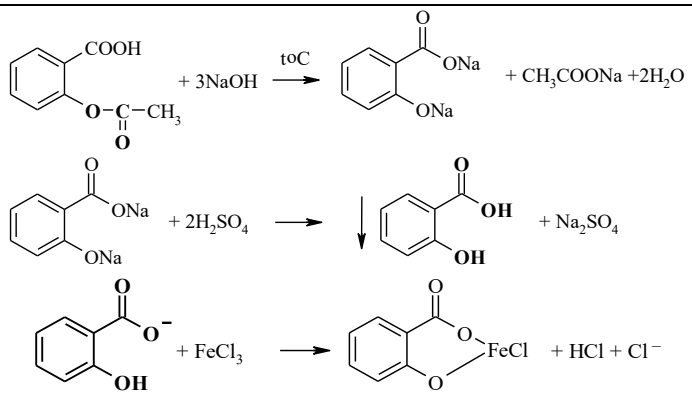
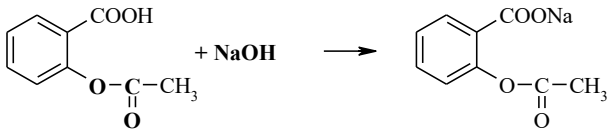
The most important way of metabolism is **glucuronidation**. There are several reasons for this: the availability of glucuronic acid (a derivative of glucose), a large number of functional groups that can interact with glucuronic acid in the presence of enzymes, a strong increase in the solubility of the conjugation product in water

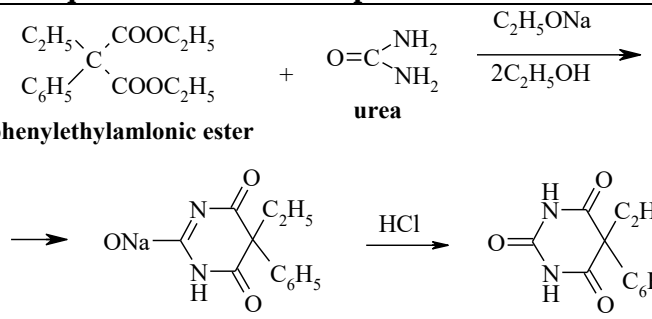
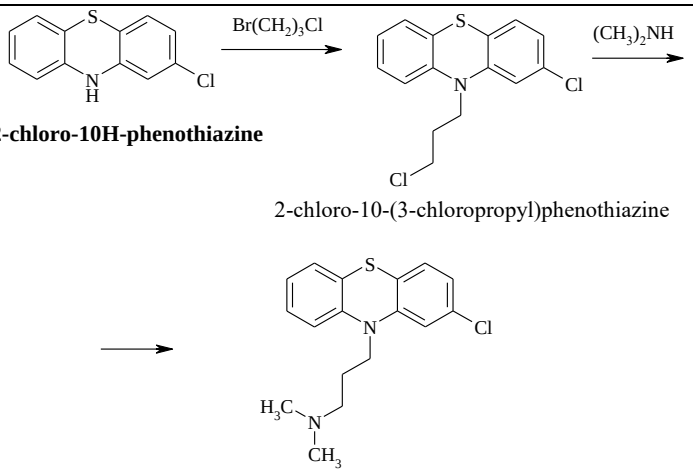
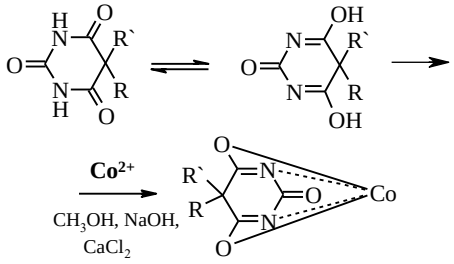
Drug metabolism is one of the stages of pharmacokinetics. Drugs that are metabolically converted into biologically active substances are called: A. *prodrugs B. vitamins C. hormones D. enzymes E. conjugates	
The principle of salol was formulated by Nentzky and is widely used in the development of prodrugs that form two active metabolites during biotransformation. What products are formed as a result of salol metabolism? A. *Phenol and salicylic acid B. Aniline and phthalic acid C. Resorcinol and acetic acid D. Pyridine and benzoic acid E. Sulfanilamide and propionic acid	If it is necessary that the effect of the drug be achieved, for example, not in the stomach, but in the intestine - the substance enters there in an unchanged state, and then is metabolized. Salol (**phenyl salicylate**) was the first example of such use of **prodrugs**. Under the name "**Nentzky principle**" became the principle of obtaining active substances in the body from inactive ones. During hydrolysis, **salicylic acid** (anti-inflammatory effect) and **phenol** (antiseptic effect) are formed. One of the tasks in the development of this tool was the desire to prevent the irritating effect of salicylic acid on the mucous membrane of the stomach and to have an effect in the intestines.
Phenyl salicylate is a classic representative of prodrugs. Under the influence of enzymes, it is hydrolysed in the intestine to form active metabolites - salicylic acid and phenol. The principle of creating prodrugs that form two active substances in the course of metabolism is called the saline principle or the principle of: A. *Nentzky's B. Mendeleev's C. Bernoulli's D. Pasteur's E. Pirogov's	 phenyl salicylate salicylic acid phenol
Prodrugs are drugs that show their pharmacological action due to the formation of the active metabolite. Choose such drug of the following: A. *phthalylsulfathiazole B. chloramphenicol C. diphenhydramine D. metronidazole E. ciprofloxacin	**Prodrugs** are a special class of drugs that form active substances after biotransformation (metabolism), but are inactive themselves.

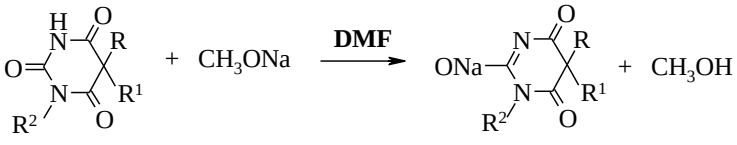
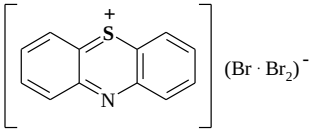
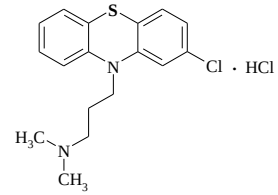
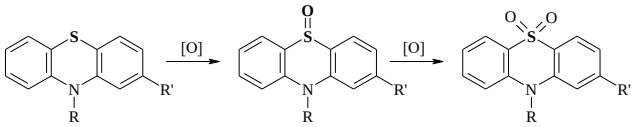
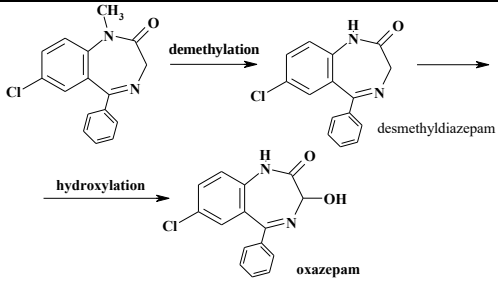
Test from «Крок-2» base	Explanation
Topic 10. Chemical basis of rational use and quality assurance of medicinal products from the group of narcotic and non-narcotic analgesics **Topic 11. Chemical basis of rational use and quality assurance of medicinal products from the group of non-steroidal anti-inflammatory drugs**	
Morphine belongs to the group of narcotic analgesics. According to the chemical structure, it is a derivative of: A. *phenanthrenisoquinoline B. tropan C. benzodiazepine D. piperidine E. furan	 Morphine hyrochloride
Morphine is an optically active substance. Which device is used by a pharmacist-analyst to measure the angle of rotation of a solution of morphine hydrochloride? A. *polarimeter B. refractometer C. potentiometer D. areometer E. spectrophotometer	 **Polarimetry** is a method based on measuring the degree of polarization of light and **the angle of rotation** of the plane of polarization of light when it passes through optically active substances. Measurement of the angle of rotation is carried out with **polarimeters**.
One of the salts of morphine used in medical practice is hydrochloride. A solution of which reagent is used to identify chloride? A. *silver nitrate B. potassium iodide C. sodium chloride D. calcium phosphate E. magnesium hydroxide	 Morphine hyrochloride  At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.
A pharmacist-analyst is identifying morphine hydrochloride. Due to the presence of a phenolic hydroxyl, morphine forms a coloured product with a solution of: A. *iron (III) chloride B. hydrochloric acid C. picric acid D. formaldehyde E. potassium pyroantimonate	 Morphine hydrochloride in the reaction to its **phenolic hydroxyl** from iron (III) chloride, as a result of which a blue color appears.

Morphine reacts with diazonium salts to form an azo dye. What functional group ensures the course of this reaction? A. *phenolic hydroxyl B. aldehyde group C. alcohol hydroxyl D. carboxyl group E. ester group	 Morphine hydrochloride due to **phenolic hydroxyl** reacts with the formation of an **azo dye**, as a result of which the orange-red precipitate is formed
The quantitative determination of morphine hydrochloride is carried out by acidimetry in a non-aqueous medium in the presence of mercury (II) acetate. A solution which is used as a titrant is: A. *perchloric acid B. sodium hydroxide C. potassium permanganate D. sodium nitrite E. silver nitrate	 The assay of **morphine hydrochloride** is carried out by the method of acidimetry in a **non-aqueous medium**: solvent - anhydrous acetic acid, titrant - **perchloric acid solution**, indicator - crystal violet, titration is carried out in the presence of mercury (II) acetate solution.
Paracetamol belongs to non-steroidal anti-inflammatory drugs and is biotransformed in the body by deacetylation. What metabolite is formed? A. **p*-aminophenol B. aminobenzene C. *o*-xylene D. nitrobenzene E. *m*-dioxybenzene	Paracetamol is metabolized by microsomal liver enzymes through glucuronidation and sulfonation. A small amount of paracetamol is deacetylated to form **p-aminophenol**, which, in turn, can be oxidized to **quinoneimine** in the body. 
The chemist-analyst identifies paracetamol by the reaction to phenolic hydroxyl, which results in the formation of a blue-violet color. What reagent did he use? A. *iron (III) chloride B. sodium chloride C. potassium pyroanhydride D. barium chloride E. silver nitrate	 The presence of **phenolic hydroxyl** in paracetamol is confirmed by reaction with a solution of **iron (III) chloride**, a purple color is formed.

A The pharmacist-analyst carries out paracetamol identification reactions. What solution does he use to determine acetyl? A. *lanthanum nitrate B. magnesium sulfate C. sodium sulfide D. potassium dichromate E. ammonium oxalate	  Paracetamol substance produces acetic acid (acetate) after heating with phosphoric acid over an open flame. With a solution of **lanthanum(III)nitrate** in the presence of **iodine** and ammonia solution, a **blue color or a blue precipitate is formed when heated**.
Paracetamol is a medicine with an analgesic, antipyretic and anti-inflammatory effect. When quantifying the active substance by the cerimetric method, the indicator is used: A. *ferroin B. sodium eosinate C. phenolphthalein D. starch E. potassium chromate	  One of the methods of paracetamol assay is cerimetry. After acid hydrolysis of paracetamol p-aminophenol is formed, which is oxidized to quinonimine with a titrated solution of cerium sulfate (IV) (the indicator is **ferroin**).
A white precipitate was formed due to the analgesic **Metamizole sodium** monohydrate reaction with **potassium pyroantimonate solution.** This confirms the presence in the structure of the medicinal substance of: A. *sodium ions B. covalently bonded sulphur C. methyl group D. phenyl redical E. keto groups	 **$Na^+ + K[Sb(OH)_6] \rightarrow Na[Sb(OH)_6]\downarrow + K^+$** When **sodium ions** interact with a solution of **potassium pyroantimonate** at heating with further cooling in ice water and rubbing with a glass rod, a thick white precipitate is formed.
Pharmacist-analyst of the control-analytical laboratory carries out quantitative determination of metamizole sodium by iodometry. What indicator does he use: A. *starch B. murexide C. phenolphthalein D. ferroin E. tropeolin 00	

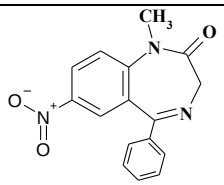
	The assay of **metamizole sodium** is carried out by the method of iodometry, titrant is **iodine solution**, the indicator is a **starch solution**.
Which indicator is used in the quantitative determination of ibuprofen by alkalimetry? A. *phenolphthalein B. iron (III) ammonium sulphate C. mordant black D. potassium chromate E. starch	The assay of ibuprofen is carried out by the method of alkalimetry in a methanol media with a blank experiment (indicator – **phenolphthalein solution**) 
The identification of acetylsalicylic acid involves alkaline hydrolysis. After acidifying the reaction medium, a crystalline precipitate is formed, which reacts with the salicylates in the solution of: A. *ferric (III) chloride B. sodium hydrotartrate C. magnesium sulfate D. ammonium oxalate E. sodium hydrocarbonate	 After boiling of **acetylsalicylic acid** with sodium hydroxide solution and subsequent acidification of the reaction mixture, a precipitate of salicylic acid is formed. For its identification, a reaction with a solution of **iron (III) chloride** is carried out (a **purple color** appears).
The quantification of acetylsalicylic acid using the method of direct alkalimetry is recommended to be carried out at the temperature no higher than 20ºC to prevent a certain process form occurring. What process is it? A. *hydrolysis of the ester group B. decarboxylation of the medicinal substance C. oxidation of the medicinal substance D. reduction of the medicinal substance E. precipitation of the formed salt	 To determine the content of acetylsalicylic acid, one can use direct alkalimetric titration of an alcoholic solution of the substance (alcohol is pre-neutralized and cooled to 8-10ºC), the indicator is phenolphthalein. Acetylsalicylic acid is an ester and is easily hydrolyzed to form salicylic and acetic acids. Therefore, the titration temperature should not exceed 20° C to **avoid hydrolysis of the ester group.**

Test from «Крок-2» base	Explanation
Topic 12: Chemical basis of rational use and quality assurance of medicinal products from the group of sedatives and anticonvulsants Topics 13-14. Chemical basis of rational use and quality assurance of medicines from the group of hypnotics, tranquillisers and neuroleptics	
At a chemical-pharmaceutical company, a drug that depresses the central nervous system is produced by condensing the diethyl ester of phenylethylmalonic acid with urea. Name this drug A. *phenobarbital B. triazolam C. barbital D. nicotinic acid E. ascorbic acid	 **phenylethylamlonic ester** **urea** 5-ethyl-5-phenylabrbtirate sodium, phenobarbital sodium 5-ethyl-5-phenylbarbituric aicd, phenobarbital
The majority of active pharmaceutical ingredients are obtained by chemical synthesis. 2-chloro-10H-phenothiazine is the starting substance in the synthesis of the substance: A. *chlorpromazine B. diphenhydramine C. aceclydine D. phenobarbital E. caffeine	 **2-chloro-10H-phenothiazine** 2-chloro-10-(3-chloropropyl)phenothiazine 2-chloro-10-(3-dimethylamainopropyl)phenothiazine **(chlorpromazine)**
To identify hypnotics derived of barbituric acid, a general pharmacopoeial reaction is used. To form coloured complex compounds, use the solution: A. *cobalt nitrate B. sodium nitrite C. potassium iodide D. sodium bromide E. ammonium chloride	 The ability to form complexes with **cobalt salts** is used by pharmacopoeias as a way to identify barbiturates (group reaction). At the same time, the formation of a **violet-blue colorand precipitate** is observed
Alkalimetry in a non-aqueous medium is used for quantification of a phenobarbital substance. What reagent is used as a solvent for this purpose? A. *dimethylformamide B. ethyl alcohol C. glacial acetic acid D. acetic anhydride E. formic acid	For the assay of phenobarbital **alkalimetry in a non-aqueous medium of dimethylformamide** (**DMF**) or a mixture of dimethylformamide and benzene is used the indicator is thymol blue

Psychotropic medicine Phenobarbital belongs to acid forms of barbiturates. This allows the analytical chemist to carry out its quantitative determination by the method: A. *alkalimetry in a non-aqueous environment B. acidimetry in a non-aqueous medium C. reverse iodometry D. reverse cerimetry E. direct bromatometry	
Phenothiazine derivatives can be oxidised to form coloured products. Which of the following reagents is used for this reaction? A. *bromine water B. ammonium chloride C. magnesium sulphate D. sodium hydroxide E. acetic acid	Phenothiazine derivatives can be oxidised to form coloured products.  У якості окиснювачів використовують конц. H_2SO_4 і HNO_3, **бромну воду**, розчин $FeCl_3$ та інші. Найбільш специфічним з наведених реактивів є **бромна вода**, з якою субстанції утворюють забарвлені пербромпохідні. As oxidizing agents, conc. H_2SO_4 and HNO_3, bromine water, FeCl3 solution and others can be used. The most specific of these reagents is **bromine water**, with which substances form colored perbromine derivatives.
Due to the presence of a heterocyclic sulfur atom in its structure, chlorpromazine hydrochloride can be oxidised to form coloured products. Which reagent is used in this reaction? A. *sulfuric acid B. ammonium chloride C. magnesium sulfate D. sodium hydroxide E. potassium bromide	 **chlorpromazine hydrochloride**  Due to the sulfur (II) heteroatom, phenothiazine derivatives are easily oxidized, forming colored products with **concentrated sulfuric acid**. Depending on the conditions, *9-S-oxide* or *9,9-S-dioxide* are formed in these reactions.
Diazepam belongs to tranquillisers, benzodiazepine derivatives. Which active metabolite is formed as a result of its biotransformation at the functionalisation stage? A. *oxazepam B. phenobarbital C. chlorpromazine D. paracetamol E. diphenhydramine	 Diazepam active metabolite (oxazepam) is formed as a result of its biotransformation at the functionalisation stage?

Nitrazepam is a benzodiazepine derivative. Nitrazepam is identified by spectrophotometry. The following are measured:

A. *optical density
B. rotation angle
C. refractive index
D. melting point
E. dynamic viscosity



nitrazepam

Photocolorimetry, as well as spectrophotometry, is based on measuring the absorption of light of a colored solution (or the substance itself, or the product of its interaction with certain reagents). For this purpose photoelectroncolorimeters are used, which determine the **optical density** of the solution.

An analytical chemist is conducting a qualitative reaction of nitrazepam with potassium tetraiodobismutate and gets an orange-red precipitate. Which fragment of the molecule is responsible for this reaction?

A. *tertiary nitrogen
B. phenolic hydroxyl
C. carboxyl group
D. ester group
E. benzene nucleus

nitrazepam

Nitrazepam with potassium tetraiodobismutate and produces an orange-red precipitate because of the tirtiary nitrogen atom presence in its sturcuture.

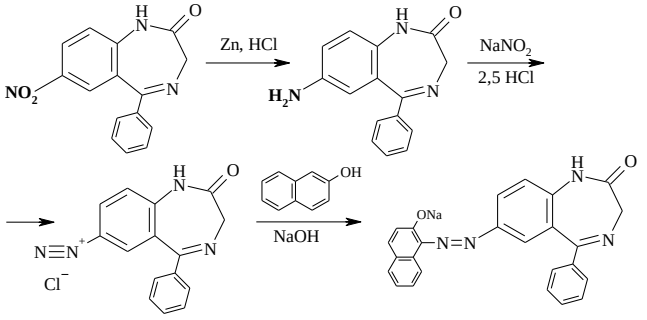
The formation of a coloured precipitate with potassium tetraiododismutate is a characteristic reaction of substances containing tertiary nitrogen. This reaction can be used to identify:

A. *nitrazepam
B. chloral hydrate
C. camphor
D. phenyl salicylate
E. phenol

The pharmaceutical analyst identifies the aromatic nitro group in the nitrazepam sample after preliminary reduction to the amino group. The final product of the identification reaction is

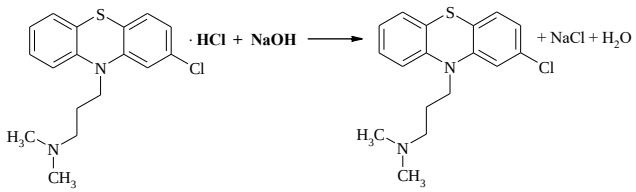
A. *azo dye
B. murexide
C. thaleoquinine
D. indophenol
E. thiochrome

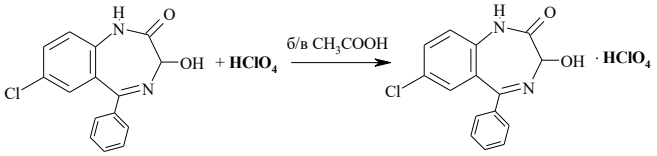
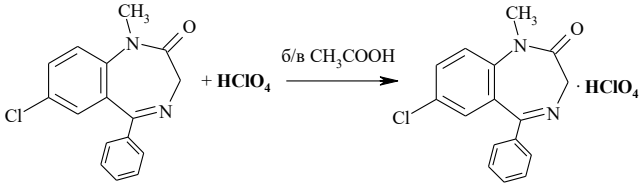
The **nitro group** of nitrazepam is reduced to the primary aromatic amino group and further determined by the reaction of the formation of an **azo dye**.

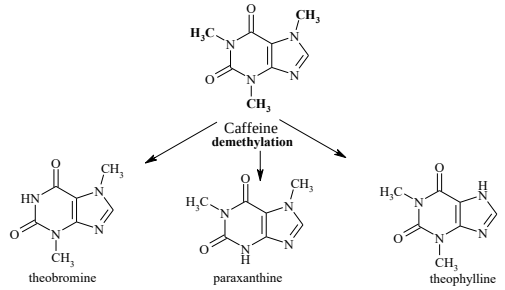
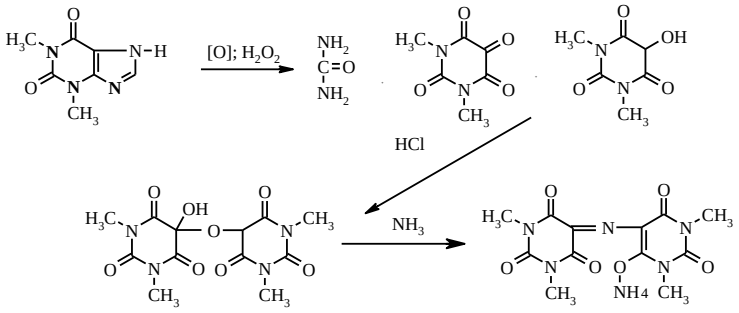
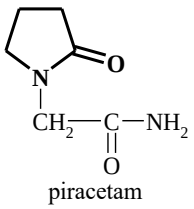
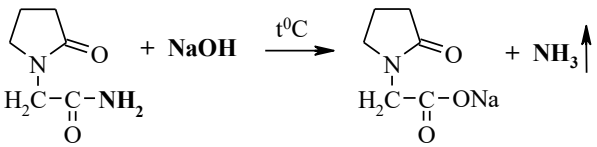


The quantitative determination of chlorpromazine hydrochloride is carried out using the alkalimetric method. Which titration solution is used?

