MINISTRY OF HEALTH OF UKRAINE

ODESSA NATIONAL MEDICAL UNIVERSITY

Faculty of Pharmacy

Department of Pharmaceutical Chemistry and Drug Technology

APPROVED by

Vice-rector for scientific and pedagogical work

_____Eduard BURYACHKIVSKY

_____, 202_

METHODOLOGICAL DEVELOPMENT
TO PRACTICAL LESSONS FROM THE EDUCATIONAL DISCIPLINE

Faculty, course Pharmaceutical, III course

Educational discipline Pharmaceutical chemistry

(the name of the educational discipline)

Approved:

The meeting of the department Pharmaceutical chemistry

Odesa National Medical University

Minutes № _ dated _____

Head of Department (_____) Volodymyr GELMBOLDT
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Developers:

Senior Lecturer Nikitin O.V., as. Holubchyk K.O., as. Lytvynchuk I.V., as. Shyshkin I.O.

Practical lesson No 1

Topic: The subject and tasks of pharmaceutical chemistry. The system of evaluation of the quality of medicinal products. Stability of the composition as a necessary condition for all stages of the existence of the medicinal product.

Goal: To acquaint students with the structure of the State Pharmacopoeia of Ukraine. To analyze the general methods of drug analysis and to determine the good quality of drugs by appearance, solubility and reaction of the environment in accordance to SPhU.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ The structure and main provisions of the State Pharmacopoeia of Ukraine regarding the quality of substances and medicinal forms of industrial production;
- ✓ General methods of analysis of medicinal products and determination of the benign quality of medicinal products by appearance, solubility and reaction of the environment in accordance with the requirements of the SPhU;
- ✓ Peculiarities of identification of medicinal products according to SPhU.

The student should be able to:

- ✓ Interpret the general requirements of the SPhU regarding the identification of medicines;
- ✓ To propose and carry out a selection of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the SPhU and AND;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs by appearance, solubility and reaction of the environment in accordance to SPhU.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

- ✓ General characteristics of the State Pharmacopoeia of Ukraine.
- ✓ Organization of quality control of medicines in Ukraine.
- ✓ Sources and methods of obtaining medicines.
- ✓ World quality standards.
- ✓ Pharmaceutical analysis. Essence.
- ✓ Unification and standardization of similar tests in groups of medicinal substances.
- ✓ General provisions, general articles and monographs of the Pharmacopoeia, their relationship.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

1) Na^+ and NH_4^+ ions are present in the solution. What analytical effect will be observed when potassium hexahydroxostibate is added to this solution? Write the equations of the corresponding reactions.

2) K^+ ions are present in the solution (pH>7). What analytical effect will be observed when sodium hexanitrocobaltate is added to this solution? Write the equations of the corresponding reactions.
3) K^+ and NH_4^+ ions are present in the solution (pH=7). What analytical effect will be observed when sodium hexanitrocobaltate is added to this solution? Write the equations of the corresponding reactions.
4) The studied solution contains potassium and sodium cations. Specify the reagent that allows you to detect potassium cations in this solution: tartaric acid, zincuranyl acetate, benzoic acid, oxalic acid, salicylic acid. Write the equation of the corresponding reaction and indicate the analytical effect.
5) The studied solution contains potassium and ammonium cations. Specify the reagent that allows you to detect ammonium cations in this solution: Nessler's reagent, sodium hydrotartrate, sodium hexanitrocobaltate, lead hexanitrocuprate(II), zincuranyl acetate. Write the equation of the corresponding reaction and indicate the analytical effect.
6) The studied solution contains ammonium and sodium cations. Specify the reagent that allows you to detect sodium cations in this solution: zincuranyl acetate, Nessler's reagent, sodium hydrotartrate, sodium hexanitrocobaltate, lead hexanitrocuprate (II). Write the equation of the corresponding reaction and indicate the analytical effect.

- Recommendations (instructions) for performing tasks.

№	Main tasks	Instructions	Answers
1	2	3	4
1.	1. Qualitative analysis. Fractional and systematic analysis.	Qualitative analysis	Analytical chemistry: teaching. reference manual for students higher education closing / V. V. Bolotov, O. A. Yevtifeeva, T. V. Zhukova, L. Yu. Klymenko, O. E. Mykytenko, V. P. Moroz, I. Yu. Petukhova; in general ed.

	2. Qualitative reactions of the sodium cation (Na^+). 3. Qualitative reactions of the potassium cation (K^+). 4. Qualitative reactions of the ammonium cation (NH_4^+). 5. Systematic course of analysis of cations of analytical group I.		V. V. Bolotova. - Kh.: NFaU, 2014. - 320 p.

− Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with the structure of the State Pharmacopoeia of Ukraine. To analyze the general methods of drug analysis and determine the benign quality of drugs by appearance, solubility and reaction of the environment in accordance to SPhU.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.

5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No 2

Topic: Identification of medicinal substances of inorganic nature.

Goal: To acquaint students with the peculiarities of pharmaceutical analysis of drugs related to the intended purpose and the professional responsibility of the pharmacist. Pharmacopoeial analysis.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ general methods of analysis of medicinal products and determination of the benign quality of medicinal products by appearance, solubility and reaction of the environment in accordance to SPhU.
- ✓ peculiarities of identification of medicinal products in accordance to SPhU.

The student should be able to:

- ✓ to interpret the general requirements of the SPhU regarding the identification of medicinal substances of an inorganic nature;
- ✓ to propose and carry out a selection of physical, physico-chemical and chemical methods for determining the quality of medicinal products in accordance with the requirements of the SPhU.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. A specific impurity in iodine preparations are cyanides, which are determined by the formation reaction:
   A. Berlin blue
   B. turnbull blue
   C. Tenar's son
   D. Rinman's greens
   E. blue color of starch
2. Analysis of impurities of aluminum salts in medicinal forms is carried out with a chloroform solution:
   A. β-naphthol
   B. pyridine
   C. 8-hydroxyquinoline
   D. ethanol
   E. hydroxylamine
3. To determine the specific admixture of sulfides in the preparation Sodium thiosulfate (Natrii thiosulfas) is used
   A. $Na_2[Fe(CN)_5NO]$
   B. $K_2Cr_2O_7$
   C. $KMnO_4$

D. $K_4[Fe(CN)_6]$

E. $K_3[Fe(CN)_6]$

4. The presence of sulfate ion in medicinal products is detected by a solution of barium chloride in the presence of:

A. diluted hydrochloric acid

B. concentrated hydrochloric acid

C. concentrated nitric acid

D. dilute phosphoric acid

E. diluted nitric acid

5. An aqueous solution of which medicinal product has a slightly alkaline reaction of the environment?

A. sodium bicarbonate

B. sodium chloride

C. potassium chloride

D. sodium bromide

E. potassium bromide

6. In medicines, calcium cations can be detected using a solution:

A. ammonium oxalate

B. silver nitrate

C. potassium permanganate

D. sodium nitrite

E. sodium chloride

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

1. The main reactions of identification of cations: K^+; Na^+; NH_4^+; Pb^{2+}; Ca^{2+}; Ba^{2+}; Al^{3+}; Zn^{2+}; Fe^{2+}; Fe^{3+}; Mg^{2+}; Cu^{2+}

2. The main reactions of anion identification: SO_3^{2-}; $S_2O_3^{2-}$; CO_3^{2-}; PO_4^{3-}; $B_4O_7^{2-}$; Cl^-; I^-; NO_2^-

3. Explain the essence of the definition of impurities of chlorides, sulfates, calcium, magnesium, aluminum, potassium, ammonium salts, zinc, fluorides, iron, arsenic, phosphates, heavy metals according to SPhU.

- Recommendations (instructions) for performing tasks.

№	Main tasks	Instructions	Answers
1	2	3	4
1.	1. Qualitative reactions to cations. 2. Qualitative reactions to anions.	Write the main reactions of identification cations: ammonium, potassium, sodium, calcium, magnesium, zinc, iron (II, III), bismuth, mercury, silver, arsenic. 2. Write the main reactions for identifying anions: chlorides, bromides, iodides, sulfates, nitrates, phosphates.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences education closing / In general ed. P.O. Bezuglio – Vinnytsia, NOVA KNYGA, 2011. – 230-245 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class, the students got acquainted with the peculiarities of pharmaceutical analysis related to the intended use of drugs and the professional responsibility of the pharmacist. We got acquainted with the identification of medicinal substances of an inorganic nature.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. :

Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 3

Topic: Laboratory work: Analysis of cations and anions.

Goal: Acquaint students with the features of pharmaceutical analysis related to cationic and anionic analysis.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ elemental analysis and analysis by functional groups.
- ✓ general provisions and articles of the State Pharmacopoeia regarding quality research of organic medicinal substances.
- ✓ determination of physical constants of organic substances for identification and relative purity (establishment of the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).
- ✓ the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their mutual influence.

The student should be able to:

- ✓ to characterize physical and physico-chemical methods of analysis of organic medicinal substances
- ✓ to interpret the determination of physical constants of organic substances for identification and relative purity (establishing the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).
- ✓ explain the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their interaction). Development and improvement of chemical methods of analysis of organic medicinal substances.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Choose the name of the reagent that is used during the identification of iron(II) ions according to the requirements of the SPHU.

   A. potassium ferricyanide solution

B. ammonia solution

C. lanthanum nitrate solution

D. sodium hydroxide solution

E. silver nitrate solution

2. The presence of an iron (II) cation in the dosage form can be confirmed by the pharmacist-analyst of the pharmacy with the help of:

A. solution of ammonium sulfide

B. sodium chloride solution

C. solution of magnesium sulfate

D. potassium bromide solution

E. sodium phosphate solution

3. Choose the name of the reagent that is used during the identification of iron(III) ions according to the requirements of the SPHU.

A. potassium thiocyanate solution

B. ammonia solution

C. potassium chloride solution

D. sodium sulfate solution

E. silver nitrate solution

4. What reagent should be used by the pharmacist-analyst for the identification of iron (III) ions according to the requirements of the SPHU

A. potassium ferrocyanide solution

B. ammonia solution

C. lanthanum nitrate solution

D. sodium hydroxide solution

E. silver nitrate solution

5. A chemist of the VTK pharmaceutical company can confirm the sodium cation in the substance under study with a solution:

A. potassium pyroantimonate

B. potassium chloride

C. potassium ferrocyanide

D. potassium hydroxide

E. potassium nitrate

6. For the express determination of the iron (III) cation, a control and analytical laboratory specialist can use the reaction with:

   A. with a solution of potassium ferrocyanide Fe (II)

   B. cobalt nitrate solution

   C. sodium chloride solution

   D. calcium chloride solution

   E. zinc sulfate solution

7. A pharmacist-analyst examines a dosage form containing magnesium sulfate. With the help of which reagent can he confirm the presence of magnesium cation in the investigated dosage form?

   A. disodium hydrogen phosphate

   B. sodium sulfide

   C. potassium ferrocyanide

   D. silver nitrate

   E. sodium tetraphenylborate

8. According to SPHU, one of the reactions for identifying mercury (II) salts is the reaction with sodium hydroxide. As a result of the reaction, a precipitate is formed:

   A. yellow color

   B. red color

   C. purple color

   D. green color

   E. blue color

9. A chemist of the VTK pharmaceutical company can confirm the sodium cation in the substance under study with a solution:

   A. potassium pyroantimonate

   B. potassium chloride

   C. potassium ferrocyanide

D. potassium hydroxide

E. potassium nitrate

10. Sodium chloride is identified by the sodium ion by the reaction with:

A. potassium pyroantimonate

B. diphenylcarbazid

C. potassium thiocyanate

D. ammonium oxalate

E. barium chloride

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the weight percentage of the alcohol content (M.m. 46.07) in chloroform, if 16.18 ml of 0.1 M sodium thiosulfate solution (CF=1.0000) was spent on the titration of 1.00 ml of the drug; volume of titrant in the control experiment - 24.86 ml; the density of chloroform is 1.478.

Task 2. Calculate the weight of the chloral hydrate sample (M.m. 165.40), if 16.53 ml was spent on the titration0.1 M solution of hydrochloric acid (CF = 1.0018), and its percentage content in the substance is 99.8%; the volume of the titrant in the control experiment is 34.60 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	1. General characteristics of medicinal products of organic nature.	1. Write and explain the chemistry of reactions for the identification of an aldehyde	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences education closing / In general ed. P.O. Bezuglio –

	2. Classification of organic pharmaceutical preparations. 3. Sources of extraction of organic preparations. 4. Peculiarities of the analysis of organic drugs in contrast to inorganic ones (determination of physico-chemical constants, reactions to functional groups).	group, a primary amino group, a carboxyl group, and give equations for the corresponding reactions.	Vinnytsia, NOVA KNYGA, 2011. – 342-350 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students got acquainted with the peculiarities of pharmaceutical analysis related to the intended use of medicines and the professional responsibility of the pharmacist. We got acquainted with functional analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.

4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 4

Topic: Analysis of medicinal substances for the limit level of ion impurities.

Goal: Acquaint students with the peculiarities of pharmaceutical analysis related to the determination of impurities.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ elemental analysis and analysis by functional groups.
- ✓ general provisions and articles of the State Pharmacopoeia regarding quality research of organic medicinal substances.

- ✓ determination of physical constants of organic substances for identification and relative purity (establishment of the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).
- ✓ the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their mutual influence.

The student should be able to:

- ✓ to characterize physical and physico-chemical methods of analysis of organic medicinal substances
- ✓ to interpret the determination of physical constants of organic substances for identification and relative purity (establishing the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).
- ✓ explain the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their interaction). Development and improvement of chemical methods of analysis of organic medicinal substances.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. To determine the permissible limit of impurities in medicinal substances, the pharmacist-analyst uses:
   A. standard solutions
   B. solutions of medicines
   C. titrated solutions
   D. buffer solutions
   E. indicator solutions

2. A specialist of the laboratory for quality control of medicinal products conducts tests on the content of heavy metal impurities in the boric acid substance in accordance with the requirements of the State Pharmacopoeia of Ukraine. The starting standard substance for the preparation of the reference solution of plumbum (lead) is:
   A. lead (II) nitrate
   B. lead (II) oxide
   C. lead (II) chloride
   D. lead (IV) oxide
   E. lead (II) sulfate
3. Specify the reagent from which the chloride ion standard solution is prepared:
   A. sodium chloride
   B. calcium chloride
   C. potassium chloride
   D. iron(III) chloride
   E. hydrochloric acid
4. The pharmacist-analyst determines the benign quality of thiamine hydrobromide in accordance with the requirements of the SPHU. What auxiliary reagent does he use when determining the admixture of sulfates in this drug?
   A. acetic acid
   B. nitric acid
   C. sulfuric acid
   D. benzoic acid
   E. salicylic acid
5. The pharmacist-analyst determines impurities of ammonium salts (method A) in sodium tetraborate according to SPHU using a solution:
   A. potassium tetraiodomercurate
   B. potassium ferrocyanide
   C. sodium tetraborate

D. barium chloride

E. silver nitrate

6. A specialist of the control and analytical laboratory determines the admixture of ammonium salts in the medicinal product using a solution of alkaline potassium tetraiodomercurate. The appearance of which color indicates the presence of this impurity?

   A. Yellow

   B. Pink

   C. Brown

   D. Gray

   E. Green

7. The pharmacist-analyst determines the admixture of ammonium salts in the medicinal substance by method B. He establishes the presence of the admixture by the appearance of a gray color:

   A. silver-manganese paper

   B. turmeric paper

   C. lead acetate paper

   D. mercury bromide paper

   E. iodine-starch paper

8. To detect calcium admixture according to SPHU, the reagent is used:

   A. ammonium oxalate solution

   B. glyoxalhydroxyanil solution

   C. sulfuric acid solution

   D. potassium ferrocyanide solution

   E. solution of phosphoric acid

9. Indicate which of the following reagents is used to determine calcium admixture in medicinal products:

   A. ammonium oxalate

   B. barium chloride

   C. potassium carbonate

D. silver nitrate

E. sodium sulfate

10. The pharmacist-analyst examines the benign quality of magnesium oxide in accordance with the requirements of the Federal Drug Administration. With the help of which reagent did he determine the presence of an admixture of calcium salts in it?

A. ammonium oxalate

B. barium sulfate

C. silver nitrate

D. potassium ferrocyanide

E. sodium sulfide

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the weight percentage of the alcohol content (M.m. 46.07) in chloroform, if 16.18 ml of 0.1 M sodium thiosulfate solution (CF=1.0000) was spent on the titration of 1.00 ml of the drug; volume of titrant in the control experiment - 24.86 ml; the density of chloroform is 1.478.

Task 2. Calculate the weight of the chloral hydrate sample (M.m. 165.40), if 16.53 ml was spent on the titration0.1 Msolution of hydrochloric acid (CF = 1.0018), and its percentage content in the substance is 99.8%; the volume of the titrant in the control experiment is 34.60 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	1. General characteristics of medicinal	1. Write and explain the chemistry of reactions for	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences education

	products of organic nature. 2. Classification of organic pharmaceutical preparations. 3. Sources of extraction of organic preparations. 4. Peculiarities of the analysis of organic drugs in contrast to inorganic ones (determination of physico-chemical constants, reactions to functional groups).	the identification of an aldehyde group, a primary amino group, a carboxyl group, and give equations for the corresponding reactions.	closing / In general ed. P.O. Bezuglio – Vinnytsia, NOVA KNYGA, 2011. – 342-350 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students got acquainted with the peculiarities of pharmaceutical analysis related to the intended use of medicines and the professional responsibility of the pharmacist. We got acquainted with functional analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 5

Topic: Laboratory work: Analysis of the limit level of ion impurities.

Goal: Acquaint students with the peculiarities of pharmaceutical analysis related to the determination of impurities.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ elemental analysis and analysis by functional groups.

- ✓ general provisions and articles of the State Pharmacopoeia regarding quality research of organic medicinal substances.
- ✓ determination of physical constants of organic substances for identification and relative purity (establishment of the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).
- ✓ the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their mutual influence.

The student should be able to:

- ✓ to characterize physical and physico-chemical methods of analysis of organic medicinal substances
- ✓ to interpret the determination of physical constants of organic substances for identification and relative purity (establishing the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).
- ✓ explain the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their interaction). Development and improvement of chemical methods of analysis of organic medicinal substances.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. To determine the permissible limit of impurities in medicinal substances, the pharmacist-analyst uses:
   A. standard solutions
   B. solutions of medicines
   C. titrated solutions

D. buffer solutions

E. indicator solutions

2. A specialist of the laboratory for quality control of medicinal products conducts tests on the content of heavy metal impurities in the boric acid substance in accordance with the requirements of the State Pharmacopoeia of Ukraine. The starting standard substance for the preparation of the reference solution of plumbum (lead) is:

   A. lead (II) nitrate

   B. lead (II) oxide

   C. lead (II) chloride

   D. lead (IV) oxide

   E. lead (II) sulfate

3. Specify the reagent from which the chloride ion standard solution is prepared:

   A. sodium chloride

   B. calcium chloride

   C. potassium chloride

   D. iron(III) chloride

   E. hydrochloric acid

4. The pharmacist-analyst determines the benign quality of thiamine hydrobromide in accordance with the requirements of the SPHU. What auxiliary reagent does he use when determining the admixture of sulfates in this drug?

   A. acetic acid

   B. nitric acid

   C. sulfuric acid

   D. benzoic acid

   E. salicylic acid

5. The pharmacist-analyst determines impurities of ammonium salts (method A) in sodium tetraborate according to SPHU using a solution:

   A. potassium tetraiodomercurate

B. potassium ferrocyanide

C. sodium tetraborate

D. barium chloride

E. silver nitrate

6. A specialist of the control and analytical laboratory determines the admixture of ammonium salts in the medicinal product using a solution of alkaline potassium tetraiodomercurate. The appearance of which color indicates the presence of this impurity?

   A. Yellow

   B. Pink

   C. Brown

   D. Gray

   E. Green

7. The pharmacist-analyst determines the admixture of ammonium salts in the medicinal substance by method B. He establishes the presence of the admixture by the appearance of a gray color:

   A. silver-manganese paper

   B. turmeric paper

   C. lead acetate paper

   D. mercury bromide paper

   E. iodine-starch paper

8. To detect calcium admixture according to SPHU, the reagent is used:

   A. ammonium oxalate solution

   B. glyoxalhydroxyanil solution

   C. sulfuric acid solution

   D. potassium ferrocyanide solution

   E. solution of phosphoric acid

9. Indicate which of the following reagents is used to determine calcium admixture in medicinal products:

   A. ammonium oxalate

B. barium chloride

C. potassium carbonate

D. silver nitrate

E. sodium sulfate

10. The pharmacist-analyst examines the benign quality of magnesium oxide in accordance with the requirements of the Federal Drug Administration. With the help of which reagent did he determine the presence of an admixture of calcium salts in it?

A. ammonium oxalate

B. barium sulfate

C. silver nitrate

D. potassium ferrocyanide

E. sodium sulfide

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the weight percentage of the alcohol content (M.m. 46.07) in chloroform, if 16.18 ml of 0.1 M sodium thiosulfate solution (CF=1.0000) was spent on the titration of 1.00 ml of the drug; volume of titrant in the control experiment - 24.86 ml; the density of chloroform is 1.478.