A. *sodium hydroxide
B. cerium sulfate
C. sodium edetate

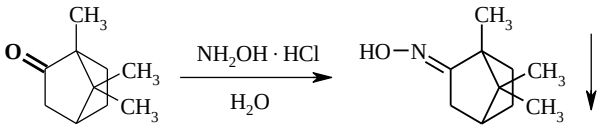


D. potassium bromate E. sodium nitrite	Chlorpromazine hydrochloride is quantitatively determined by the **bound HCl** by the method of alkalimetry and titrated with **sodium hydroxide solution**.
Oxazepam is a benzodiazepine derivative. Which method is used to quantify it? A. *acidimetry in a non-aqueous medium B. reverse complexometry C. alkalimetry by substituent D. direct bromatometry E. alkalimetry in aqueous medium	 The assay of oxazepam as a nitrogen-containing compound is carried out by the method of **acidimetry in a non-aqueous medium** (anhydrous acetic acid), the **titrant is a perchloric acid** solution, and the indicator is crystal violet.
In the laboratory during the certification of diazepam, the quantitative content is determined by acidimetry in a non-aqueous medium. Titration is carried out with a solution of: A. *perchloric acid B. potassium bromate C. silver nitrate D. sodium edetate E. cerium sulphate	 The assay of diazepam is carried out by the method of acidimetry in a non-aqueous media. Determination is carried out in the medium of anhydrous acetic acid; titrant – **perchloric acid** solution, indicator – crystal violet.
Dosage forms containing potassium bromide are used to treat insomnia. What solution should be used to identify the potassium cation in them? A. *sodium cobalt nitrite B. potassium pyroantimonate C. silver nitrate D. barium chloride E. potassium ferrocyanide	$2K^+ + Na_3[Co(NO_2)_6] \rightarrow K_2Na[Co(NO_2)_6]\downarrow + 2Na^+$ When **potassium ions** interact with a solution of **sodium cobaltinitrite, a yellow or orange-yellow precipitate** is formed.
A pharmacist-analyst conducts an express analysis of a sedative mixture with sodium bromide. What method is used to quantify sodium bromide? A. *argentometry B. complexonometry C. alkalimetry D. acidimetry E. nitritometry	Methods of **argentometry** are used for the assay of alkaline metal halides. The cvontent of sodium bromide and calcium chloride can be determined by argentometry (Mohr's method, direct titration): **NaBr + AgNO3** $\rightarrow AgBr\downarrow + NaNO_3$ $AgNO_3 + NH_4CNS \rightarrow AgCNS\downarrow + NH_4NO_3$ $3\ NH_4CNS + Fe(NH_4)(SO_4)_2 \rightarrow$ $\rightarrow Fe(CNS)_3\downarrow + 2\ (NH_4)_2(SO_4)$ (Mohr's method, direct titration): **NaBr + AgNO3** $\rightarrow AgBr\downarrow + NaNO_3$ $K_2CrO_4 + 2\ AgNO_3 \rightarrow Ag_2CrO_4\downarrow + 2KNO_3$

Test from «Крок-2» base	Explanation
Topic 15. Chemical basis of rational use and quality assurance of medicinal products from the group of psychostimulants and antidepressants **Topic 16. Chemical basis of rational use and quality assurance of medicinal products from the group of analeptic and nootropic drugs**	
Caffeine by chemical structure is a trimethylxanthine. Which chemical transformation is the main pathway of its metabolism? A. *N-demethylation B. hydrolysis C. oxidation D. reduction E. acetylation	
Caffeine belongs to the purine (xanthine) derivatives. An analytical chemist can identify it by the general pharmacopoeial reaction to form: A. *murexide B. ningidrine C. thaleoquinine D. indophenol E. thiochrome	 **murexide**
The chemist-analyst identifies purine derivatives. For this he uses a general pharmacopoeian reaction to: A. *xanthines B. barbiturates C. citrates D. lactates E. esters	The **murexide test** is a pharmacopoeial general group reaction for purine alkaloids: the substance is heated with an oxidant (bromine water, perhydrol, nitric acid, etc.) in the presence of hydrochloric acid, and then treated with an ammonia solution; a red-violet color appears due to the formation of the ammonium salt of purpuric acid.
Piracetam is a nootropic drug. According to the chemical classification, it belongs to the following derivatives: A. *pyrrolidone B. pyridine C. benzodiazepine D. furan E.xanthine	
A reaction that produces ammonia when heated is used to identify the nootropic drug “Piracetam”. What reagent is used in this reaction? A. *sodium hydroxide solution B. magnesium sulphate solution C. potassium thiocyanate solution D. barium chloride solution E. ammonium oxalate solution	 When piracetam is heated with a **solution of sodium hydroxide**, **ammonia** is formed, which is determined by the smell or the change of the colour of the wet red litmus paper.

Camphor belongs to bicyclic terpenes. A pharmaceutical analyst can determine the presence of a keto group in its structure by reaction with:

A. *hydroxylamine
B. ninhydrin
C. diphenylamine
D. 2,4-dinitrochlorobenzene
E. cyanobromide



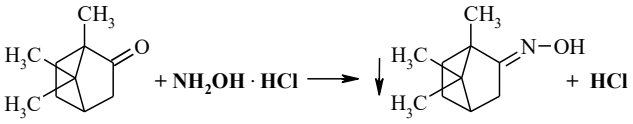
A pharmacist-analyst received an antiseptic ointment containing racemic camphor for analysis. Which reagent is used to confirm the presence of a keto group in this drug?

A. *hydroxylamine
B. cyanobromide
C. indophenol
D. diphenylamine
E. chlorobenzene

Camphor is identified by the **keto group** by reaction with **hydroxylamine hydrochloride** in the presence of anhydrous sodium acetate; a ketoxime is formed, which is identified by its melting point

Racemic camphor is used externally as an irritant and antiseptic. The quantitative content of the substance is determined by the method of alkalimetry after the release of an equivalent amount of hydrochloric acid as a result of previous interaction with the reagent:

A. *hydroxylamine hydrochloride
B. p-dimethylaminobenzaldehyde
C. 2,4-dinitrophenylhydrazine
D. chloramine
E. furfural

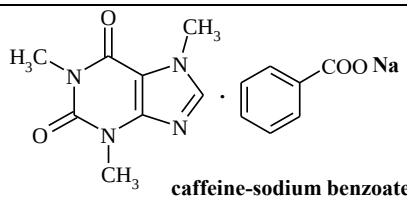


HCl + NaOH → NaCl + H2O

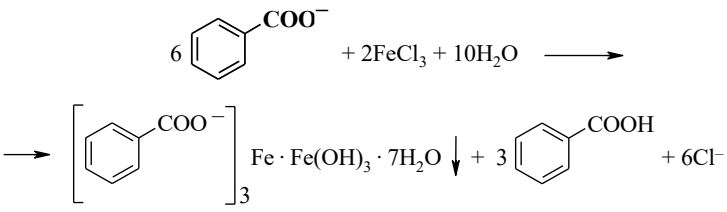
A reaction with hydroxylamine hydrochloride can be used for the assay of camphor. In this reaction, ketoxime and hydrochloric acid are formed, which is titrated with sodium hydroxide solution, the indicator is bromothymol blue

A pharmacist-analyst in the drug quality control department of a pharmaceutical company has received a series of sodium caffeine benzoate tablets for analysis. Which reagent should he use to identify sodium benzoate?

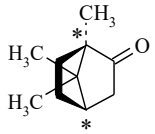
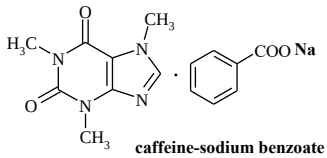
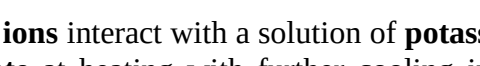
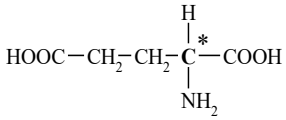
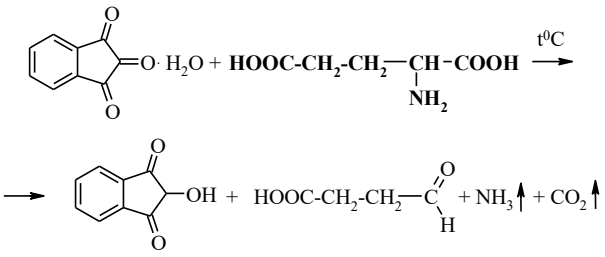
A. *ferric (III) chloride
B. ammonium oxalate
C. magnesium sulphate
D. potassium iodide
E. zinc sulphate

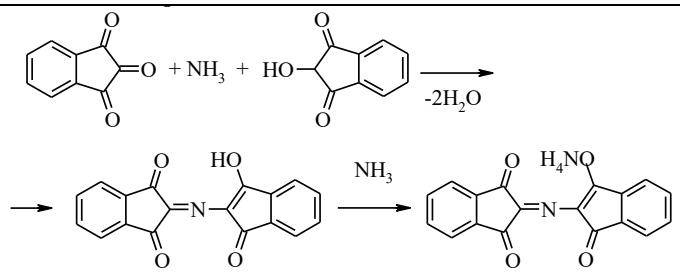
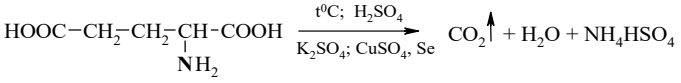
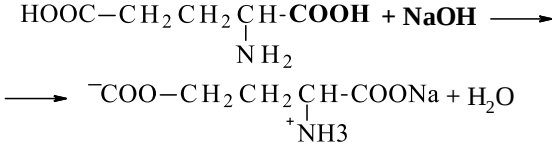


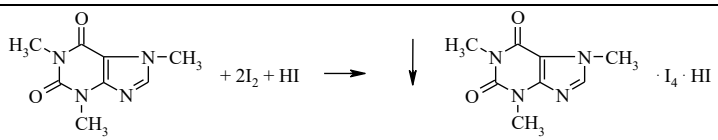
caffeine-sodium benzoate



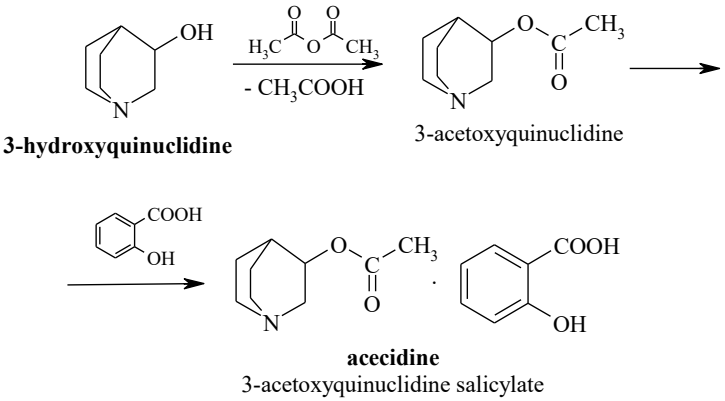
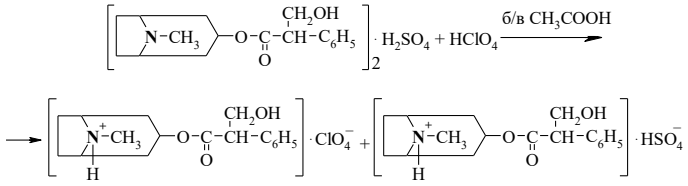
When **benzoate ions** interact with a solution of ferric chloride, a **pale yellow** precipitate is formed, which is soluble in ether.

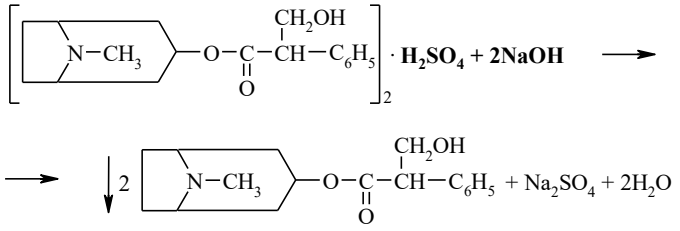
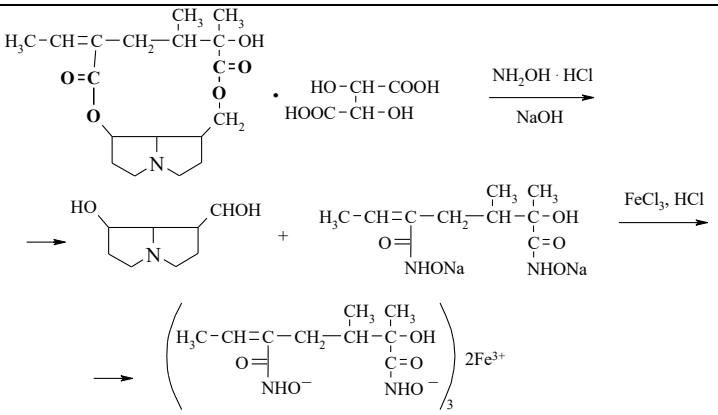
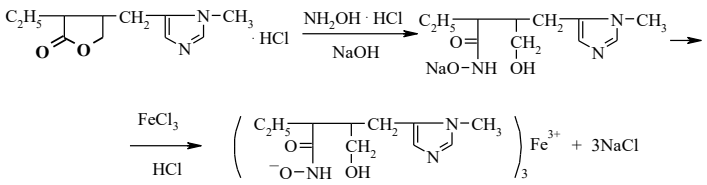
In medical practice, racemic camphor is used. What is the difference between this substance and its optically active isomers? A. *angle of rotation B. refractive index C. boiling point D. dynamic viscosity E. relative density	 **Polarimetry** is a method based on measuring the degree of polarization of light and **the angle of rotation** of the plane of polarization of light when it passes through optically active substances. Measurement of the angle of rotation is carried out with **polarimeters**.
The chemist-analyst determines the presence of sodium cation in the composition of caffeine-sodium benzoate. To do this, he uses a solution of: A. *potassium pyroantimonate B. barium chloride C. sodium sulfate D. silver nitrate E. sodium cobaltinitrite	 **caffeine-sodium benzoate**  When **sodium ions** interact with a solution of **potassium pyroantimonate** at heating with further cooling in ice water and rubbing with a glass rod, a thick white precipitate is formed.
A quality control and analysis laboratory certifies a series of **glutamic acid**, an optically active substance. What is the identification indicator of the **polarimetry**? A. *angle of rotation B. absorbance C. refrective index D. pH of the solution E. density	 **Polarimetry** is a method based on measuring the degree of polarization of light and the angle of rotation of the plane of polarization of light when it passes through optically active substances. Measurement of the **angle of rotation** is carried out on devices - polarimeters. The angle of rotation in solutions depends on their concentration; therefore, polarimetry is widely used to measure the concentration of optically active substances. To confirm the purity and identification of the optically active substance, the value of the **specific optical rotation** is calculated $[\alpha]_D^{20}$**.**
In a pharmacopoeia analysis laboratory, glutamic acid, an aliphatic amino acid, is being identified by thin-layer chromatography. Which reagent is used to develop the chromatogram? A. *ninhydrin B. pyridine C. aniline D. biphenylamine E. bromocyanine	All **amino acids** form a blue-violet color when heated with **ninhydrin**: 

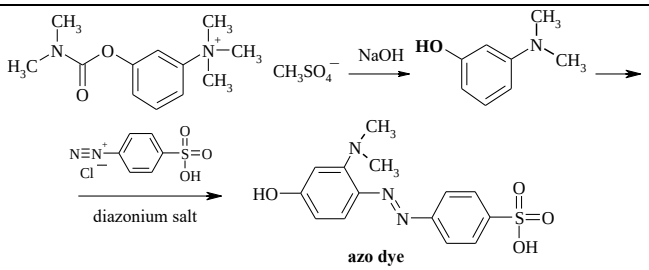
	
The chemical laboratory checks the quality of medicines. Specify the substance whose quantitative analysis can be carried out by the method of nitrogen determination after mineralization: A. *glutamic acid B. salicylic acid C. calcium gluconate D. ascorbic acid E. sodium benzoate	The method of determining nitrogen after digestion with sulfuric acid (Kjeldahl method) is used for the quantitative analysis of nitrogen-containing organic compounds, for example, amines, amides and compounds with heterocyclic nitrogen. The method is based on the combination of mineralization of organic matter followed by acid-base titration. First, the substance is decomposed at heating with concentrated sulfuric acid (in the presence of catalysts – potassium sulfate, copper sulfate, and selenium):
Quantitative analysis of glutamic acid is carried out in the laboratory of the pharmaceutical product certification center by the method of nitrogen determination after mineralization with sulfuric acid. The use of this method is associated with the presence of a functional group in the structure of the medicinal substance: A. *amino group B. carboxylic group C. alkyl radical D. alcohol hydroxyl E. sulfogroup	 Then a concentrated solution of sodium hydroxide is added and the released ammonia is distilled off in a flask containing an excess of a titrated solution of hydrochloric acid. The excess of **hydrochloric acid** is titrated with a sodium hydroxide solution using a mixed indicator (a solution of methyl red and methylene blue). In parallel, a control experiment is carried out, using glucose instead of the analyzed substance.
Pharmaceutical analysis of glutamic acid involves the determination of nitrogen after mineralization with concentrated sulfuric acid. Ammonia formed during the test is distilled into a receiving flask, which should contain: A. *titrated solution of hydrochloric acid B. saturated sodium chloride solution C. titrated sodium edetate solution D. freshly prepared tannin solution E. iodized potassium iodide solution	$NH_4HSO_4 + 2NaOH \rightarrow NH_3\uparrow + Na_2SO_4 + 2H_2O$ $\mathbf{NH_3 + HCl} \rightarrow NH_4Cl$ $\mathbf{HCl + NaOH} \rightarrow NaCl + H_2O$
According to its chemical structure, glutamic acid belongs to the amino acids of the aliphatic series. What method is used for its quantitative determination? A. *alkalimetry B. nitritometry C. bromatometry D. argentometry E. complexonometry	 Glutamic acid has pronounced acidic properties (one NH_2 group and two COOH groups). Therefore, the assay can be carried out by the method of alkalimetry, titrating with sodium hydroxide solution and using bromothymol blue as an indicator.

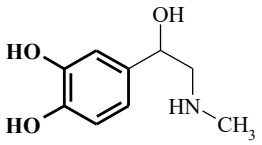
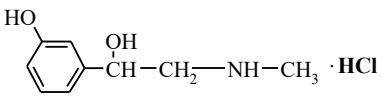
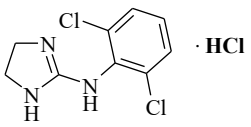
An analytical chemist is carrying out a quantitative determination of caffeine using iodometry. Which solution does he use as an indicator? A. *starch B. murexide C. phenolphthalein D. ferroin E. tropeolin 00	 $I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$ Assay of caffeine is carried out by the method of **back iodometry**, titrants are **solutions of iodine and sodium thiosulfate**, and the indicator is a **solution of starch**.

Content module 4. Medicines affecting the peripheral nervous system

Test from «Крок-2» base	Explanation
Topic 17. Chemical bases of rational use and quality assurance of cholinergic and anticholinergic drugs	
In chemical-pharmaceutical company produces an anti-glaucoma drug, acecidine. The starting materials for the synthesis are: A. *3-hydroxyquinuclidine B. p-aminophenol C. diethyl malonate D. triethylamine E. benzohydrol	 **3-hydroxyquinuclidine** 3-acetoxyquinuclidine **acecidine** 3-acetoxyquinuclidine salicylate
A certain component in the structure of atropine sulfate makes it possible to quantify atropine sulfate using acidimetry in a non-aqueous medium. Name this structural component. A. *tertiary nitrogen atom B. phenyl radical C. bound sulfuric acid D. ester group E. alcohol hydroxyl	
The analytical chemist performs the quantitative determination of the anti-glaucoma agent pilocarpine hydrochloride by the acidimetric method in non-aqueous solvents. As a titration solution he uses: A. *perchloric acid B. sodium hydroxide C. sodium nitrite D. sodium edetate E. potassium bromate	 Assay of drugs from the group of alkaloids is carried out by the method of **acidimetry in a non-aqueous medium**, since alkaloids are weak nitrogenous bases containing a **tertiary nitrogen atom** in the structure. Atropine sulfate is titrated potentiometrically with a solution of **perchloric acid** in anhydrous acetic acid.

The cholinergic agent atropine sulfate belongs to the salts of nitrogen-containing bases. What method is used to quantify it? A. *acidimetry in the non-aqueous environment B. direct complexometry C. indirect iodometry D. alkalimetry by substitution E. indirect cerimetry	
The pharmacist-analyst performs the quantitative determination of the cholinergic blocker atropine sulfate by the acidimetric method in non-aqueous solvents. As a titration solution, he uses: A. *perchloric acid B. sodium hydroxide C. sodium nitrite D. sodium edetate E. potassium bromate	
Atropine sulfate is a medicine that has a cholinolytic effect. Quantitative determination of atropine sulfate by the method of alkalimetry in an alcohol-chloroform environment is possible due to the presence of the following substance in its structure: A. *bound sulfuric acid B. tertiary nitrogen atom C. alcohol hydroxyl D. phenyl radical E. ester group	 The assay for atropine sulfate can be carried out by the method of alkalimetry based on **bound sulfuric acid** in the presence of an alcohol-chloroform mixture neutralized with phenolphthalein
The ester bond in the structure of the cholinergic agent platafiline hydrochloride causes the reaction to form a colored hydroxamate. Which of the following reagents is used in this reaction? A. *ferric chloride B. sodium chloride C. potassium iodide D. sodium nitrite E. ammonium chloride	 The ester group in the structure of platyphyllin hydrotartrate is determined by the hydroxamate test by the formation of red-violet colored **iron (III) hydroxamate**.
Lactones are intramolecular esters by their chemical structure. The lactone cycle in the structure of the cholinergic agent pilocarpine hydrochloride is determined by the reaction of formation of: A. *hydroxamate B. azo dye C. indophenol	

D. murexide E. thiochrome	The lactone ring of butyrolactone in the structure of pilocarpine hydrochloride is identified by the **hydroxam test by the formation of ferrum (III) hydroxamate** of red-violet color.
The alkaline hydrolysis of the anticholinesterase agent neostigmine methyl sulfate produces 3-dimethylaminophenol. It is further identified by the reaction of formation of: A. *azo dye B. indophenol C. hydroxamate D. murexide E. thiochrome	 azo dye As a result of alkaline hydrolysis of neostigmine methyl sulfate, **3-dimethylamino-phenol is formed**, which is detected by the reaction of the formation of an orange-red azo dye.

Test from «Крок-2» base	Explanation
Topic 18. Chemical bases of rational use and quality assurance of adrenergic and antiadrenergic drugs	
Adrenaline tartrate belongs to catecholamines by its chemical structure. The starting compounds for the synthesis of the substance are: A. *pyrocatechin B. nitrotoluene C. aminophenol D. cresol E. xylene	 Adrenaline (Epinephrine) contains a pyrocatechin (catechol) nucleus.
Epinephrine is a direct-acting adrenomimetic that stimulates α- and β-adrenoceptors. By chemical structure, it belongs to: A. *catecholamines B. tannins C. proteins D. lipids E. carbohydrates	
α1-Adrenomimetic phenylephrine hydrochloride (mesaton) is a salt of hydrochloric acid. The presence of the chloride ion is determined using a solution of: A. *silver nitrate B. potassium bromide C. magnesium sulfate D. sodium nitrate E. ammonium hydrochloride	 **phenylephrine hydrochloride (mesaton)**  **clonidine hydrochloride (clofelin)**

A pharmacist-analyst is analyzing the α2-adrenomimetic clonidine hydrochloride (clofelin). Which reagent is used to confirm the presence of chloride ion during the identification of a substance?

A. *silver nitrate
B. potassium hydroxide
C. zinc chloride
D. magnesium sulfate
E. sodium bicarbonate

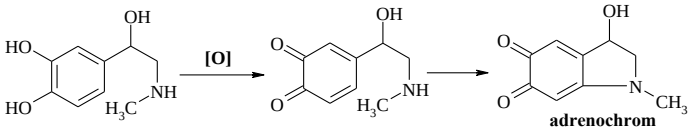
$$Cl^- + AgNO_3 \xrightarrow{HNO_3} AgCl\downarrow + NO_3^-$$
$$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$$

At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.

Adrenaline contains two phenolic hydroxyls in its structure, which causes chemical instability of the compound. What chemical process can occur if the substance is stored improperly?

A. *oxidation
B. restoration
C. polymerizations
D. hydrolysis
E. weatherization

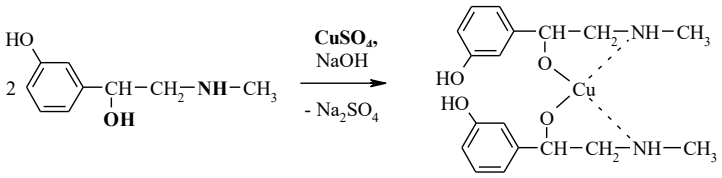
Adrenaline is easily destroyed in both acidic and alkaline media. It is easily oxidized even in a neutral media. The appearance of a pink color in solutions and in the light is due to the formation of adrenochrome:



adrenochrom

A laboratory conducts analysis of a phenylephrine hydrochloride substance (Mesatonum). What reagent is used to identify it?

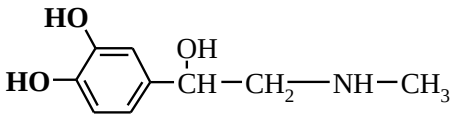
A. *copper(Il) sulfate
B. magnesium sulfate
C. ammonium chloride
D. sodium nitrate
E. potassium bromide



Phenylephrine with a solution **of copper (II) sulfate** in the presence of sodium hydroxide forms a **blue-violet complex**.

To identify epinephrine tartrate, a reaction is performed with a solution of ferric (III) chloride. The emerald green color formed as a result of the reaction is due to the presence of:

A. *phenolic hydroxyls
B. aldehyde group
C. aromatic amino group
D. keto groups
E. carboxylic group



epinephrine

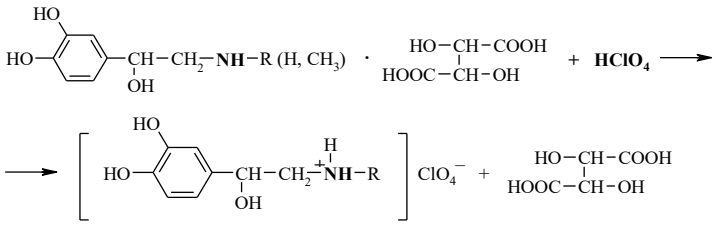
With a solution of **iron (III) chloride**, adrenaline forms an emerald-green color due to **phenolic hydroxyls**, which changes from the addition of ammonia to cherry-red, and then to orange-red.

The adrenergic drug epinephrine tartrate contains phenolic hydroxyls in its structure. What solution should be used to react with to detect them?

A. *iron (III) chloride
B. potassium bromide
C. magnesium sulfate
D. sodium nitrate
E. copper (II) sulfate

The quantitative determination of epinephrine tartrate is performed by the acidimetric method in a non-aqueous medium. Which solution is used as a titrant in this case?

A. perchloric acid
B. sodium hydroxide
C. potassium bromate
D. sodium edetate
E. sodium nitrite



Quantitative determination of the substance adrenaline tartrate is carried out by the method of acidimetry in a non-aqueous environment. As a titrant, a solution is used:

A. *chloric acid
B. sodium hydroxide
C. potassium bromate
D. iodine
E. sodium nitrite

The assay for medicines containing a **tertiary nitrogen atom** in the structure can be determined by the method of **acidimetry in non-aqueous solvents**.

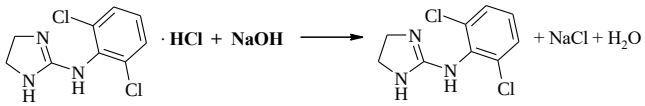
The assay of adrenaline tartrate (epinephrine tartrate) is carried out by the method of acidimetry in the medium of anhydrous acetic acid; titrant – **perchloric acid solution**, indicator – **crystal violet**.

The laboratory of the State Inspectorate for Quality Control of Medicines is analyzing the substance epinephrine tartrate. Which functional group is the basis for the quantitative determination of the substance by the acidimetry method in a non-aqueous medium?

A. tertiary nitrogen
B. phenolic hydroxyl
C. carboxylic group
D. alcohol hydroxyl
E. aromatic amino group

Clonidine hydrochloride is an organic base salt. What method is used to quantify this substance?

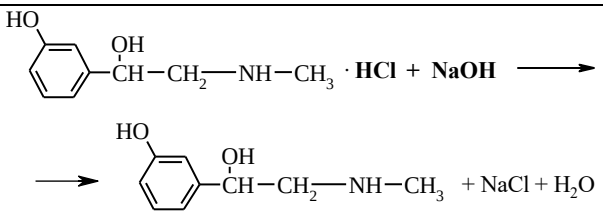
A. *alkalimetry
B. bromatometry
C. complexometry
D. iodometry
E. nitritometry

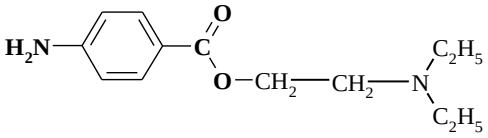
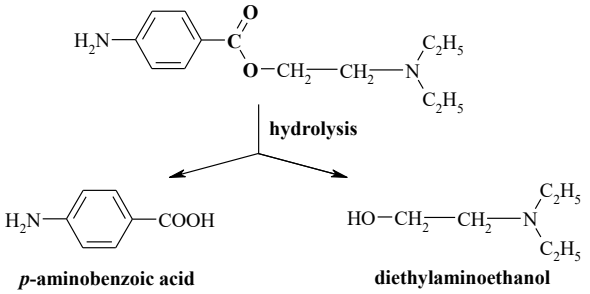
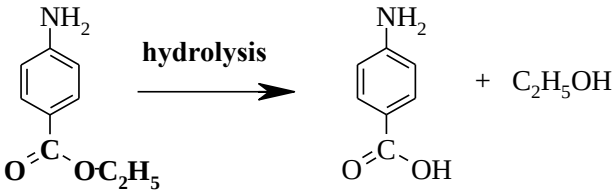


Clonidine hydrochloride is quantified by alkalimetry in ethanol according to the requirements of the SFC. The end point of the titration is determined by:

A. *potentiometer
B. refractometer
C. spectrophotometer
D. polarimeter
E. viscosimeter

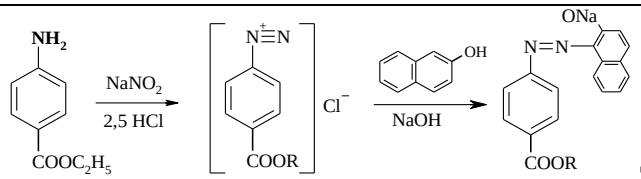
Clonidine hydrochloride is quantitatively determined by the bound HCl by the method of **alkalimetry** and titrated with sodium hydroxide solution, the end point of the titration is determined **potentiometrically**

Phenylephrine hydrochloride (mesaton) is widely used in medical practice as a vasoconstrictor. Quantitative determination of the substance is carried out by the following method: A. *alkalimetry B. nitritometry C. complexometry D. permanganatometry E. thiocyanatometry	 Phenylephrine hydrochloride is quantitatively determined by the bound HCl by the method of **alkalimetry** and titrated with sodium hydroxide solution.

Test from «Крок-2» base	Explanation
Topic 19. Chemical bases of rational use and quality assurance of medicines from the group of local anesthetics	
Procaine hydrochloride (novocaine) is a local anesthetic agent. By its chemical structure, it is a derivative of: A. *p-aminobenzoic acid B. salicylic acid C. chromotropic acid D. sulfonic acid E. nicotinic acid	 Procaine hydrochloride is a derivative of **p-aminobenzoic acid**
Procaine hydrochloride (novocaine) is a local anesthetic agent. One of its metabolic pathways is hydrolysis. Choose one of the products that is formed. A. *diethylaminoethanol B. propanol C. butanol D. octanol E. acetone	 hydrolysis *p*-aminobenzoic acid diethylaminoethanol
One of the stages of drug pharmacokinetics is biotransformation. Procaine hydrochloride (novocaine) is hydrolyzed by esterases to form: A. p-aminobenzoic acid B. sulfonic acid C. phthalic acid D. p-aminosalicylic acid E. mefenamic acid	
Benzocaine is an ethyl ester of p-aminobenzoic acid, which has a local anesthetic effect. In the body, under the influence of esterases, it is: A. *hydrolysis B. S-oxidation C. hydroxylation D. restoration E. demethylation	 hydrolysis

In the structure of benzocaine (anaesthesine), a pharmaceutical analyst identifies the primary aromatic amino group. To identify this substance, he uses the reaction to form:

A. *azo dye
B. fluorescein
C. murexide
D. indophenol
E. iodoform



3

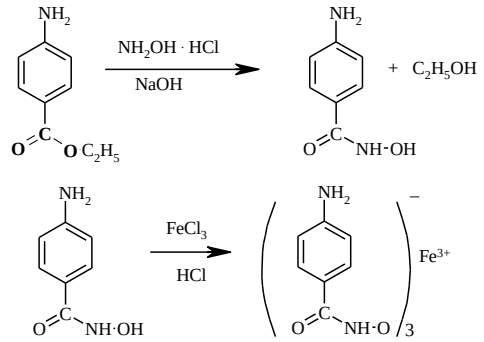
Sodium nitrite solution in the presence of hydrochloric acid solution with the further addition of alkaline β-naphthol solution produces an orange or red color of the azo dye formed and, as a rule, a precipitate of the same color is formed.

Local anesthetics, derivatives of p-aminobenzoic acid, contain an ester group. Its presence causes the reaction of formation of:

A. *hydroxamate
B. indophenol
C. murexide
D. thiochrome
E. fluorescein

Local anesthetic **benzocaine** can be identified using the reaction of **iron(III) hydroxamate formation.** What makes possible this reaction?

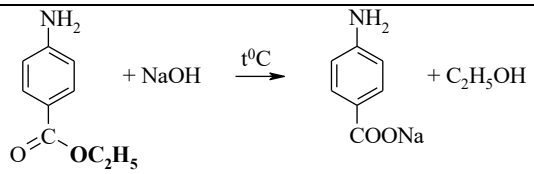
A. *esther group
B. sulfamide group
C. carboxylic group
D. ketone group
E. aldehyde group



Benzocaine is an **ester** of p-aminobenzoic acid and ethanol. During the reaction of benzocaine with hydroxylamine in an alkaline environment, hydroxamic acid is formed, which with a solution of iron (III) chloride produces a cherry-red iron hydroxamate.

Ethanol is formed by alkali hydrolysis of local anaesthetic Benzocaine. The pharmacist-analyst confirms the reaction product by performing:

A. *iodoform test
B. murexide test
C. thiochrome test
D. ninhydrine test
E. hydroxamic test

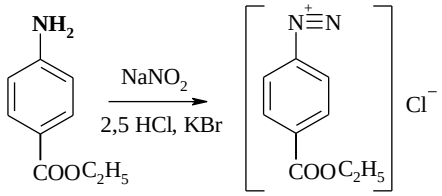


$C_2H_5OH + 4I_2 + 6NaOH \rightarrow$
$\rightarrow CHI_3\downarrow + 5NaI + HCOONa + 5H_2O$

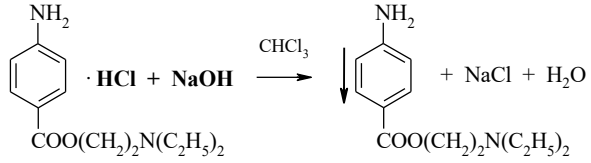
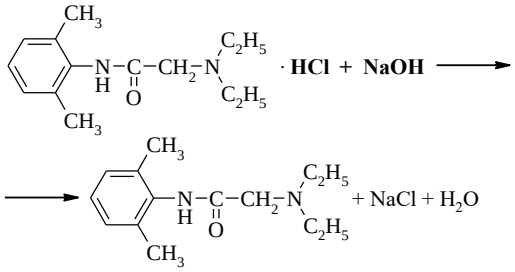
The ether group of anesthesin is hydrolyzed when heated with a sodium hydroxide solution, as a result of which **ethyl alcohol** is released, which can be detected by the reaction of the formation of **iodoform** (the appearance of a yellow precipitate or turbidity and a **characteristic odour**)

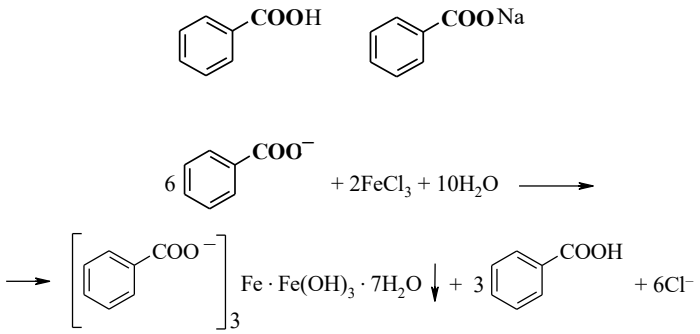
The structure of benzocaine (anaesthesine) contains a primary aromatic amino group. An analytical chemist determines the quantitative content of a substance by the following methods:

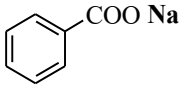
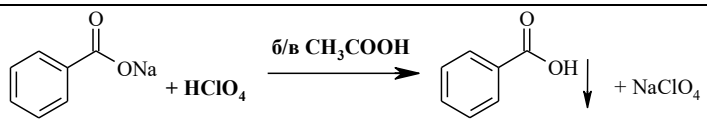
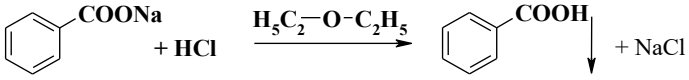
A. *nitritometry
B. alkalimetry
C. complexometry
D. acidimetry
E. argentometry

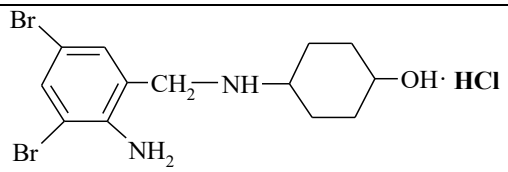


Benzocaine contains a **primary aromatic amino group**, so it is quantified using a method for determining nitrogen in compounds containing a primary aromatic amino group (**nitritometry**).

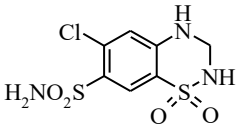
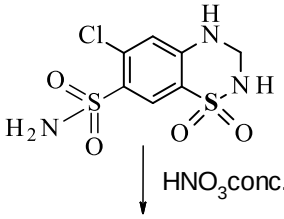
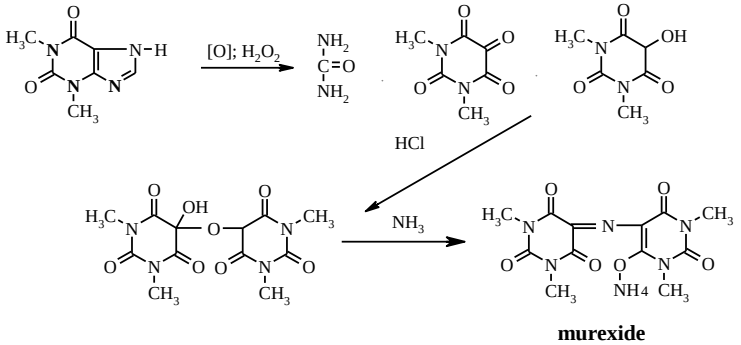
What is present in the structure of procaine hydrochloride, making its alkilimetric titration possible? A. *bound hydrochloric acid B. residue of n-aminobenzoic acid C. diethylamino group D. unsubstituted aromatic cycle E. ester bond	 The assay for procaine hydrochloride can be carried out by the method of alkalimetry based on **bound hydrochloric acid**. The titration is carried out in the presence of chloroform, which extracts the released base, the indicator is phenolphthalein
In the quality control laboratory, quantitative determination of the local anesthetic Procaine hydrochloride is carried out. The method of its alkalimetric titration is based on the presence in the structure of: A. *bound hydrochloric acid B. diethylamino groups C. ester bond D. unsubstituted aromatic cycle E. residue of p-aminobenzoic acid	
A pharmacist-analyst determines the quantitative content of lidocaine hydrochloride by alkalimetry with potentiometric endpoint determination. Which solution is used as a titrant? A. *sodium hydroxide B. hydrochloric acid C. potassium bromate D. sodium nitrite E. cerium sulfate	 Lidocaine hydrochloride is quantitatively determined by the bound HCl using the method of alkalimetry and sodium hydroxide solution as a titrant.

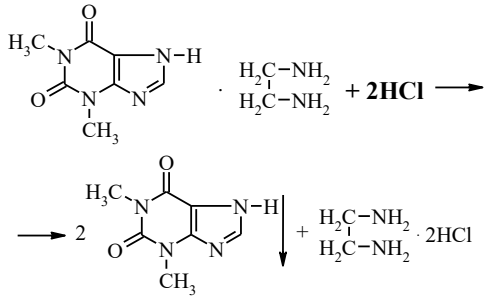
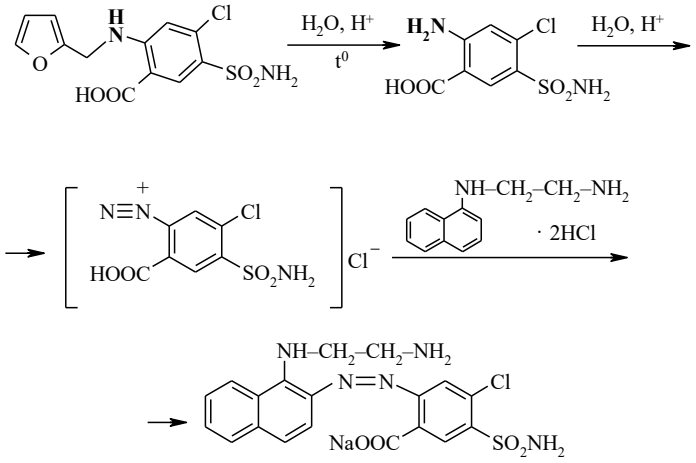
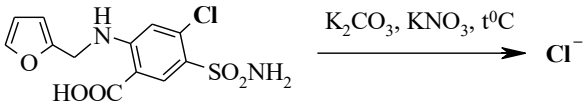
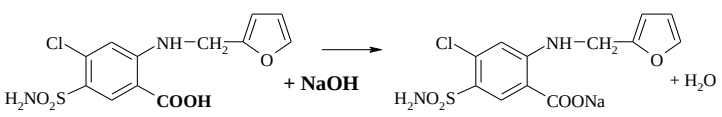
Test from «Крок-2» base	Explanation
Topic 20. Chemical bases of rational use and quality assurance of expectorant, mucolytic and irritant drugs	
The laboratory certifies an expectorant drug containing sodium benzoate. To identify the benzoate ion, a reaction is carried out with a solution of: A. *iron (III) chloride B. sodium nitrite C. potassium chloride D. sodium carbonate E. ammonium thiocyanate	
Salts of benzoic acid are used in medical practice. According to the requirements of the SPhU, which reagent is involved in a qualitative reaction with **benzoate ion** to form a pale yellow precipitate? A. *ferric (III) chloride solution B. sodium hydrogen carbonate solution	When **benzoate ions** interact with a solution of ferric chloride, a **pale yellow** precipitate is formed, which is soluble in ether.

C. potassium permanganate solution D. magnesium sulfate solution E. sodium nitrite solution	
A pharmacist-analyst conducts an express analysis of an extemporaneous mixture. He identifies sodium benzoate in the composition of the mixture by the reaction with the solution of: A. *iron (III) chloride B. sodium bicarbonate C. ammonium oxalate D. sodium acetate E. magnesium sulfate	
The Central Laboratory analyzes the expectorant drug sodium benzoate. The presence of sodium cation is identified by the reaction of a white precipitate with a solution of: A. *potassium pyroantimonate B. sodium nitrite C. ammonium oxalate D. iron (III) chloride E. zinc sulfate	 **Sodium benzoate** $\mathbf{Na^+ + K[Sb(OH)_6]} \rightarrow Na[Sb(OH)_6]\downarrow + K^+$ When **sodium ions** interact with a solution of **potassium pyroantimonate** at heating with further cooling in ice water and rubbing with a glass rod, a **thick white** precipitate is formed.
The quantitative determination of the expectorant sodium benzoate is performed by acidimetry in a non-aqueous medium. Which reagent is used as a solvent? A. *acetic acid anhydrous B. pyridine C. benzene D. dimethylformamide E. dimethyl sulfoxide	 Assay of sodium benzoate is carried out by the method of **acidimetry in a non-aqueous medium**: the substance is dissolved in **anhydrous acetic acid**, titrated with a solution of hydrochloric acid, the indicator is a solution of naphtholbenzene. Anhydrous acetic acid enhances the main properties of sodium benzoate.
A pharmaceutical analyst is quantitatively analyzing sodium benzoate and is using a hydrochloric acid solution as a titrant. Name this method of quantification. A. *acidimetry B. complexometry C. nitritometry D. bromatometry E. iodometry	 **Acidimetric** titration of **sodium benzoate** is carried out in the presence of **diethyl ether**, since benzoic acid is released, which changes the pH of the aqueous solution to 2.5-3.0. This leads to a change in the color of the solution to the equivalence point. **Diethyl ether** is used to extract the benzoic acid that has formed.
A pharmacist-analyst performs quantitative determination of the expectorant 'Sodium benzoate' by the method of acidimetry. To eliminate the influence of benzoic acid on the indicator, the titration should be carried out in the presence of: A. *diethyl ether B. manittol C. mercury (II) acetate D. hydrochloric acid E. sodium hydroxide	

The drug quality control laboratory has received a mucolytic preparation containing ambroxol hydrochloride. A solution which has to be used for the **chloride ions** identification is A. *silver nitrate B. barium sulfate C. glyoxal-hydroxyanil D. potassium ferrocyanide E. diphenylamine	 **Cl^- + $AgNO_3$ → $AgCl\downarrow$ + NO_3^-** **$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$** At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.