Task 2. Calculate the weight of the chloral hydrate sample (M.m. 165.40), if 16.53 ml was spent on the titration0.1 Msolution of hydrochloric acid (CF = 1.0018), and its percentage content in the substance is 99.8%; the volume of the titrant in the control experiment is 34.60 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	1. General characteristics	1. Write and explain the	Pharmaceutical chemistry: Textbook for students. higher pharmacy

	of medicinal products of organic nature. 2. Classification of organic pharmaceutical preparations. 3. Sources of extraction of organic preparations. 4. Peculiarities of the analysis of organic drugs in contrast to inorganic ones (determination of physico-chemical constants, reactions to functional groups).	chemistry of reactions for the identification of an aldehyde group, a primary amino group, a carboxyl group, and give equations for the corresponding reactions.	education closing and pharmacy Faculty of Medical Sciences education closing / In general ed. P.O. Bezuglio – Vinnytsia, NOVA KNYGA, 2011. – 342-350 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students got acquainted with the peculiarities of pharmaceutical analysis related to the intended use of medicines and the professional responsibility of the pharmacist. We got acquainted with functional analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
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7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 6

Topic: Identification of medicinal substances of organic nature by functional groups (functional analysis).

Goal: Acquaint students with the features of pharmaceutical analysis related to functional analysis.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ elemental analysis and analysis by functional groups.
- ✓ general provisions and articles of the State Pharmacopoeia regarding quality research of organic medicinal substances.
- ✓ determination of physical constants of organic substances for identification and relative purity (establishment of the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).
- ✓ the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their mutual influence.

The student should be able to:

- ✓ to characterize physical and physico-chemical methods of analysis of organic medicinal substances
- ✓ to interpret the determination of physical constants of organic substances for identification and relative purity (establishing the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).
- ✓ explain the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their interaction). Development and improvement of chemical methods of analysis of organic medicinal substances.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. According to the requirements of SPHU, a reaction with potassium permanganate in dilute sulfuric acid is used to identify ethanol. What is the oxidation product of ethanol?

A. Acetaldehyde*

B. Acetone

C. Acetylene

D. Diethyl ether

E. Acetate-ethyl ether

2. For the purpose of identification, the pharmacist-analyst heated the ethanol substance with acetic acid diluted in the presence of concentrated sulfuric acid; a pleasant fruity smell appears. What kind of substance does this indicate?

   A. Ethyl acetate*

   B. Acetone

   C. Acetylene

   D. Ethylene

   E. Acetaldehyde

3. The presence of phenolic hydroxyl in the paracetamol molecule can be confirmed by the complexation reaction with:

   A. FeCl3

   B. HCl

   C. K2Cr2O7

   D. K[BiI4]

   E. NH2OH

4. In order to identify the phenol substance in accordance with the requirements of the SPHU, a specialist of the State Inspection for Quality Control of Medicinal Products conducts an oxidation reaction in an ammonia environment. Name the compound formed.

   A. Indophenol dye*

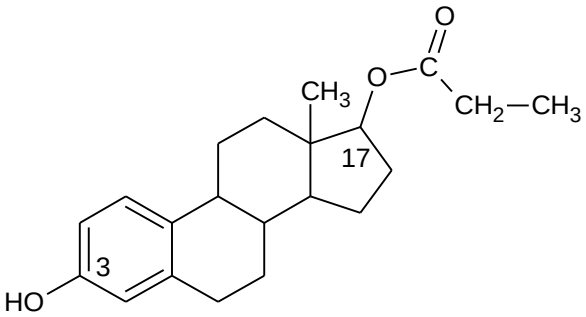
   B. Azo dye

   C. Azomethyl dye

   D. Aurine dye

   E. Complex salt

5. The drug thymol has a phenolic hydroxyl in its structure and is therefore easily oxidized. An indophenol test can be used to identify thymol. Select the reagents for this reaction.
    A. Chloramine solution and ammonia solution*
    B. Hydrochloric acid solution
    C. A solution of sulfuric acid and formaldehyde
    D. Iodine solution and sodium hydroxide solution
    E. Sulfuric acid solution and bromine solution
6. Medicinal products that have a phenolic hydroxyl in their structure undergo an electrophilic substitution reaction. Name the reaction that can be used both for the identification of resorcinol and for its quantitative determination.
    A. Bromination*
    B. Sulfation
    C. Nitration
    D. Alkylation
    E. Hydroxymethylation
7. Identification of pyridoxine hydrochloride (SPHU) is carried out by a specialist of the State Inspection for Quality Control of Medicinal Products by the method of thin-layer chromatography. To develop a chromatogram, he uses the reactions of the formation of an indophenol dye. Name the required reagent.
    A. Dichloroquinone chloramide*
    B. Potassium iodobismuthate
    C. Potassium nitrate
    D. Dinitrobenzaldehyde
    E. Sodium cobaltinitrite
8. Name the functional groups in the estradiol propionate molecule:



A. Phenolic hydroxyl, ester group*

B. Alcohol hydroxyl, keto group

C. Enol hydroxyl, carboxyl group

D. Phenolic hydroxyl, ethoxy group

E. Alcohol hydroxyl, ester group

9. The structure of the drug molecule contains an ester group. To confirm its presence in the medicinal product, the pharmacist-analyst uses:

A. Hydroxam test*

B. Le Rosen test

C. Murexide sample

D. Beilstein's test

E. Indophenol sample

10. The pharmacist-analyst conducts tests on the purity of the ether substance for anesthesia. One of the unacceptable impurities in the substance are aldehydes. In order to detect the content of aldehyde impurities in accordance with the requirements of the SPHU, he conducts a reaction with reagents:

A. Potassium tetraiodomercurate alkaline solution*

B. Ammonium oxalate, ammonium chloride

C. Hydrochloric acid, chloroform

D. Sodium hydrogen phosphate, hydrochloric acid

E. Sodium hydroxide, sodium carbonate

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the weight percentage of the alcohol content (M.m. 46.07) in chloroform, if 16.18 ml of 0.1 M sodium thiosulfate solution (CF=1.0000) was spent on the titration of 1.00 ml of the drug; volume of titrant in the control experiment - 24.86 ml; the density of chloroform is 1.478.

Task 2. Calculate the weight of the chloral hydrate sample (M.m. 165.40), if 16.53 ml was spent on the titration0.1 Msolution of hydrochloric acid (CF = 1.0018), and its percentage content in the substance is 99.8%; the volume of the titrant in the control experiment is 34.60 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	1. General characteristics of medicinal products of organic nature. 2. Classification of organic pharmaceutical preparations. 3. Sources of extraction of organic preparations. 4. Peculiarities of the analysis of organic drugs	1. Write and explain the chemistry of reactions for the identification of an aldehyde group, a primary amino group, a carboxyl group, and give equations for the corresponding reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences education closing / In general ed. P.O. Bezuglio – Vinnytsia, NOVA KNYGA, 2011. – 342-350 p.

	in contrast to inorganic ones (determination of physico-chemical constants, reactions to functional groups).		

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students got acquainted with the peculiarities of pharmaceutical analysis related to the intended use of medicines and the professional responsibility of the pharmacist. We got acquainted with functional analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 7

Topic: Laboratory work: Analysis by functional groups.

Goal: Acquaint students with the features of pharmaceutical analysis related to functional analysis.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ elemental analysis and analysis by functional groups.
- ✓ general provisions and articles of the State Pharmacopoeia regarding quality research of organic medicinal substances.
- ✓ determination of physical constants of organic substances for identification and relative purity (establishment of the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).
- ✓ the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their mutual influence.

The student should be able to:

- ✓ to characterize physical and physico-chemical methods of analysis of organic medicinal substances
- ✓ to interpret the determination of physical constants of organic substances for identification and relative purity (establishing the nature of substances, temperature limit of distillation, melting point, density, viscosity, etc.).

- ✓ explain the use of certain types of reactions for the analysis of medicinal substances depending on the chemical structure (the presence of certain functional groups and their interaction). Development and improvement of chemical methods of analysis of organic medicinal substances.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. According to the requirements of SPHU, a reaction with potassium permanganate in dilute sulfuric acid is used to identify ethanol. What is the oxidation product of ethanol?
   A. Acetaldehyde*
   B. Acetone
   C. Acetylene
   D. Diethyl ether
   E. Acetate-ethyl ether
2. For the purpose of identification, the pharmacist-analyst heated the ethanol substance with acetic acid diluted in the presence of concentrated sulfuric acid; a pleasant fruity smell appears. What kind of substance does this indicate?
   A. Ethyl acetate*
   B. Acetone
   C. Acetylene
   D. Ethylene
   E. Acetaldehyde
3. The presence of phenolic hydroxyl in the paracetamol molecule can be confirmed by the complexation reaction with:
   A. $FeCl_3$

B. HCl

C. $K_2Cr_2O_7$

D. $K[BiI_4]$

E. NH_2OH

4. In order to identify the phenol substance in accordance with the requirements of the SPhU, a specialist of the State Inspection for Quality Control of Medicinal Products conducts an oxidation reaction in an ammonia environment. Name the compound formed.

   A. Indophenol dye*

   B. Azo dye

   C. Azomethyl dye

   D. Aurine dye

   E. Complex salt

5. The drug thymol has a phenolic hydroxyl in its structure and is therefore easily oxidized. An indophenol test can be used to identify thymol. Select the reagents for this reaction.

   A. Chloramine solution and ammonia solution*

   B. Hydrochloric acid solution

   C. A solution of sulfuric acid and formaldehyde

   D. Iodine solution and sodium hydroxide solution

   E. Sulfuric acid solution and bromine solution

6. Medicinal products that have a phenolic hydroxyl in their structure undergo an electrophilic substitution reaction. Name the reaction that can be used both for the identification of resorcinol and for its quantitative determination.

   A. Bromination*

   B. Sulfation

   C. Nitration

   D. Alkylation

   E. Hydroxymethylation

7. Identification of pyridoxine hydrochloride (SPHU) is carried out by a specialist of the State Inspection for Quality Control of Medicinal Products by the method of thin-layer chromatography. To develop a chromatogram, he uses the reactions of the formation of an indophenol dye. Name the required reagent.

   A. Dichloroquinone chloramide*

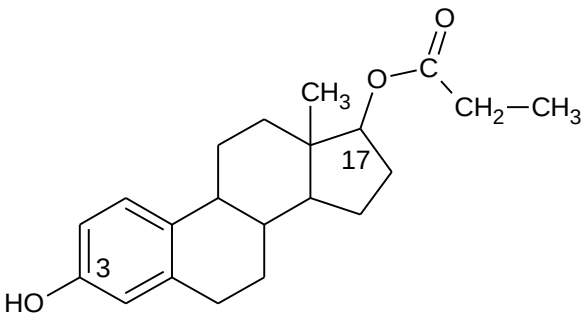
   B. Potassium iodobismuthate

   C. Potassium nitrate

   D. Dinitrobenzaldehyde

   E. Sodium cobaltinitrite

8. Name the functional groups in the estradiol propionate molecule:



   A. Phenolic hydroxyl, ester group*

   B. Alcohol hydroxyl, keto group

   C. Enol hydroxyl, carboxyl group

   D. Phenolic hydroxyl, ethoxy group

   E. Alcohol hydroxyl, ester group

9. The structure of the drug molecule contains an ester group. To confirm its presence in the medicinal product, the pharmacist-analyst uses:

   A. Hydroxam test*

   B. Le Rosen test

   C. Murexide sample

   D. Beilstein's test

   E. Indophenol sample

10. The pharmacist-analyst conducts tests on the purity of the ether substance for anesthesia. One of the unacceptable impurities in the substance are aldehydes. In order to detect the content of aldehyde impurities in accordance with the requirements of the SPhU, he conducts a reaction with reagents:

A. Potassium tetraiodomercurate alkaline solution*

B. Ammonium oxalate, ammonium chloride

C. Hydrochloric acid, chloroform

D. Sodium hydrogen phosphate, hydrochloric acid

E. Sodium hydroxide, sodium carbonate

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the weight percentage of the alcohol content (M.m. 46.07) in chloroform, if 16.18 ml of 0.1 M sodium thiosulfate solution (CF=1.0000) was spent on the titration of 1.00 ml of the drug; volume of titrant in the control experiment - 24.86 ml; the density of chloroform is 1.478.

Task 2. Calculate the weight of the chloral hydrate sample (M.m. 165.40), if 16.53 ml was spent on the titration0.1 Msolution of hydrochloric acid (CF = 1.0018), and its percentage content in the substance is 99.8%; the volume of the titrant in the control experiment is 34.60 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	1. General characteristics of medicinal products of organic nature.	1. Write and explain the chemistry of reactions for the identification of	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences education closing / In general ed. P.O. Bezuglio –

	2. Classification of organic pharmaceutical preparations. 3. Sources of extraction of organic preparations. 4. Peculiarities of the analysis of organic drugs in contrast to inorganic ones (determination of physico-chemical constants, reactions to functional groups).	an aldehyde group, a primary amino group, a carboxyl group, and give equations for the corresponding reactions.	Vinnytsia, NOVA KNYGA, 2011. – 342-350 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students got acquainted with the peculiarities of pharmaceutical analysis related to the intended use of medicines and the professional responsibility of the pharmacist. We got acquainted with functional analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.

4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 8

Topic: Thematic control work on the topic: "Analysis of medicinal substances of inorganic nature and functional analysis."

Goal: consolidation of knowledge regarding the analysis of medicinal substances of an inorganic nature and functional analysis.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ classification of methods of quantitative analysis.
- ✓ Equipment and techniques for performing basic operations
- ✓ calculations in methods of quantitative analysis.

The student should be able to:

- ✓ to interpret the general requirements of the SFU regarding the determination of the quantitative content of medicinal products.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The presence of phenolic hydroxyl in the paracetamol molecule can be confirmed by the complexation reaction with:
   A. $FeCl_3$
   B. HCl
   C. $K_2Cr_2O_7$
   D. $K[BiI_4]$
   E. NH_2OH
2. Analysis of impurities of aluminum salts in dosage forms is carried out with a chloroform solution:
   A. β-naphthol
   B. Pyridine
   C. 8-hydroxyquinoline
   D. Ethanol
   E. Hydroxylamine
3. To determine the specific admixture of sulfides in the preparation Sodium thiosulfate (Natrii thiosulfas) is used
   A. Na2[Fe(CN)5NO]
   B. K2Cr2O7
   C. KMnO4
   D. K4[Fe(CN)6]
   E. K3[Fe(CN)6]

4. The presence of sulfate ion in medicinal products is detected by barium chloride solution in the presence of:
    A. diluted hydrochloric acid
    B. concentrated hydrochloric acid
    C. concentrated nitric acid
    D. diluted phosphoric acid
    E. of dilute nitric acid
5. The aqueous solution of which drug has a slightly alkaline reaction of the medium?
    A. sodium bicarbonate
    B. sodium chloride
    C. potassium chloride
    D. sodium bromide
    E. potassium bromide
6. In medicines, calcium cations can be detected using a solution:
    A. ammonium oxalate
    B. silver nitrate
    C. potassium permanganate
    D. sodium nitrite
    E. sodium chloride
7. The pharmacist of the control and analytical laboratory examines the substance of procaine hydrochloride in accordance with the requirements of the SPHU. What method does the SPHU recommend to determine the quantitative content of this drug?
    A. Complexonometry
    B. Alkalimetry
    C. Nitritometry
    D. Bromatometry
    E. Acidimetry

8. A citric acid substance was sent to the control and analytical laboratory for analysis. In accordance with the requirements of the SPHU, the quantitative content of citric acid can be determined by the method:
    A. Bromatometry
    B. Iodometry
    C. Acidimetry
    D. Iodine chlormetry
    E. Alkalimetry
9. A pharmacy student needs to confirm the presence of a keto group in the prednisone substance. What reagent should be used?
    A. Phenylhydrazine sulfate*
    B. Argentum nitrate
    C. Sodium nitrate
    D. Barium sulfate
    E. Ammonium molybdate
10. The analyzed mineralization contains precipitates of barium sulfate and lead sulfate. You can separate these salts using:
    A. Ammonium nitrate solution
    B. Sodium acetate solution
    C. Sulfuric acid
    D. Acetic acid
    E. Ammonium acetate solution

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

1. Determination of the permissible level of impurities. Ways of their formation.
2. Give a functional analysis scheme for carboxyl, primary aromatic amino and nitro groups.
3. Give the scheme of identification of chlorides, bromides and iodides.

4. Provide a scheme for identifying sulfates and sulfites.
5. Give a scheme for the identification of nitrates and nitrites.
6. Provide a scheme for the identification of sodium, potassium, zinc and aluminum.
7. Give a diagram of the functional analysis of aldehyde and keto groups.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicines: sodium fluoride, sodium salicylate.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences education closing / In general ed. P.O. Bezuglio – Vinnytsia, NOVA KNYGA, 2011. – pp. 295-303.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students consolidated their knowledge of cationic, anionic and functional analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття.

Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 9

Topic: Methods of analysis of the quantitative content of medicinal products.

Goal: Acquaint students with the features of quantitative analysis of medicinal products.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ classification of methods of quantitative analysis.
- ✓ Equipment and techniques for performing basic operations
- ✓ calculations in methods of quantitative analysis.

The student should be able to:

- ✓ to interpret the general requirements of the SFU regarding the determination of the quantitative content of medicinal products.
- ✓ propose and carry out the selection of the method of quantitative determination of medicinal products in accordance with the requirements of the SPHU.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The gravimetric method was used to determine the mass fraction of aluminum in the medicinal product. A solution of ammonium hydroxide was used as a precipitant. The gravimetric form in this case is:
   A. Aluminum oxide;
   B. Aluminum hydroxide;
   C. Ammonium chloride;
   D. Ammonium nitrate;
   E. Aluminum carbonate.
2. Choose the indicator and the method of titrimetric analysis for the determination of hydrogen carbonate ions in the pharmaceutical preparation:
   A. Methyl orange, acidimetry;
   B. Phenolphthalein, acidimetry;
   C. Methyl orange, alkalimetry;
   D. Phenolphthalein, alkalimetry;
   E. Murexide, acidimetry.
3. Buffer solutions are widely used for the manufacture and analysis of medicinal products. Buffer solutions used for:
   A. Maintenance of a certain value of the pH value of the solution;
   B. Changes in the pH value of the solution;
   C. Changes in the ionization constant of a substance;
   D. Changes in the ionic strength of the solution;
   E. Changes in the solubility product of a substance.
4. Gravimetric determination of moisture in pharmaceutical preparations is carried out by the method:

A. Indirect distillation;
B. Allocation;
C. Sedimentation;
D. Direct distillation;
E. Isolation and indirect distillation.

5. What method of titration is used if an accurately measured excess is added to the solution of the substance under investigation auxiliary titrant:
   A. Titration by residue;
   B. Non-aqueous titration;
   C. Direct titration;
   D. Surrogate titration;
   E. Any titration.
6. The analysis of sodium sulfate crystal hydrate was carried out by the gravimetric method, precipitating sulfate ions with a barium solution chloride After ripening, the barium sulfate precipitate is washed by decantation using it as a washing liquid:
   A. Dilute solution of sulfuric acid;
   B. Distilled water;
   C. Barium chloride solution;
   D. Sodium sulfate solution;
   E. Ammonium sulfate solution.
7. In the reverse titration of an aqueous solution of acetic acid, the following is used as an indicator:
   A. phenolphthalein;
   B. diphenylamine;
   C. diphenylcarbazone;
   D. eriochrome black T;
   E. murexide.
8. When calculating the results of the analysis of compounds through the titrant of the test substance, the titrant is introduced:

A. correction factor to molar concentration;

B. conversion factor;

C. correction index;

D. ratio coefficient;

E. deviation coefficient.

9. To determine the volume of the titrant during titrimetric analysis, use:

A. Burettes;

B. Measuring flasks;

C. Measuring cups;

D. Cylinders;

E. Beakers.

10. Solutions of primary standards are prepared according to exact weighing. At the same time, the sample is dissolved in:

A. Measuring flask;

B. Burettes;

C. A measuring cup;

D. Cylinders;

E. Beakers.

3. Formation of professional skills and abilities:

− Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the percentage content of potassium chloride (M. m. 74.56) in the substance, if 13.02 ml of a 0.1 M solution of silver nitrate (CF = 1.0100) is spent on the titration of a suspension of 0.9850 g, the volume of the volumetric flask is 50 ml, the volume of the pipette is 5 ml. Give the characteristics and give examples of LZ derivatives of elements of the VII group PS D.I. Mendeleev. Describe their methods of synthesis, identification reactions, application in medicine.

Task 2. Calculate the mass of magnesium peroxide suspension (M. MgO2 56.31), if 18.08 ml of 0.1 M potassium permanganate solution (CF = 0.9960) was spent on its titration, and its content in the substance is 25.2%. Give a description

and give examples of LZ of derivative elements of group VI of PS D.I. Mendeleev. Describe their methods of synthesis, identification reactions, application in medicine.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Acidimetry in a non-aqueous medium.	State the conditions for non-aqueous titration.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences education closing / In general ed. P.O. Bezuglio – Vinnytsia, NOVA KNYGA, 2011. – 241-247 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class studentsgot acquainted with the quantitative methods of analysis of medicinal substances.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 10

Topic: Gravimetric analysis of medicines.

Goal: Acquaint students with the features of gravimetric analysis of medicinal products.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ the main regularities of gravimetric analysis.
- ✓ the technique of performing all operations of the gravimetric method;
- ✓ how to draw up research results in the form of a protocol and draw correct conclusions.