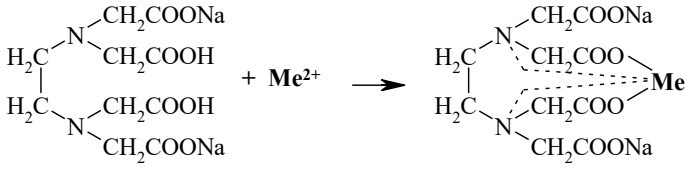
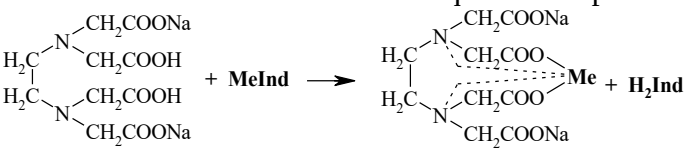
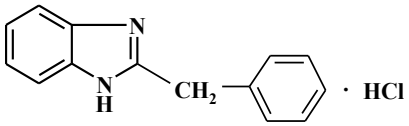
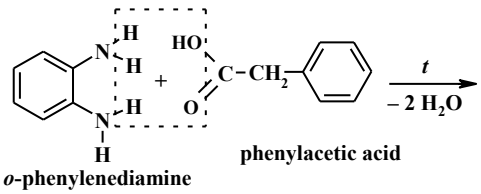
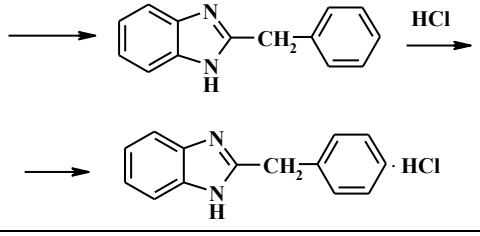
Content module 5. Drugs affecting the excretory, cardiovascular and gastrointestinal systems

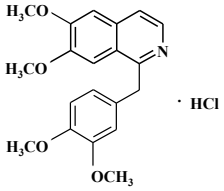
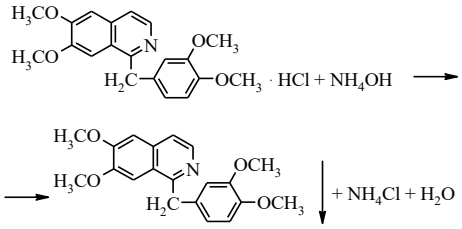
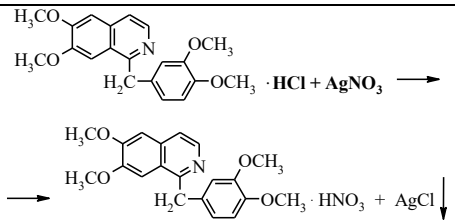
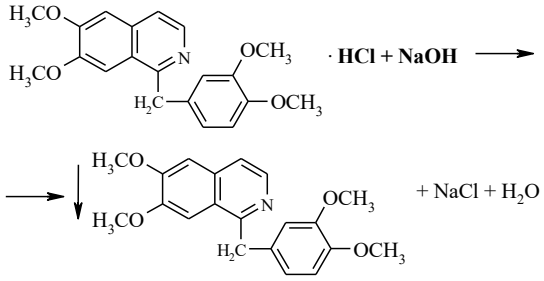
Test from «Крок-2» base	Explanation
Topic 21. Chemical bases of rational use and quality assurance of diuretic drugs	
The patient is prescribed a diuretic – hydrochlorothiazide tablets (hypothiazide). The structure of the active substance is based on a condensed system: A. *benzothiadiazine B. isoquinoline C. xanthine D. indole E. quinoline	 hydrochlorothiazide tablets (hypothiazide)
An analytical pharmacist identifies a hydrochlorothiazide substance. In this case, sulfate ions that formed after mineralization of the substance can be determined using the reaction with a certain solution. Name this solution. A. *barium chloride solution B. cobalt nitrate solution C. copper(Il) sulfate solution D. sodium hvdroxide solution E. silver nitrate solution	Hydrochlorothiazide contains sulfur, which after mineralization is identified by the reaction to sulfates  **H_2SO_4**+ HCl + CO_2 + NH_4NO_3 + NO_2 + NO + H_2O H_2SO_4 + **$BaCl_2$** → $BaSO_4\downarrow$ + 2HCl
The laboratory analyzes the substance of theophylline-ethylenediamine. Theophylline, as a derivative of xanthine, is identified by the reaction of formation: A. *murexide B. thaleoquinine C. thiochrome D. indophenol E. azo dye	 **murexide** Theophylline as a derivative of xanthine is identified by the reaction to **xanthines (murexide test)**

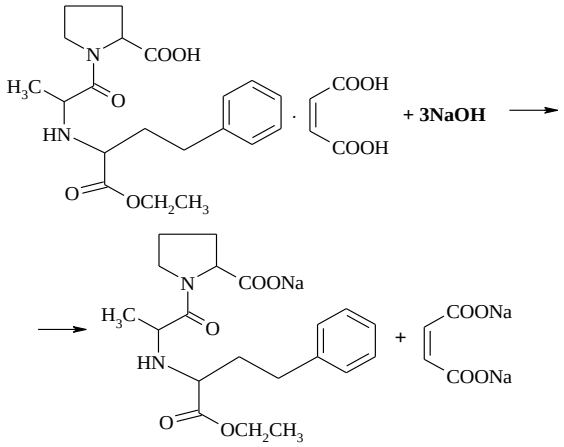
In the analytical laboratory of the pharmaceutical enterprise for the assay of ethylenediamine in substance theophylline-ethylenediamine the applied method is: A. *acidimetry B. alkalimetry C. iodometry D. nitritometry E. complexiметry	Ethylenediamine in the substance theophylline-ethylenediamine (Theophyllinun et ethylenediaminum) is determined **acidimetrically**, the indicator is methyl orange. 
As a result of acid hydrolysis of the diuretic Furosemide, a product containing a primary aromatic amino group is formed. This makes it possible to carry out a further formation reaction of: A. *azo dye B. thiochrome C. iodoform D. thaleoquine E. murexide	 As a result of furosemide hydrolysis, a derivative containing a primary **aromatic amino group** is formed. Its presence is confirmed by the reaction of the formation of a **violet-red azo dye**.
The test substance is sintered with a mixture of potassium carbonate and potassium nitrate to confirm the presence of covalently bound chlorine in the diuretic "Furosemide" structure. The resulting chloride ions are identified by the solution of: A. *silver nitrate B. ammonium oxalate C. potassium iodide D. sodium sulfide E. calcium chloride	 **$Cl^- + AgNO_3 \rightarrow AgCl\downarrow + NO_3^-$** **$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$** At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.
In the laboratory for quality control of drugs in the quantitative determination of the substance of furosemide by alkalimetry as a titrant used a solution of: A. *sodium hydroxide B. potassium permanganate C. cerium sulfate D. zinc sulfate E. perchloric acid	The assay of furosemide is carried out by **alkalimetry; solvent is dimethylformamide**, titrant is **sodium hydroxide**, the an point is ddetermined potentiometrically. 

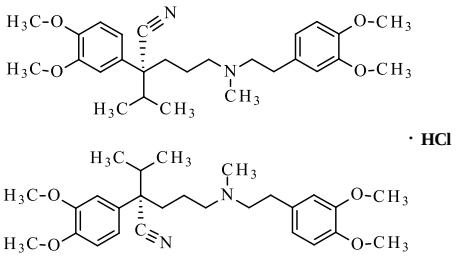
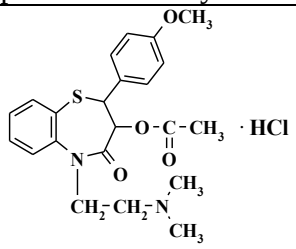
The pharmacist-analyst analyzes the furosemide solution for injection by instrumental method. To calculate the quantitative content of the substance, he uses the value of optical density, which is measured using: A. *spectrophotometer B. refractometer C. potentiometer D. polarimeter E. chromatograph	**Spectrophotometry** is based on measuring the absorption of a substance by monochromatic radiation. Absorption spectrophotometry in the ultraviolet and visible regions of the spectrum can be used for drug identification, purity testing, and quantification. To calculate the **quantitative content**, it is necessary to measure the optical density of the solution of the substance under investigation on a spectrophotometer and calculate the content using the specific absorption index or by the standard method

Test from «Крок-2» base	Explanation
Topic 22. Chemical bases of rational use and quality assurance of cardiotonic drugs: cardiac glycosides. Medicines affecting the blood coagulation system. Hypolipidemic agents. Topic 23-24. Chemical bases of rational use and quality assurance of antiarrhythmic drugs. Chemical bases of rational use and quality assurance of antihypertensive drugs: angiotensin-converting enzyme (ACE) inhibitors, spasmolytics	
In pharmaceutical analysis, a sample of a substance moistened with **dilute hydrochloric acid** is placed in a colourless flame. The appearance of an **orange-red colour** allows identifying the cation of: A. *calcium B. sodium C. potassium D. ammonium E. barium	**Calcium salt**, moistened with hydrochloric acid and placed into a **colorless flame**, colors it in an **orange-red color**.
A pharmacist-analyst performs an express analysis of a liquid dosage form containing **calcium chloride**. He identifies the **chloride ion** by reaction with the solution: A. *silver nitrate B. potassium pyroantimonate C. sodium tetraphenylborate D. ammonium oxalate E. barium chloride	$Ca\mathbf{Cl_2}$ $\mathbf{Cl^- + AgNO_3 \rightarrow AgCl\downarrow + NO_3^-}$ $\mathbf{AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O}$ At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.
A pharmacist-analyst performs an express analysis of a mixture containing calcium chloride. He identifies the calcium cation by reaction with a solution of: A. *ammonium oxalate B. potassium pyroantimonate C. sodium tetraphenylborate D. copper II sulfate E. barium chloride	$\mathbf{Ca^{2+} + (NH_4)_2C_2O_4 \rightarrow CaC_2O_4\downarrow + 2NH_4^+}$ When **calcium ions** interact with **ammonium oxalate** solution, a **white precipitate** is formed, which is insoluble in diluted acetic acid and ammonia solution.

A pharmacist-analyst analyzes an extemporaneous mixture containing calcium chloride. Quantitative determination of the active substance is carried out by the method: A. *complexonometry B. alkalimetry C. nitritometry D. acidimetry E. permanganatometry	For the assay of inorganic and organic substances, which include metal cations (calcium, magnesium, zinc, bismuth, lead, aluminum), the method of complexonometry is used. In the process of assay, a small amount of metal indicator is added to the substance solution, which at a certain pH value forms an intensely colored complex with metal ions. The appropriate pH value is adjusted by the addition of auxiliary reagents (determination of zinc salts with xylenol orange in the presence of hexamethylenetetramine; determination of calcium salts with chalcone carboxylic acid in the presence of sodium hydroxide solution. A relatively stable, well-soluble compound in water is formed: $Me^{2+} + H_2Ind \leftrightarrow MeInd + 2H^+$ During titration with sodium edetate, a complex with free metal ions is first formed.  A free indicator is released at the equivalence point. 
The doctor has prescribed the patient an antispasmodic agent bendazol hydrochloride (Dibazol). Based on its chemical structure, bendazol hydrochloride is a derivative of: A. *benzimidazole B. acridine C. phenothiazine D. sndole E. purine	Bendazole hydrochloride (dibazole) belongs to **benzimidazole** derivatives:  2-Benzyl**benzimidazole** hydrochloride
Bendazol hydrochloride is used as an antispasmodic agent that has a hypotensive effect and belongs to benzimidazole derivatives. The starting compound for its synthesis is A. *_o_-phenylenediamine B. ethylenediamine C. m-dioxybenzene D. p-methylpyridine E. o-aminophenol	Bendazole hydrochloride (dibazole) is obtained by condensation of ***o*-phenylenediamine with phenylacetic acid**:  ***o*-phenylenediamine** **phenylacetic acid**
At the chemical-pharmaceutical plant the technological scheme of receiving bendazole hydrochloride (dibazole) is introduced. The synthesis of the compound is based on the condensation reaction of o-phenylenediamine with:	

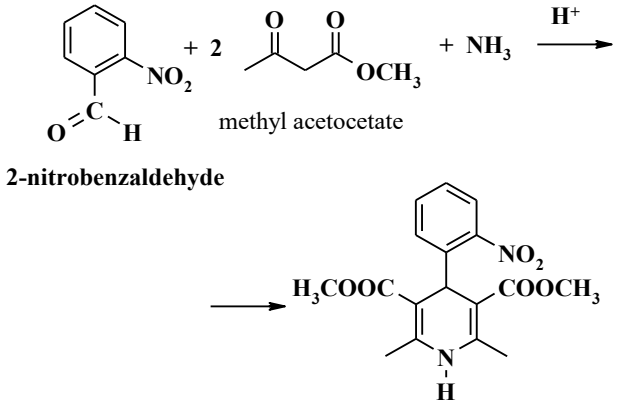
A. *phenylacetic acid B. anthranilic acid C. acetic acid D. malonic acid E. mefenamic acid	
Papaverine hydrochloride - a drug of plant origin from the group of alkaloids, used in medicine as an antispasmodic. The chemical structure of papaverine is derived from: A. *isoquinoline B. furan C. indole D. tropan E. purine	Papaverine hydrochloride belongs to **isoquinoline derivatives:**  6,7-dimethoxy-1-(3,4-dimethoxybenzyl)-isoquinoline hydrochloride
In order to identify the substance of papaverine hydrochloride, the chemist-analyst reacts with an ammonia solution. This reaction is accompanied by the formation of a precipitate of papaverine base, which is identified by: A. *melting point B. drop point C. boiling point D. refractive index E. relative density	By the action of a solution of the substance papaverine hydrochloride of an ammonia solution; a white precipitate is formed, which is identified by the melting point: 
One of the tests for the identification of papaverine hydrochloride is the reaction to chlorides. Choose the solution used: A. *silver nitrate B. sodium nitrite C. potassium iodide D. ammonium molybdate E. barium chloride	 **$Cl^- + AgNO_3 \rightarrow AgCl\downarrow + NO_3^-$** **$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$** At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.
Chemist-analyst determines the quantitative content of papaverine hydrochloride in the drug by titration with sodium hydroxide solution. Name this method of quantification. A. *alkalimetry B. complexometry C. iodometry D. nitritometry E. bromatometry	$HCl + NaOH \rightarrow NaCl + H_2O$  **Alkalimetry**, direct titration in a medium of 0.01 M hydrochloric acid and 96% alcohol. Titrate with 0.1 M sodium hydroxide solution, the equivalence point is determined potentiometrically. The titrant volume between two potential jumps on the titration curve is taken into account.

Pharmacist-analyst performs quantitative determination of enalapril maleat alcalimetric method. He determines the end point of the titration using: A. *potentiometer B. refractometer C. polarimeter D. polarograph E. fluorimeter	**Alkalimetry**, direct titration, the end of titration is set **potentiometrically**. 

Test from «Крок-2» base	Explanation
Topic 25. Chemical bases of rational use and quality assurance of antianginal drugs: nitrovasodilators, calcium channels blockers	
The patient was prescribed antihypertensive drug "Verapamil", tablets. The active substance – verapamil hydrochloride – by chemical structure belongs to the derivatives: A. *phenylalkylamine B. phenothiazine C. benzothiazepine D. dihydropyridine E. pyrimidine	 Verapamil hydrochloride (2R,S)-2-(3,4-dimethoxyphenyl)-5-[[2-(3,4-dimethoxyphenyl)ethyl]-(methyl)amino]-2-(1-methyl-ethyl)pentanenitrile hydrochloride
Diltiazem hydrochloride, which is a calcium channel blocker, is used as an antihypertensive agent. According to the chemical structure it is a derivetive of: A. *benzothiazepine B. benzofuran C. benzimidazole D. purine E. quinoline	 Diltiazem hydrochloride (2S,3S)-5-[2-(dimethylamino)ethyl]-2-(4-methoxyphenyl)-4-oxo-2,3,4,5-tetrahydro-1,5-benzothiazepin-3-ol acetate hydrochloride
At the chemical-pharmaceutical enterprise, the substance nifedipine is obtained by the interaction of acetoacetic ester, ammonia and 2-nitrobenzaldehyde. What type of reaction underlies this interaction? A. *condensation B. hydrolysis C. alkylation D. esterification E. acylation	Nifedipine is synthesized **by condensation of 2-nitrobenzaldehyde** with methyl acetoacetate and ammonia according to the scheme:

At the pharmaceutical plant the technology of production of the substance nifedipine is introduced. One of the starting substances in the synthesis of this drug is:

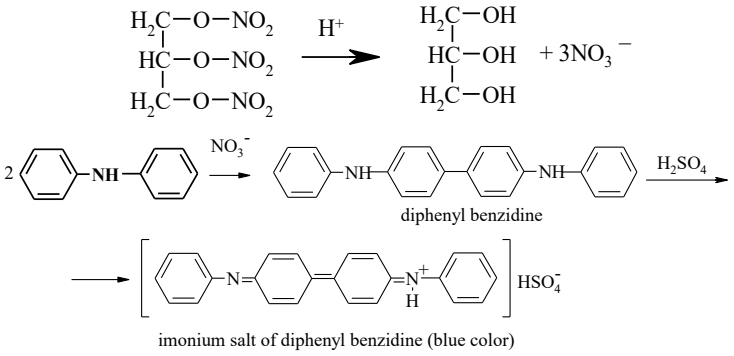
A. *_o_-nitrobenzaldehyde
B. p-methylaniline
C. m-aminophenol
D. pyridine
E. fufrfural



In the laboratory for quality control of medicines, a series of nitroglycerin tablets is certified. After hydrolysis of nitroglycerin, the nitric acid residue can be identified by reaction with a solution:

A. *diphenylamine
B. cyanbromide
C. silver nitrate
D. potassium pyroantimonate
E. sodium nitroprusside

Glycerol trinitrate (ester) undergoes hydrolysis with the formation of the corresponding alcohol (glycerol) and acid (nitric) or its salt. The reaction to the residue of nitric acid formed as a result of ester hydrolysis - the appearance of a blue color when interacting with **diphenylamine** in the presence of concentrated sulfuric acid:



An analytical chemist is analysing the anti-anginal drug glycerol trinitrate (nitroglycerin). To identify the nitrate ions formed after hydrolysis, he uses a solution of:

A. *diphenylamine
B. lanthanum (III) nitrate
C. thiourea
D. chloramine
E. glyoxalhydroxyanile

The antianginal agent glycerol trinitrate (nitroglycerol) chemically belongs to esters of nitric acid. Specify the reaction of substance identification by nitrate ions.

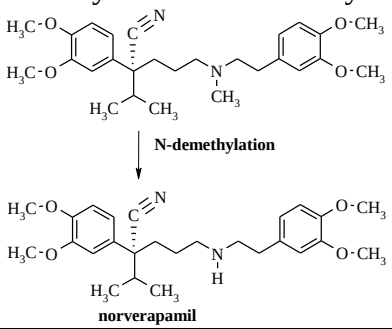
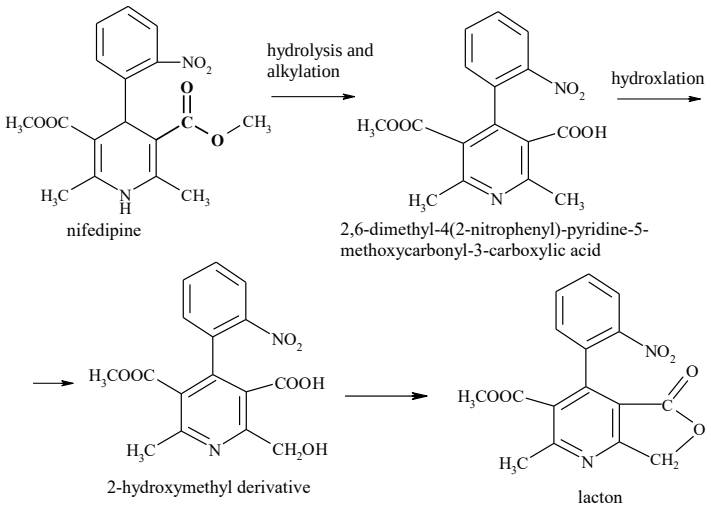
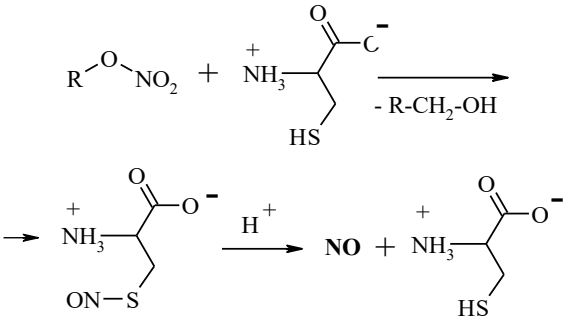
A. *hydrolysis
B. pyrolysis
C. oxidation
D. decarboxylation
E. dehydration

When conducting a quantitative analysis of glycerol trinitrate solution by the method of absorption spectrophotometry, the chemist-analyst determines on the spectrophotometer:

A. *optical density
B. refractive index
C. boiling point
D. angle of rotation
E. pH of the solution

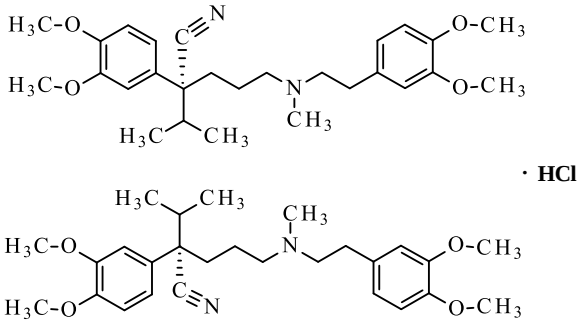
Spectrophotometry is based on measuring the absorption of a substance by monochromatic radiation. Absorption spectrophotometry in the ultraviolet and visible regions of the spectrum can be used for drug identification, purity testing, and quantification.

To calculate the **quantitative content**, it is necessary to measure the optical density of the solution of the substance under investigation on a spectrophotometer and calculate the content using the specific absorption index or by the standard method

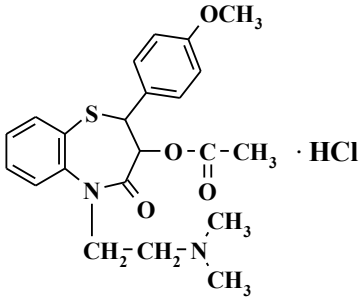
Calcium channel blocker verapamil hydrochloride is metabolized in the liver with the formation of norverapamil. What is the name of reaction for this transformation? A. *N-demethylation B. acetylation C. hydroxylation D. glucuronidation E. deamination	Verapamil is metabolized by **N-demethylation** of CYT3A4 to the major metabolite norverapamil, which retains approximately 20% of the activity of verapamil  norverapamil
One of the areas of biotransformation of nifedipine is hydrolysis. Due to which functional group is this transformation: A. *ester group B. nitro group C. dihydropyridine cycle D. carboxyl group E. phenolic hydroxyl	One of the directions of nifedipine metabolism is hydrolysis:  nifedipine 2,6-dimethyl-4(2-nitrophenyl)-pyridine-5-methoxycarbonyl-3-carboxylic acid 2-hydroxymethyl derivative lacton
Nitroglycerin is used in acute heart failure. At sublingual reception it quickly gets into blood where gives in to recovery with formation: A. *nitrogen (II) oxide B. sulfur (VI) oxide C. carbon (IV) oxide D. carbon (II) oxide E. sulfur (IV) oxide	Nitrovasodilators are drugs that mimic the action of **endogenous nitrogen (II) oxide** (NO), releasing NO or generating NO in tissues. From this point of view, they are prodrugs, because the pharmacologically active substance (nitrogen oxide) is formed in the process of their biotransformation 
The substance of verapamil hydrochloride is examined in the control-analytical laboratory. Which of the following reagents can be used to identify it? A. *silver nitrate B. sodium chloride C. ammonium oxalate D. potassium bromide E. copper sulfate	At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.

Pharmacist-analyst identifies diltiazem hydrochloride. The presence of chloride ions is determined using a solution of:

A. *silver nitrate
B. barium chloride
C. ammonium oxalate
D. copper sulfate
E. potassium permanganate



Verapamil hydrochloride



Diltiazem hydrochloride

$$Cl^- + AgNO_3 \rightarrow AgCl\downarrow + NO_3^-$$
$$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$$

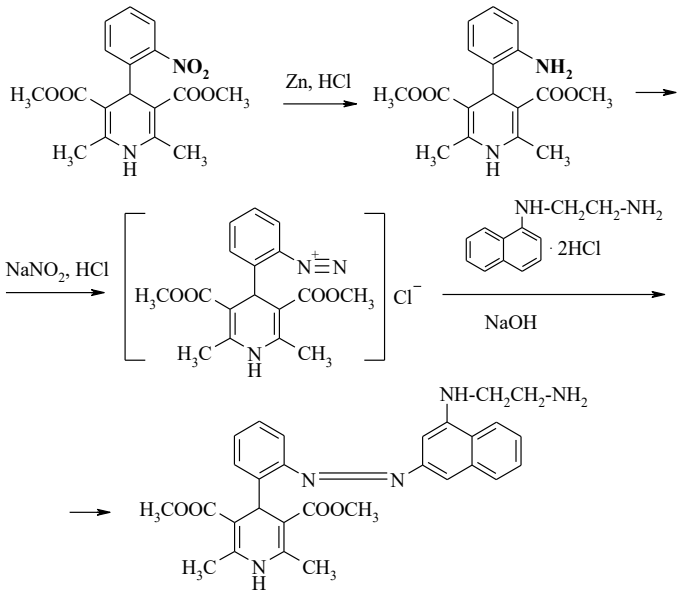
Chemist-analyst identifies nefedipine after reduction of the nitro group to the primary aromatic amino group. The reduction product is determined by the reaction of formation

A. *azo dye
B. murexide
C. thiochrome
D. fluorescein
E. talleoquinine

Nifedipine is a synthetic drug that belongs to the group of calcium channel blockers. According to the SPhU, zinc and HCl are added to the drug during identification. Next, a solution of sodium nitrite and naphthylenediamine dihydrochloride is added - an intense red color appears. This reaction indicates the presence of a functional group in the nifedipine molecule:

A. *aromatic nitro group
B. aldehyde group
C. aliphatic amino group
D. lactone cycle
E. ester group

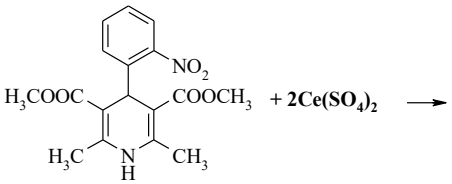
The reaction of the formation of a red **azo dye** with N-(1-naphthyl)-ethylenediamine dihydrochloride after the preliminary reduction of the nitro group of nifedipine to the amino group.

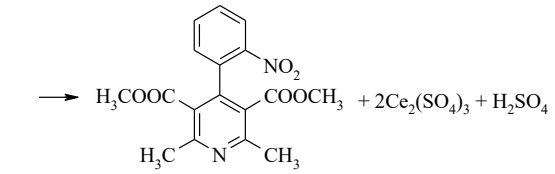


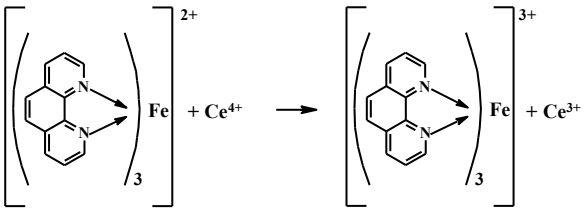
A sample of the substance nifedipine was received by the laboratory for quality control of medicines. What method can be used to quantify this substance?

A. *cerimetry
B. thiocyanatometry
C. argentometry
D. complexometry
E. alkalimetry

For the assay of nifedipine, the **cerimetry** method is used in the medium of 2-methyl-2-propanol, the indicator is **ferroin**, and a blank experiment is conducted in parallel.







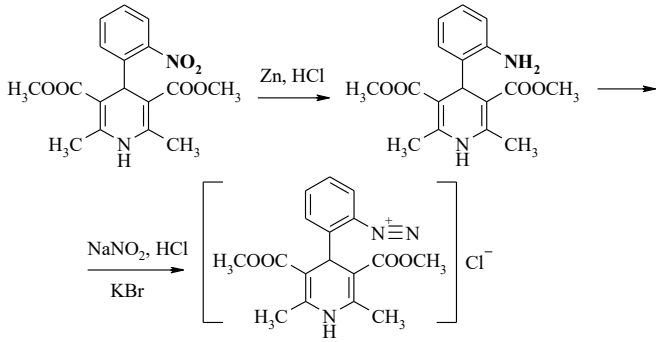
Pharmacist-analyst quantifies nifedipine by cerimetry. Specify the indicator used in this method?

A. *ferroin
B. potassium chromate
C. phenolphthalein
D. tropeolin 00
E. methyl orange

In the control-analytical laboratory the quality control of nifedipine preparations is carried out. Which method of quantitative determination of the active substance requires prior reduction of the nitro group to the amino group?

A. *nitritometry
B. complexometry
C. acidimetry
D. argentometry
E. alkalimetry

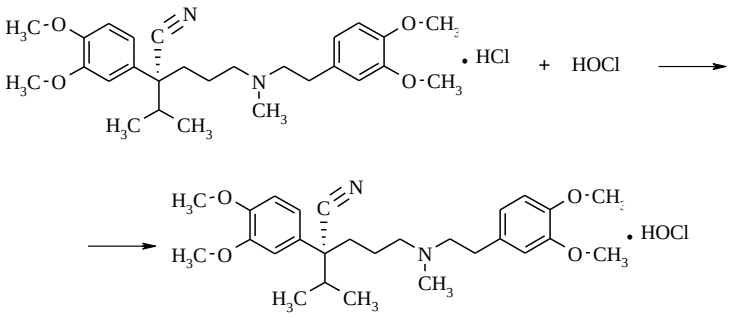
Assay of nifedipine is carried out by the method of **nitritometry** after preliminary reduction of the nitro group to the amino group:

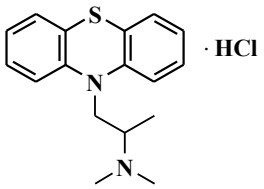
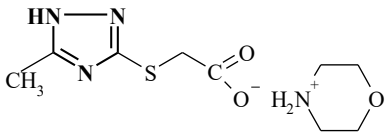
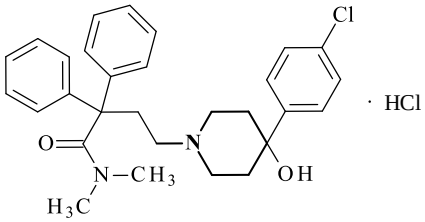
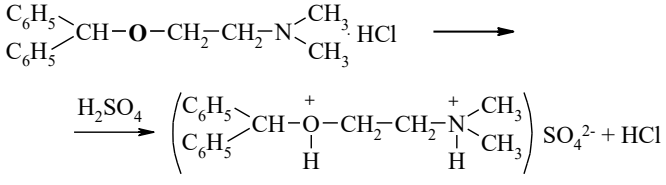


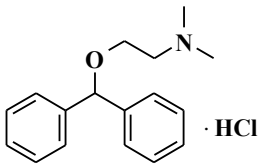
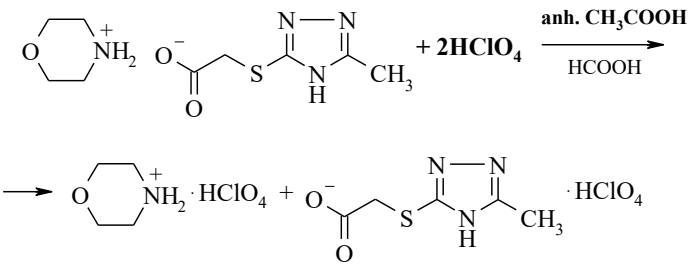
The pharmacist of the control and analytical laboratory examines the substance of verapamil hydrochloride by acidimetry in a non-aqueous medium. What titrant is used for this method?

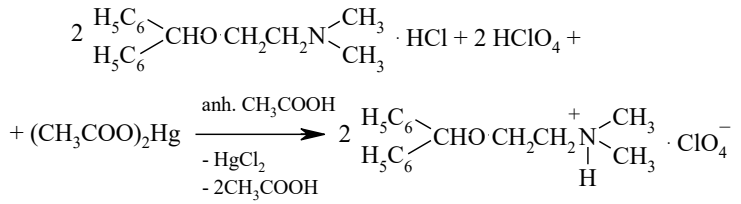
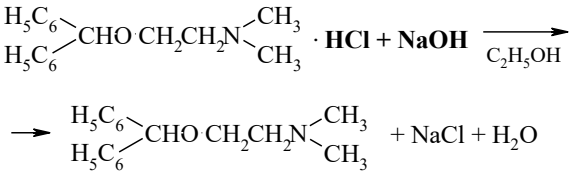
A. *perchloric acid
B. potassium bromate
C. sodium nitrite
D. sodium edetate
E. zinc sulfate

Assay of verapamil hydrochloride carried out by acidimetry in a non-aqueous medium with potentiometric determination of the end point of the titration, titrant is **perchloric acid**.



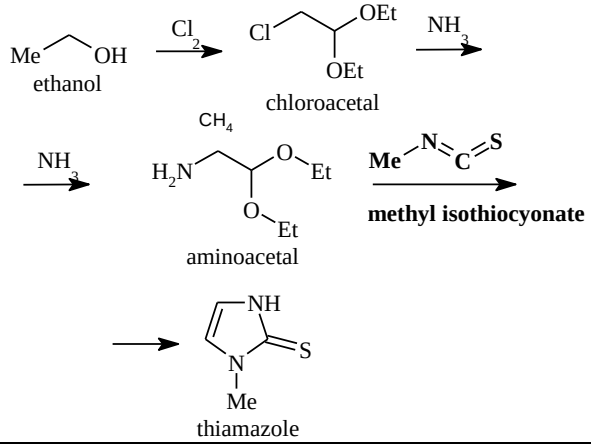
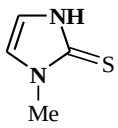
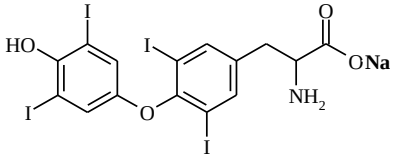
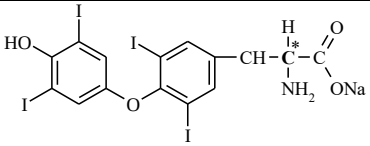
Test from «Крок-2» base	Explanation
Topic 26. Chemical bases of rational use and quality assurance of antiallergic drugs Topic 27. Chemical bases of rational use and quality assurance of drugs affecting the gastrointestinal tract: antisecretory (H2-histamine receptor blockers, proton pump inhibitors), antacids, and astringents Topic 28. Chemical bases of rational use and quality assurance of hepatoprotectors, laxative and antidiarrheal drugs	
Promethazine hydrochloride belongs to the first generation of antihistamines. Which condensed heterocycle underlies the chemical structure of this drug? A. *phenothiazine B. purine C. indole D. quinoline E. acridine	Promethazine hydrochloride belongs to **phenothiazine** derivatives:  (RS)-N,N,α-tremtilyl-10H-phenothiazine-10-ethanamine hydrochloride
Thiotriazoline is an original drug with hepatoprotective action. According to the chemical structure of thiotriazoline belongs to the derivatives: A. *triazole B. purine C. imidazole D. acridine E. pyrrole	Thiotriazoline belongs to **triazole** derivatives:  Morpholine 3-methyl-1,2,4-triazolyl-5-thioacetate
Loperamide hydrochloride acts on intestinal opioid receptors and belongs to the group of antidiarrheal drugs. This drug is a derivative of: A. *piperidine B. phenothiazine C. pyridine D. triazole E. imidazole	Loperamide hydrochloride belongs to **piperidine** derivatives:  4-[4-(4-chlorophenyl)-4-hydroxypiperidin-1-yl]-N,N-dimethyl-2,2-diphenylbutanamide hydrochloride
The pharmacist-analyst performs the identification reaction of diphenhydramine hydrochloride. Which compound is formed by adding concentrated sulfuric acid to a drug? A. *oxonium salt B. aurine dye C. azo dye D. picrate E. indophenol dye	Due to the presence of an ether group for diphenhydramine, the reaction of the formation of an **oxonium salt** when interacting with concentrated sulfuric acid is characteristic - an intense yellow color appears, which changes to red when concentrated nitric acid is added. 
The antihistamine "Diphenhydramine hydrochloride" is an ester by structure. A pharmacist-analyst identifies the compound by the formation of an oxonium salt upon addition of: A. *concentrated sulfuric acid B. hydroxylamine hydrochloride solution	

C. ferric (III) chloride solution D. dilute nitric acid E. potassium pyroantimonate solution	
An analyst of the technical control department of a pharmaceutical company analyzes the diphenhydramine hydrochloride substance. To identify chloride ions, he uses the reaction with a solution of: A. *silver nitrate B. ammonium oxalate C. barium chloride D. sodium hydroxide E. potassium iodide	 Diphenhydramine hydrochloride $Cl^- + AgNO_3 \quad AgCl\downarrow + NO_3^-$ $AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$ At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.
An anti-ulcer drug containing bismuth subcitrate has arrived at the drug quality control laboratory. During the reaction on the bismuth cation, the formation of a yellowish-orange color was observed. What reagent was used in this test? A. *thiourea B. glyoxalhydroxyanil C. hydrochloric acid D. sodium hydroxide E. potassium acetate	Solutions of bismuth salts acidified with nitric acid give a **yellowish-orange** colour with **thiourea**: $Bi^{3+} + (NH_2)_2CS \rightarrow [Bi((NH_2)_2CS)_3]^{3+}$
The quantitative content of thiotriazoline in the substance is determined by a specialist of the analytical laboratory by the method of acidimetry in a non-aqueous environment. How the titrant uses the solution: A. *perchloric acid B. sodium edetate C. sodium hydroxide D. potassium bromate E. silver nitrate	Acidimetry in a non-aqueous medium with potentiometric determination of the equivalence point (solvents are a mixture of formic acid and **anhydrous acetic acid**, titrated with a 0.1 M **perchloric acid** solution): 
The pharmacist-analyst carries out determination of thiotriazoline in the substance by acidimetry in a non-aqueous medium. He dissolves a portion of the substance in: A. *anhydrous acetic acid B. ethanol C. methylene chloride D. chloroform E. ether	

A pharmacist-analyst performs the quantitative determination of the antihistamine 'Diphenhydramine hydrochloride' by the method of acidimetry in a non-aqueous environment. For what purpose does he add a solution of mercury (II) acetate? A. *to bind chloride ions into a slightly dissociated compound B. to enhance the hydrolysis of diphenhydramine hydrochloride C. to change the density of the solution D. to create the optimal pH value of the solution E. to accelerate precipitation of diphenhydramine base	 Assay of diphenhydramine hydrochloride is carried out by the method of **acidimetry in a non-aqueous media**: the solvent is anhydrous acetic acid, the titrant is a solution of perchloric acid, the indicator is crystal violet. Titration is carried out in the presence of a mercury (II) acetate solution, which binds the chloride ion into a slightly dissociated compound ($HgCl_2$), thus preventing the formation of hydrogen halides (hydrogen chloride), which even in the environment of anhydrous acetic acid have a degree of dissociation sufficient to lead to a change in the color of the indicator.
The quantitative content of the antihistamine 'Diphenhydramine hydrochloride' is determined by the method of alkalimetry. As a titrant, a solution is used: A. *sodium hydroxide B. potassium bromate C. sodium thiosulfate D. potassium permanganate E. hydrochloric acid	 The assay of Diphenhydramine hydrochloride is carried out by direct alkalimetry in a mixture of alcohol and 0.01 M hydrochloric acid solution. The and point is determined potentiometrically. The titrant volume between two points of inflection on the titration curve is used for calculations.

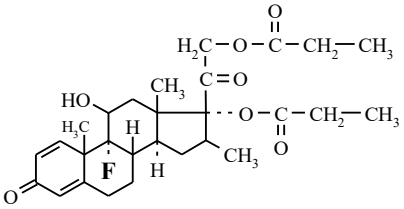
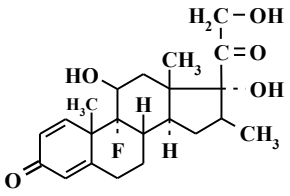
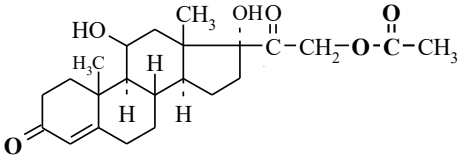
MODULE 3
Drugs affecting metabolism and tissue processes. Antimicrobial drugs

Content module 6. Drugs affecting metabolism and tissue processes

Test from «Крок-2» base	Explanation
Topic 29: Chemical bases of rational use and quality assurance of medicinal products used in case of thyroid disorders	
A pharmaceutical factory produces Thiamazole (Merkazolil) that is a medicinal substance with an antithyroid effect. Select from the list one of the initial compounds in its synthesis. A. *methyl isothiocyanate B. hydroxyquinoline C. acridine D. naphthoquinone E. furfural	Thiamazole (mercazolil) is obtained from ethanol by chlorination to chloroacetal. The chloroacetal is saturated with ammonia to produce aminoacetal. Amino acetal reacts with methyl isothiocyanate to form thiamazole:  ethanol; chloroacetal; aminoacetal; methyl isothiocyonate; thiamazole
A laboratory for quality control of medicines is analysing the substance levothyroxine sodium salt. Which solution is used to identify the sodium cation? A. *potassium pyroantimonate B. potassium iodide C. calcium chloride D. Iron (III) chloride E. magnesium sulphate	The molecule of Tiamazole (mercazolil) is based on a heterocycle - imidazole:  1-Methyl-1,3-dihydro-2H-imidazole-2-thione
An effective means of correcting increased thyroid function is thiamazole (mercazolil). The mechanism of anti-thyroid action of this medicine is associated with inhibition of the enzyme: A. *thyroperoxidase B. hyaluronidase C. cyclooxygenase D. carbonic anhydrase E. phosphodiesterase	Levothyroxine sodium Levothyroxinum natricum (Thyroxine Thyroxinum)  $\mathbf{Na^+ + K[Sb(OH)_6]} \rightarrow Na[Sb(OH)_6]\downarrow + K^+$
A pharmacist-analyst measures the angle of rotation of the test solution when identifying levothyroxine sodium salt. Which device does he use? A. *polarimeter B. refractometer C. spectrophotometer D. potentiometer E. photoelectrocolourimeter	 **Polarimetry** is a method based on measuring the degree of polarization of light and the angle of rotation of the plane of polarization of light when it passes through optically active substances.

The pharmacist-analyst uses a **polarimeter** to check the "Levothyroxine sodium" quality. It is used to measure: A. *angle of rotation B. refrective index C. absorbance D. melting point E. electromotive force	Measurement of the **angle of rotation** is carried out on devices - polarimeters. The angle of rotation in solutions depends on their concentration; therefore, polarimetry is widely used to measure the concentration of optically active substances. To confirm the purity and identification of the optically active substance, the value of the **specific optical rotation** is calculated $[\alpha]_D^{20}$**.**
Effective antithyroid drugs, for example, thiamazole (mercazolil), are produced on the basis of thiourea. Which heterocycle is the basis of this substance molecule? A. *imidazole B. furan C. pyridine D. pyrimidine E. quinoline	**Tiamazole** (mercazolil) belongs to the thionamides, which have a pronounced thyrostatic effect by blocking thyroid peroxidase and inhibiting the conversion of ionised iodine into the active form (elemental iodine), by interfering with the iodination of tyrosine residues of the thyroglobulin molecule with the formation of mono- and diiodotyrosine and also tri- and tetraiodotyronine
A pharmacist-analyst performs an express analysis of anti-inflammatory eye drops containing potassium iodide. Quantitative determination of the active substance is carried out by the method: A. *argentometry B. complexonometry C. nitritometry D. acidimetry E. alkalimetry	Argentometric methods are used for the assay of alkali metal halides. The quantitative content of potassium iodide can be determined by the method of argentometry (Fajan's method), with sodium eosinate as the indicator. $KI + AgNO_3 \rightarrow AgI\downarrow + KNO_3$

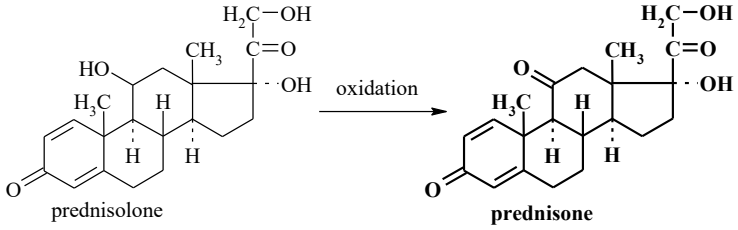
Test from «Крок-2» base	Explanation
Topic 30. Chemical basis for rational use and quality assurance of insulin and synthetic hypoglycaemic drugs (sulfonylurea derivatives, biguanides)	
The pharmacist-analyst identifies glibenclamide by spectrophotometry using the absorbance value. This value is calculated after measuring: A. *optical density B. refractive index C. viscosity D. pH of the solution E. angle of rotation	**Spectrophotometry** is based on the measurement of the absorption of a substance by monochromatic radiation. Absorption spectrophotometry in the ultraviolet and visible regions of the spectrum can be used for identification, purity testing and quantification of drugs. To calculate the quantitative content, the **optical density** of the test substance solution must be measured on a spectrophotometer and the content calculated using the specific absorbance or the standard method.

Test from «Крок-2» base	Explanation
Topic 31: Chemical bases of rational use and quality assurance of medicinal products of steroid hormones group: glucocorticosteroids and their fluorinated derivatives	
The introduction of fluorine atoms into a glucocorticosteroid molecule results in a significant increase of the antiinflammatory effect. What drug is a fluorine derivative glucocorticoid? A. *betamethasone dipropionate B. prednisolone C. prednisone D. hydrocortisone acetate E. cortisone acetate	**Betamethasone dipropionate** Betamethasoni dipropionas  9-**Fluoro**-11β-hydroxy-16β-methyl-3,20-dioxopregna-1,4-diene-17,21-diyl dipropanoate
The anti-inflammatory activity of glucocorticosteroids increases with the introduction of fluorine atoms into the molecule. Representative of fluorine-derived glucocorticosteroids are: A. *dexamethasone B. hydrocortisone acetate C. levothyroxine sodium D. prednisolone E. phenylephrine hydrochloride	**Dexamethasone** **Dexamethasonum** 
The range of medicinal products of a pharmacy includes hormonal drugs. Specify the drug that belongs to glucocorticosteroids. A. *hydrocortisone acetate B. diethylstilbestrol C. testosterone propionate D. adrenaline hydrochloride E. progesterone	**Hydrocortisone acetate** **Hydrocortisoni acetas** 
At the laboratory of a pharmaceutical company, a corticosteroid medicinal substance – hydrocortisone acetate is being analyzed. What cycle in its molecule causes the appearance of an intense bright yellow coloring, when concentrated sulfuric acid is added? A. *steroid cycle B. pyridine cycle C. xanthine cycle D. imidazole cycle E. naphthalene cycle	A common reaction for all steroid hormones and their synthetic analogues is **the steroid cycle determination reaction with concentrated sulfuric acid**. When dissolved in this acid and heated, the substances give off a specific colour, sometimes fluorescence. With the further addition of water, chloroform, and a solution of iron (III) ammonium sulphate, the colour changes and a specific fluorescence appears. In particular, when the **hydrocortisone** substance is dissolved in **concentrated sulfuric acid**, a yellow colour gradually appears after 15-20 minutes.
The laboratory of quality control of medicinal products performs certification of drugs from the group of hormones. Which reagent is used to determine the steroid cycle? A. *concentrated sulfuric acid B. dilute nitric acid C. sodium nitrite solution D. diphenylamine solution E. magnesium sulphate solution	

During biotransformation in the body, prednisolone forms several oxidation products. Which of the following compounds is a metabolite of prednisolone?

A. *prednisone
B. urocortisol
C. estriol
D. androsterone
E. cortisone

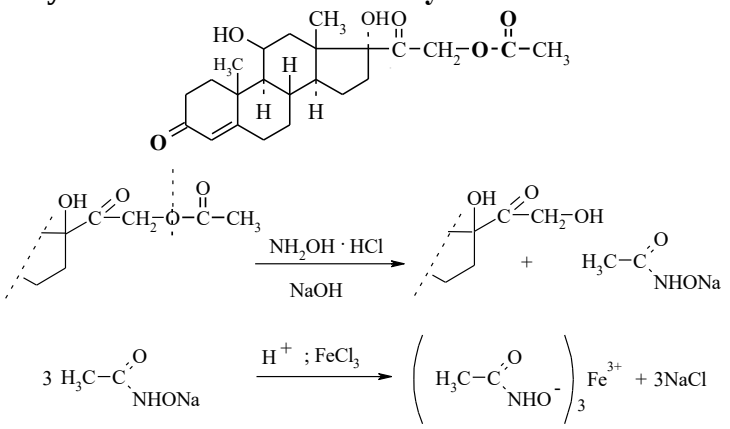
Prednisone is a metabolite of prednisolone



In order to identify hydrocortisone acetate, the analyst performs the reaction of iron (III) hydroxamate formation. This reaction confirms the presence of:

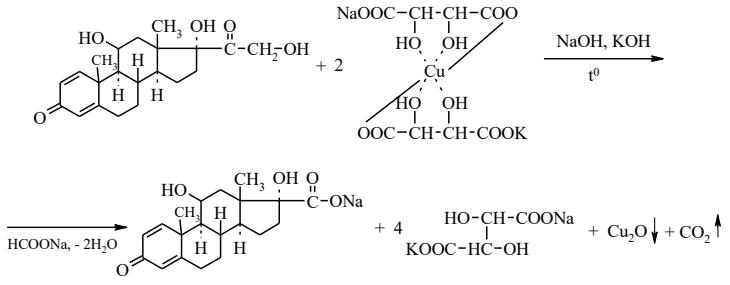
A. *ester group
B. an alcohol hydroxyl group
C. an aldehyde group
D. phenolic hydroxyl group
E. keto group

Hydrocortisone acetate **Hydrocortisoni acetas**



In a chemical laboratory, prednisolone is being identified. Which functional group in the structure of prednisolone causes a positive reaction with copper tartrate solution (Fehling's reagent)?

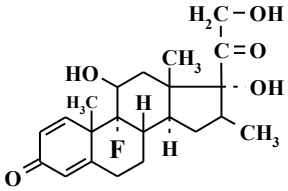
A. *α-ketol group
B. carboxyl group
C. nitro group
D. aromatic amino group
E. methyl group



Dexamethasone is a hormonal agent with covalently bound fluorine in its structure. After mineralisation of the substance, which solution can be used to identify fluoride ions?