The student should be able to:

- ✓ apply gravimetry for the analysis of medicinal substances.
- ✓ determine the water of crystallization.
- ✓ determine the mass fraction of -ions by the gravimetric method
- ✓ draw conclusions from the results of the analysis and draw them up in the form of a protocol.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. What are the requirements for the precipitator?
    A. The settler must be volatile
    B. The settler must be specific
    C. The precipitator should form the least soluble precipitate
    D. All the listed requirements
    E. The precipitator should form a large crystalline precipitate.
2. How to reduce the solubility of sediment?
    A. Introduce extraneous ions into the solution
    B. Apply excess precipitant
    C. Heat the solution
    D. Dilute the solution
    E. All options are correct.
3. What conditions are necessary for the formation of amorphous sediments?
    A. Slow precipitation from concentrated hot solutions
    B. All options are correct
    C. Slow precipitation from cold concentrated solutions
    D. Rapid precipitation from hot concentrated solutions
    E. Rapid precipitation from cold concentrated solutions.
4. What co-deposition is superficial?
    A. Post-deposition
    B. Occlusion
    C. Isomorphism
    D. Adsorption
    E. Diffusion.
5. What types of occlusion do you know?
    A. The correct options are B, C, D
    B. Mechanical

C. Adsorption

D. Chemical

E. Isomorphic.

6. What type of compaction can be eliminated by washing the sediment?

A. From occlusion

B. From isomorphism

C. From all types of accommodation

D. From adsorption

E. Washing the sediment does not lead to anything.

7. What type of co-precipitation can be removed by recrystallization?

A. From adsorption

B. From occlusion and isomorphism

C. From all types of accommodation

D. From diffusion

E. Recrystallization of the precipitate does not lead to anything.

8. What is the internal ratio?

A. Adsorption and isomorphism

B. Adsorption

C. Occlusion

D. Isomorphism

E. Choices B and C are correct.

9. What is the main reason for copulation?

A. Desorption

B. Occlusion

C. Diffusion

D. Adsorption

E. Choices C and D are correct.

10. What conditions must be observed during the precipitation of barium ions with sulfuric acid?

A. The correct options are C and E

B. Slow precipitation of a cold concentrated solution

C. Slow precipitation from a concentrated hot solution

D. Slow precipitation of a hot dilute solution with rapid stirring

E. Rapid precipitation from a concentrated hot solution.

3. Formation of professional skills and abilities:

− Content of tasks (tasks, clinical situations, etc.).

Task 1. To determine the copper in the alloy, a weight of the alloy weighing 0.2152 g was taken. From it, a pure copper precipitate weighing 0.0898 g was obtained by electrolysis. Calculate the copper content in the alloy in percent.

Task 2. When determining volatile substances in hard coal, the following data were obtained: crucible weight 5.3280 g; the mass of the crucible with a weight of 6.5110 g; the mass of the crucible with a weight after removing volatile substances is 6.2745 g. Calculate the mass fraction of volatile substances in hard coal.

− Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Modern methods of gravimetric analysis. Application of organic reagents in gravimetric analysis.	Gravimetric analysis	Analytical chemistry: study guide / V.V. Bolotov, O.M. Svechnikova, S.V. Kolisnyk and others. - X.: Original, Publication of NFAU, 2004. - 479 p. (365 pages)

− Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students got acquainted with the features of gravimetric analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 11

Topic: Titrimetric methods of analysis. Classification of methods. Acid-base titration in an aqueous medium.

Goal: Acquaint students with the peculiarities of titrimetric methods of quantitative analysis of medicinal products.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic concepts and principles of titrimetric quantitative analysis.
- ✓ general classification of titrimetry methods.
- ✓ Peculiarities of methods and titrants of acidity and alkalimetry.

The student should be able to:

- ✓ identify drugs that can be quantified by the neutralization method.
- ✓ to propose an indicator for titrimetric acid-base analysis of the drug based on its properties.
- ✓ conduct an analysis and make appropriate calculations
- ✓ on the basis of calculations, give an estimate of the quantitative content of the substance in the medicinal product.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. An indicator is used for the quantitative determination of sodium carbonate in the preparation by the method of acid-base titration:
   A. methyl orange;
   B. murexide;
   C. methylene blue;
   D. Diphenylamine;
   E. ferroin.
2. For the quantitative determination of medicinal substances, the method of acidimetry is used, the titrant of which is a secondary standard solution of hydrochloric acid. The exact concentration of hydrochloric acid is set by:
   A. sodium tetraborate;
   B. oxalic acid;
   C. potassium dichromate;
   D. sodium thiosulfate;

E. magnesium sulfate.

3. In the reverse titration, an aqueous solution of acetic acid is used as an indicator:
   A. phenolphthalein;
   B. Diphenylamine;
   C. Diphenylcarbazone;
   D. eriochrome black T;
   E. murexide.
4. The sample contains sodium bicarbonate and sodium chloride. Suggest a titrimetric method for the quantitative determination of sodium bicarbonate:
   A. acidic - basic;
   B. Dichromatometry;
   C. Cerimetry;
   D. Trilonometry;
   E. Iodometry.
5. Boric acid (Kd = 5.8 • 10-10) in an aqueous solution in the presence of glycerol can be determined by the method:
   A. Alkalimetry;
   B. Acidimetry;
   C. Iodometry;
   D. Permanganatometry;
   E. Cerimetry.
6. Specify the standard substances used to standardize solutions - titrants (NaOH, KOH) of the alkalimetry method:
   A. oxalic and succinic acids;
   B. acetic and succinic acids;
   C. formic and acetic acid;
   D. sulfanilic and oxalic acids;
   E. sulfanilic and salicylic acids.

7. It is necessary to carry out a quantitative determination of sodium bicarbonate in the preparation. Which of the titrimetric methods of analysis can be used to determine it?
    A. acid-base titration;
    B. compleximetric titration;
    C. precipitation titration;
    D. non-aqueous titration;
    E. redox titration.
8. It is determined by the method of acid-base titration:
    A. acids, bases and salts that are hydrolyzed;
    B. only strong acids;
    C. only strong foundations;
    D. only strong acids and weak bases;
    E. only salts that are hydrolyzed.
9. What method of titrimetric analysis can be used to quantitatively determine sulfuric acid with a solution of potassium hydroxide?
    A. Alkalimetry;
    B. Acidimetry;
    C. oxidation-reduction;
    D. Sedimentation;
    E. Complex formation.
10. Specify the value of the Na2CO3 equivalence factor when quantified according to the reaction: Na2CO3 + HCl = NaCl + NaHCO3:
    A. f=1;
    B. f=1/2;
    C. f = 2;
    D. f=1/4;
    E. f=4.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of isoniazid (M.m. 137.14), if the excess of 0.1 M iodine solution (CF = 0.9858) after the reaction with 0.2246 g of isoniazid was titrated with 17.60 ml of 0.1 M sodium thiosulfate solution (CF = 1.1442), the volume of the iodine solution is 50.00 ml.

Task 2. Determine the weight of the benzocaine sample (M.m. 165.19), if 12.54 ml of 0.1 M sodium nitrite solution (CF = 1.0275) was spent on its titration; the mass fraction of benzocaine in the medicinal product is 99.87%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	**2**	**3**	**4**
1.	Titrimetric analysis of sodium bicarbonate, sodium carbonate, ammonium solution and others	Give reactions, indicate the indicator and conditions for quantitative determination of substances.	Analytical chemistry: study guide / V.V. Bolotov, O.M. Svechnikova, S.V. Kolisnyk and others. - X.: Original, Publication of NFAU, 2004. - 479 p. (366 pages).

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with titrimetric methods of quantitative analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
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5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
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8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
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3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 12

Topic: Acid-base titration in a non-aqueous medium.

Goal: Acquaint students with the features of acid-base titration in a non-aqueous medium.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic concepts and principles of titrimetric quantitative analysis.

- ✓ general classification of titrimetry methods.
- ✓ Peculiarities of methods and titrants of acidity and alkalimetry.

The student should be able to:

- ✓ identify drugs that can be quantified by the neutralization method.
- ✓ to propose an indicator for titrimetric acid-base analysis of the drug based on its properties.
- ✓ conduct an analysis and make appropriate calculations
- ✓ on the basis of calculations, give an estimate of the quantitative content of the substance in the medicinal product.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The pharmacist-analyst performs the quantitative determination of potassium acetate according to SPHU by the method of acidimetry in a non-aqueous environment. It is used as a titrated solution:
   A. perchloric acid
   B. sodium hydroxide
   C. potassium bromate
   D. sodium nitrite
   E. iodomonochloride
2. Quantitative determination of potassium acetate according to SPHU is carried out by the following method:
   A. acidimetry in a non-aqueous medium
   B. alkalimetry in a non-aqueous medium
   C. cerimetry
   D. argentometry
   E. complexonometry

3. The quantitative content of sodium citrate in accordance with the requirements of the SPHU is determined by the method of acid-base titration in a non-aqueous medium. The following is used as a titrated solution:
    A. perchloric acid
    B. sodium hydroxide
    C. potassium bromate
    D. sodium nitrite
    E. iodomonochloride
4. For what purpose does a chemist-analyst of the CZL add a solution of mercury (II) acetate during the quantitative determination of diphenhydramine hydrochloride (diphenhydramine) by the method of acidimetry in a non-aqueous environment:
    A. For binding chloride ions into a slightly dissociated compound
    B. To enhance the hydrolysis of diphenhydramine
    C. To change the density of the solution
    D. To create the optimal pH value of the solution
    E. To accelerate precipitation of the diphenhydramine base
5. For the quantitative determination of trimecaine (diethylamino-2,4,6-trimethylacetanilide hydrochloride), a local anesthetic, use:
    A. Acidimetry in a non-aqueous medium
    B. Cerimetry
    C. Permanganatometry
    D. Bromatometry
    E. Iodometry
6. For the quantitative determination of the medicinal product according to the SPHU, the method of acidimetry in a non-aqueous environment is used. Name this medicine.
    A. sodium benzoate
    B. sodium tetraborate
    C. sodium thiosulfate

D. sodium bicarbonate

E. sodium bromide

7. The analyst determines the quantitative content of sodium benzoate by the method of acidimetry in a non-aqueous environment in accordance with the requirements of the Federal State Administration of Ukraine. What reagent did he use as a solvent?

   A. acetic acid anhydrous

   B. pyridine

   C. concentrated sulfuric acid

   D. dimethylformamide

   E. sulfanilic acid

8. Medicinal preparations, derivatives of pyridine, are quantitatively determined by the method of acidimetry in a non-aqueous environment. The titrant is used:

   A. perchloric acid

   B. sulfuric acid

   C. nitric acid

   D. sodium hydroxide

   E. sodium thiosulfate

9. The pharmacist-analyst uses the non-aqueous titration method for quantitative determination of the fluorouracil substance according to the SPHU. What titrated solution should he use?

   A. Tetrabutylammonium hydroxide

   B. Sodium nitrite

   C. Potassium bromate

   D. Ammonium thiocyanate

   E. Sodium edetate

10. The quantitative content of medicines from the group of alkaloids is determined by the method of acid-base titration in a non-aqueous environment. A solution is used as a titrant:

A. perchloric acid

B. sodium thiosulfate

C. sulfuric acid

D. potassium bromate

E. silver nitrate

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of isoniazid (M.m. 137.14), if the excess of 0.1 M iodine solution (CF = 0.9858) after the reaction with 0.2246 g of isoniazid was titrated with 17.60 ml of 0.1 M sodium thiosulfate solution (CF = 1.1442), the volume of the iodine solution is 50.00 ml.

Task 2. Determine the weight of the benzocaine sample (M.m. 165.19), if 12.54 ml of 0.1 M sodium nitrite solution (CF = 1.0275) was spent on its titration; the mass fraction of benzocaine in the medicinal product is 99.87%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Titrimetric analysis of sodium bicarbonate, sodium carbonate, ammonium solution and others	Give reactions, indicate the indicator and conditions for quantitative determination of substances.	Analytical chemistry: study guide / V.V. Bolotov, O.M. Svechnikova, S.V. Kolisnyk and others. - X.: Original, Publication of NFAU, 2004. - 479 p. (366 pages).

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with titrimetric methods of quantitative analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. :

Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 13

Topic: Laboratory work: Quantitative determination of hydrochloric acid.

Goal: Summarize knowledge students on the analysis of hydrochloric acid.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic concepts and principles of titrimetric quantitative analysis.
- ✓ general classification of titrimetry methods.
- ✓ Peculiarities of methods and titrants of acidity and alkalimetry.

The student should be able to:

- ✓ identify drugs that can be quantified by the neutralization method.
- ✓ to propose an indicator for titrimetric acid-base analysis of the drug based on its properties.
- ✓ conduct an analysis and make appropriate calculations
- ✓ on the basis of calculations, give an estimate of the quantitative content of the substance in the medicinal product.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. In order to identify drugs that contain sulfite ions, the pharmacist-analyst adds hydrochloric acid to the solution of the medicinal compound and observes:
   A. release of gas with a sharp smell
   B. release of brown gas
   C. the appearance of a yellow color of the solution
   D. the appearance of a yellow precipitate
   E. the appearance of a white precipitate
2. Select the name of the reagent that is used during the identification of sulfite ions according to the requirements of the SPHU.
   A. diluted hydrochloric acid
   B. oxalic acid
   C. sulfuric acid
   D. dilute nitric acid
   E. acetic acid

3. Determination of the degree of coloration of liquids is carried out visually by comparison with the corresponding standards. Indicate how standard solutions are prepared.
    A. dilution of basic solutions with hydrochloric acid
    B. mixing basic solutions
    C. by mixing the initial solutions
    D. by mixing the initial and basic solutions
    E. by diluting the original solutions with water
4. To determine free chlorine in concentrated hydrochloric acid, use:
    A. A solution of potassium iodide in the presence of starch
    B. Barium chloride solution
    C. A solution of sodium nitrite and beta-naphthol
    D. Potassium permanganate solution
    E. Solution of iron (III) chloride
5. When analyzing a 10% ammonia solution, its identity is determined by the formation of white smoke in the presence of:
    A. hydrochloric acid
    B. sodium hydroxide
    C. sulfuric acid
    D. potassium permanganate
    E. sodium nitrite
6. To confirm the presence of sulfate ion in the medicinal substance "Magnesium sulfate", the pharmacist-analyst of the pharmacy uses the following reagents:
    A. barium chloride solution and hydrochloric acid
    B. solution of ammonium chloride and ammonia
    C. solution of silver nitrate and nitric acid
    D. a solution of benzenesulfonic acid
    E. diphenylamine solution
7. Quantitative determination of diphenhydramine hydrochloride (diphenhydramine) is performed by a pharmacist-analyst by titration method

in non-aqueous solvents. What is the purpose of adding a solution of mercury (II) acetate?

A. for binding hydrochloric acid
B. to increase the solubility of the substance to be determined
C. to strengthen the main properties of the drug under study
D. for the formation of a metal-indicator complex
E. to speed up the reaction

8. As a titrated solution in the acid-base titration of xycaine (by bound hydrochloric acid), the pharmacist-analyst uses the solution:

A. sodium hydroxide
B. sodium methylate
C. sodium nitrite
D. sodium edetate
E. sodium thiosulfate

9. To identify which functional group of benzocaine (anesthesia) does the pharmacist-analyst use diluted hydrochloric acid, sodium nitrite solution, and alkaline β-naphthol solution?

A. primary aromatic amino group
B. carboxyl group
C. ester group
D. aldehyde group
E. ketogroups

10. Indicate which set of reagents is used by a pharmacist-analyst to confirm the presence of a primary aromatic amino group in the structure of sodium p-aminosalicylate:

A. sodium nitrite, hydrochloric acid solution, beta-naphthol alkaline solution
B. sodium chloride, hydrochloric acid solution, beta-naphthol alkaline solution
C. copper sulfate, hydrochloric acid solution, phenol solution

D. sodium nitrite, sodium hydroxide solution, beta-naphthol alkaline solution

E. sodium thiosulfate solution, hydrochloric acid solution, resorcinol solution

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of isoniazid (M.m. 137.14), if the excess of 0.1 M iodine solution (CF = 0.9858) after the reaction with 0.2246 g of isoniazid was titrated with 17.60 ml of 0.1 M sodium thiosulfate solution (CF = 1.1442), the volume of the iodine solution is 50.00 ml.

Task 2. Determine the weight of the benzocaine sample (M.m. 165.19), if 12.54 ml of 0.1 M sodium nitrite solution (CF = 1.0275) was spent on its titration; the mass fraction of benzocaine in the medicinal product is 99.87%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Titrimetric analysis of sodium bicarbonate, sodium carbonate, ammonium solution and others	Give reactions, indicate the indicator and conditions for quantitative determination of substances.	Analytical chemistry: study guide / V.V. Bolotov, O.M. Svechnikova, S.V. Kolisnyk and others. - X.: Original, Publication of NFAU, 2004. - 479 p. (366 pages).

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4. Summary:

As a result of the lesson, students got acquainted with titrimetric methods of quantitative analysis.

5. References:

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8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.

2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 14

Topic: Titrimetric methods of analysis. Titrimetric precipitation methods. Methods of complex formation.

Goal: Acquaint students with the features of titrimetric methods of drug analysis by methods of precipitation and complexonometry.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic principles and features of various precipitation titration methods
- ✓ basic principles of the complexometric titration method
- ✓ examples of substances analyzed by methods of precipitation titration or complexonometry.

The student should be able to:

- ✓ choose among the proposed substances those that can be determined by the method of precipitation titration or complexonometry
- ✓ perform a quantitative analysis using one of these methods
- ✓ process the results (make calculations) and give an assessment of the quality of the substance that was analyzed.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The quantitative content of calcium chloride in the medicinal product is determined by the method of direct complexometric titration. Select an indicator to capture the end point of the titration:
   A. eriochrome black T;
   B. starch;
   C. Fluorescein;
   D. potassium chromate;
   E. Eosin.
2. What method of analysis can a chemist-analyst use to determine the aluminum content in the drug Alumag (maalox) by indirect titration?

A. Complexonometry;
B. Dichromatometry;
C. Argentometry;
D. Mercurometry;
E. Iodometry.

3. The quantitative content of calcium chloride is determined by the method of direct complexometric titration. Select an indicator to capture the end point of the titration:
   A. eriochrome black T;
   B. phenolphthalein;
   C. methyl red;
   D. Eosin;
   E. Starch.
4. Trilonometric titration is used to determine medicinal products containing magnesium and calcium cations. Indicate what type of chemical reaction takes place in this case?
   A. Complex formation;
   B. oxidation-reduction;
   C. electrophilic substitution;
   D. Alkylation;
   E. Sedimentation.
5. A solution containing potassium chloride and magnesium chloride was taken for research. What titrimetric method can be used to determine the amount of magnesium chloride in a mixture?
   A. by the complexonometry method;
   B. by the method of argentometry;
   C. by the method of mercurometry;
   D. by the method of permanganatometry;
   E. by the method of iodometry.

6. For the quantitative determination of medicines containing alkaline earth and heavy metals, the method is used:
    A. Complexonometry;
    B. Permanganatometry;
    C. Acidimetry;
    D. Mercurimetry;
    E. Alkalimetry.
7. What working solutions (titrants) are used in the sedimentation titration method - Folgard's method?
    A. AgNO3; NH4SCN;
    B. H2SO4; NaOH;
    C. Na2S2O3; K[I3];
    D. KMnO4; KBrO3;
    E. HClO4; KOH.
8. To determine the mass fraction of sodium chloride in the drug, the Fayans-Khodakov method is used. Titration is carried out in the presence of an indicator solution:
    A. fluorescein;
    B. methyl red;
    C. potassium chromate;
    D. ammonium iron (III) sulfate;
    E. phenolphthalein.
9. What indicator is used in the Fayansu-Khodakov method when determining sodium iodide?
    A. Eosin;
    B. Methyl orange;
    C. Diphenylcarbazone;
    D. potassium chromate;
    E. iron - ammonium alum.
10. When determining sodium chloride, the Folgard method is used:

A. reverse titration, argentometry;

B. direct titration, argentometry;

C. substitution titration;

D. reverse titration, mercurimetry;

E. direct titration, mercurimetry.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the percentage content of potassium chloride (M. m. 74.56) in the substance, if 13.02 ml of a 0.1 M solution of silver nitrate (CF = 1.0100) is spent on the titration of a sample of 0.9850 g, the volume of a volumetric flask is 50 ml, the volume of the pipette is 5 ml.

Task 2. Calculate the content of zinc oxide (g.g. 81.37), if 10.54 ml of a 0.1 M solution of sodium edetate (CF = 1.0010) was used for the titration of a sample of 0.8617 g, the volume of the volumetric flask is 100 ml, the volume of the pipette - 10 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Basic characteristics of precipitation and complexonometry methods	Lead titration reactions	Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 64 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class studentsgot acquainted with the sedimentation and complexonometric methods of quantitative analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 15

Topic: Laboratory work: Quantitative determination of the substance Sodium chloride by Mohr's method.

Goal: Acquaint students with the features of titrimetric methods of analysis of medicinal products by precipitation methods.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic principles and features of various precipitation titration methods
- ✓ basic principles of the complexometric titration method
- ✓ examples of substances analyzed by methods of precipitation titration or complexonometry.

The student should be able to:

- ✓ choose among the proposed substances those that can be determined by the method of precipitation titration or complexonometry
- ✓ perform a quantitative analysis using one of these methods
- ✓ process the results (make calculations) and give an assessment of the quality of the substance that was analyzed.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Sodium chloride tablets are manufactured at a pharmaceutical enterprise. Specify the method of quantitative determination of the active substance:
   A. argentometry
   B. iodometry
   C. nitritometry
   D. alkalimetry
   E. acidimetry
2. When carrying out the quantitative determination of potassium chloride by the argentometric method (back titration) according to the SPHU, the following is used as an indicator:
   A. iron(III) ammonium sulfate
   B. diphenylcarbazone
   C. potassium chromate

D. phenolphthalein

E. sodium eosinate

3. What method is recommended by the SPHU for the quantitative determination of the potassium chloride substance used in hypokalemia?