A. *calcium chloride
B. sodium chloride
C. ammonium oxalate
D. silver nitrate
E. sodium acetate

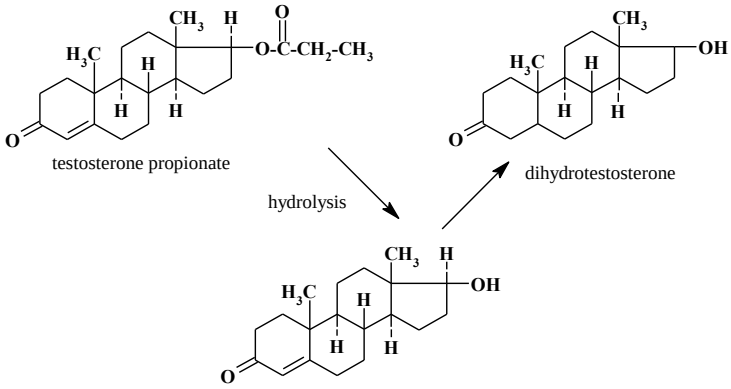
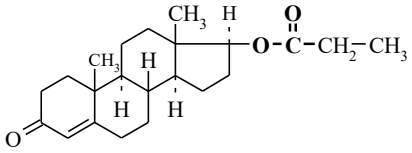
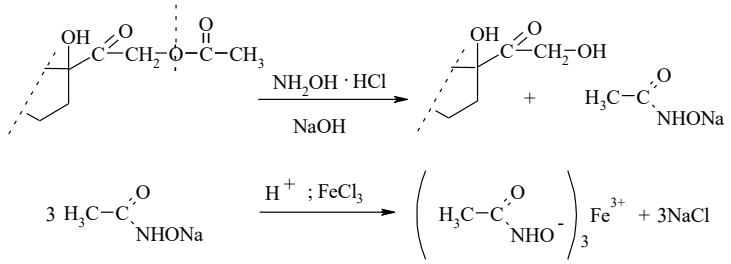
Dexamethasone **Dexamethasonum**

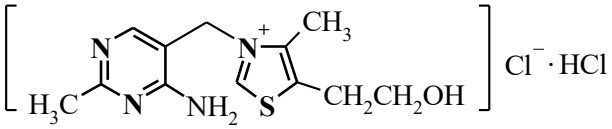


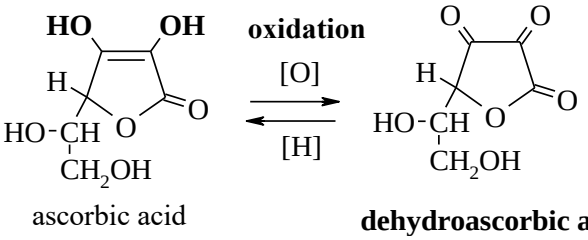
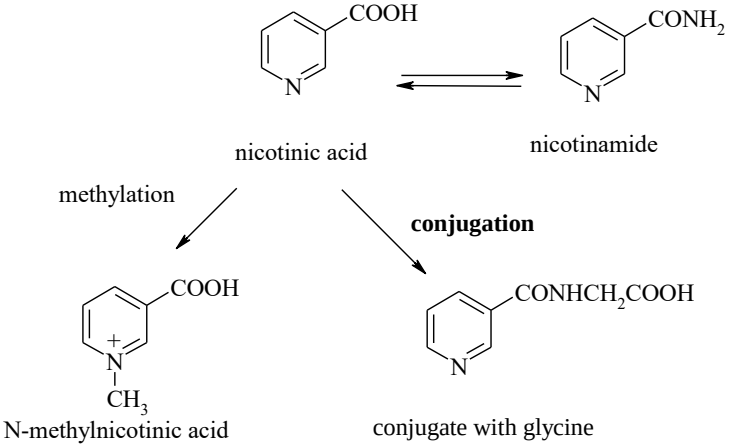
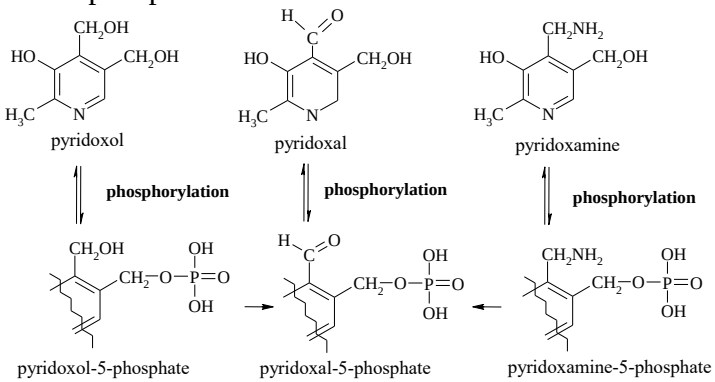
$2F^- + CaCl_2 \rightarrow CaF_2 + 2Cl^-$

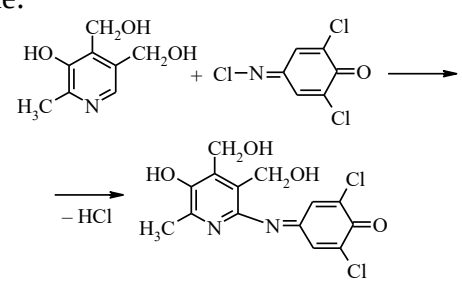
In a chemical laboratory, a series of dexamethasone substances are tested for certification purposes. After mineralisation of the substance, the pharmacist-analyst performs a reaction on:

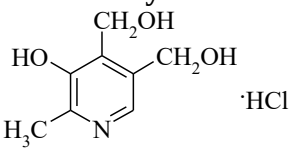
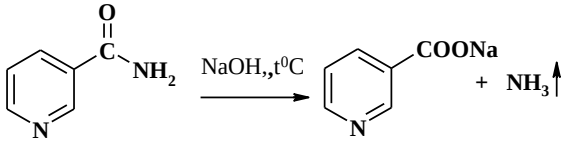
A. *fluorides
B. sulfates
C. iodides
D. nitrates
E. bromides

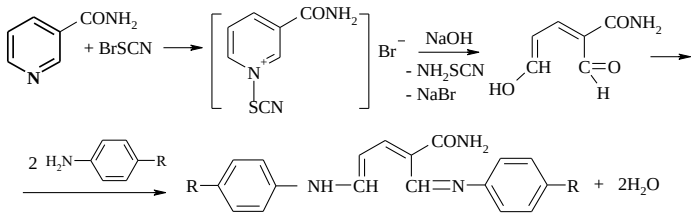
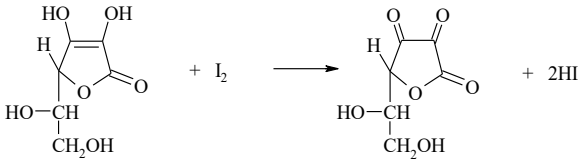
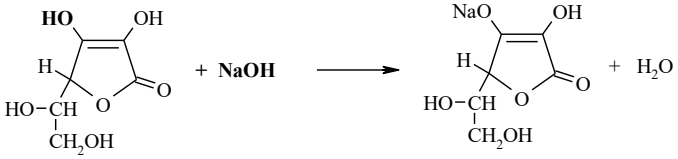
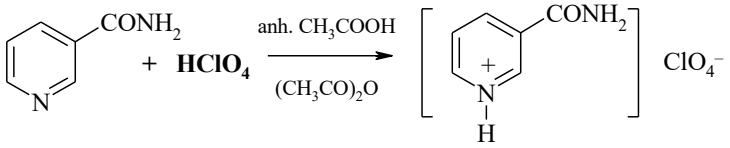
Test from «Крок-2» base	Explanation
Topic 32. Chemical basis of rational use and quality assurance of medicinal products of the group of sex hormones and their synthetic analogues	
Testosterone propionate is used as an androgenic agent. During the biotrans-formation of testosterone propionate, the active metabolite is formed: A. *dihydrotestosterone B. prednisone C. urocortisol D. orotidin-5-phosphate E. estriol	
When testing the substance testosterone propionate, the pharmacist-analyst performs a hydroxamic reaction. This reaction confirms the presence of the following in the molecule: A. *ester group B. carboxyl group C. an aldehyde group D. phenolic hydroxyl group E. amino group	 testosterone propionate 

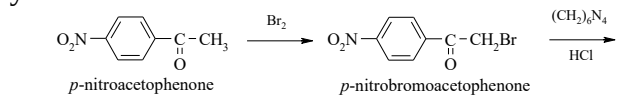
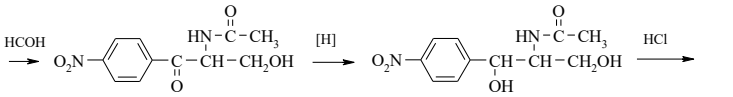
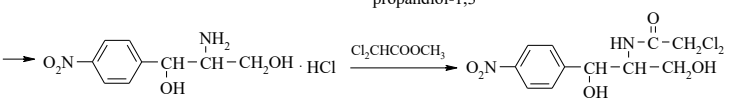
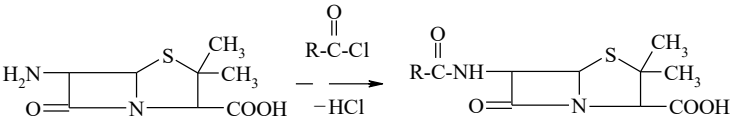
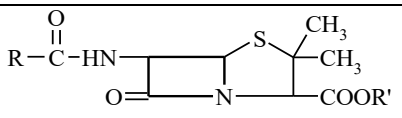
Test from «Крок-2» base	Explanation
Topic 33. Chemical basis of rational use and quality assurance of medicinal products of water-soluble vitamins group **Topic 34. Chemical bases of rational use and quality assurance of medicinal products of the group of fat-soluble vitamins. Enzymatic agents**	
The thiamine molecule contains of two heterocycles connected by a methylene group. Name these heterocycles. A. *pyrimidine and thiazole B. oxazole and pyrazine C. imidazole and pyrrole D. isoxazole and pyridazine E. pyran and morpholine	**Thiamine hydrochloride** Thiamini hydrochloridum  3-[(4-amino-2-methyl**pyrimidin**-5-yl)methyl]-5-(2-hydroxyethyl)-4-methyl**thiazole** chloride hydrochloride
In the process of biotransformation, ascorbic acid is converted to dehydro-ascorbic acid. In this reaction, the compound exhibits: A. *restorative properties B. oxidizing properties C. acidic properties D. basic properties E. complex-forming properties	Due to the presence of an endiol group, ascorbic acid exhibits **reducing (restorative)** and acidic properties. Ascorbic acid can give up two hydrogen atoms, **oxidising into dehydroascorbic acid**, which, in turn, can be reduced again to the endiol form and to the irreversible form furfural.

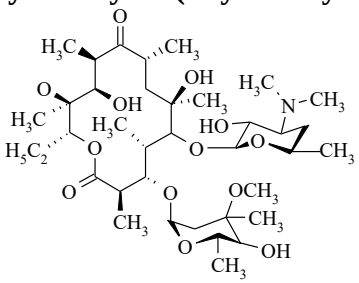
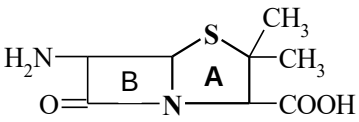
Ascorbic acid is known for its antioxidant properties. In the human body it is oxidized to form: A. *dehydroascorbic acid B. pantothenic acid C. salicylic acid D. nicotinic acid E. benzoic acid	In the course of metabolism, **ascorbic acid is oxidised to form dehydroascorbic acid**, which penetrates cell membranes by diffusion. Further biotransformation involves opening of the lactone ring to form 2,3-diketogulonic acid and such metabolites as oxalic acid and L-threonic acid. All products of metabolism and conjugation with sulfuric acid are excreted by the kidneys in the urine.
Dehydroascorbic acid is one of the metabolites of ascorbic acid. Which biotransformation reaction leads to the formation of this metabolite? A. *oxidation B. hydrolysis C. deamination D. acetylation E. glucuronidation	
During biotransformation in the body, nicotinamide forms a product of interaction with glycine. What type of reaction does this interaction belong to? A. *conjugation B. recovery C. oxidation D. hydrolysis E. dealkylation	Nicotinamide is biotransformed by methylation to form 5-methylnicotinic acid and conjugation with glycine. 
Which reaction is the basis of the conversion of pyridoxine in the human body under the influence of a specific enzyme pyridoxal kinase into a coenzyme form, which is involved in metabolism? A. *phosphorylation B. hydrolysis C. recovery D. oxidation E. conjugation	In tissues, pyridoxine is converted by phosphorylation to pyridoxine phosphate, pyridoxal phosphate and pyridoxamine phosphate: 
Pyridoxine hydrochloride and cyanocobalamin are not recommended to be administered in the same syringe because of their chemical incompatibility. What reaction occurs in this case? A. *complexation B. neutralisation	**Vitamin B12 (cyanocobalamin)** promotes the destruction of **vitamin B6 (pyridoxine hydrochloride)** due to the presence of cobalt cation, with which a complexation reaction occurs.

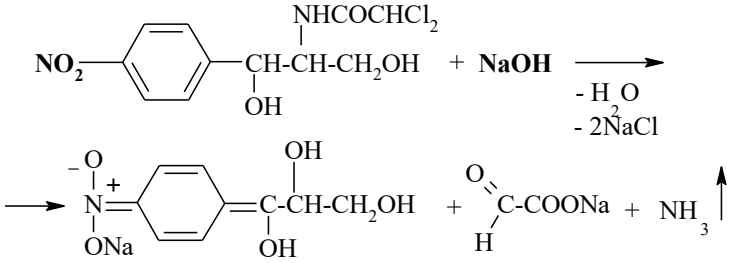
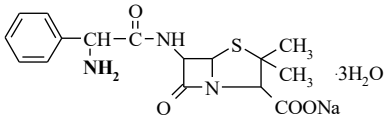
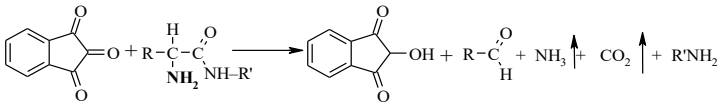
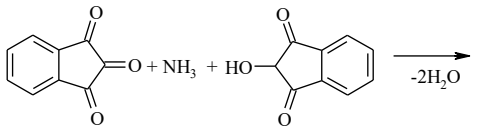
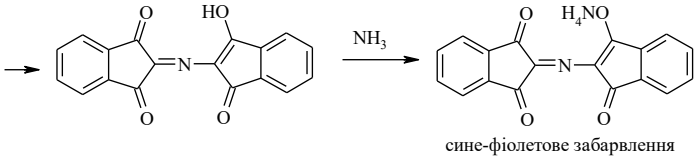
C. oxidation D. recovery E. hydrolysis	
In the chemical laboratory of the pharmaceutical company conduct input control of nicotinamide. According to the pharmacopoeia monograph, the aqueous solution of the substance must be transparent. The test solution should be compared with: A. *water B. chloroform C. methanol D. ether E. propanol-2	The test fluid is considered to be transparent if it can be compared with ***water R*** or the solvent used in the preparation of the test fluid when viewed under the conditions described above, or if its turbidity does not exceed that of reference I.
A pharmacist is testing a substance thiamine hydrobromide. Which basic reagent is used to determine the presence of sulphate? A. *barium chloride solution B. sodium nitrite solution C. ammonium oxalate solution D. sodium benzoate solution E. calcium chloride solution	Sulphate limit test: $SO_4^{2-} + BaCl_2 \xrightarrow{CH_3COOH} \underset{\text{white precipitate}}{BaSO_4\downarrow} + 2Cl^-$ The solutions are brought to a neutral reaction as described in the SPhU to increase the sensitivity of the reaction, 1.5 ml of a reference alcohol solution of sulfate ion (10 ppm) is added to the test solution. A white opalescence or turbidity appears, which should not be more intense than in the experiment with the reference solution.
In the control-analytical laboratory the ascorbic acid substance is analyzed. For determine the specific optical rotation it is necessary to use: A. *polarimeter B. spectrophotometer C. refractometer D. areometer E. viscometer	**Polarimetry** is a method based on measuring the degree of polarization of light and the angle of rotation of the plane of polarization of light when it passes through optically active substances. Measurement of the **angle of rotation** is carried out on devices - polarimeters. The angle of rotation in solutions depends on their concentration; therefore, polarimetry is widely used to measure the concentration of optically active substances. To confirm the purity and identification of the optically active substance, the value of the **specific optical rotation** is calculated $[\alpha]_D^{20}$**.**
A pharmaceutical analyst identifies the substance pyridoxine hydrochloride by thin-layer chromatography. He uses the following solution as a specific developer: A. *2,6-dichloroquinone chlorimide B. cyanobromide C. ninhydrin D. diphenylamine E. 2,4-dinitrochlorobenzene	For the identification of pyridoxine hydrochloride, thin-layer chromatography is used. The chromatogram is developed with a solution of 2,6-dichloroquinon-chlorimide: 

A pharmaceutical analyst, in the process of identifying the substance pyridoxine hydrochloride, carried out a reaction with a solution of silver nitrate, which resulted in the formation of a white precipitate that is soluble in ammonia solution. What structural fragment of the substance causes this result? A. *chloride ions B. phenolic hydroxyl C. pyridine cycle D. methyl group E. hydroxymethyl group	To identify hydrogen chloride salts a reaction with a silver nitrate solution is used. **Pyridoxine hydrochloride**  $\mathbf{Cl^- + AgNO_3 \xrightarrow{HNO_3} AgCl\downarrow + NO_3^-}$ $\mathbf{AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O}$ At the interaction of **chloride ions** with a solution of silver nitrate in the presence of dilute nitric acid, a **white curdled precipitate** is formed, which quickly dissolves when ammonia is added to the solution.
One of the reactions for identifying the substance nicotinamide is the reaction of ammonia release when boiled with sodium hydroxide solution. Which functional group is involved in this reaction? A. *amide B. ketone C. aldehyde D. thiol E. carboxylic	The **amide group** in the nicotinamide molecule can be confirmed by reacting with a sodium hydroxide solution. When heated, **ammonia** is released, which can be detected by an odour: 
A pharmaceutical analyst identifies the substance nicotinamide by reacting it with sodium hydroxide solution under boiling. Which gaseous product is released as a result of the reaction? A. *ammonia B. carbon (IV) oxide C. hydrogen sulphide D. sulfur (VI) oxide E. formaldehyde	
An analytical chemist is identifying nicotinamide by a pyridine cycle reaction. Which reagents should he use? A. *cyanobromide and aniline solutions B. solutions of potassium bromide and potassium bromate C. solutions of iodine and potassium iodide D. Solutions of potassium hydroxide and dimethylformamide E. sulfuric acid and formaldehyde solution	Nicotinamide is a vitamin, which belongs to derivatives of **pyridine**. When reacted with a solution of **cyanobromide (rhodanium bromide reagent) and aniline**, a yellow colour appears. Opening of the pyridine cycle produces glutaconic aldehyde, which, upon condensation with aniline, forms a yellow Schiff base. $Br_2 + NH_4SCN \rightarrow BrSCN + NH_4Br$

A pharmacist-analyst is analysing the medicinal substance **nicotinamide.** The pharmacopoeial reaction with a solution of cyanobromide and aniline produces a yellow colour. To which functional group is the reaction performed? A. *pyridine cycle B. amide group C. caroxylic group D. phenol hydroxide group E. ester group	
An analytical pharmacist quantifles the ascorbic acid substance using the iodometric method. What indicator must be used in the process? A. *starch B. methyl orange C. murexide D. bromophenol blue E. phenolphthalein	The quantitative content of ascorbic acid is determined by iodometry in the presence of dilute sulfuric acid, by direct titration, using starch as an indicator. 
In a drug quality control laboratory, ascorbic acid in a vitamin supplement is determined by alkalimetry. Which chemical process is the basis of this method? A. *neutralisation B. complexation C. hydrolysis D. oxidation E. reduction	The acidic nature of ascorbic acid is due to the hydrogen mobility of the hydroxyl at the 4-position; when titrated with alkali, ascorbic acid behaves as a monobasic acid. The quantitative content of ascorbic acid can be determined by alkalimetry **(based on the neutralisation process**), based on its acidic properties due to the presence of an endiol group. 
A pharmaceutical analyst is quantifying the substance nicotinamide using the acidimetric method in a non-aqueous medium. Which titration solution should he use? A. *perchloric acid solution B. iodine solution C. sodium hydroxide solution D. sodium edetate solution E. silver nitrate solution	Acidimetry in a mixture of anhydrous acetic acid and acetic anhydride is used for nicotinamide assay. **Perchloric acid** solution should be used for titration. 

Test from «Крок-2» base	Explanation
Topic 35. Chemical bases of rational use and quality assurance of drugs of the antibiotic group: *β*-lactams (penicillins, cephalosporins, carbapenems, monobactams), tetracyclines, amphenicols, aminoglycosides, macrolides)	
Chloramphenicol is natural antibiotic with an aromatic structure. The API of chloramphenicol is obtained synthetically. The starting compound in the synthesis of a substance is: A. *p-nitroacetophenone B. m-aminobenzoic acid C. acetic acid D. salicylic acid E. ascorbic acid	It is synthesised from **p-nitroacetophenone** by separating the necessary isomers at certain stages of synthesis:  *p*-nitroacetophenone → *p*-nitrobromoacetophenone → *n*-nitroaminoacetophenone hydrochloride → *p*-nitroacetylaminoacetophenone  *n*-nitroacetylaminooxypropiophenone → D,L-treo-1-*p*-nitrophenyl-2-acetylamino-propandiol-1,3  D,L-treo-1-*n*-nitrophenyl-2-amino-propandiol-1,3 hydrochloride → D,L-treo-1-*p*-nitrophenyl-2-dichloro-acetylaminopropanediol-1,3 (chloramphenicol)
Chloramphenicol (levomycetin) belongs to antibiotics of a wide spectrum of action. The starting substance in its synthesis is: A. *p-nitroacetophenone B. p-aminophenol C. o-phenylenediamine D. m-dioxybenzene E. m-methylpyridine	
What semi-synthetic antibiotic can be synthesized inthe process of reaction between 6-aminopenicillanic acid and phenylaminoacetic acid chloranhydride? A. *ampicillin B. cephalexin C. methacycline D. rifampicin E. amikacin	Semi-synthetic antibiotics (second-generation penicillins) are produced by acylating 6-aminopenicillanic acid (6-APA) with synthetic acids that do not occur in nature:  **6-aminopenicillanic acid** → acyl derivative of 6-APA
Semi-synthetic antibiotics of the penicillin series are obtained by combining microbiological and chemical synthesis. What starting compound is used in the synthesis of amoxicillin? A. *6-aminopenicilanic acid B. *p*-aminobenzoic acid C. sulfanilic acid D. 7-aminocephalosporanic acid E. *p*-aminosalicylic acid	
Natural penicillins are unstable at high temperatures and quickly break down in alkaline and acidic environment. What. cycle causes such chemical properties of natural penicillins? A. *β-lactam B. pyridine	 The β-lactam cycle is very unstable and is destroyed at an increased temperature, in acidic and alkaline media.