   A. argentometry

   B. bromatometry

   C. iodometry

   D. cerimetry

   E. polarimetry

4. The pharmacist-analyst determines the admixture of chlorides in potassium bromide according to the SPHU method:

   A. argentometry

   B. nitritometry

   C. bromatometry

   D. alkalimetry

   E. iodometry

5. The pharmacist-analyst determines the admixture of chlorides in sodium bromide according to the SPHU method:

   A. argentometry

   B. nitritometry

   C. bromatometry

   D. alkalimetry

   E. iodometry

6. The pharmacist-analyst performs internal pharmacy control of the dosage form containing diphenhydramine hydrochloride (diphenhydramine) and sugar. For the quantitative determination of diphenhydramine hydrochloride (diphenhydramine), he uses the method:

   A. argentometry

   B. complexonometry

   C. nitritometry

D. iodometry

E. permanganatometry

7. The quantitative content of xycain can be determined by argentometry (back titration). What indicator is used in this method?

   A. iron (III) ammonium sulfate

   B. sodium eosinate

   C. bromophenol blue

   D. starch

   E. potassium chromate

8. To determine the mass fraction of sodium chloride in the drug, the Fayans-Khodakov method is used. Titration is carried out in the presence of an indicator solution:

   A. fluorescein;

   B. methyl red;

   C. potassium chromate;

   D. ammonium iron (III) sulfate;

   E. phenolphthalein.

9. What indicator is used in the Fayansu-Khodakov method when determining sodium iodide?

   A. Eosin;

   B. Methyl orange;

   C. Diphenylcarbazone;

   D. potassium chromate;

   E. iron - ammonium alum.

10. When determining sodium chloride, the Folgard method is used:

   A. reverse titration, argentometry;

   B. direct titration, argentometry;

   C. substitution titration;

   D. reverse titration, mercurimetry;

   E. direct titration, mercurimetry.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the percentage content of potassium chloride (M. m. 74.56) in the substance, if 13.02 ml of a 0.1 M solution of silver nitrate (CF = 1.0100) is spent on the titration of a sample of 0.9850 g, the volume of a volumetric flask is 50 ml, the volume of the pipette is 5 ml.

Task 2. Calculate the content of zinc oxide (g.g. 81.37), if 10.54 ml of a 0.1 M solution of sodium edetate (CF = 1.0010) was used for the titration of a sample of 0.8617 g, the volume of the volumetric flask is 100 ml, the volume of the pipette - 10 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Basic characteristics of precipitation and complexonometry methods	Lead titration reactions	Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 64 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class students got acquainted with the sedimentation and complexonometric methods of quantitative analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.

4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 16

Topic: Laboratory work: Quantitative determination of magnesium sulfate by complexonometry.

Goal: Acquaint students with the peculiarities of titrimetric methods of analysis of medicinal products by the method of complex formation.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic principles and features of various precipitation titration methods
- ✓ basic principles of the complexometric titration method
- ✓ examples of substances analyzed by methods of precipitation titration or complexonometry.

The student should be able to:

- ✓ choose among the proposed substances those that can be determined by the method of precipitation titration or complexonometry
- ✓ perform a quantitative analysis using one of these methods
- ✓ process the results (make calculations) and give an assessment of the quality of the substance that was analyzed.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The quantitative content of calcium chloride in the medicinal product is determined by the method of direct complexometric titration. Select an indicator to capture the end point of the titration:
   A. eriochrome black T;
   B. starch;
   C. Fluorescein;
   D. potassium chromate;
   E. Eosin.
2. What method of analysis can a chemist-analyst use to determine the aluminum content in the drug Alumag (maalox) by indirect titration?
   A. Complexonometry;
   B. Dichromatometry;
   C. Argentometry;
   D. Mercurometry;
   E. Iodometry.
3. The quantitative content of calcium chloride is determined by the method of direct complexometric titration. Select an indicator to capture the end point of the titration:

A. eriochrome black T;
B. phenolphthalein;
C. methyl red;
D. Eosin;
E. Starch.

4. Trilonometric titration is used to determine medicinal products containing magnesium and calcium cations. Indicate what type of chemical reaction takes place in this case?
   A. Complex formation;
   B. oxidation-reduction;
   C. electrophilic substitution;
   D. Alkylation;
   E. Sedimentation.
5. A solution containing potassium chloride and magnesium chloride was taken for research. What titrimetric method can be used to determine the amount of magnesium chloride in a mixture?
   A. by the complexonometry method;
   B. by the method of argentometry;
   C. by the method of mercurometry;
   D. by the method of permanganatometry;
   E. by the method of iodometry.
6. For the quantitative determination of medicines containing alkaline earth and heavy metals, the method is used:
   A. Complexonometry;
   B. Permanganatometry;
   C. Acidimetry;
   D. Mercurimetry;
   E. Alkalimetry.
7. The quantitative determination of the medicinal product "Bismuthi subnitras" is carried out by the following method:

A. complexonometry
B. neutralization
C. bromatometry
D. iodometry
E. permanganatometry

8. Preparations of calcium chloride, magnesium sulfate, zinc sulfate, bismuth nitrate basic can be quantitatively determined:
   A. complexonometrically
   B. iodometrically
   C. nitritometrically
   D. acidimetrically
   E. alkalimetrically
9. For the quantitative determination of calcium, magnesium, and zinc salts, the following method is used:
   A. Complexonometry
   B. Alkalimetry
   C. Acidimetry
   D. Gravimetry
   E. Argentometry
10. The substance zinc sulfate heptahydrate was sent to the control and analytical laboratory for analysis. What method does the SPHU recommend for its quantification?
   A. Complexonometry
   B. Alkalimetry
   C. Acidimetry
   D. Permanganatometry
   E. Cerimetry

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the percentage content of potassium chloride (M. m. 74.56) in the substance, if 13.02 ml of a 0.1 M solution of silver nitrate (CF = 1.0100) is spent on the titration of a sample of 0.9850 g, the volume of a volumetric flask is 50 ml, the volume of the pipette is 5 ml.

Task 2. Calculate the content of zinc oxide (g.g. 81.37), if 10.54 ml of a 0.1 M solution of sodium edetate (CF = 1.0010) was used for the titration of a sample of 0.8617 g, the volume of the volumetric flask is 100 ml, the volume of the pipette - 10 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Basic characteristics of precipitation and complexonometry methods	Lead titration reactions	Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 64 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class studentsgot acquainted with the sedimentation and complexonometric methods of quantitative analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття.

Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 17

Topic: Redox titration.

Goal: Acquaint students with the features of redox methods of quantitative analysis of medicinal substances.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ classification of methods of quantitative analysis.
- ✓ Equipment and techniques for performing basic operations
- ✓ calculations in methods of quantitative analysis.

The student should be able to:

- ✓ characterize the chemical methods of analysis of potassium permanganate.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. In the methods of redoximetry, when determining oxidizing agents and reducing agents, the end point of the titration is fixed by:
    A. In all the listed ways;
    B. Indicatorless method;
    C. Using specific indicators;
    D. When using redox indicators;
    E. When using the instrument indication.
2. The quantitative content of hydrogen peroxide can be determined by the indicator-free method:
    A. Permanganatometry;
    B. Bromatometry;
    C. Iodimetry;
    D. Nitritometry;
    E. Argentometry.
3. The titrant of the nitritometry method is0.1 Msodium nitrite solution, which is prepared as a secondary standard solution. The exact concentration of sodium nitrite is set according to:
    A. sulfanilic acid;
    B. hydrochloric acid;
    C. acetic acid;
    D. oxalic acid;
    E. sulfuric acid.
4. Specify the type of reaction that takes place in the determination of ascorbic acid in the preparation by the iodometric method:
    A. oxidation - reduction;
    B. acylation;
    C. Neutralization;

D. Sedimentation;

E. Complex formation.

5. Sulfanilamide drugs have a primary aromatic amino group in their structure. Specify the method of quantitative determination of these compounds:

   A. Nitritometry;

   B. Iodometry;

   C. Dichromatometry;

   D. Permanganatometry;

   E. Cerimetry.

6. For the quantitative determination of iron (II) in a pharmaceutical preparation, an indicator-free method is used:

   A. Permanganatometry;

   B. Complexonometry;

   C. Argentometry;

   D. Iodometry;

   E. Nitritometry.

7. In which environment is the permanganatometric titration of iron (II) most often carried out?

   A. in sulfuric acid;

   B. in alcohol;

   C. in nitric acid;

   D. in alkaline;

   E. in hydrochloric acid.

8. In the bromatometric determination of streptocide (primary aromatic amine), direct titration with a standard solution of potassium bromate is used. It is used as an indicator of this titration:

   A. methyl orange;

   B. Phenolphthalein;

   C. eriochrome black T;

   D. iron (III) thiocyanate;

E. Murexid.

9. For the iodimetric determination of formaldehyde in formalin, reverse titration is used. Excess iodine is titrated with a standard solution:
   A. sodium thiosulfate;
   B. sodium nitrate;
   C. sodium sulfate;
   D. sodium carbonate;
   E. sodium phosphate.
10. KMnO4 is used as a titrant in permanganatometry. What is the equivalence factor of this compound if the titration is carried out in an acidic medium:
   A. 1/5;
   B. 1/4;
   C. 1/2;
   D. 1/3;
   E. 1.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the suspended mass of magnesium peroxide (M.m. MgO2 56.31), if 18.08 ml of 0.1 M potassium permanganate solution (CF = 0.9960) was spent on its titration, and its content in the substance is 25.2% .

Task 2. Calculate the content of formaldehyde (M.m. 30.03) in the solution, if 7.54 ml of 0.1 M sodium thiosulfate solution (CF = 0.9980) is used for the titration of 1.0216 g of the drug, the volume of 0.1 M solution iodine (CF = 1.0000) – 20 ml; the volume of the measuring flask is 100 ml, the volume of the pipette is 5 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the	Bring the reactions of	Pharmaceutical chemistry / P.O. Bezugliy, V.A. Georgiants, I.S.

	analysis of medicinal products containing elements of the VII group of the periodic table D.I. Mendeleev according to SPHU	identification of ions: sodium, potassium, chlorine, bromine, iodine.	Hrytsenko, I.V. etc.: edited by ON. Cornerless. – Vinnytsia: Nova kniga, 2017. – 121 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lessonstudents got acquainted with redox methods of quantitative analysis of medicinal substances.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 18

Topic: Laboratory work: Quantitative determination of 3% hydrogen peroxide solution by permanganatometry.

Goal: Acquaint students with the features of redox methods of quantitative analysis of medicinal substances.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ classification of methods of quantitative analysis.
- ✓ Equipment and techniques for performing basic operations
- ✓ calculations in methods of quantitative analysis.

The student should be able to:

- ✓ characterize the chemical methods of analysis of potassium permanganate.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The pharmacist-analyst of the pharmacy conducts an analysis of purified water. To do this, he brings a certain amount of the studied sample to a boil, adds a 0.02 M solution of potassium permanganate and diluted sulfuric acid.

After boiling the resulting solution for 5 minutes, the pink color should remain. What impurity did the pharmacist-analyst determine?

A. renewable substances
B. nitrates
C. carbon dioxide
D. sulfates
E. heavy metals

2. The quantitative content of hydrogen peroxide can be determined by the indicator-free method:

A. Permanganatometry;
B. Bromatometry;
C. Iodimetry;
D. Nitritometry;
E. Argentometry.

3. Quantitative determination of the drug "Magnesii peroxydum" is carried out after preliminary dissolution in sulfuric acid by the method?

A. permanganatometry
B. complexonometry
C. iodometry
D. nitritometry
E. bromatometry

4. A specialist of the control and analytical laboratory conducts a quantitative determination of the hydrogen peroxide solution by the permanganatometry method. What environment should it create in the solution before titration?

A. sour
B. phosphate buffer medium
C. neutral
D. alkaline
E. ammonia buffer medium

5. The pharmacist-analyst of the pharmacy received a hydrogen peroxide substance for analysis. Quantitative determination of this medicinal product should be carried out by the permanganatometric method. Until the appearance of which color of the solution is the titration according to AED?
    A. pink
    B. purple
    C. yellow
    D. blue
    E. colorless
6. Accordingly, the SPHU (AND) quantitative determination of hydrogen peroxide solution is carried out by the method:
    A. permanganatometry
    B. argentometry
    C. iodometry
    D. neutralization
    E. bromatometry
7. In which environment is the permanganatometric titration of iron (II) most often carried out?
    A. in sulfuric acid;
    B. in alcohol;
    C. in nitric acid;
    D. in alkaline;
    E. in hydrochloric acid.
8. In the bromatometric determination of streptocide (primary aromatic amine), direct titration with a standard solution of potassium bromate is used. It is used as an indicator of this titration:
    A. methyl orange;
    B. Phenolphthalein;
    C. eriochrome black T;
    D. iron (III) thiocyanate;

E. Murexid.

9. For the iodimetric determination of formaldehyde in formalin, reverse titration is used. Excess iodine is titrated with a standard solution:
   A. sodium thiosulfate;
   B. sodium nitrate;
   C. sodium sulfate;
   D. sodium carbonate;
   E. sodium phosphate.
10. KMnO4 is used as a titrant in permanganatometry. What is the equivalence factor of this compound if the titration is carried out in an acidic medium?
   A. 1/5;
   B. 1/4;
   C. 1/2;
   D. 1/3;
   E. 1.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the suspended mass of magnesium peroxide (M.m. MgO2 56.31), if 18.08 ml of 0.1 M potassium permanganate solution (CF = 0.9960) was spent on its titration, and its content in the substance is 25.2% .

Task 2. Calculate the content of formaldehyde (M.m. 30.03) in the solution, if 7.54 ml of 0.1 M sodium thiosulfate solution (CF = 0.9980) is used for the titration of 1.0216 g of the drug, the volume of 0.1 M solution iodine (CF = 1.0000) – 20 ml; the volume of the measuring flask is 100 ml, the volume of the pipette is 5 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the	Bring the reactions of	Pharmaceutical chemistry / P.O. Bezugliy, V.A. Georgiants, I.S.

	analysis of medicinal products containing elements of the VII group of the periodic table D.I. Mendeleev according to SPHU	identification of ions: sodium, potassium, chlorine, bromine, iodine.	Hrytsenko, I.V. etc.: edited by ON. Cornerless. – Vinnytsia: Nova kniga, 2017. – 121 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lessonstudents got acquainted with redox methods of quantitative analysis of medicinal substances.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 19

Topic: Thematic control work on the topic: "Methods of quantitative analysis of the content of medicinal products."

Goal: Summarize knowledge about quantitative methods of analysis of medicinal substances.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ classification of methods of quantitative analysis.
- ✓ Equipment and techniques for performing basic operations
- ✓ calculations in methods of quantitative analysis.

The student should be able to:

- ✓ choose among the proposed substances those that can be determined by the method of precipitation titration or complexonometry
- ✓ perform a quantitative analysis using one of these methods
- ✓ process the results (make calculations) and give an assessment of the quality of the substance that was analyzed.
- ✓ characterize the chemical methods of analysis of potassium permanganate.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. For the quantitative determination of iron (II) in a pharmaceutical preparation, an indicatorless method is used:
   A. Permanganatometry;
   B. Complexonometry;
   C. Argentometry;
   D. Iodometry;
   E. Nitritometry.
2. In which environment is the permanganatometric titration of iron (II) most often carried out?
   A. in sulfuric acid;
   B. in alcohol;
   C. in nitric acid;
   D. in alkaline;
   E. in hydrochloric acid.
3. In the bromatometric determination of streptocide (primary aromatic amine), direct titration with a standard solution of potassium bromate is used. It is used as an indicator of this titration:
   A. methyl orange;
   B. Phenolphthalein;
   C. eriochrome black T;
   D. iron (III) thiocyanate;
   E. Murexid.
4. For the iodimetric determination of formaldehyde in formalin, reverse titration is used. Excess iodine is titrated with a standard solution:
   A. sodium thiosulfate;
   B. sodium nitrate;
   C. sodium sulfate;

D. sodium carbonate;

E. sodium phosphate.

5. KMnO4 is used as a titrant in permanganatometry. What is the equivalence factor of this compound if the titration is carried out in an acidic medium?

   A. 1/5;

   B. 1/4;

   C. 1/2;

   D. 1/3;

   E. 1.

6. The quantitative content of calcium chloride is determined by the method of direct complexometric titration. Select an indicator to capture the end point of the titration:

   A. eriochrome black T;

   B. phenolphthalein;

   C. methyl red;

   D. Eosin;

   E. Starch.

7. Trilonometric titration is used to determine medicinal products containing magnesium and calcium cations. Indicate what type of chemical reaction takes place in this case?

   A. Complex formation;

   B. oxidation-reduction;

   C. electrophilic substitution;

   D. Alkylation;

   E. Sedimentation.

8. A solution containing potassium chloride and magnesium chloride was taken for research. What titrimetric method can be used to determine the amount of magnesium chloride in a mixture?

   A. by the complexonometry method;

   B. by the method of argentometry;

C. by the method of mercurometry;

D. by the method of permanganatometry;

E. by the method of iodometry.

9. For the quantitative determination of medicines containing alkaline earth and heavy metals, the method is used:

A. Complexonometry;

B. Permanganatometry;

C. Acidimetry;

D. Mercurimetry;

E. Alkalimetry.

10. What working solutions (titrants) are used in the sedimentation titration method - Folgard's method?

A. AgNO3; NH4SCN;

B. H2SO4; NaOH;

C. Na2S2O3; K[I3];

D. KMnO4; KBrO3;

E. HClO4; KOH.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the volume of 0.1 N silver nitrate solution (CF = 0.9983), which will be used for the titration of 1.9718 g of Bromocamphor (M.m. 231.14). Bromocamphor content in the substance is 95.1%. 0.1 N solution of ammonium thiocyanate (CF = 1.0000).

Task 2. Calculate the content of thymol (M.m. 150.22) in the substance, if 12.83 ml of 0.1 M potassium bromate solution (CF = 0.9997) was used for the titration of a suspension of 0.2863 g. Describe and give examples of phenol derivatives. Describe their methods of synthesis, identification reactions, application in medicine.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Basic characteristics of precipitation and complexonometry methods	Lead titration reactions	Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 64 p.

− Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class studentsgeneralize the use of titrimetric methods of quantitative analysis of medicinal substances.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.

7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 20

Topic: Spectral methods of drug analysis.

Goal: Acquaint students with the peculiarities of evaluating the quality of medicinal products based on the physical and chemical properties of medicinal substances.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ Physical indicators of medicinal substances of inorganic nature and to evaluate the quality of the investigated substances.
- ✓ Physical indicators of medicinal substances of organic nature and to evaluate the quality of the studied substances

The student should be able to:

- ✓ propose a method of quantitative analysis based on the properties or structure of a substance.
- ✓ characterize methods of chemical analysis
- ✓ to know the conditions of their implementation
- ✓ be able to give an assessment of the quality of the medicinal product based on calculations.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Quantitative determination of the substance nitrofural (furacilin) is carried out by the spectrophotometric method. A pharmacist-analyst can calculate the quantitative content after measurement:
   A. optical density
   B. index of refraction
   C. angle of rotation
   D. pH of the solution
   E. melting point
2. Quantitative determination of nitrofural in accordance with the requirements of the SPHU is carried out by the spectrophotometry method, measuring:
   A. optical density
   B. angle of rotation
   C. refractive index
   D. melting point
   E. viscosity
3. When testing for the purity of the ethylmorphine hydrochloride substance, it is necessary to determine the specific optical rotation. This research is conducted using:
   A. polarimeter
   B. spectrophotometer
   C. photoelectrocolorimeter
   D. refractometer
   E. polarograph
4. The chemical laboratory analyst received the glucose substance for analysis. To determine its benign quality, he measured the angle of rotation of its aqueous solution. He conducted these studies using
   A. polarimeter

B. refractometer

C. spectrophotometer

D. potentiometer

E. photoelectrocolorimeter

5. Quantitative determination of the substance is routinely carried out by the spectrophotometric method. A pharmacist-analyst will be able to calculate the quantitative content if he measures:

A. optical density

B. pH of the solution

C. angle of rotation

D. melting point

E. refractive index

6. Quantitative determination of the riboflavin substance according to the requirements of the SPHU is carried out by the following method:

A. Spectrophotometry

B. Refractometry

C. Thin-layer chromatography

D. Column chromatography

E. Acidimetry in an aqueous environment

7. The main method of quantitative determination of corticosteroids is:

A. Spectrophotometry

B. Potentiometry

C. Cerimetry

D. Argentometry

E. Acidimetry

8. Testosterone propionate ampoules were sent to the control and analytical laboratory for analysis. A pharmacist-analyst should perform quantitative determination according to the requirements of the ND by the following method:

A. UV-spectrophotometric

B. IR spectrophotometric

C. chromatographic

D. photocolorimetric

E. gravimetric

9. A pharmacist-analyst analyzes a 10% solution of calcium chloride. For quantitative determination, he uses one of the physicochemical methods, measuring the refractive index using:

A. refractometer

B. UV spectrophotometer

C. gas chromatograph

D. potentiometer

E. polarimeter

10. The pharmacist-analyst needs to determine the refractive index of methyl salicylate. What device should he use for this?

A. refractometer

B. polarimeter

C. potentiometer

D. polarograph

E. spectrophotometer

3. Formation of professional skills and abilities:

− Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the volume of 0.1 M sodium nitrite solution (CF = 1.0000), which will be spent on the titration of 0.2525 g of paracetamol (M. 151.17), if its content in the substance is 98.6%.

Task 2. Calculate the percentage content of potassium chloride (M. m. 74.56) in the substance, if 13.02 ml of a 0.1 M solution of silver nitrate (CF = 1.0100) is spent on the titration of a suspension of 0.9850 g, the volume of the volumetric flask is 50 ml, the volume of the pipette is 5 ml.

− Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Modern methods of gravimetric analysis. Application of organic reagents in gravimetric analysis.	Gravimetric analysis	Analytical chemistry: study guide / V.V. Bolotov, O.M. Svechnikova, S.V. Kolisnyk and others. - X.: Original, Publication of NFAU, 2004. - 479 p. (365 pages)

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class students got acquainted with features of the evaluation of the quality of medicinal products based on the physical and chemical properties of medicinal substances.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 21

Topic: Chromatographic methods of drug analysis.

Goal: Acquaint students with the peculiarities of using chromatographic methods of analysis.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment:visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic concepts and laws underlying various instrumental methods of analysis;
- ✓ basic principles and possibilities of practical application of common instrumental methods of chemical analysis;
- ✓ methods, techniques and methods of physical and chemical analysis to establish qualitative composition and quantitative determinations;
- ✓ methods of separation of substances (chemical, chromatographic, extraction);
- ✓ the basics of mathematical statistics regarding the assessment of correctness and reproducibility of analysis results;
- ✓ safety rules when working in a chemical laboratory;
- ✓ the role and significance of instrumental methods in pharmacy, in the practical activity of a pharmacist;
- ✓ main literary sources, reference literature.

The student should be able to:

- ✓ work with the main types of devices used in the analysis;
- ✓ to choose the optimal instrumental method of qualitative and quantitative analysis of substances when analyzing real objects;

- ✓ separate cations and anions by chromatographic methods.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. By what method, according to the SPHU, is the admixture of methyl alcohol in ethyl alcohol discovered:
   A. By the method of gas chromatography
   B. Redox method
   C. By the method of neutralization
   D. By the deposition method
   E. Complexonometry
2. In the control and analytical laboratory, the quantitative content of sodium citrate is determined by the method of ion exchange chromatography using a cationite. What titrated solution should be used for the subsequent titration of citric acid that is formed?
   A. Sodium hydroxide
   B. Iodine
   C. Potassium iodate
   D. Hydrochloric acids
   E. Trylon B
3. The pharmacist-analyst identifies glutamic acid by thin-layer chromatography. To detect spots on the chromatogram, he must treat it with a solution of the substance:
   A. ninhydrin
   B. benzaldehyde
   C. diphenylamine
   D. pyridine

E. aniline

4. The control and analytical laboratory received the drug substance. Its identification, according to the requirements of the SPHU, involves the determination of substances that are detected by ninhydrin and carried out by the method of thin-layer chromatography. Name this medicine.
   A. glutamic acid
   B. benzoic acid
   C. acetylsalicylic acid
   D. ascorbic acid
   E. hydrochloric acid
5. The amino acid valine is identified by TLC according to the requirements of the SPHU. To develop a chromatogram, a solution of the following reagent is used:
   A. ninhydrin
   B. cyanide bromide
   C. 2,4-dinitrochlorobenzene
   D. 2,4-dinitrophenylhydrazine
   E. concentrated ammonia
6. The control and analytical laboratory received glutamic acid. Identification in accordance with the Federal Federal Tax Service is carried out by the following method:
   A. thin layer chromatography
   B. gas chromatography
   C. liquid chromatography
   D. paper chromatography
   E. ion exchange chromatography
7. A physicochemical method is used for the quantitative determination of the folic acid substance according to the SPHU. Name this method.
   A. liquid chromatography
   B. ion exchange chromatography

C. ultraviolet spectrophotometry

D. refractometry

E. polarimetry

8. According to SPHU, the quantitative determination of benzylpenicillin sodium salt is carried out by the method:

A. liquid chromatography

B. gravimetry

C. iodometry

D. alkalimetry

E. argentometry

9. The method of gas-liquid chromatography is used to identify substances. Identification of substances in the gas-liquid chromatography method is carried out according to:

A. retention parameters

B. peak width at half its height

C. peak area

D. character of the zero line

E. peak height

10. Chromatographic analysis is widely used in the Department of Agriculture of Ukraine for the identification of plant raw materials and phytopreparations. To identify individual substances in chromatographic analysis, the following value is determined:

A. value of Rf

B. melting point

C. boiling point

D. angle of refraction

E. angle of rotation

3. Formation of professional skills and abilities:

− Content of tasks (tasks, clinical situations, etc.).

Task 1. After dissolution, a weight of 1.5432 g of the sample was placed in a volumetric flask with a capacity of 200.0 ml, the necessary reagents to obtain a colored solution were added, and the volume was brought up to the mark with distilled water. Then an aliquot of 5.0 ml was taken and titrated with a 0.05 N EDTA solution at a certain wavelength.

Task 2. A weight of the analyzed sample with a weight of 1.020 g was dissolved and, after appropriate treatment, Fe2+ ions were titrated with KMnO4 titrant T=0.00319 photometrically. Construct a titration curve and calculate the mass fraction (%) of X in the sample based on the following measurement results.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Spectrophotometric titration Molecular spectral analysis Analytical chemistry. Textbook for higher educational institutions / A.S. Alemasova, V.M. Zaitsev, L.Ya. Yenalieva, N.D. Shchepina, S.M. Hozhdzinsky / Ed. V.M. Zaitseva - Donetsk: DonNU, 2009. - 415 p.	Spectrophotometric titration Molecular spectral analysis Analytical chemistry. Textbook for higher educational institutions / A.S. Alemasova, V.M. Zaitsev, L.Ya. Yenalieva, N.D. Shchepina, S.M. Hozhdzinsky / Ed. V.M. Zaitseva - Donetsk: DonNU, 2009. - 415 p.	Spectrophotometric titration Molecular spectral analysis Analytical chemistry. Textbook for higher educational institutions / A.S. Alemasova, V.M. Zaitsev, L.Ya. Yenalieva, N.D. Shchepina, S.M. Hozhdzinsky / Ed. V.M. Zaitseva - Donetsk: DonNU, 2009. - 415 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class studentsgot acquainted withfeatures of using spectroscopic and chromatographic methods of analysis.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. :

Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 22

Topic: Optical methods of drug analysis.

Goal: Acquaint students with the basic principles and laws underlying optical methods of analysis and the classification of spectroscopic analysis methods.

Basic concepts: instrumental analysis, optical methods, photocolorimetry, spectrophotometry, UV-spectrometry, IR-spectrometry.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic concepts and laws underlying various instrumental methods of analysis;
- ✓ basic principles and possibilities of practical application of common instrumental methods of chemical analysis;
- ✓ methods, techniques and methods of physical and chemical analysis to establish qualitative composition and quantitative determinations;
- ✓ methods of separation of substances (chemical, chromatographic, extraction);
- ✓ the basics of mathematical statistics regarding the assessment of correctness and reproducibility of analysis results;
- ✓ safety rules when working in a chemical laboratory;
- ✓ the role and significance of instrumental methods in pharmacy, in the practical activity of a pharmacist;
- ✓ main literary sources, reference literature.

The student should be able to:

- ✓ work with the main types of devices used in the analysis;
- ✓ to choose the optimal instrumental method of qualitative and quantitative analysis of substances when analyzing real objects;
- ✓ separate cations and anions by chromatographic methods.
- ✓ conduct laboratory experiments, explain the essence of specific reactions and their analytical effects, draw up report documentation based on experimental data;
- ✓ perform initial calculations, final calculations using statistical processing of quantitative analysis results;
- ✓ work independently with educational and reference literature.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Instrumental (physical and physico-chemical) methods of analysis include:
   A. Spectroscopic;
   B. Electrochemical;
   C. Gravimetric;
   D. Correct options A and B;
   E. None.
2. Groups causing the appearance of absorption bands in molecular spectra are called:
   A. Auxochromes;
   B. Chromophores;
   C. Functional;
   D. Coordinated;
   E. Pharmacophores.
3. The methods of calculating the concentration of a substance include:
   A. Method of one standard;
   B. Method of two standards;
   C. Method of three standards;
   D. Correct options A and B;
   E. None.
4. The absorption spectrum of a substance is a graphical dependence:
   A. The radiation intensity of the solution from the wavelength of the emitted light;
   B. The optical density of the solution from the wavelength of the incident light;
   C. Permeation of the solution depends on the concentration of the substance in the solution;
   D. Optical density from the concentration of the substance in the solution;
   E. Optical density from solvent dilution.

5. Electromagnetic radiation with a wavelength of 450 nm corresponds to the area:
    A. UV radiation;
    B. IR radiation;
    C. Visible radiation;
    D. γ-radiation;
    E. None.
6. The non-monochromaticity of the radiation source leads to the following deviations from the basic law of light absorption:
    A. Positive;
    B. True;
    C. Negative;
    D. Chemical;
    E. Static.
7. To eliminate spectral interference in spectroscopic methods of analysis, the following techniques are used:
    A. Chemical;
    B. Instrumental;
    C. Mathematical;
    D. All options are correct;
    E. None.
8. Atomic absorption spectra are:
    A. Broadband;
    B. Linear;
    C. Weakly structured;
    D. There is no correct Answers option;
    E. The correct options are A and C.
9. The sources of primary radiation in an atomic absorption spectrometer are:
    A. Deuterium lamp;
    B. Incandescent lamp;
    C. A lamp with an empty cathode;

D. All options are correct;

E. There are no correct answers.

10. The working temperature range in the atomizer of the atomic absorption spectrometer is:

A. 800-3000°C;

B. 3000-7000 °C;

C. 6000-10000 °C;

D. There are no correct answers;

E. 1500-2500°C.

3. Formation of professional skills and abilities:

− Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of isoniazid (M.m. 137.14), if the excess of 0.1 M iodine solution (CF = 0.9858) after the reaction with 0.2246 g of isoniazid was titrated with 17.60 ml of 0.1 M sodium thiosulfate solution (CF = 1.1442), the volume of the iodine solution is 50.00 ml.

Task 2. Determine the volume of 0.1 M sodium nitrite solution (CF=0.9684), which will be spent on the titration of 0.2916 g of dicaine (M.m. 300.83), if its mass fraction in the medicinal product is 99.80 %.

− Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Optical analysis	Methods of atomic spectral analysis	Analytical chemistry. Textbook for higher educational institutions / A.S. Alemasova, V.M. Zaitsev, L.Ya. Yenalieva, N.D. Shchepina, S.M. Hozhdzinsky / Ed. V.M. Zaitseva - Donetsk: DonNU, 2009. - 415 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lessonstudents familiarized themselves with the basiCfrinciples and laws underlying optical methods of analysis and classification of spectroscopic analysis methods.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.

2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 23

Topic: Laboratory work: Quantitative determination of Glucose solution d/in. 40% 20 ml by the method of polarimetry.

Goal: Summarize knowledge students on the pharmaceutical analysis of glucose solution using the polarimetric method of analysis.

Basic concepts: instrumental analysis, optical methods, angle of rotation, asymmetric atom, polarimetry.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

– Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic concepts and laws underlying various instrumental methods of analysis;
- ✓ basic principles and possibilities of practical application of common instrumental methods of chemical analysis;
- ✓ methods, techniques and methods of physical and chemical analysis to establish qualitative composition and quantitative determinations;
- ✓ methods of separation of substances (chemical, chromatographic, extraction);
- ✓ the basics of mathematical statistics regarding the assessment of correctness and reproducibility of analysis results;
- ✓ safety rules when working in a chemical laboratory;
- ✓ the role and significance of instrumental methods in pharmacy, in the practical activity of a pharmacist;
- ✓ main literary sources, reference literature.

The student should be able to:

- ✓ work with the main types of devices used in the analysis;
- ✓ to choose the optimal instrumental method of qualitative and quantitative analysis of substances when analyzing real objects;
- ✓ separate cations and anions by chromatographic methods.
- ✓ conduct laboratory experiments, explain the essence of specific reactions and their analytical effects, draw up report documentation based on experimental data;
- ✓ perform initial calculations, final calculations using statistical processing of quantitative analysis results;
- ✓ work independently with educational and reference literature.

List of didactic units:

- ✓ textbook text;

✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Choose a drug that gives a positive reaction with the copper-tartrate reagent:
   A. glucose
   B. heparin
   C. polyglukin
   D. strophanthin
   E. erysymine
2. The pharmacist-analyst of the laboratory of the State Inspection for Quality Control of Medicinal Products carries out the identification of the medicinal substance "Anhydrous Glucose" with a copper-tartrate solution. What color precipitate is formed?
   A. red
   B. blue
   C. black
   D. blue-violet
   E. white
3. Glucose substance was submitted for analysis. When it is heated with a copper-tartrate reagent (Fehling's reagent), a red precipitate is formed, which indicates the presence in its structure:
   A. aldehyde group
   B. phenolic hydroxyl
   C. amide group
   D. ester group
   E. alcohol hydroxyl
4. A pharmacist-analyst can identify glucose by the value of the specific optical rotation after determining:
   A. angle of rotation

B. index of refraction
C. optical density
D. melting point
E. viscosity

5. The chemical laboratory analyst received the glucose substance for analysis. To determine its benign quality, he measured the angle of rotation of its aqueous solution. He conducted these studies using:
   A. polarimeter
   B. refractometer
   C. spectrophotometer
   D. potentiometer
   E. photoelectrocolorimeter
6. The chemical laboratory analyst received the glucose substance for analysis. He used a polarimeter to determine its benignity. At the same time, he measured:
   A. angle of rotation
   B. refractive index
   C. optical density
   D. melting point
   E. specific gravity
7. The specific optical rotation of 10% glucose solution according to SPHU should be from + 52.5° to 53.3°. To calculate this value, the pharmacist-analyst must measure:
   A. angle of rotation
   B. refractive index
   C. density
   D. melting point
   E. viscosity
8. A pharmacist-analyst analyzes a 10% glucose solution. For quantitative determination, he uses one of the physico-chemical methods, measuring the angle of rotation of the solution, using:

A. polarimeter

B. potentiometer

C. gas chromatograph

D. refractometer

E. UV spectrophotometer

9. The specific impurity of the drug Glucose [Glucosum] is:

A. dextrin

B. ammonium salts

C. formaldehyde [paraform]

D. pantoyllactone

E. seneciphylline

10. The pharmacist-analyst conducts tests on the purity of the medicinal product glucose anhydrous according to the SPHU. He determines the unacceptable impurity of barium with the help of:

A. sulfuric acid

B. hydrochloric acid

C. acetic acid

D. nitric acid

E. perchloric acid

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of isoniazid (M.m. 137.14), if the excess of 0.1 M iodine solution (CF = 0.9858) after the reaction with 0.2246 g of isoniazid was titrated with 17.60 ml of 0.1 M sodium thiosulfate solution (CF = 1.1442), the volume of the iodine solution is 50.00 ml.

Task 2. Determine the volume of 0.1 M sodium nitrite solution (CF=0.9684), which will be spent on the titration of 0.2916 g of dicaine (M.m. 300.83), if its mass fraction in the medicinal product is 99.80 %.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Optical analysis	Methods of atomic spectral analysis	Analytical chemistry. Textbook for higher educational institutions / A.S. Alemasova, V.M. Zaitsev, L.Ya. Yenalieva, N.D. Shchepina, S.M. Hozhdzinsky / Ed. V.M. Zaitseva - Donetsk: DonNU, 2009. - 415 p.

− Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson students familiarized themselves with the basic principles and laws underlying optical methods of analysis and classification of spectroscopic analysis methods.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 24

Topic: Express analysis of single-component and complex medicines.

Goal: Acquaint students with express methods of analysis of medicinal substances.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic concepts and laws underlying various instrumental methods of analysis;
- ✓ basic principles and possibilities of practical application of common instrumental methods of chemical analysis;
- ✓ methods, techniques and methods of physical and chemical analysis to establish qualitative composition and quantitative determinations;
- ✓ methods of separation of substances (chemical, chromatographic, extraction);
- ✓ the basics of mathematical statistics regarding the assessment of correctness and reproducibility of analysis results;
- ✓ safety rules when working in a chemical laboratory;
- ✓ the role and significance of instrumental methods in pharmacy, in the practical activity of a pharmacist;
- ✓ main literary sources, reference literature.

The student should be able to:

- ✓ work with the main types of devices used in the analysis;
- ✓ to choose the optimal instrumental method of qualitative and quantitative analysis of substances when analyzing real objects;

- ✓ separate cations and anions by chromatographic methods.
- ✓ conduct laboratory experiments, explain the essence of specific reactions and their analytical effects, draw up report documentation based on experimental data;
- ✓ perform initial calculations, final calculations using statistical processing of quantitative analysis results;
- ✓ work independently with educational and reference literature.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Levothyroxine sodium is a drug used for hypofunction of the thyroid gland. To detect chloride admixture when testing this agent, you must use a solution:
   A. Silver nitrate;
   B. Barium chloride;
   C. Magnesium sulfate;
   D. Copper (II) sulfate;
   E. Iron (III) chloride.
2. Furosemide is a drug from the group of loop diuretics. When testing this tool, a reaction was carried out with silver nitrate in the medium of dilute nitric acid. The appearance of white opalescence indicates the presence of an impurity:
   A. Chlorides;
   B. Calcium;
   C. Magnesium;
   D. Heavy metals;
   E. Ammonia salts.

3. A pharmacist-analyst conducts research on the substance of anhydrous glucose. To determine the calcium admixture, he conducts a reaction with the solution:
    A. Ammonium oxalate;
    B. Potassium pyroantimonate;
    C. Barium chloride;
    D. Sodium hydroxide;
    E. Sodium nitrite.
4. When testing the analgesic agent "Metamisole sodium monohydrate", a reaction was carried out with a solution of barium chloride in the medium of diluted acetic acid. The appearance of white opalescence indicates the presence of an impurity:
    A. Sulfates;
    B. Chlorides;
    C. Calcium;
    D. Heavy metals;
    E. Ammonia salts.
5. Testing the calcium lactate substance involves a reaction with a solution of thioglycolic acid in the presence of citric acid and an ammonia solution. This reaction is used to determine the following impurity:
    A. Iron;
    B. Potassium;
    C. Chlorides;
    D. Sulfates;
    E. Ammonia salts.
6. The substance of diltiazem hydrochloride has arrived at the laboratory of the pharmaceutical enterprise. When testing it for the presence of heavy metal impurities, the following reagent must be used:
    A. Thioacetamide;
    B. Copper-tartrate;

C. Molybdenum-vanadium;

D. Sulfomolybdenum;

E. Cyan bromide.

7. A pharmacist-analyst analyzes the substance sodium benzoate. The presence of which impurity in the substance is indicated by the formation of white opalescence after the addition of dilute acetic acid and barium chloride solution?

   A. Sulfates;

   B. Zinc;

   C. Phosphates;

   D. Ammonia;

   E. Magnesium

8. The pharmacist-analyst of the laboratory of the State Inspection for Quality Control of Medicinal Products conducts tests on the purity of the substance "Procaine hydrochloride" with the thioacetamide reagent. Does the formation of a brown color indicate the presence of an impurity?

   A. INheavy metals;

   B. Potassium;

   C. Aluminum;

   D. Magnesium;

   E. Calcium.

9. A sample of purified water from a pharmacy was sent for analysis. Which reagent can be used to detect the presence of heavy metals in it?

   A. Thiocetamide;

   B. Thiosemicarbazide;

   C. Sodium nitroprusside;

   D. 2,6-dichlorophenylinphenol;

   E. Ninhydrin.

10. As the main reagent when testing for the limit content of aluminum impurities, the chemical analyst uses the solution:

A. Hydroxyquinoline;

B. Benzaldehyde;

C. Pyridine;

D. Resorcinol;

E. Formaldehyde.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of chloramphenicol (M.m. 323.13) in the medicinal product, if 16.40 ml of 0.1 M sodium nitrite solution (CF = 0.9928) was spent on the titration of 0.5234 g of chloramphenicol.

Task 2. Determine the volume of 0.1 M perchloric acid solution (CF = 1.0125), which will be spent on the titration of 0.1506 g of ftivazide (M.m. anhydrous 271.28), if the percent content of ftivazide in the medicinal product is - 98, 80%

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Qualitative analysis of fluoroanions.	Write qualitative reactions for the determination of fluoride ions.	Pharmaceutical analysis: Study. manual for students higher pharmacy education closing III-IV levels of accreditation / P.O. Bezugliy, V.O. Grudko, S.G. Leonova and others; Under the editorship ON. Cornerless. – X.: Issued by NFAU; Golden pages, 2001- 240 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class studentsgot acquainted withexpress methods of analysis of medicinal substances.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.

5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.

7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.

8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.

2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 25

Topic: Thematic control work on the topic: "Physico-chemical methods of analysis."

Goal: Generalize students' knowledge of physico-chemical and express analysis of medicinal substances.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ basic concepts and laws underlying various instrumental methods of analysis;
- ✓ basic principles and possibilities of practical application of common instrumental methods of chemical analysis;
- ✓ methods, techniques and methods of physical and chemical analysis to establish qualitative composition and quantitative determinations;
- ✓ methods of separation of substances (chemical, chromatographic, extraction);
- ✓ the basics of mathematical statistics regarding the assessment of correctness and reproducibility of analysis results;
- ✓ safety rules when working in a chemical laboratory;
- ✓ the role and significance of instrumental methods in pharmacy, in the practical activity of a pharmacist;
- ✓ main literary sources, reference literature.

The student should be able to:

- ✓ work with the main types of devices used in the analysis;
- ✓ to choose the optimal instrumental method of qualitative and quantitative analysis of substances when analyzing real objects;
- ✓ separate cations and anions by chromatographic methods.
- ✓ conduct laboratory experiments, explain the essence of specific reactions and their analytical effects, draw up report documentation based on experimental data;
- ✓ perform initial calculations, final calculations using statistical processing of quantitative analysis results;
- ✓ work independently with educational and reference literature.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. A pharmacist-analyst conducts research on the substance of anhydrous glucose. To determine the calcium admixture, he conducts a reaction with the solution:
    A. Ammonium oxalate;
    B. Potassium pyroantimonate;
    C. Barium chloride;
    D. Sodium hydroxide;
    E. Sodium nitrite.
2. When testing the analgesic agent "Metamisole sodium monohydrate", a reaction was carried out with a solution of barium chloride in the medium of diluted acetic acid. The appearance of white opalescence indicates the presence of an impurity:
    A. Sulfates;
    B. Chlorides;
    C. Calcium;
    D. Heavy metals;
    E. Ammonia salts.
3. Testing the calcium lactate substance involves a reaction with a solution of thioglycolic acid in the presence of citric acid and an ammonia solution. This reaction is used to determine the following impurity:
    A. Iron;
    B. Potassium;
    C. Chlorides;
    D. Sulfates;
    E. Ammonia salts.
4. To eliminate spectral interference in spectroscopic methods of analysis, the following techniques are used:
    A. Chemical;
    B. Instrumental;
    C. Mathematical;

D. All options are correct;

E. None.

5. Atomic absorption spectra are:

   A. Broadband;

   B. Linear;

   C. Weakly structured;

   D. There is no correct Answers option;

   E. The correct options are A and C.

6. The sources of primary radiation in an atomic absorption spectrometer are:

   A. Deuterium lamp;

   B. Incandescent lamp;

   C. A lamp with an empty cathode;

   D. All options are correct;

   E. There are no correct answers.

7. The working temperature range in the atomizer of the atomic absorption spectrometer is:

   A. 800-3000°C;

   B. 3000-7000 °C;

   C. 6000-10000 °C;

   D. There are no correct answers;

   E. 1500-2500°C.?

8. The method of chromatographic detection, which is carried out by increasing the detector signal when passing through the zone detector, is determined by the substance, which is called:

   A. Direct;

   B. Indirect;

   C. Collateral;

   D. With a post-column reaction;

   E. Reverse.

9. The distance between the starting line and the front of the solvent on the chromatogram was 10.0 cm, the starting line and the center of the spot of the substance was 4.0 cm. The Rf value of the substance is:

   A. 0.40;

   B. 4.0;

   C. 0.60;

   D. 1.0;

   E. 5.0.

10. The speed of movement of the separated substance along the thin layer of the sorbent is estimated as:

   A. Rf;

   B. D;

   C. N;

   D. H;

   E. O.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the volume of 0.1 M perchloric acid solution (CF=1.0023), which will be spent on the titration of 0.1487 g of ftivazid (M.m. 271.28), if the mass fraction of ftivazid in the medicinal product is 99.15%

Task 2. Determine the mass fraction (%) of potassium chloride (M.m. 74.56) in the medicinal product, if 13.02 ml of a 0.1 M solution of argentum(I) nitrate was spent on the titration of a 0.9850 g sample (CF=1.0100); the volume of the measuring flask is 50.00 ml, the volume of the pipette is 5 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4

1.	Optical analysis	X-ray structural analysis method.	Analytical chemistry. Textbook for higher educational institutions / A.S. Alemasova, V.M. Zaitsev, L.Ya. Yenalieva, N.D. Shchepina, S.M. Hozhdzinsky / Ed. V.M. Zaitseva - Donetsk: DonNU, 2009. - 498 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students summarized the methods of physico-chemical and express analysis of medicinal substances.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.

5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.

7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.

8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 26

Topic: Principles of classification of medicinal products, their nomenclature. Structure-activity relationship in the creation and analysis of medicinal products. The main ways of drug metabolism. Factors affecting metabolic processes. Prodrugs

Goal: Acquaint acquaint students with the features of drug classification and the influence of structural fragments on the physicochemical and pharmacological properties of medicinal substances.

Basic concepts: State Pharmacopoeia of Ukraine, QSAR; PASS screening; biological activity, express analysis.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ pharmacophore groups;
- ✓ general classifications of drugs by pharmacological activity.

The student should be able to:

- ✓ use computer programs.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The introduction of phenolic hydroxyl into the structure gives the following bioactivity:
   A. Antiseptic;
   B. Sleepy;
   C. Tranquilizing;
   D. Anti-inflammatory;
   E. Anthelmintic.

2. The introduction of a carboxamide group into the structure gives the following bioactivity:
    A. Sleepy;
    B. Antiseptic;
    C. Tranquilizing;
    D. Anti-inflammatory;
    E. Anthelmintic;
3. The introduction of a diaryl (aminoalkyl)methane group into the structure gives the following bioactivity:
    A. Antihistamine;
    B. Sleepy;
    C. Tranquilizing;
    D. Anti-inflammatory;
    E. Antiseptic.
4. Branched alkyl substituents in the presence of halogen atoms provide:
    A. Difficulty in metabolism;
    B. Acceleration of metabolism;
    C. Do not affect metabolism;
    D. Acceleration of hydrolysis;
    E. Acceleration of oxidation.
5. The presence of n-alkyl chains provides:
    A. Increase in lipophilicity;
    B. Decrease in lipophilicity;
    C. Acceleration of metabolism;
    D. Difficulty in metabolism;
    E. Antiseptic effect.
6. Cycloalkyl groups improve binding to the bioreceptor due to:
    A. van der Waals forces;
    B. Electrostatics;
    C. Dragon`s topological index;

D. Lipophilicity;

E. Donor/acceptor of H-bonds.

7. Ethers and esters change the polarity of molecules and affect bioavailability by:

A. Slowing down of biodecarboxylation;

B. Slowing down biooxidation;

C. Acceleration of biodecarboxylation;

D. Acceleration of biooxidation;

E. Slowing down hydrolysis.

8. Flat organic rings have:

A. The same pharmacological effect;

B. Heterocyclic rings have a more pronounced pharmacological effect;

C. Heterocyclic rings have a more pronounced pharmacological effect;

D. Carbocyclic rings have a more pronounced pharmacological effect;

E. Carbocyclic rings have a more pronounced pharmacological effect.

9. The introduction of a bromine atom into the structure gives the following bioactivity:

A. Sedative;

B. Tranquilizing;

C. Accelerate metabolism;

D. Sleeping pills;

E. Anti-inflammatory.

10. The introduction of an isopropion group into the structure gives the following bioactivity:

A. Anti-inflammatory;

B. Analgesic;

C. Sleeping pills;

D. Antiseptic;

E. Antianginal.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Find the most pronounced biological activities in the structure of p-chlorobenzamide.

Task 2. Based on the structural formula, formulate pharmacological effects in the structure of p-bromophenol.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Pharmacophore.	List the pharmacophore groups.	May V.F. Organic chemistry: a textbook for universities: V 2 vol. / V.F. May. - M.: IKC "Academic Book", 2004. - 727 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class studentsgot acquainted withfeatures of the classification of medicinal products and the influence of structural fragments on the physicochemical and pharmacological properties of medicinal substances.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 27

Topic: Nonsteroidal anti-inflammatory drugs (NSAIDs). Sodium salicylate, acetylsalicylic acid, metamizole sodium salt, butadione, paracetamol, sodium diclofenac.

Goal: Acquaint acquaint students with the peculiarities of pharmaceutical analysis of non-steroidal anti-inflammatory drugs.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmacophore, express analysis, anti-inflammatory activity.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.

- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Paracetamol is a drug that has an analgesic, antipyretic and anti-inflammatory effect. When quantifying the active substance by the cerimetric method, the following is used as an indicator:
   A. Feroin;
   B. Sodium eosinate;
   C. Phenolphthalein;
   D. Starch;
   E. Potassium chromate.
2. Paracetamol is a drug that has an analgesic, antipyretic and anti-inflammatory effect. The identification reaction with a solution of iron (III) chloride is due to the presence in its structure:
   A. Phenolic hydroxyl;
   B. Aromatic nitro group;
   C. Ester group;
   D. Aldehyde group;
   E. Carboxylic group.
3. 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 a solution:
   A. Iron (III) chloride;
   B. Potassium iodide;
   C. Sodium nitrite;
   D. Ammonium chloride;

E. Aluminum sulfate.

4. Acetylsalicylic acid (aspirin) belongs to the group of nonsteroidal anti-inflammatory drugs. Its quantitative determination by the method of direct alkalimetry is recommended to be carried out at a temperature not higher than 20 °C in order to prevent:
   A. Hydrolysis of the ester group;
   B. Recovery of medicinal substance;
   C. Oxidation of medicinal substance;
   D. Decarboxylation of medicinal substance;
   E. Precipitation of the resulting salt.
5. Specify the reaction product of paracetamol with hydrochloric acid and the following addition of potassium dichromate:
   A. Indophenol dye;
   B. Aurine dye;
   C. Triphenylmethane dye;
   D. Azo dye;
   E. Schiff base.
6. Phenylsalicylate (Phenyliisalicilas) can be identified by the smell of phenol, which will be released when added to the drug:
   A. H2SO4;
   B. NaCl;
   C. CuSO4;
   D. AgNO3;
   E. CoC12.
7. A pharmacist-analyst performs an analysis of diclofenac sodium. Indicate the method of its quantitative determination in accordance with the requirements of the State Federal Office of Ukraine:
   A. Acidimetry in an anhydrous environment;
   B. Alkalimetry in an alcohol-chloroform mixture;
   C. Alkalimetry in the water environment;

D. Alkalimetry in an anhydrous environment;

E. Acidimetry in an aqueous medium.

8. An acidic environment is optimal for the absorption of the main metabolite of acetylsalicylic acid. Name this metabolite:

   A. Salicylic acid;

   B. Barbituric acid;

   C. Phenylacetic acid;

   D. Uric acid;

   E. Valproic acid.

9. One of the directions of biotransformation of paracetamol in the liver is oxidation by microsomal enzymes. As a result, a toxic metabolite is formed:

   A. Quinonimine;

   B. Phenol;

   C. *o*-xylene;

   D. Phthalic anhydride;

   E. *m*-dioxybenzene.

10. The analyst of the control and analytical laboratory performs an express analysis of sodium paraaminosalicylate. The presence of phenolic hydroxyl is confirmed by reaction with the solution:

   A. FeCl3;

   B. NH3;

   C. AgNO3;

   D. K3[Fe(CN)6];

   E. Concentrated HNO3.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of sodium salicylate (M.m. 160.11) in the medicinal product, if 17.38 ml of 0.5 N hydrochloric acid solution (CF = 1.1218) was spent on the titration of a weight of 1.5668 g of sodium salicylate.

Task 2. To determine the mass of the weight of metamizole sodium salt (M.m. = 333.36), if 11.95 ml of 0.1 M iodine solution (CF = 0.9956) will be spent on its titration, the percentage content of metamizole sodium salt in the medicinal product is 99.00%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of diclofenac sodium.	Calculate the equivalence factor in quantification reactions.	Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class students got acquainted with features of pharmaceutical analysis of non-steroidal anti-inflammatory drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.

5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 28

Topic: Laboratory work: Analysis of Analgin tab. 500 mg.

Goal: Generalize practical skills in identification and quantification of non-steroidal anti-inflammatory drugs.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmacophore, express analysis, anti-inflammatory activity.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;

✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. As a result of the reaction of the analgesic "Metamisole sodium monohydrate" with a solution of potassium pyroantimonate, a white precipitate was formed. This confirms the presence of a medicinal substance in the structure:
   A. Sodium ions;
   B. Covalently bonded sulfur;
   C. Methyl groups;
   D. Phenyl radical;
   E. Keto groups.
2. The pharmacist-analyst conducts 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.
3. Diclofenac sodium belongs to non-steroidal anti-inflammatory drugs. What method is used for its quantitative determination?
   A. Acidimetry in a non-aqueous environment;
   B. Reverse bromatometry;
   C. Alkalimetry by substitute;
   D. Reverse argentometry;
   E. Direct iodometry.
4. Paracetamol belongs to non-steroidal anti-inflammatory drugs and is biotransformed in the body by deacetylation. What metabolite is formed?
   A. *n*-aminophenol;
   B. Aminobenzene;

C. *o*-xylene;

D. Nitrobenzene;

E. *m*-dioxybenzene.

5. An analytical chemist identifies the reaction of paracetamol with phenolic hydroxyl, as a result of which a blue-violet color is formed. What reagent did he use?

   A. Iron (III) chloride;

   B. Sodium chloride;

   C. Potassium pyroantimonate;

   D. Barium chloride;

   E. Silver nitrate.

6. Phenylsalicylate is a classic representative of prodrugs. It is hydrolyzed in the intestines and forms the following compounds:

   A. Salicylic acid and phenol;

   B. Aminobenzoic acid and ethanol;

   C. Benzoic acid and methanol;

   D. Isovaleric acid and menthol;

   E. Nicotinic acid and diethylamine.

7. The principle of salol was formed by Nentsky and is widely used in the development of medicines that form two active ingredients in the process of biotransformation. As a result of metabolism, salol forms phenol and salicylic acid. Its international name is:

   A. Phenyl salicylate;

   B. Acetaminophen;

   C. Chloramphenicol;

   D. Diphenhydramine;

   E. Phthalylsulfathiazole.

8. One of the directions of biotransformation of paracetamol in the liver is oxidation by microsomal enzymes. As a result, a toxic metabolite is formed:

   A. Quinonimine;

B. Phenol;

C. *o*-xylene;

D. Phthalic anhydride;

E. *m*-dioxybenzene.

9. Quantitative determination of which medicinal product by the nitritometry method requires preliminary hydrolysis?

A. Paracetamol;

B. Anesthesin;

C. Procaine hydrochloride;

D. Sodium paraaminosalicylate;

E. Dikain.

10. When identifying the substance of acetylsalicylic acid (aspirin), its hydrolysis is carried out. What reagent is used to detect one of the hydrolysis products?

A. Iron (III) chloride;

B. Sodium hydrotartrate;

C. Magnesium sulfate;

D. Ammonium oxalate;

E. Sodium bicarbonate.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of salicylic acid (M.m. 138.12) in the medicinal product, if 19.59 ml of 0.1 N sodium hydroxide solution (CF = 0.9876) was spent on the titration of a weight of 0.2675 g.

Task 2. Determine the volume of 0.1 N sodium hydroxide solution (CF=0.9894), which will be spent on the titration of 0.6220 g of acetylsalicylic acid (M.m. 180.16), if its percentage content in the medicinal product is 99, 88%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4

1.	Quantitative determination of Acetylsalicylic acid.	Calculate the equivalence factor in quantification reactions.	Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.

− Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students generalized practical skills in identification and quantification of non-steroidal anti-inflammatory drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.

5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.

7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.

8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 29

Topic: Narcotic analgesics and their analogues. Morphine hydrochloride, codeine, codeine phosphate, fentanyl, promedol.

Goal: Acquaint students with the peculiarities of pharmaceutical analysis of narcotic analgesics and their analogues.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmacophore, express analysis, analgesic activity.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

– Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

– Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Morphine belongs to the group of narcotic analgesics. According to its chemical structure, it is a derivative:
   A. Phenantrenisoquinoline;
   B. Tropan;

C. Benzdiazepine;

D. Piperidine;

E. Furan.

2. Codeine is used as an antitussive. The starting material for its synthesis is:

   A. Morphine;

   B. Paracetamol;

   C. Pyrocatechin;

   D. Nitrofural;

   E. Caffeine.

3. Metabolism of morphine is carried out mainly in the liver. The main way of its metabolism is:

   A. Glucuronidation;

   B. Hydrolysis;

   C. Restoration;

   D. Halogenation;

   E. Decarboxylation.

4. Due to the presence of a tertiary nitrogen atom, morphine forms sparingly soluble products when interacting with general alkaloid precipitation reagents. With which solution will it form a precipitate:

   A. Potassium tetraiodbismuthate;

   B. Ammonium oxalate;

   C. Calcium chloride;

   D. Formaldehyde;

   E. Potassium pyroantimonate.

5. A pharmacist-analyst performs the identification of morphine hydrochloride. Due to the presence of phenolic hydroxyl, morphine forms a colored product with a solution:

   A. Iron (III) chloride;

   B. Hydrochloric acid;

   C. Picric acid;

D. Formaldehyde;

E. Potassium pyroantimonate.

6. Morphine is an optically active substance. With which device does the pharmacist-analyst measure the angle of rotation of the morphine hydrochloride solution?

   A. Polarimeter;

   B. Refractometer;

   C. Potentiometer;

   D. Areometer;

   E. Spectrophotometer.

7. In medical practice, morphine is used in the form of hydrochloride. What solution is used to identify chlorides:

   A. Silver nitrate;

   B. Potassium iodide;

   C. Sodium chloride;

   D. Calcium phosphate;

   E. Magnesium hydroxide.

8. Morphine undergoes an azo coupling reaction with the formation of an azo dye. What functional group ensures the course of this reaction?

   A. Phenolic hydroxyl;

   B. Aldehyde group;

   C. Alcoholic hydroxyl;

   D. Carboxylic group;

   E. Ester group.

9. Quantitative determination of morphine hydrochloride is carried out by the method of acidimetry in a non-aqueous medium in the presence of mercury (II) acetate. How is the solution used as a titrant?

   A. Chloric acid;

   B. Sodium hydroxide;

   C. Potassium permanganate;

D. Sodium nitrite;

E. Silver nitrate.

10. Codeine for medical purposes can be obtained semisynthetically from a plant alkaloid. Choose this alkaloid:

A. Morphine;

B. Papaverine;

C. berberine;

D. Protopin;

E. Helidonin.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the weight of the codeine sample (M.m. 299.39), if 10.02 ml of hydrochloric acid solution (CF = 0.9678) will be spent on its titration. The percentage content of codeine in the medicinal product is 99.40%.

Task 2. Determine the mass fraction of codeine phosphate (M.m. 397.36) in the medicinal product, if 6.19 ml of 0.1 M perchloric acid solution (CF = 0.9916) was spent on the titration of a weight of 0.2517 g.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of Codeine phosphate	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 263 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with the peculiarities of pharmaceutical analysis of narcotic analgesics and their analogues.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.

2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 30

Topic: Sleep aids. Derivatives of barbituric acid, chloral hydrate, bromisoval.

Goal: Acquaint acquaint students with the peculiarities of pharmaceutical analysis of hypnotic drugs.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

– Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

– Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Quantitative determination of the substance "Phenobarbital" is carried out by the method of alkalimetry in a non-aqueous environment. What reagent is used as a solvent?
   A. Dimethylformamide;
   B. Glacial acetic acid;
   C. Acetic anhydride;
   D. Formic acid;
   E. Ethanol.

2. The drug "Phenobarbital" belongs to acid forms of barbiturates. This allows the pharmacist-analyst to carry out its quantitative determination by the method:
    A. Alkalimetry in a non-aqueous environment;
    B. Acidimetry in a non-aqueous environment;
    C. Reverse iodometry;
    D. Reverse cerimetry;
    E. Direct bromatometry.
3. At a chemical and pharmaceutical enterprise, a drug that depresses the central nervous system is synthesized by condensation of phenylethylmalonic ether with urea. Name this medicine:
    A. Phenobarbital;
    B. Triazolam;
    C. Barbital;
    D. Nicotinic acid;
    E. Ascorbic acid.
4. A general pharmacopoeial reaction is used to identify hypnotics derived from barbituric acid. For the formation of colored complex compounds, a solution is used:
    A. Cobalt nitrate;
    B. Sodium nitrite;
    C. Potassium iodide;
    D. Sodium bromide;
    E. Ammonium chloride.
5. The quantitative content of phenobarbital is determined by a chemist-analyst by the method of alkalimetry. What titrated solution does he use?
    A. sodium hydroxide;
    B. potassium bromate;
    C. silver nitrate;
    D. sodium edetate;

E. cerium sulfate.

6. A positive "silver mirror" reaction indicates the presence of chloral hydrate in the structure:
   A. Aldehyde group;
   B. Complex ester group;
   C. Amide group;
   D. Carboxylic group;
   E. Nitro groups.
7. What compound is synthesized by the reaction between malonic acid diethyl ether and urea?
   A. Barbituric acid;
   B. Benzoic acid;
   C. Uric acid;
   D. Nicotinic acid;
   E. Ascorbic acid.
8. Which medicinal substance from the group of barbiturates corresponds to the chemical name 1-benzoyl-5-ethyl-5-phenylbarbituric acid?
   A. Benzonal;
   B. Barbital;
   C. Phenobarbital;
   D. Hexanal;
   E. Benzobamil.
9. In which of the barbiturates can the residue of benzoic acid be identified by the hydroxam test?
   A. Benzonal;
   B. Barbital;
   C. Phenobarbital;
   D. Hexanal;
   E. Sodium barbital.

10. The drug phenobarbital has a sedative, hypnotic and antiepileptic effect. Name its international non-proprietary name:

A. Luminal;

B. Nitrofural;

C. Chloramphenicol;

D. Diazepam;

E. Salol.

3. Formation of professional skills and abilities:

− Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the content of barbital (M. m. 184.20), if 8.0 ml of 0.1 N sodium hydroxide solution (CF = 1.0022) was used for the titration of an exact weight of 0.1516 g.

Task 2. Calculate the content of free alkali (m.m. NaOH 40.00) in sodium barbital, if 0.6 ml of a 0.05 N hydrochloric acid solution was used for its determination (CF = 0.9986).

− Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of Phenobarbital	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 291 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class students got acquainted with features of pharmaceutical analysis of hypnotic drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне

підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.

4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.

5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 31

Topic: Means for anesthesia. Medical ether, flurothane, nitrous oxide, sodium thiopental, hexenal.