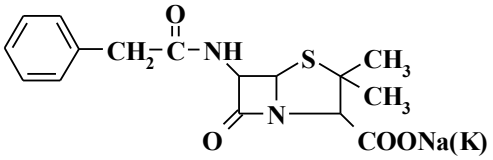
C. phenothiazine D. quinoline E. furan	
Which one of the listed drugs is a glycol-side antibiotic? A. *erythromycin B. levomycetin (Chloramphenicol) C. tetracvcline D. cephalexin E. polymyxin	**Erythromycin (Erythromycin)** 
Penicillins are the representatives of β-lactam antibiotics. Name the heterocyclic fragment that is included in the penicillin molecules: A. *thiazolidine cycle B. pyridine cycle C. piperazine cycle D. furanic cycle E. morpoline cycle	The basis of the penicillin molecule is 6-aminopenicilanic acid acid (6-APA), which consists of condensed thiazolidine (A) and β-lactam (B) cycles:  6-aminopenicilanic acid
An expert at the laboratory of the pharmaceutical product certification center tests a chloramphenicol substance. What instrument must be used when determining its specific optical rotation? A. *polarimeter B. potentiometer C. spectrophotometer D. refractometer E. viscometer	**Polarimetry** is a method based on measuring the degree of polarization of light and the angle of rotation of the polarisation plane of light as it passes through optically active substances. The measurement of the angle of rotation is conducted using **polarimeters**. The angle of rotation in solutions is dependent on their concentration, which is why polarimetry is a widely employed technique for measuring the concentration of optically active substances. The value of the specific optical rotation is calculated to confirm the purity and identify the optically active substance $[\alpha]_D^{20}$.
A pharmacist-analyst analyzes the substance chloramphenicol (levomycetin) and uses the value of the specific absorption index to calculate the quantitative content. What method did he use to quantify? A. *spectrophotometry B. polarography C. refractometry D. photocolorimetry E. polarimetry	**Spectrophotometry** is based on the measurement of the absorption of a substance by monochromatic radiation. Absorption spectrophotometry in the ultraviolet and visible regions of the spectrum can be used for identification, purity testing and quantification of drugs. To calculate the quantitative content, the **optical density** of the test substance solution must be measured on a spectrophotometer and the content calculated using the specific absorbance or the standard method.
Quantative determination of the substance of chloramphenicol (levomycetin) is carried out by the spectrophotometric method according to the State Pharmecopoeia of Ukraine's method in laboratory for quality control of medicinal products. What indicator is measured for a solution	

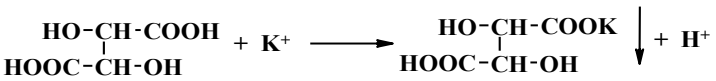
of a substance? A. *optical density B. boiling temperature C. angle of rotation D. refractive index E. dynamic viscosity	
A pharmacist-analyst conducts an analysis of chloramphenicol eye drops. He adds sodium hydroxide solution to detect the active pharmaceutical ingredient. A yellow color appears, which turns into a red-orange color. What functional group was detected during the reaction? A. *aromatic nitro group B. phenyl radical C. aldehyde group D. aminogroup E. alchohol hydroxyl	Aromatic nitro group reaction When chloramphenicol is heated with sodium hydroxide solution, the colour changes from yellow to reddish-orange (due to the formation of acinitro form) and on further heating a brick-red precipitate forms and an ammonia odour develops:  acinitro form
The structure of semi-synthetic penicillins (amoxicillin trihydrate, sodium ampicillin) contains a fragment of alpha-amino acids. What reagent allows you to identify this structural fragment? A. *ninhydrin B. diphenylamine C. formaldehyde D. cyanobromide E. aniline	**Ampicillin sodium Ampicillinum natricum**     сине-фіолетове забарвлення
Antibiotics certification is carried out in the laboratory for quality control of medicinal products. In which of the listed antibiotics can you determine the alpha-amino acid residue using the ninhydrin reaction? A. *ampicillin B. oxacillin C. chloramphenicol D. cefazolin E. lincomycin	
Ampicillin is analyzed in the drug quality control laboratory. Which of the listed reagents is sutable for the determination of the alpha-amino acid residue of the substance? A. *ninhydrin B. pyridine C. aniline D. hydroxylamine E. phenol	

The laboratory for quality control of medicinal products conducts certification of the substance benzylpenicillin potassium. A solution is used to identify the potassium ion:

A. *tartaric acid
B. sodium nitrite
C. zincuranyl acetate
D. ammonium oxalate
E. silver nitrate

Benzylpenicillin potassium
Benzylpenicillinum Kalicum





The drug quality control laboratory conducts an analysis of ampicillin sodium. To identify the sodium ion, a solution is used:

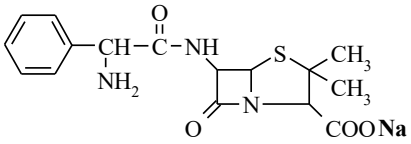
A. *potassium pyroantimonate
B. nitrite sodium
C. tartaric acid
D. ammonium oxalate
E. silver nitrate

The drug quality control laboratory received a substance of antibiotic "**Ampicillin sodium**". The sodium ion was identified by reacting with **potassium pyroantimonate** solution to form a precipitate of the following colour:

A. *white
B. blue
C. yellow
D. red
E. green

A pharmacist-analyst conducts an analysis of the substance cefazolin sodium. To identify the sodium ion, he uses a solution:

A. *potassium pyroantimonate
B. sodium nitrite
C. barium chloride
D. ammonium oxalate
E. magnesium sulfate



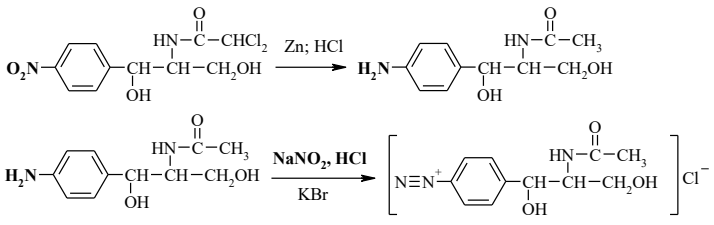
$$Na^+ + K[Sb(OH)_6] \rightarrow Na[Sb(OH)_6]\downarrow + K^+$$

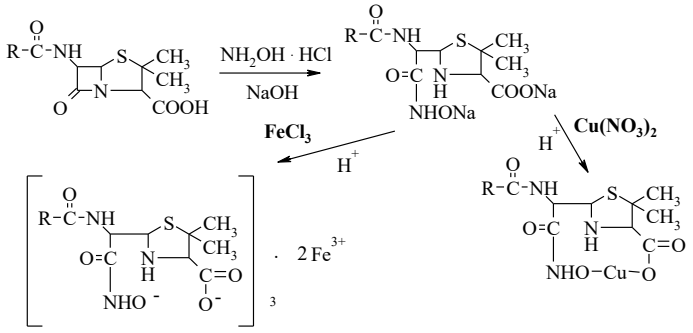
When sodium ions interact with a solution of **potassium pyroantimonate,** a thick white precipitate forms when heated and cooled in ice water and rubbed with a glass rod.

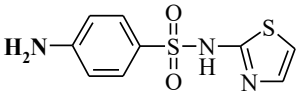
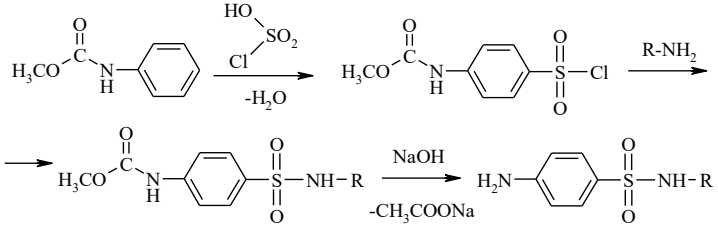
The quantitative content of chloramphenicol, which is an antibiotic with an aromatic structure, is determined by the nitritometry method after the reduction of the aromatic nitro group. A solution is used as a titrant:

A. *sodium nitrite
B. hydrochloric acid
C. potassium bromate
D. sodium hydroxide
E. silver nitrate

Nitritometry after preliminary reduction of the nitro group to the amino group with zinc dust in an acidic medium, titrated with sodium nitrite solution:



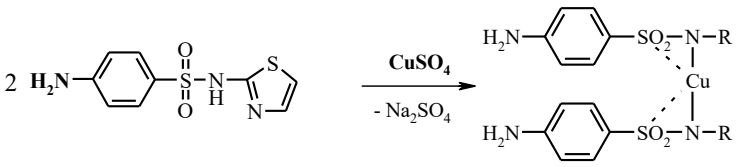
In the laboratory for quality control of medical drugs, the substance of chloramphenicol (levomicetin) is quantitatively determinated by the method, which is carried out after the reduction of the aromatic nitro group to the amino group. Give the name of this method: A. *nitritometry B. complexonometry C. argentometry D. alkalimetry E. mercurimetry	
Ampicillin is analyzed in the drug quality control laboratory. Choose the reagent that shood be added to obtain colored products with hydroxamic acids in the determination of the beta-lactam cycle of penicillins: A. *iron (III) chloride B. sodium chloride C. sodium phosphate D. sodium carbonate E. mercury chloride	

Test from «Крок-2» base	Explanation
Topic 36. Chemical bases of rational use and quality assurance of drugs of the sulfonamide group	
Sulfathiazole (norsulfazole) is a representative of drugs from the group of sulfonamides. What heterocycle is included in the structure of a substance molecule: A. *thiazole B. pyrimidine C. pyridine D. thiadiazole E. oxazole	Sufathiazole Norsulfasol (Norsulfazolum)  2 2-(*p*-Aminobenzenesulfamido)-thiazole
Sulfanilamide (streptocide) is a medicinal substance with an antimicrobial effect. As a starting compound for its synthesis, the following is used: A. *N-carbomethoxyaniline B. o-phenylenediamine C. 5-nitrofurfural D. p-dimethylaminobenzaldehyde E. 8-hydroxyquinoline	The most rational and economical way to obtain sulfonamide is the synthesis of the compound using **N-carbomethoxyaniline**: 

Sulfonamides are broad-spectrum antibacterial agents. The presence of a sulfamide group in the structure of sulfathiazole (norsulfazole) is detected by reaction with a solution:

A. *copper sulfate
B. potassium bromide
C. sodium carbonate
D. ammonium chloride
E. potassium bromate

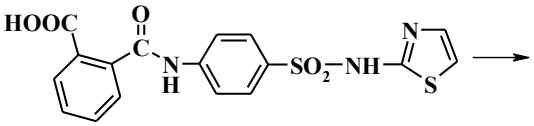
The reaction with salts of heavy metals makes it possible to identify drugs from the group of sulfonamide drugs:



Phthalylsulfathiazole (phthalazole), as a representative of prodrugs, forms an active metabolite as a result of metabolism. Choose it from the following:

A. *norsulfasol
B. norepinephrine
C. desloratadine
D. sulfanilamide
E. methylxanthine

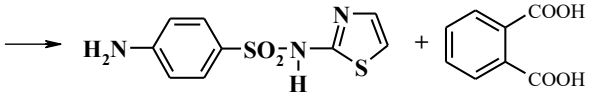
Phthalylsulfathiazole (phthalazole), as a representative of prodrugs, forms an active metabolite **norsulfasol** as a result of metabolism.



phthalylsulfathiazole

One of the substances from the group of sulfonamides is an active metabolite of phthalylsulfathiazole (phthalazole). What is the trivial name of this substance?

A. *norsulfasol
B. sulgin
C. urosulfan
D. phtasin
E. sulfanilamide

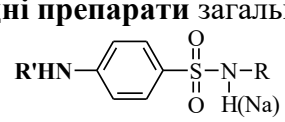


norsulfasol

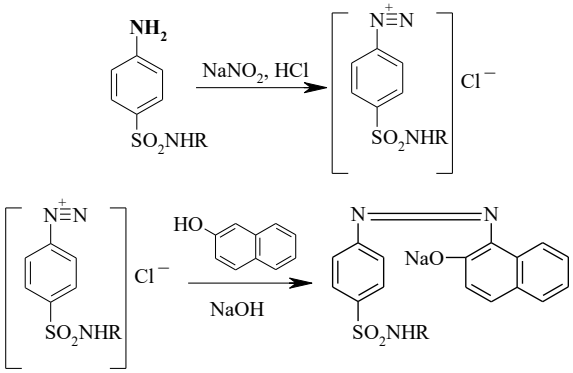
Sulfonamide drugs contain a primary aromatic amino group in the structure. What reaction is used to identify these compounds?

A. *reaction of diazotization and azo coupling
B. reaction of the formation of indophenol
C. reaction of formation of auric dye
D. reaction with cyanobromide
E. reaction with sodium hydroxide

Сульфаніламідні препарати загальної формули:

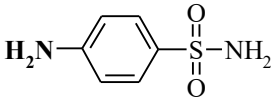
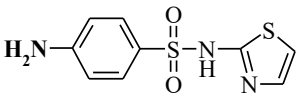
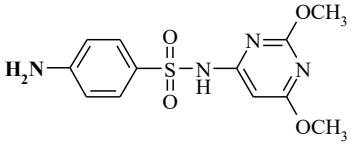


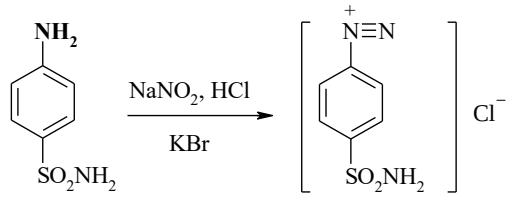
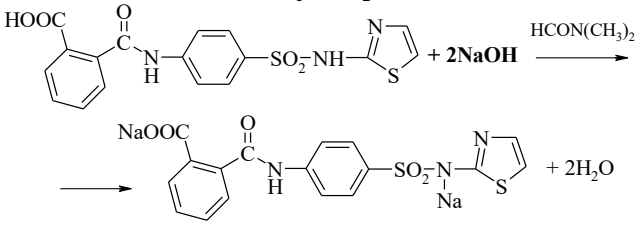
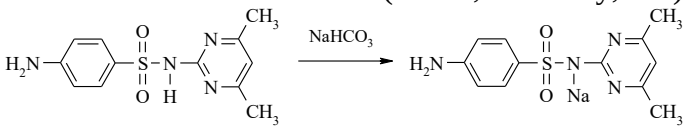
Sulfanilamide drugs contain a **primary aromatic amino group** in the structure and unrego the reaction of **diazotization and azo coupling**, as a result of which azo dyes are formed and a cherry-red color appears or an orange-red precipitate is formed:

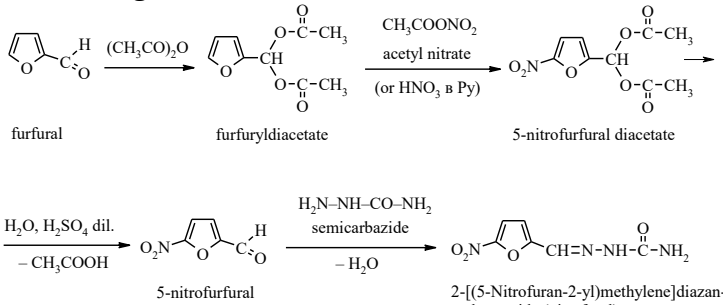


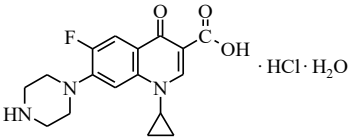
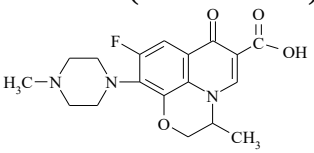
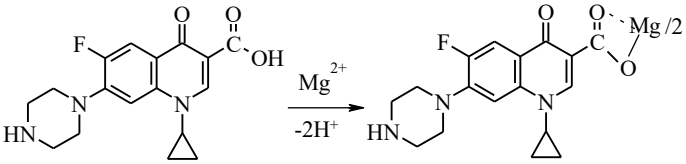
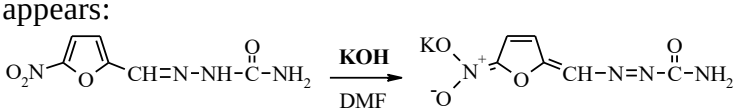
A pharmacist-analyst performs a quantitative determination of the sulfathiazole antibacterial agent by the nitritometry method. The presence of which functional group determines the choice of this method?

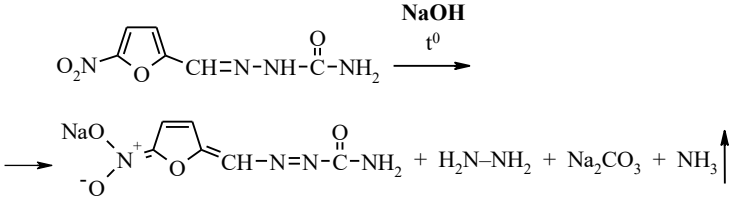
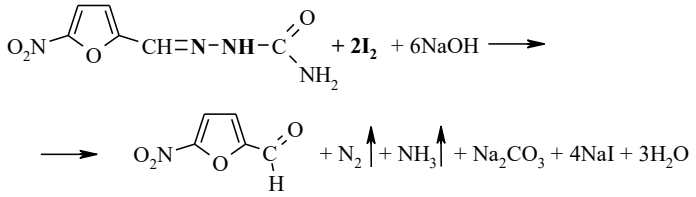
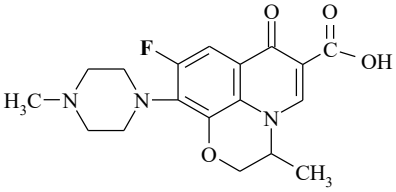
A. *primary aromatic amino group
B. aldehyde group
C. carboxyl group
D. sulfogroups
E. hydroxyl group

In the control and analytical laboratory, it is necessary to conduct an analysis of drugs from the group of sulfonamides. Choose a general identification reaction for this group of substances. A. *formation of azo dye B. formation of indophenol C. formation of thiochrome D. formation of iodoform E. formation of quinonymine	Sulfonamide Sulfanilamidum Streptocide Streptocidum  4-Aminobenzenesulfonamide
Certification of sulfonamide (streptocide) is carried out in the laboratory for quality control of medicinal products. Suggest a reaction for the identification of this medicinal product: A. *reaction to the primary aromatic amino group B. reaction to the nitro group C. reaction to the ester group D. reaction to phenolic hydroxyl E. reaction to the carboxyl group	Sufathiazole Norsulfasol (Norsulfazolum)  2 2-(*p*-Aminobenzenesulfamido)-thiazole
A pharmacist-analyst performs identification of the substance sulfathiazole (norsulfasol). The presence of a primary aromatic amino group in its structure is confirmed by the formation reaction: A. *azodye B. fluorescein C. murexide D. indophenol E. iodoform	Sulfadimethoxine (Sulfadimethoxinum)  6-(p-Aminobenzenesulfamido)-2,4-dimethoxypyrimidine
A pharmacist analyzes tablets of sulfadimethoxine. After the addition of sodium nitrite solution in the presence of hydrochloric acid followed by the addition of an alkaline β-naphthol solution, an orange-red color appeared. This reaction was carried out to identify which functional group of the substance? A. *primary aromatic amino group B. acetyl group C. residue of sulfonic acid D. phenyl radical E. pyrimidine cycle	
Most antimicrobial agents from the group of amidated sulfanilic acid derivatives contain a primary aromatic amino group in their structure. What reaction is used to identify sulfadimethoxine: A. *diazotization and azo coupling B. formation of indophenol C. formation of auric dye D. formation of the Schiff base E. complex formation	

Sulfadimethoxine is a sulfonamide antibacterial drug containing a primary aromatic amino group. What method is used for its quantitative determination? A. *nitritometry B. iodometry C. acidimetry D. argentometry E. permanganatometry	Sulfanilamides are determined by the method of nitritometry. The substance is titrated with sodium nitrite in an acidic environment in the presence of a potassium bromide catalyst at a temperature not higher than 20°C. Indicators – internal or external 
Quantitative content of phthalylsulfathiazole (phthalazole) is determined by the method of alkalimetry. As a titrant, a solution is used: A. *sodium hydroxide B. hydrochloric acid C. potassium bromate D. sodium nitrite E. sodium edetate	The assay of phthalylsulfathiazole is carried out by the method of alkalimetry in the medium of dimethylformamide, the titrant is sodium hydroxide solution, the indicator is thymolphthalein: 
To prevent crystalluria, the pharmacist advised the patient to use an alkaline drink while taking the medicine. This medicinal product belongs to the group A. *sulfanilamides B. barbiturates C. benzodiazepines D. penicillins E. catecholamines	Derivatives of sulfonamides easily precipitate in an acidic environment and contribute to the side effect of crystalluria. To prevent such a side effect and speed up the removal of sulfonamides from the body, it is recommended to use alkaline drinks in large quantities, as well as not to take acidic foods (lemon, cranberry, etc.) 

Test from «Крок-2» base	Explanation
Topic 37. Chemical bases of the rational use and quality assurance of medicines derivatives of nitrofural, 8-hydroxyquinoline, quinolone carboxylic acids	
Antimicrobial agent nitrofural (Furacilin) is obtained at a chemical and pharmaceutical enterprise. What starting material is used during its synthesis? A. *furfural B. benzaldehyde C. hydroxyquinoline D. resorcinol E. aniline	The starting material for the synthesis of nitrofural (furacilin) and other drugs of the group 5-nitrofurfural is furfural, which is obtained as a result of the hydrolysis of wood waste, straw, sunflower husks and other pentosan-containing raw materials. Synthesis is carried out in several stages: 
What substance can be synthesized as a result of the condensation of 5-nitrofurfural with semicarbazide? A. *nitrofural (Nitrofurazone) B. metronidazole C. norfloxacin D. phthalazole (Phthalylsulfathiazole) E. nitroxoline	

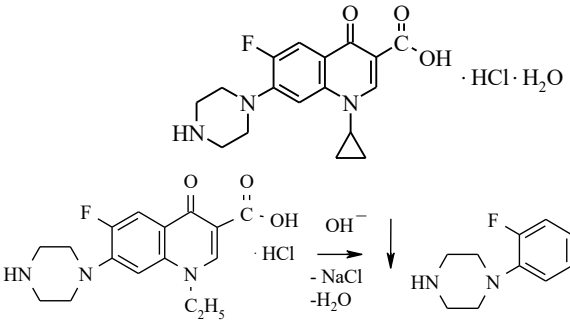
The chemical interaction of drugs from the group of fluoroquinolones with other drugs can lead to the formation of new substances, which can result in a deterioration of bioavailability. Medicines from the following groups have the greatest risk of such a chemical interaction among the following: A. *antacids B. barbiturates C. benzodiazepines D. phenothiazines E. sulfanilamides	Ciprofloxacin hydrochloride (Ciprofloxacini hydrochloridum)  Ofloxacin (Ofloxacinum)  
The structure of ciprofloxacin contains a free carboxyl group. When combined with which drugs can the substance form chelate complexes? A. *magnesium oxide B. sodium benzoate C. potassium orotate D. sodium tetraborate E. resorcinol	
Nitrofural (Furacillin) is a synthetic antibacterial agent. What indicator does a pharmacist-analyst measure when quantifying this agent by spectrophotometric -method? A. *optical density B. melting temperature C. angle of rotation D. refractive index E. pH of the solution	**Spectrophotometry** is based on measuring the absorption of a substance by monochromatic radiation. Absorption spectrophotometry in the ultraviolet and visible regions of the spectrum can be used for drug identification, purity testing, and quantification. To calculate the quantitative content, it is necessary to measure the **optical density** of the solution of the substance under investigation on a spectrophotometer and calculate the content using the specific absorption index or by the standard method
What parameter must be measured by an analytical pharmacist, when using spectrophotometry to quantify furacillin? A. *optical density B. pH of a solution C. angle of rotation D. refractive index E. melting point	
Nitrofural (Furacilin) substance is certified in the drug quality control laboratory . What solution is used to identify this substance? A. *potassium alcohol hydroxide B. barium chloride C. ammonium oxalate D. iron (III) chloride E. silver nitrate	When Nitrofural (Furacilin) is dissolved in dimethylformamide and the subsequent addition of an alcoholic **potassium hydroxide solution**, a purple-red color appears: 

A pharmacist-analyst identifies the substance nitrofural (furacilin). He confirms the presence of a nitro group in its structure by reaction with a solution: A. *sodium hydroxide B. potassium bromide C. zinc sulfate D. ammonium oxalate E. hydrochloric acid	When dissolving a portion of the substance in a mixture of equal volumes of water and **alkali solution**, an orange-red color appears, which can be explained by the formation of an acinitroform salt. Heating the resulting alkaline solution of nitrofural leads to the release of ammonia, which is detected by the smell or by the bluing of wet red litmus paper: 
A pharmacist-analyst identifies the aromatic nitro group in the antibacterial agent Nitrofural (furacilin) structure. What reagent do they use? A. *sodium hydroxide B. magnesium sulfate C. ammonium oxalate D. calcium chloride E. ferric (III) chloride	
A pharmacist-analyst performs a quantitative determination of a 0.02% nitrofural solution using the iodometric method. What indicator does he use? A. *starch B. potassium chromate C. methyl red D. phenolphthalein E. crystal violet	Assay of nitrofural is carried out by iodometry in an alkaline medium (back titration) with the starch as indicator.  $I_2 + 2NaOH \rightarrow NaI + NaOI + H_2O$ $NaI + NaOI + H_2SO_4 \rightarrow I_2 + Na_2SO_4 + H_2O$ $\mathbf{I_2 + 2Na_2S_2O_3} \rightarrow 2NaI + Na_2S_4O_6$
A pharmacist-analyst conducts photo-colorimetric quantitative determination of a 0.02 % solution of nitrofural. For this he measures: A. *optical density of the solution B. pH of the studied solution C. index of refraction of the solution D. angle of rotation of the solution E. boiling temperature of the solution	**Photometric analysis** methods are a group of methods based on measuring the transmission, **absorption**, or scattering of **electromagnetic radiation** by the analysed substance. These methods are divided into several groups: colorimetry, photocolorimetry; spectrophotometry; fluorimetry; turbidimetry; nephelometry. To calculate the quantitative content, it is necessary to measure the **optical density of the solution** of the substance under investigation on a spectrophotometer and calculate the content using the specific absorption index or by the standard method
Ofloxacin is a broad-spectrum antimicrobial with covalently bound fluorine in its structure. Its determination is carried out after mineralization of the substance to fluoride ion using a solution: A. *calcium chloride B. barium chloride C. ammonium chloride D. magnesium sulfate E. sodium acetate	 Ofloxacin (Ofloxacinum) The **fluorine atom** is determined after mineralization with a sintering mixture by reaction with a **calcium chloride** solution by the formation of white opalescence: $2F^- + CaCl_2 \rightarrow CaF_2\downarrow + 2Cl^-$

Ciprofloxacin hydrochloride is an antibacterial agent from the group of fluoroquinolones, which is often prescribed in combined treatment regimens. What can happen when ciprofloxacin hydrochloride injection solution is mixed with medicinal solutions that have an alkaline environment?