Goal: Acquaint acquaint students with the peculiarities of pharmaceutical analysis of anesthetic agents.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Barbituric acid is a stronger acid than acetic acid. This is due to:
   A. Keto-enol tautomerism;
   B. Lactam-lactim tautomerism;
   C. Prototropic tautomerism;
   D. Its cyclical structure;
   E. The presence of two nitrogen atoms in the molecule.
2. The pharmacist-analyst performs the reaction of identification of barbiturates according to the SPHU by the formation of a blue-violet color with the solution:
   A. Cobalt nitrate;
   B. Copper sulfate;

C. Iron (III) chloride;

D. Lead nitrate;

E. Nickel nitrate.

3. When identifying the medicinal substance by reaction with copper (II) sulfate in the presence of potassium hydrogen carbonate and potassium carbonate, a blue color and a red-lilac precipitate were formed. Name this medicinal substance:

   A. Barbital;

   B. Antipyrine;

   C. Ethacridine lactate;

   D. Benzocaine;

   E. Dibazol.

4. When barbital is fused with crystalline sodium hydroxide, the following is formed:

   A. Sodium 2-ethylbutanoate;

   B. Sodium 2-methylbutanoate;

   C. Sodium butanoate;

   D. Sodium ethanoate;

   E. Sodium propanoate.

5. The chemist of VTK of the pharmaceutical enterprise conducts the alloying of the medicinal substance with sodium hydroxide. Further acidification of the reaction product leads to the release of gas (carbon dioxide) and the appearance of the characteristic smell of phenylethylacetic acid. Name this medicinal substance:

   A. Phenobarbital;

   B. Resorcinol;

   C. Codeine;

   D. Streptocide;

   E. Phenoxymethylpenicillin.

6. Which of the barbiturates decolorizes bromine water?

A. Hexanal;
B. Barbital;
C. Phenobarbital;
D. Benzonal;
E. Sodium barbital.

7. Hexanal in its structure contains a double bond, which can be determined by the reaction with:
   A. Bromine water;
   B. Potassium iodide solution;
   C. Barite water;
   D. Calcium hydroxide solution;
   E. A solution of ammonium thiocinate.
8. Which of the following compounds is a specific impurity in the substance sodium ethaminal?
   A. Free meadow;
   B. Phenylbarbituric acid;
   C. Ethylbarbituric acid;
   D. Semicarbazide;
   E. Vanillin.
9. Indicate which of the following medicinal products corresponds to the chemical name: 5,5-diethylbarbituric acid?
   A. Barbital;
   B. Phenobarbital;
   C. Hexanal;
   D. Benzonal;
   E. Methyluracil.
10. A student of the Faculty of Pharmacy performs the identification of a medicinal product by the reaction of potassium permanganate discoloration. Name the medicine:
   A. Hexanal;

B. Nicotinamide;

C. Phenobarbital;

D. Cordiamine;

E. Nicotinic acid.

3. Formation of professional skills and abilities:

− Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the content of free alkali (m.m. NaOH 40.00) in sodium ethaminal, if 0.7 ml of 0.05 N hydrochloric acid solution (CF = 1.0000) was used when determining its content.

Task 2. Calculate the percentage content of ethaminal-sodium (M, m. 248.26), if 18.4 ml of 0.1 M hydrochloric acid (CF = 1.0012) was used for the titration of an exact measurement of 0.4786 g. The content of free alkali is 0.28%, the loss in mass during drying is 2.3%.

− Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of Ethaminal sodium	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 291 p.

− Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with the peculiarities of pharmaceutical analysis of anesthetic agents.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 32

Topic: Thematic control work on the topic: "Non-steroidal anti-inflammatory drugs. Narcotic analgesics. Sleep aids. Means for anesthesia".

Goal: Generalize practical skills for identification and quantification of narcotic analgesics, hypnotics and anesthetics.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Which of the barbiturates decolorizes bromine water?
   A. Hexanal;
   B. Barbital;
   C. Phenobarbital;
   D. Benzonal;
   E. Sodium barbital.
2. Hexanal in its structure contains a double bond, which can be determined by the reaction with:
   A. Bromine water;
   B. Potassium iodide solution;
   C. Barite water;
   D. Calcium hydroxide solution;

E. A solution of ammonium thiocinate.

3. Which of the following compounds is a specific impurity in the substance sodium ethaminal?
   A. Free meadow;
   B. Phenylbarbituric acid;
   C. Ethylbarbituric acid;
   D. Semicarbazide;
   E. Vanillin.
4. Indicate which of the following medicinal products corresponds to the chemical name: 5,5-diethylbarbituric acid?
   A. Barbital;
   B. Phenobarbital;
   C. Hexanal;
   D. Benzonal;
   E. Methyluracil.
5. A student of the Faculty of Pharmacy performs the identification of a medicinal product by the reaction of potassium permanganate discoloration. Name the medicine:
   A. Hexanal;
   B. Nicotinamide;
   C. Phenobarbital;
   D. Cordiamine;
   E. Nicotinic acid.:
6. What compound is synthesized by the reaction between malonic acid diethyl ether and urea?
   A. Barbituric acid;
   B. Benzoic acid;
   C. Uric acid;
   D. Nicotinic acid;
   E. Ascorbic acid.

7. Which medicinal substance from the group of barbiturates corresponds to the chemical name 1-benzoyl-5-ethyl-5-phenylbarbituric acid?
    A. Benzonal;
    B. Barbital;
    C. Phenobarbital;
    D. Hexanal;
    E. Benzobamil.
8. In which of the barbiturates can the residue of benzoic acid be identified by the hydroxam test?
    A. Benzonal;
    B. Barbital;
    C. Phenobarbital;
    D. Hexanal;
    E. Sodium barbital.
9. In medical practice, morphine is used in the form of hydrochloride. What solution is used to identify chlorides:
    A. Silver nitrate;
    B. Potassium iodide;
    C. Sodium chloride;
    D. Calcium phosphate;
    E. Magnesium hydroxide.
10. Morphine undergoes an azo coupling reaction with the formation of an azo dye. What functional group ensures the course of this reaction?
    A. Phenolic hydroxyl;
    B. Aldehyde group;
    C. Alcoholic hydroxyl;
    D. Carboxylic group;
    E. Ester group.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the weight of the codeine sample (M.m. 299.39), if 10.02 ml of hydrochloric acid solution (CF = 0.9678) will be spent on its titration. The percentage content of codeine in the medicinal product is 99.40%.

Task 2. Determine the mass fraction of codeine phosphate (M.m. 397.36) in the medicinal product, if 6.19 ml of 0.1 M perchloric acid solution (CF=0.9916) was spent on the titration of a weight of 0.2517 g.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantification of Hexanal.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 291 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class, students generalized practical skills in identification and quantification of narcotic analgesics, hypnotics, and anesthetics.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття.

Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 33

Topic: Psychotropic drugs. Part 1. Neuroleptics: phenothiazine derivatives, chlorprothixene, haloperidol. Antidepressants: imizin, amitriptyline, nialamide, transamine.

Goal: Acquaint acquaint students with the peculiarities of pharmaceutical analysis of psychotropic drugs derived from phenothiazine. Chlorprothixene. Haloperidol. Imizil Amitriptyline. Nialamide. Transamine.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Biologically active substances are obtained by chemical synthesis. The reaction of 1-chloro-3-(2-chloro-10H-phenothiazin-10-yl)-propane with dimethylamine gives:
   A. chlorpromazine;
   B. Diphenhydramine;
   C. Aceclidine;
   D. Phenobarbital;
   E. Caffeine.
2. Phenothiazine derivatives can be oxidized with the formation of colored products. What reagent is used for this reaction?
   A. bromine water;
   B. ammonium chloride;
   C. magnesium sulfate;
   D. sodium hydroxide;
   E. acetic acid.
3. Promethazine hydrochloride belongs to the antihistamines of the first generation. What condensed heterocycle is the basis of the chemical structure of this medicinal substance?
   A. Phenothiazine;

B. Purine;

C. Indole;

D. Quinoline;

E. Acridine.

4. A medicinal product, the active ingredient of which has the chemical name 2-chloro-10-(3'-dimethylaminopropyl)-phenothiazine hydrochloride, was sent to a private pharmacy for sale. Specify this medicine:

   A. Chlorpromazine hydrochloride;

   B. Promethazine hydrochloride;

   C. Trifluoroperazine hydrochloride;

   D. Clonidine hydrochloride;

   E. Diphenhydramine hydrochloride.

5. Which of the following compounds is the starting material for the synthesis of chlorpromazine. hydrochloride?

   A. 2-chlorophenothiazine;

   B. 4-chlorophenothiazine;

   C. 3-chlorophenothiazine;

   D. 5-chlorophenothiazine;

   E. 6-chlorophenothiazine.

6. The substance chlorpromazine hydrochloride was obtained for analysis. What condensed heterocycle is the basis of the chemical structure of this medicinal substance?

   A. Phenothiazine;

   B. Purine;

   C. Acridine;

   D. Indole;

   E. Benzothiazine.

7. Due to the presence of a Sulfur atom, phenothiazine derivatives are easily oxidized. What reagent does the SPHU recommend for the identification of the promethazine hydrochloride substance for its oxidation??

A. Concentrated nitric acid;
B. Hydrogen peroxide;
C. Sodium nitrite;
D. Iron (III) chloride;
E. Potassium permanganate.

8. The method of thin-layer chromatography is used to detect aminazine. What reagents do not show aminazine on a chromatogram:
   A. A solution of diphenylcarbazide in chloroform;
   B. Ferrum (III) chloride solution;
   C. Dragendorf's reagent;
   D. Mark's reagent;
   E. Iodine vapors.
9. The studied extract from biological material contains a substance of a basic nature. For which substance is the Vitaly-Moren reaction not characteristic?
   A. Aminazine;
   B. Diprazine;
   C. Dikain;
   D. Strychnine;
   E. Atropine.
10. The liver of a corpse with suspicion of aminazine poisoning was submitted for examination. In order to exclude phenothiazine derivatives in terms of forensic toxicological analysis, it is necessary to conduct a preliminary test that would be positive with:
   A. FNN reagent;
   B. Bromine water;
   C. Nitric acid;
   D. 5% KMnO4 solution;
   E. Bouchard's reagent.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the volume of 0.1 N perchloric acid solution (CF = 1.0125), which will be spent on the titration of 0.1506 g of aminazine, if the percentage content of aminazine in the medicinal product is 98.80%.

Task 2. Determine the volume of 0.5 N of sodium hydroxide solution (CF = 1.0364), which will be spent on titration of a weight of 1.4955 g of promethazine hydrochloride, if its percentage content in the medicinal product is 99.30%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of Etaperazine.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 381 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students got acquainted with the peculiarities of pharmaceutical analysis of psychotropic drugs derived from phenothiazine. Chlorprothixene. Haloperidol. Imizil Amitriptyline. Nialamide. Transamine.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.

5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 34

Topic: Psychotropic drugs. Part 2. Tranquilizers: benzodiazepine derivatives, meprotan, amisil.

Goal: Acquaint acquaint students with the peculiarities of pharmaceutical analysis of psychotropic drugs derived from benzodiazepines. Meprotan. Amizil

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. To identify drugs that are benzodiazepine derivatives according to the SPHU, the formation reaction is used (after preliminary acid hydrolysis):
   A. azo dye;
   B. auric dye;
   C. indophenol dye;
   D. azomethine dye;
   E. polymethine dye.
2. The drug sibazon has a tranquilizing (calming) effect. Name its international name:
   A. diazepam;
   B. nitrazepam;
   C. oxazepam;
   D. nosepam;
   E. phenazepam
3. To identify diazepam in accordance with the requirements of the SPHU, the pharmacist-analyst uses the following reaction: 80 mg of the substance is placed in a porcelain crucible, 0.3 g of anhydrous sodium carbonate P is added and heated over an open flame for 10 minutes. After cooling, the obtained

residue is dissolved in 5 ml of dilute nitric acid P and filtered. 1 ml of water P is added to 1 ml of filtrate, the solution gives a reaction to:

A. chlorides;
B. sulfates;
C. carbonates;
D. bromides;
E. nitrates

4. Nitrazepam belongs to benzodiazepine derivatives. Identification of nitrazepam is carried out by spectrophotometry. At the same time, measure:
   A. optical density;
   B. rotation angle;
   C. refractive index;
   D. melting point;
   E. dynamic viscosity.
5. Diazepam belongs to benzodiazepine derivatives with a tranquilizing effect. As a result of its biotransformation at the stage of functionalization, an active metabolite is formed:
   A. Oxazepam;
   B. Phenobarbital;
   C. Chlorpromazine;
   D. Paracetamol;
   E. Diphenhydramine.
6. In the CZL laboratory, when certifying diazepam, the quantitative content is determined by the method of acidimetry in a non-aqueous environment. Titration is carried out with a solution:
   A. perchloric acid;
   B. potassium bromate;
   C. silver nitrate;
   D. sodium edetate;
   E. cerium sulfate.

7. The analytical chemist determines the aromatic nitro group in the studied sample of nitrazepam after preliminary reduction to the amino group. The final product of this reaction is:
    A. Azo dye;
    B. Murexid;
    C. Taleioquinine;
    D. Indophenol;
    E. Thiochrome.
8. Oxazepam belongs to benzodiazepine derivatives. What method is used for its quantitative determination?
    A. acidimetry in a non-aqueous medium;
    B. reverse complexonometry;
    C. alkalimetry by substitute;
    D. direct bromatometry;
    E. alkalimetry in an aqueous medium.
9. 2-Aminobenzophenones are formed in the process of biotransformation:
    A. 1,4-benzdiazepines;
    B. Phenothiazines;
    C. Barbiturates;
    D. Butyrophenonov;
    E. Opiates
10. When analyzing the chloroform extract obtained after the isolation of 1,4-benzodiazepine derivatives, the reaction with β-naphthol gave an orange coloration. Which compound enters into the reaction of the formation of an azo dye:
    A. Aminobenzophenone;
    B. Methylaminobenzophenone;
    C. Oxazepam;
    D. Nitrazepam;
    E. Diazepam.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of phenazepam in the medicinal product, if 17.38 ml of a 0.5 M solution of hydrochloric acid is spent on the titration of a 1.5668 g sample (CF = 1.1218).

Task 2. Determine the volume of 0.5 N perchloric acid solution (CF = 1.0364), which will be spent on titration of 1.4955 g of oxazepam, if its percentage content in the medicinal product is 99.30%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of Clozepid.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 385 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students got acquainted with the peculiarities of the pharmaceutical analysis of psychotropic drugs of benzdiazepine derivatives. Meprotan. Amizil.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.

5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.

7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.

8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.

2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.

4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 35

Topic: Psychotropic drugs. Part 3. Sedatives: sodium and potassium bromide. Psychostimulants: phenamine, pyridrol, sodium caffeine benzoate, cocaine hydrochloride.

Goal: Acquaint students with the peculiarities of pharmaceutical analysis of psychotropic sedative drugs and psychostimulants.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.

- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The dry residue obtained after evaporation of the analyzed solution turns the colorless flame of the burner yellow, and when viewed through a blue glass - purple. What cations were in the dry residue?
   A. Na+, K+;
   B. Na+, Sr2+;
   C. Ca2+, K+;
   D. Na+, Ca2+;
   E. Li+, Ba2+.
2. The substance sodium caffeine benzoate is obtained at a chemical and pharmaceutical enterprise. The starting substance in the synthesis of caffeine is:
   A. dimethylurea;
   B. diphenylamine;
   C. ethyl acetate;
   D. diethyl malonate;

E. benzhydrol

3. An analytical chemist determines the presence of a sodium cation in the composition of sodium caffeine benzoate. For this, a solution is used:
   A. potassium pyroantimonate;
   B. barium chloride;
   C. sodium sulfate;
   D. silver nitrate;
   E. sodium cobalt nitrite.
4. A pharmacist-analyst conducts an express analysis of a sedative mixture with sodium bromide. Quantitative determination of sodium bromide is carried out by the method:
   A. argentometry;
   B. complexonometry;
   C. alkalimetry;
   D. acidimetry;
   E. nitritometry.
5. Dosage forms containing potassium bromide are used to treat insomnia. Potassium cation can be identified by reaction with a solution:
   A. sodium cobaltinitrite;
   B. potassium pyroantimonate;
   C. silver nitrate;
   D. barium chloride;
   E. potassium ferrocyanide.
6. An express analysis of the mixture containing calcium chloride and sodium bromide is carried out. The summary definition of the ingredients of this dosage form can be determined:
   A. argentometrically;
   B. complexonometrically;
   C. alkalimetrically;
   D. polarimetrically;

E. nitritometrically.

7. A characteristic feature of purine alkaloids is their instability when heated in an alkaline environment, which leads to the destruction of the heterocycle. In this case, caffeine turns into:
   A. caffeine;
   B. ninhydrin;
   C. theophylidine;
   D. benzhydrol;
   E. aminophenol.
8. The substance sodium caffeine benzoate is obtained at a chemical and pharmaceutical enterprise. The starting substance in the synthesis of caffeine is:
   A. dimethylurea;
   B. diphenylamine;
   C. ethyl acetate;
   D. diethyl malonate;
   E. benzhydrol
9. The chemical structure of caffeine is trimethylxanthine. The main way of its metabolism is:
   A. *N*-demethylation;
   B. hydrolysis;
   C. oxidation;
   D. restoration;
   E. acetylation.
10. A chemist-analyst performs quantitative determination of caffeine by the method of iodometry. As an indicator, he uses a solution:
   A. starch;
   B. murexide;
   C. phenolphthalein;
   D. ferroin;

E. tropeolin 00.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction of sodium benzoate (M.m. 144.11) in caffeine-sodium benzoate, if the weight of the test piece is 1.5114 g, the volume of a 0.5 N solution of hydrochloric acid (CF = 1.0022) is 12.54 ml.

Task 2. Determine the mass fraction of anhydrous caffeine (M.m. 194.19), if 7.73 ml of a 0.1 N solution of perchloric acid (CF - 1.0165) was spent on the titration of a weight of 0.1536 g of caffeine.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of caffeine-sodium bromide.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 77 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with the peculiarities of pharmaceutical analysis of psychotropic sedative drugs and psychostimulants.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.

5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.

7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.

8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.

2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.

3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.

4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 36

Topic: Anticonvulsant and antiepileptic drugs. Phenobarbital, carbamazepine, difenin, clonazepam, hexamidine, sodium valproate.

Goal: Acquaint students with the peculiarities of pharmaceutical analysis of anticonvulsant and antiepileptic drugs.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.

- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Quantitative determination of the substance "Phenobarbital" is carried out by the method of alkalimetry in a non-aqueous environment. What reagent is used as a solvent?
   A. dimethylformamide;
   B. glacial acetic acid;
   C. acetic anhydride;
   D. formic acid;
   E. ethanol.
2. The drug "Phenobarbital" belongs to acid forms of barbiturates. This allows the pharmacist-analyst to carry out its quantitative determination by the method:
   A. alkalimetry in a non-aqueous medium;
   B. acidimetry in a non-aqueous medium;
   C. reverse iodometry;
   D. reverse cerimetry;
   E. direct bromatometry.

3. At a chemical and pharmaceutical enterprise, a drug that depresses the central nervous system is synthesized by condensation of phenylethylmalonic ether with urea. Name this medicine:
    A. phenobarbital;
    B. triazolam;
    C. barbital;
    D. nicotinic acid;
    E. ascorbic acid.
4. The quantitative content of phenobarbital is determined by a chemist-analyst by the method of alkalimetry. What titrated solution does he use?
    A. sodium hydroxide;
    B. potassium bromate;
    C. silver nitrate;
    D. sodium edetate;
    E. cerium sulfate.
5. Which medicinal substance from the group of barbiturates corresponds to the chemical name 1-benzoyl-5-ethyl-5-phenylbarbituric acid:
    A. benzonal;
    B. barbital;
    C. phenobarbital;
    D. hexanal;
    E. benzobamil
6. The drug phenobarbital has a sedative, hypnotic and antiepileptic effect. Name its international non-proprietary name:
    A. luminal;
    B. nitrofural;
    C. chloramphenicol;
    D. diazepam;
    E. salol

7. In which of the barbiturates can the residue of benzoic acid be identified by the hydroxam test?
    A. benzonal;
    B. barbital;
    C. phenobarbital;
    D. hexanal;
    E. sodium barbital.
8. The chemist of VTK of the pharmaceutical enterprise conducts the alloying of the medicinal substance with sodium hydroxide. Further acidification of the reaction product leads to the release of gas (carbon dioxide) and the appearance of the characteristic smell of phenylethylacetic acid. Name this medicinal substance:
    A. phenobarbital;
    B. resorcinol;
    C. codeine;
    D. streptocide;
    E. phenoxymethylpenicillin.
9. Which of the barbiturates decolorizes bromine water?
    A. hexanal;
    B. barbital;
    C. phenobarbital;
    D. benzonal;
    E. sodium barbital.
10. Hexanal in its structure contains a double bond, which can be determined by the reaction with:
    A. bromine water;
    B. potassium iodide solution;
    C. barite water;
    D. calcium hydroxide solution;
    E. ammonium thiocinate solution.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the content of barbital (M. m. 184.20), if the titration of the substance - 0.1516 g took 8.0 ml of 0.1 N sodium hydroxide solution (CF 1.0022).

Task 2. To determine the mass fraction of clonazepam in the medicinal product, if 7.42 ml of 0.1 N perchloric acid solution were used for the titration of the weight of 0.4983 g (CF=0.9892).

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of barbital.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 338 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class, the students got acquainted with the peculiarities of pharmaceutical analysis of anticonvulsant and antiepileptic drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.

5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 37

Topic: Means for the treatment of parkinsonism. Levodopa, bromocriptine, selegiline, mydantan, cyclodol.