A. *formation of sediment/turbidity
B. formation of a gaseous product
C. disappearance of color
D. appearance of smell
E. dissolution of sediment

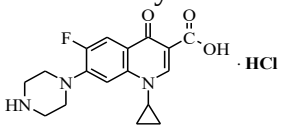
Ciprofloxacin hydrochloride
(Ciprofloxacini hydrochloridum)

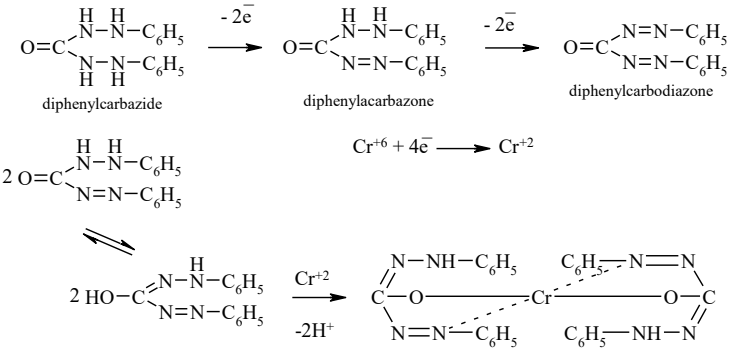


The antimicrobial drug ciprofloxacin hydrochloride was received by the laboratory for quality control of medicines. A pharmacist-analyst determines the chloride ion in the presence of concentrated sulfuric acid with the following reagent:

A. *potassium dichromate
B. magnesium sulfate
C. disodium hydrophosphate
D. ammonium oxalate
E. zinc sulfate

Ciprofloxacin hydrochloride
(Ciprofloxacini hydrochloridum)





The drug quality control laboratory has received the antimicrobial ciprofloxacin hydrochloride. The pharmacist-analyst determines the **chloride ion** in the presence of **sulfuric acid** concentrated with the following reagent:

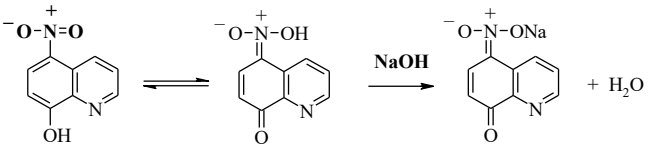
A. *potassium dichromate
B. sodium hydroxide
C. magnesium sulfate
D. potassium chloride
E. zinc oxide

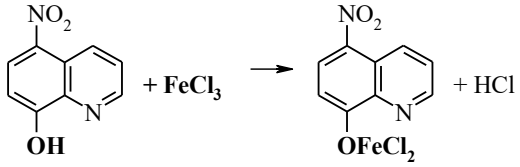
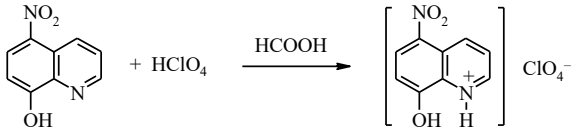
When **chloride ions** interact with **potassium dichromate** in a sulfuric acid environment, chromyl chloride is formed, which reacts with diphenylcarbazide to form a **purple-red** complex compound.

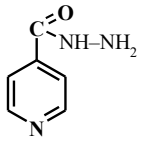
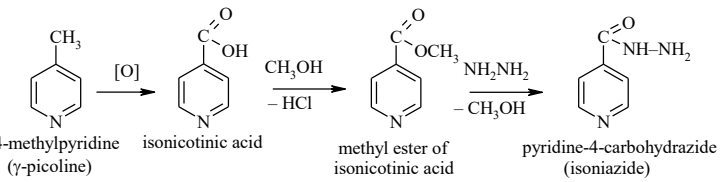
A pharmacist-analyst conducts a reaction for the presence of a nitro group in the structure of nitroxoline, while a red-orange color is observed. What reagent did he use?

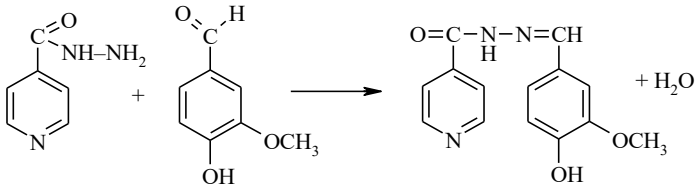
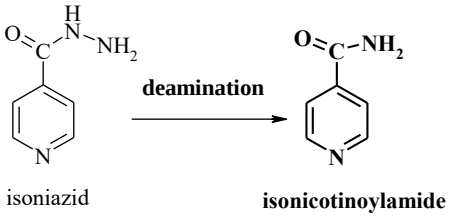
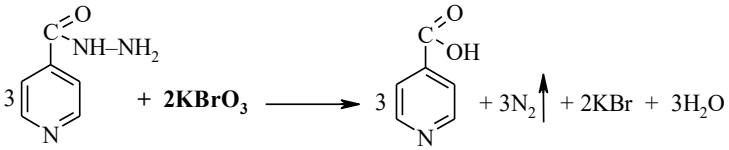
A. *sodium hydroxide solution
B. aniline solution
C. formaldehyde solution
D. cyanobromide solution
E. hydroxylamine solution

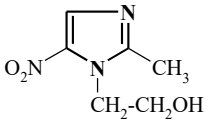
The presence of a nitro group in the structure of **nitroxolin** is confirmed by the reaction with **sodium hydroxide solution** by the formation of a **red-orange color**:



Nitroxoline is analyzed in the laboratory for quality control of medicinal products. The presence of which functional group determines the appearance of a black-green color with a solution of iron (III) chloride? A. *phenolic hydroxyl B. aliphatic amino groups C. carboxyl group D. aromatic amino groups E. aldehyde group	The presence of **phenolic hydroxyl** group in Nitroxoline is identified with a solution of **iron (III) chloride** (black-green color) 
Nitroxoline is a quinoline derivative used in infectious diseases of the urinary tract. The presence of a tertiary nitrogen atom in the quinoline heterocycle makes it possible to determine its quantitative content by the method: A. *acidimetry in non-aqueous solvents B. reverse bromatometry C. complexonometry by substitute D. reverse alkalimetry E. inverse argentometry	The presence of a tertiary nitrogen atom makes it possible to determine the quantitative content of nitroxolin by the method of **acidimetry in a non-aqueous media**. The sample is dissolved in formic acid and titrated with a solution of perchloric acid, the indicator is malachite green: 

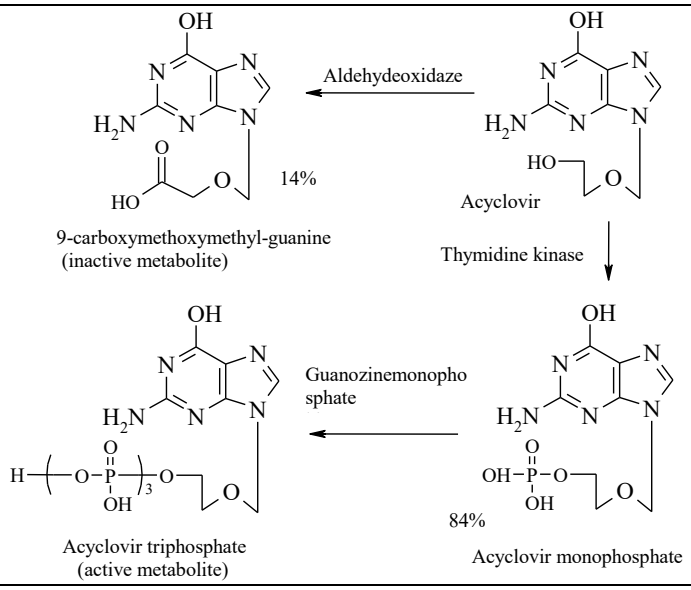
Test from «Крок-2» base	Explanation
Topic 38. Chemical bases of rational use and quality assurance of anti-tuberculosis drugs	
Isoniazid exhibits restorative properties. The presence of which functional group allows you to identify it with an ammonia solution of argentum nitrate: A. *hydrazide B. amide C. carboxyl D. sulfamide E. esternol	 Isoniazid (Isoniazidum) **Hydrazide** of 4-pyridinecarboxylic (isonicotinic) acid
According to the chemical structure, isoniazid is a hydrazide isonicotinic acid. As a starting compound for its synthesis, the following is used: A. *4-methylpyridine B. ethyl malonate C. ethyl acetate D. furfural E. urea	As a starting compound for synthesis isoniazide, the 4-methylpyridine (γ-picoline) is used: 

Ftivazid is an anti-tuberculosis agent belonging to isonicotinic acid derivatives. The synthesis of ftivazide is carried out by condensation of which reagents? A. *isoniazid and vanillin B. salicylic acid and hydrazine C. nicotinic acid and hydrazine D. nicotinamide and formaldehyde E. isonicotinic acid and benzaldehyde	Ftivazid is obtained by the interaction of **isoniazid** and **vanillin:** 
At a chemical and pharmaceutical enterprise, the substance ftivazid is obtained by the interaction of isoniazid and vanillin. What type of reaction underlies this interaction? A. *condensation B. hydrolysis C. acylation D. esterification E. amidation	
About 50-70% of isoniazid is excreted unchanged by the kidneys, the rest is metabolized in the liver. The active metabolite of isoniazid formed in the process of deamination is: A. *isonicotinoylamide B. succinic aldehyde C. benzoic acid D. nicotinic acid E. ethylmalonic ester	 deamination isoniazid **isonicotinoylamide**
An analytical pharmacist analyzes an isoniazid substance. What method must be used for the quantification of this substance? A. *bromatometry B. alkalimetry C. argentometry D. acidimetry E. complexonometry	**Bromatometry**, direct titration, indicator – methyl red. The method is based on the oxidation of the substance with bromine:  **$KBrO_3$** + 5KBr + 6HCl → $3Br_2$ + 6KBr + $3H_2O$

Test from «Крок-2» base	Explanation
Topics 39-40. Chemical bases of rational use and quality assurance of antiprotozoal, antiviral and antitumor drugs	
Antiprotozoal and antibacterial drug metronidazole arrived at the pharmacy . What five-membered heterocycle is the basis of its molecule? A. *imidazole B. pyrazole C. furan D. pyrrole E. thiazole	 Metronidazole (Metronidazolum) 2-(2-methyl-5-nitro-1H-imidazol-1-yl)ethanol

Acyclovir is a drug with the nucleoside structure, effective against herpes virus. What reaction of its transformation in the body is associated with its antiviral effect?

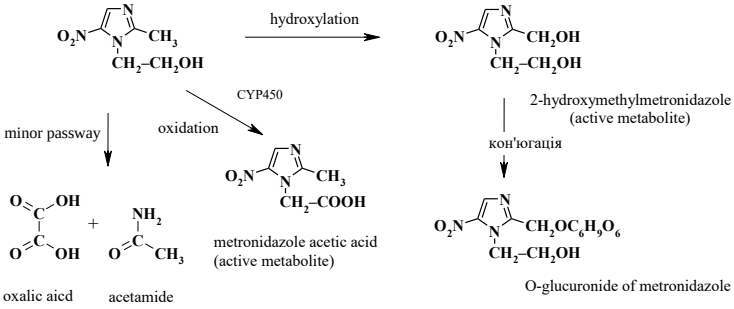
A. *phosphorylation
B. reduction
C. hydroxylation
D. hydrolysis
E. oxidation



Metronidazole is a broad-spectrum antimicrobial that belongs to imidazole derivatives. One of the directions of its biotransformation in the liver is conjugation with endogenous substances. Which of the following reactions belongs to this phase of metabolism?

A. *glucuronidation
B. oxidation
C. halogenation
D. hydrolysis
E. restoration

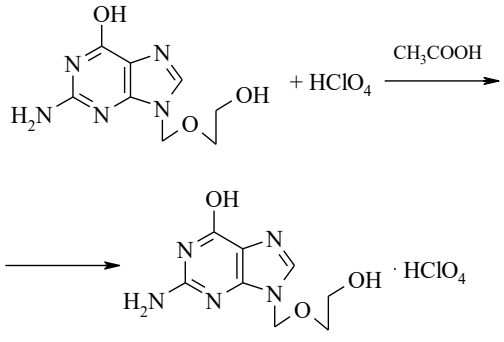
Metabolism of metronidazole occurs in the liver by hydroxylation followed by the formation of conjugates with glucuronic acid, as well as oxidation by the hydroxyl group or cleavage of the imidazole ring with the formation of acetamide and oxalic acid:



When determining the quantitative content of acyclovir substance, the pharmacist titrates a sample of the substance with a solution of perchloric acid in anhydrous acetic acid. What volumetric analysis method does he use?

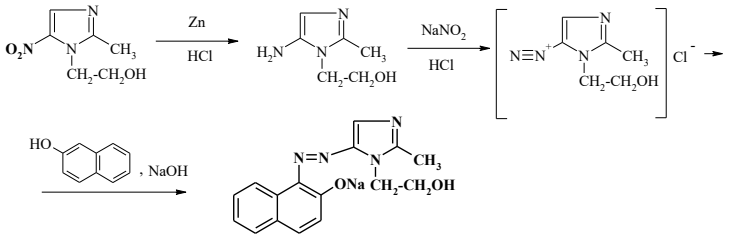
A. *acidimetry in a non-aqueous medium
B. complexonometry by substitute
C. inverse argentometry
D. reverse bromatometry
E. alkalimetry in a non-aqueous environment

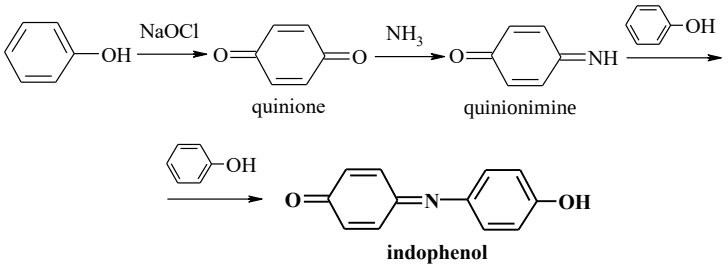
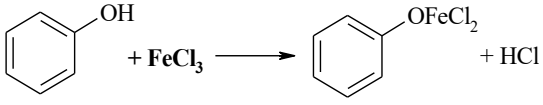
Acidimetry in a non-aqueous media. Titrate **potentiometrically** with perchloric acid solution. In parallel, a blank experiment is carried out:

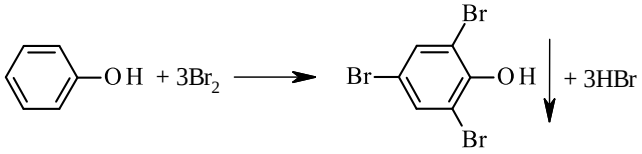
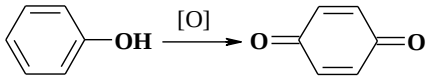
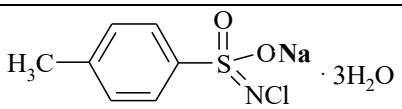
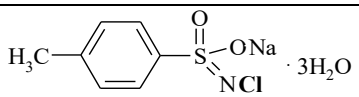


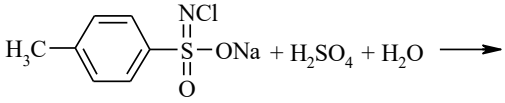
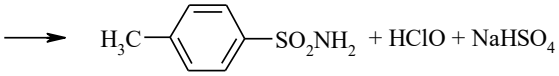
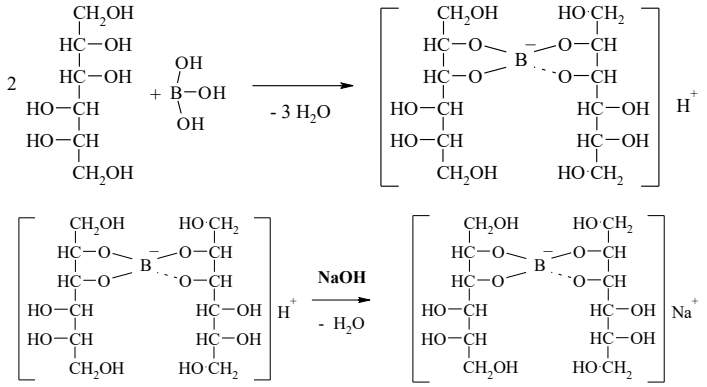
In the laboratory for quality control of medicinal products, the quantitative content of the acyclovir substance is determined by the method of acidimetry in non-aqueous solvents. The endpoint of the titration is fixed using:

A. *potentiometer
B. refractometer
C. pycnometer
D. fluorimeter
E. hydrometer

A pharmacist-analyst identifies metronidazole (2-(2-methyl-5-nitro-1H-imidazol-1-yl)ethanol) by the reaction of the formation of an azo dye. To carry out the diazotization reaction with the following azo compound, the previous one is necessary: A. *restoration B. hydrolysis C. oxidation D. pyrolysis E. nitration	Azo dye formation reaction. After preliminary **reduction** of the nitro group to the amino group with zinc powder in an acidic medium, the substance forms a red azo dye with an alkaline solution of β-naphthol: 

Test from «Крок-2» base	Explanation
Topic 41. Chemical bases of ration use and quality assurance of antiseptic and disinfectant medicinal products	
In order to identify phenol, a pharmacist-analyst conducts a reaction with a solution of sodium hypochlorite in an ammonia medium. As a result of this reaction, a substance with a blue color is formed. Specify this compound. A. *indophenol B. azo dye C. murexid D. thiochrome E. acrolein	When phenol is oxidized with a solution of sodium hypochlorite in an ammonia medium, **indophenol** is formed, as a result of which a **blue color** appears, which becomes more intense over time: 
During the pharmacopoeial analysis of phenol, a reaction was carried out with a concentrated sodium hypochlorite solution and an ammonia solution; during the reaction, a blue color appears, which later becomes more intense. What product is formed in this reaction? A. *indophenol B. ethyl acetate C. murexid D. polynitro compound E. methyl salicylate	
A pharmacist-analyst is testing for **phenol** in an antiseptic medicine. The presence of the **phenolic hydroxyl** is determined through reaction with a solution of: A. *ferric (III) chloride B. ninhydrin C. barium chloride D. potassium permanganate E. silver nitrate	A phenol solution (1:100) forms a blue-violet color with a neutral $FeCl_3$ solution. When a drop of alkali or acid is added, the color disappears (unlike salicylic acid): 

An analytical pharmacist of the quality control department analyzes the phenol substance. What method of quantification is used for this purpose? A. *bromatometry B. permanganatometry C. complexonometry D. mercurimetry E. argentometry	Bromatometry, back titration, indicator – **starch solution**: $KBrO_3 + 5KBr + 6HCl \rightarrow 3Br_2 + 6KCl + 3H_2O$  $Br_2 + 2KI \rightarrow I_2 + 2KBr$ $I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$
Phenol changes colour under the influence of moisture and light if it is stored in improper conditions. The discolouration is a result of the process of: A. *oxidation B. weathering C. reduction D. hydrolysis E. polymerisation	Phenol is colorless, needle-like crystals that turn pink in air due to oxidation, which leads to the formation of a complex mixture of colored substances (this is due to the intermediate formation of quinones). 
The disinfectant sodium tosylchloramide (chloramine) was sent to the quality control laboratory for analysis. What ion is determined by adding a solution of potassium pyroantimonate after calcination of the substance? A. *sodium B. magnesium C. calcium D. zinc E. potassium	 sodium tosylchloramide (chloramine) Sodium N-chloro-4-methylbenzenesulfonimide trihydrate The substance is decomposed at heating, the residue is dissolved in water. The resulting solution reacts with the sodium cation $\mathbf{Na^+} + K[Sb(OH)_6] \rightarrow Na[Sb(OH)_6]\downarrow + K^+$
The disinfectant sodium tosylchloramide (chloramine) was sent to the quality control laboratory for analysis. What ion is determined after mineralization of a substance with a solution of silver nitrate? A. *chloride B. sulfate C. carbonate D. phosphate E. nitrate When identifying the disinfectant sodium tosylchloramide (chloramine), the substance is calcined for the purpose of mineralization. What ion is further determined by adding a solution of barium chloride? A. *sulfate B. carbonate C. phosphate D. chloride E. nitrate	 sodium tosylchloramide (chloramine) Sodium N-chloro-4-methylbenzenesulfonimide trihydrate The substance is decomposed at heating, the residue is dissolved in water. The resulting solution gives positive reaction to chlorides: with a solution of silver nitrate in the presence of dilute nitric acid, a white curdled precipitate is formed, soluble in ammonia solution $\mathbf{Cl^-} + AgNO_3 \rightarrow AgCl\downarrow + NO_3^-$ $AgCl + 2NH_4OH \rightarrow [Ag(NH_3)]Cl + 2H_2O$ The resulting solution gives positive reaction to sulphates: with a solution of barium chloride in the medium of diluted hydrochloric acid, a white precipitate is formed: $\mathbf{SO_4^{2-}} + BaCl_2 \rightarrow BaSO_4\downarrow + 2Cl^-$

In the laboratory for the control of the quality of medicinal drugs, when performing quantitative determination of the substance chloramine (sodium tosylchloramide) by the iodometry method, a substitute solution was used as a titrant: A. *sodium thiosulfate B. potassium permanganate C. cerium sulfate D. zinc sulfate E. chloric acid	**Iodometry** by substitute.   $2HClO + 4KI + H_2SO_4 \rightarrow 2I_2 + 2KCl + 2H_2O$ $I_2 + 2\mathbf{Na_2S_2O_3} \rightarrow 2NaI + Na_2S_4O_6$
Sodium tosylchloramide (chloramine) exhibits a disinfecting effect due to the release of active chlorine in an acidic environment. What method should be used to quantify it? A. *iodometry B. nitritometry C. complexonometry D. permanganatometry E. iodochlorometry	
A pharmacist-analyst performs an express analysis of eye drops containing zinc sulfate. He identifies sulfates by reaction with a solution of: A. *barium chloride B. ammonium oxalate C. potassium nitrate D. sodium nitrite E. iron (III) chloride	**$ZnSO_4$** **$SO_4^{2-} + BaCl_2 \rightarrow BaSO_4\downarrow + 2Cl^-$** When **sulfate ions** interact with a **barium chloride** solution in the presence of diluted hydrochloric acid, a **white precipitate** is formed.
An analytical pharmacist conducts an express analysis of a 2% of boric acid solution. What method must be used in this case to quantify the active ingredient? A. *alkalimetry B. argentometry C. nitritometry D. complexonometry E. acidimetry	 The aasy of boric acid is carried out by the method of alkalimetry in the presence of mannitol. Boric acid belongs to very weak acids. When it is titrated with a solution of sodium hydroxide, metaboric acid (HBO_2) salts are formed, which are strongly hydrolyzed $H_3BO_3 + NaOH \leftrightarrow NaBO_2 + 2H_2O$ To increase the acidic properties of boric acid, its ability to react with polyatomic alcohols or sugars (mannitol, sorbitol, glycerin, glucose, etc.) is used. In these reactions, coordinative compounds with stronger acidic properties than boric acid are formed. These compounds can be titrated with the required accuracy with sodium hydroxide solution in the presence of phenolphthalein.

LITERATURE

Basic

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