Goal: Acquaint acquaint students with the peculiarities of pharmaceutical analysis of drugs for the treatment of parkinsonism.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The man was diagnosed with Parkinson's disease. What remedy should be prescribed to the patient?
    A. Levodopa
    B. Nitrazepam
    C. Paracetamol
    D. Aminazine
    E. Anaprilin
2. The patient receives levodopa in connection with Parkinson's disease. What is the mechanism of action of this tool?
    A. It is a precursor of dopamine
    B. It is a precursor of steroid hormones
    C. Blocks the degradation of dopamine
    D. It is a precursor of acetylcholine
    E. Is a sympatholytic
3. At a chemical and pharmaceutical enterprise, a drug that depresses the central nervous system is synthesized by condensation of phenylethylmalonic ether with urea. Name this medicine:
    A. phenobarbital;
    B. triazolam;

C. barbital;

D. nicotinic acid;

E. ascorbic acid.

4. The quantitative content of phenobarbital is determined by a chemist-analyst by the method of alkalimetry. What titrated solution does he use?

   A. sodium hydroxide;

   B. potassium bromate;

   C. silver nitrate;

   D. sodium edetate;

   E. cerium sulfate.

5. Which medicinal substance from the group of barbiturates corresponds to the chemical name 1-benzoyl-5-ethyl-5-phenylbarbituric acid:

   A. benzonal;

   B. barbital;

   C. phenobarbital;

   D. hexanal;

   E. benzobamil

6. The drug phenobarbital has a sedative, hypnotic and antiepileptic effect. Name its international non-proprietary name:

   A. luminal;

   B. nitrofural;

   C. chloramphenicol;

   D. diazepam;

   E. salol

7. In which of the barbiturates can the residue of benzoic acid be identified by the hydroxam test?

   A. benzonal;

   B. barbital;

   C. phenobarbital;

   D. hexanal;

E. sodium barbital.

8. The chemist of VTK of the pharmaceutical enterprise conducts the alloying of the medicinal substance with sodium hydroxide. Further acidification of the reaction product leads to the release of gas (carbon dioxide) and the appearance of the characteristic smell of phenylethylacetic acid. Name this medicinal substance:
   A. phenobarbital;
   B. resorcinol;
   C. codeine;
   D. streptocide;
   E. phenoxymethylpenicillin.
9. Which of the barbiturates decolorizes bromine water?
   A. hexanal;
   B. barbital;
   C. phenobarbital;
   D. benzonal;
   E. sodium barbital.
10. Hexanal in its structure contains a double bond, which can be determined by the reaction with:
   A. bromine water;
   B. potassium iodide solution;
   C. barite water;
   D. calcium hydroxide solution;
   E. ammonium thiocinate solution.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the content of barbital (M. m. 184.20), if the titration of the substance - 0.1516 g took 8.0 ml of 0.1 N sodium hydroxide solution (CF 1.0022).

Task 2. To determine the mass fraction of clonazepam in the medicinal product, if 7.42 ml of 0.1 N perchloric acid solution were used for the titration of the weight of 0.4983 g (CF=0.9892).

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of barbital.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 338 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the class, the students got acquainted with the peculiarities of pharmaceutical analysis of anticonvulsant and antiepileptic drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
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5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 38

Topic: Thematic control work on the topic: "Psychotropic drugs. Anticonvulsant and antiepileptic drugs. Means for the treatment of parkinsonism".

Goal: Generalize practical skills for identification and quantification: psychotropic drugs; Anticonvulsant and antiepileptic drugs; Means for the treatment of parkinsonism.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.

- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Which medicinal substance from the group of barbiturates corresponds to the chemical name 1-benzoyl-5-ethyl-5-phenylbarbituric acid:
   A. benzonal;
   B. barbital;
   C. phenobarbital;
   D. hexanal;
   E. benzobamil
2. The drug phenobarbital has a sedative, hypnotic and antiepileptic effect. Name its international non-proprietary name:
   A. luminal;
   B. nitrofural;
   C. chloramphenicol;
   D. diazepam;
   E. salol
3. In which of the barbiturates can the residue of benzoic acid be identified by the hydroxam test?
   A. benzonal;
   B. barbital;
   C. phenobarbital;
   D. hexanal;
   E. sodium barbital.

4. The chemist of VTK of the pharmaceutical enterprise conducts the alloying of the medicinal substance with sodium hydroxide. Further acidification of the reaction product leads to the release of gas (carbon dioxide) and the appearance of the characteristic smell of phenylethylacetic acid. Name this medicinal substance:
    A. phenobarbital;
    B. resorcinol;
    C. codeine;
    D. streptocide;
    E. phenoxymethylpenicillin.
5. The pharmacist-analyst determines the admixture of chlorides in sodium bromide according to the SPHU method:
    A. argentometry;
    B. nitritometry;
    C. bromatometry;
    D. alkalimetry;
    E. iodometry.
6. The pharmacist-analyst determines the admixture of chlorides in potassium bromide according to the SPHU method:
    A. argentometry;
    B. nitritometry;
    C. bromatometry;
    D. alkalimetry;
    E. iodometry.
7. A pharmacist-analyst conducts an express analysis of a sedative mixture with sodium bromide. Quantitative determination of sodium bromide is carried out by the method:
    A. argentometry;
    B. complexonometry;
    C. alkalimetry;

D. acidimetry;

E. nitritometry.

8. An express analysis of the mixture containing calcium chloride and sodium bromide is carried out. The quantitative determination of calcium chloride in this dosage form can be determined:

   A. complexonometrically;

   B. alkalimetrically;

   C. mercurimetrically;

   D. nitritometrically;

   E. argentometrically.

9. Dosage forms containing potassium bromide are used to treat insomnia. Is it possible to identify the potassium cation by reaction with the solution?

   A. sodium cobaltinitrite;

   B. potassium pyroantimonate;

   C. silver nitrate;

   D. barium chloride;

   E. potassium ferrocyanide.

10. Biologically active substances are obtained by chemical synthesis. The reaction of 1-chloro-3-(2-chloro-10H-phenothiazin-10-yl)-propane with dimethylamine gives:

    A. chlorpromazine;

    B. Diphenhydramine;

    C. Aceclidine;

    D. Phenobarbital;

    E. Caffeine.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the mass fraction (%) of sodium bromide (M.m. 102.90) in the medicinal product, if 19.94 ml of a 0.1 N solution of argentum(I) nitrate (CF = 0 .9954).

Task 2. Determine the volume of 0.5 N of sodium hydroxide solution (CF = 1.0364), which will be spent on titration of a weight of 1.4955 g of promethazine hydrochloride, if its percentage content in the medicinal product is 99.30%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of caffeine-benzoate sodium.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 434 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with the peculiarities of pharmaceutical analysis of emetic and antiemetic drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 39

Topic: Emetics and antiemetics. Emetics: copper sulfate pentahydrate, zinc sulfate heptahydrate. Antiemetics: scopolamine, diprazine, stageperazine, tryphtazine.

Goal: Acquaint acquaint students with the peculiarities of pharmaceutical analysis of emetic and antiemetic drugs.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.

- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. A pharmacist-analyst performs an express analysis of eye drops containing zinc sulfate. He identifies the zinc cation by reacting it with a solution:
   A. potassium ferrocyanide;
   B. sodium chloride;
   C. potassium permanganate;
   D. sodium nitrite;
   E. ammonium oxalate.
2. A pharmacist-analyst performs an express analysis of eye drops containing zinc sulfate. He identifies sulfates by reacting with a solution:
   A. barium chloride;
   B. ammonium oxalate;
   C. potassium nitrate;
   D. sodium nitrite;
   E. iron (III) chloride.
3. An express analysis of eye drops containing zinc sulfate and boric acid is carried out. The quantitative content of zinc sulfate in this dosage form can be determined by the method:
   A. complexonometry;
   B. alkalimetry;
   C. cerimetry;
   D. polarimetry;
   E. nitritometry.

4. The Vitaly-Moren reaction is used for the qualitative detection of some poisonous substances. What substances is this reaction used to detect?
    A. Strychnine, atropine, scopolamine;
    B. Morphine, codeine, dionine;
    C. Pachycarpine, nicotine, anabazin;
    D. Quinine, quinidine, cinchonine;
    E. Diprazine, Diazolin, Aminazine.
5. Poisoning with diprazine (a phenothiazine derivative) can be established even 14 days after taking it if its main metabolite is present in the urine:
    A. Sulfoxide;
    B. Phenylpropanolamine;
    C. Diethylaminoethanol;
    D. *p*-aminobenzoic acid;
    E. *p*-aminophenol.
6. When describing the internal organs, a blue-green substance was found in the contents of the stomach. For which substance is it necessary to conduct a chemical-toxicological study?
    A. Copper salts;
    B. Barium salts;
    C. Potassium nitrate;
    D. Sodium chloride;
    E. Ammonium oxalate.
7. What reaction is used to identify copper ions?
    A. With ammonium tetrarhodonomercuriate;
    B. With dithizone;
    C. With ammonium persulfate;
    D. With thiourea;
    E. With 8-oxyquinoline.

8. In the chemical and toxicological analysis, the extraction-photocolorimetric method is used for the quantitative determination of copper ions in the mineralization, which is based on the reaction of the ions of this metal with:
    A. Lead diethyldithiocarbamate;
    B. Dithizone;
    C. Potassium hexacyanoferrate (II);
    D. Ammonium tetrarhodanmercuroate;
    E. Pyridine-rhodanide reagent.
9. Masking must be used during the forensic chemical examination of the mineral. What compound is released by copper ions from the mineral?
    A. Diethyldithiocarbamate;
    B. Dithizonate;
    C. Tetrarhodonomercuriate;
    D. Hexacyanoferrate;
    E. Sulfate.
10. During preliminary tests, different indicator papers are used. The blue color of the indicator paper (litmus and treated with copper sulfate) indicates the presence in the biological object:
    A. Ammonium hydroxide;
    B. Hydrogen chloride;
    C. Hydrogen sulfide;
    D. Sulfuric acid;
    E. Sodium hydroxide.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the mass of the copper sulfate substance (M. 249.68), if 20.42 ml of 0.1 N sodium thiosulfate solution (CF = 1.0000) was used for its titration. The substance content is 96.6%.

Task 2. Calculate the content of zinc sulfate, if 10.54 ml of 0.1 N sodium edetate solution (CF = 1.0010) was used for the titration of 0.8617 g of the substance,

the volume of the volumetric flask was 100 ml, and the volume of the pipette was 10 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of scopolamine hydrobromide.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 406 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with the peculiarities of pharmaceutical analysis of emetic and antiemetic drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.

2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.

3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.

4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 40

Topic: Laboratory work: Analysis of the substance Copper sulfate pentahydrate.

Goal: Generalize practical skills for identification and quantification of copper sulfate pentahydrate.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. A pharmacist-analyst performs an express analysis of eye drops containing zinc sulfate. He identifies the zinc cation by reacting it with a solution:
   A. potassium ferrocyanide;
   B. sodium chloride;
   C. potassium permanganate;
   D. sodium nitrite;
   E. ammonium oxalate.
2. A pharmacist-analyst performs an express analysis of eye drops containing zinc sulfate. He identifies sulfates by reacting with a solution:
   A. barium chloride;
   B. ammonium oxalate;
   C. potassium nitrate;
   D. sodium nitrite;
   E. iron (III) chloride.
3. An express analysis of eye drops containing zinc sulfate and boric acid is carried out. The quantitative content of zinc sulfate in this dosage form can be determined by the method:
   A. complexonometry;
   B. alkalimetry;
   C. cerimetry;
   D. polarimetry;
   E. nitritometry.
4. The Vitaly-Moren reaction is used for the qualitative detection of some poisonous substances. What substances is this reaction used to detect?

A. Strychnine, atropine, scopolamine;

B. Morphine, codeine, dionine;

C. Pachycarpine, nicotine, anabazin;

D. Quinine, quinidine, cinchonine;

E. Diprazine, Diazolin, Aminazine.

5. Poisoning with diprazine (a phenothiazine derivative) can be established even 14 days after taking it if its main metabolite is present in the urine:

A. Sulfoxide;

B. Phenylpropanolamine;

C. Diethylaminoethanol;

D. *p*-aminobenzoic acid;

E. *p*-aminophenol.

6. When describing the internal organs, a blue-green substance was found in the contents of the stomach. For which substance is it necessary to conduct a chemical-toxicological study?

A. Copper salts;

B. Barium salts;

C. Potassium nitrate;

D. Sodium chloride;

E. Ammonium oxalate.

7. What reaction is used to identify copper ions?

A. With ammonium tetrarhodonomercuriate;

B. With dithizone;

C. With ammonium persulfate;

D. With thiourea;

E. With 8-oxyquinoline.

8. In the chemical and toxicological analysis, the extraction-photocolorimetric method is used for the quantitative determination of copper ions in the mineralization, which is based on the reaction of the ions of this metal with:

A. Lead diethyldithiocarbamate;

B. Dithizone;

C. Potassium hexacyanoferrate (II);

D. Ammonium tetrarhodanmercuroate;

E. Pyridine-rhodanide reagent.

9. Masking must be used during the forensic chemical examination of the mineral. What compound is released by copper ions from the mineral?

A. Diethyldithiocarbamate;

B. Dithizonate;

C. Tetrarhodonomercuriate;

D. Hexacyanoferrate;

E. Sulfate.

10. During preliminary tests, different indicator papers are used. The blue color of the indicator paper (litmus and treated with copper sulfate) indicates the presence in the biological object:

A. Ammonium hydroxide;

B. Hydrogen chloride;

C. Hydrogen sulfide;

D. Sulfuric acid;

E. Sodium hydroxide.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the mass of the copper sulfate substance (M. 249.68), if 19.2 ml of 0.1 N sodium thiosulfate solution (CF = 1.0000) was used for its titration. The substance content is 99.2%.

Task 2. Calculate the content of zinc sulfate, if 13.54 ml of 0.05 N sodium edetate solution (CF = 1.0010) is used for the titration of 0.8617 g of the substance, the volume of the measuring flask is 100 ml, the volume of the pipette is 10 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of zinc sulfate heptahydrate.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 115 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students generalized practical skills in the identification and quantification of copper sulfate pentahydrate.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.

6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 41

Topic: Means for the treatment of cough. Codeine, Codeine phosphate, ethylmorphine hydrochloride, libexin.

Goal: Acquaint students with the peculiarities of pharmaceutical analysis of means for the treatment of cough.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;

✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Codeine is used as an antitussive. The starting material for its synthesis is:
   A. morphine;
   B. paracetamol;
   C. pyrocatechin;
   D. nitrofural;
   E. caffeine.
2. Codeine for medical purposes can be obtained semisynthetically from a plant alkaloid. Choose this alkaloid:
   A. Morphine;
   B. Papaverine;
   C. berberine;
   D. Protopin;
   E. Helidonin.
3. Morphine hydrochloride, which contains phenolic hydroxyl, can be distinguished from codeine by the action of the reagent:
   A. FeCl3;
   B. BaCl2;
   C. HCl;
   D. NaCl;
   E. CaCl2.
4. Which of the following reagents allows you to open the phosphate ion:
   A. Molybdenum-vanadium reagent;
   B. Barium chloride in an acidic environment;
   C. 2H solution of nitric acid;
   D. Chlorine water;
   E. Diphenylamine.

5. In the first phase of biotransformation, xenobiotics can be oxidized, reduced, hydrolyzed, dealkylated, deaminated, desulfurized. What is the mechanism by which codeine is converted to morphine?
    A. By O-dealkylation;
    B. By N-dealkylation;
    C. By means of S-dealkylation;
    D. By means of demining;
    E. By desulfation.
6. A pharmacist-analyst uses a phosphate ion to identify drugs that contain phosphate:
    A. silver nitrate solution;
    B. ammonia solution;
    C. mercury nitrate solution;
    D. calcium chloride solution;
    E. sodium hydroxide solution.
7. As a result of the metabolism of codeine in the body, morphine is formed. What metabolic process is the basis of this transformation?
    A. Dealkylation;
    B. Hydrolysis;
    C. Oxidation;
    D. Restoration;
    E. Conjugation.
8. As the main reagent when testing for the limit content of phosphate impurities, the SPHU recommends using it:
    A. sulfomolybdenum reagent;
    B. copper-tartrate reagent;
    C. thioacetamide reagent;
    D. acetylacetone reagent;
    E. hypophosphite reagent.

9. What color does codeine form when heated with a solution of concentrated sulfuric acid and iron (III) chloride and the subsequent addition of concentrated nitric acid?
   A. blue changing to red;
   B. yellow turning orange;
   C. blue fading to purple;
   D. red turning to green;
   E. green fading to black.
10. The pharmacist-analyst performs the analysis of the substance ethylmorphine hydrochloride. To determine water impurity using the semi-micro method in the purity test, he uses the following reagent:
   A. Sulfuric iodine;
   B. Biuret;
   C. Methoxyphenylacetic acid;
   D. Molybdenum vanadium;
   E. Hypophosphite.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Determine the weight of the codeine sample (M.m. 299.39), if 10.02 ml of hydrochloric acid solution (CF = 0.9678) will be spent on its titration. The percentage content of codeine in the medicinal product is 99.40%.

Task 2. Determine the volume of a 0.1 M solution of perchloric acid (CF - 0.9985), which will be used for the titration of a weight of 0.1518 g of morphine hydrochloride M.m. 321.80). The percentage content of morphine hydrochloride in the medicinal product is 99.50%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4

1.	Quantitative determination of Ethylmorphine hydrochloride.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 425 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students got acquainted with the peculiarities of pharmaceutical analysis of means for the treatment of cough.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.

7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 42

Topic: Nootropic drugs. Piracetam, GABA, aminalon, picamilon, glycine.

Goal: Acquaint students with the peculiarities of pharmaceutical analysis of nootropic drugs.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Medicines are metabolized in several stages. The phase of drug metabolism, during which the biochemical conjugation of functional groups of the molecule with acid residues, such as glucuronic and sulfate, or glycine, occurs, is called:
    A. conjugation phase;
    B. functionalization phase;
    C. secretion phase;
    D. mitosis phase;
    E. depolarization phase.
2. In the process of biotransformation in the body, nicotinamide forms a product of interaction with glycine. What type of reaction does this interaction belong to?
    A. conjugation;
    B. restoration;
    C. oxidation;
    D. hydrolysis;
    E. dealkylation.
3. A separate group of nootropics is chemically similar to gamma-aminobutyric acid. What drug is its intramolecular amide?
    A. piracetam;
    B. caffeine;
    C. camphor;
    D. aceclidine;
    E. ampicillin
4. To identify the nootropic agent "Piracetam", a reaction is carried out, as a result of which ammonia is released when heated. What reagent is used in this reaction?
    A. sodium hydroxide solution;
    B. magnesium sulfate solution;
    C. potassium thiocyanate solution;

D. barium chloride solution;

E. ammonium oxalate solution.

5. When piracetam is heated with a solution of sodium hydroxide, ammonia is released as a result of the hydrolysis of the amide group. To detect it, use:

   A. red litmus paper;

   B. iodide starch paper;

   C. turmeric paper;

   D. mercury bromide paper;

   E. silver-manganese paper.

6. Piracetam is a nootropic agent. According to the chemical classification, it belongs to the derivatives:

   A. pyrrolidone;

   B. pyridine;

   C. benzdiazepine;

   D. furan;

   E. xanthine

7. A separate group of nootropics is chemically similar to gamma-aminobutyric acid. What drug is its intramolecular amide?

   A. piracetam;

   B. caffeine;

   C. camphor;

   D. aceclidine;

   E. ampicillin

8. When conducting a qualitative chemical analysis of the piracetam substance, a reaction was carried out, as a result of which ammonia is released when heated. What reagent was used in this case:

   A. Sodium hydroxide solution;

   B. Silver nitrate solution;

   C. Cobalt nitrate solution;

   D. Ammonium oxalate solution;

E. Potassium iodide solution.

9. A substance of alpha-aminobutyric acid was received in the control and analytical laboratory. What reagent does the pharmacist-analyst use to identify this substance?

   A. ninhydrin;

   B. sodium nitrate;

   C. Ensol;

   D. aniline;

   E. calcium bromide.

10. A separate group of nootropics is chemically similar to gamma-aminobutyric acid. What drug is its intramolecular amide?

   A. piracetam;

   B. aceclidine;

   C. camphor;

   D. caffeine;

   E. ampicillin

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the volume of 0.1 N perchloric acid (CF 1.0016), which will be used for the titration of the sample = 0.1627 g of aminalon. The content of aminalon in the substance is 97.15%.

Task 2. Calculate the volume of 0.05 N perchloric acid (CF 1.0016), which will be used for the titration of the sample = 0.2501 g of aminalon. The content of aminalon in the substance is 94.10%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4

1.	Quantitative determination of Piracetam.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 305 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with the peculiarities of pharmaceutical analysis of nootropic drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
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5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.

7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
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5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 43

Topic: Antihistamines. Diphenhydramine (diphenhydramine hydrochloride), suprastin, diazolin, diprazine.

Goal: Acquaint students with the peculiarities of pharmaceutical analysis of antihistamine drugs.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

– Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. An analytical chemist performs quantitative determination of the antihistamine diphenhydramine hydrochloride by the method of alkalimetry. A solution is used as a titrant:
   A. sodium hydroxide;
   B. ammonium thiocyanate;
   C. sodium nitrite;
   D. silver nitrate;
   E. potassium bromate.
2. The process oficrosomal oxidation in the liver is an important component of drug biotransformation. Which of the following substances is oxidized with the formation of N-oxide:
   A. diphenhydramine hydrochloride;
   B. benzoic acid;
   C. phenol;
   D. vikasol;
   E. prednisone
3. A VTK analyst of a pharmaceutical enterprise analyzes the substance diphenhydramine hydrochloride. To identify chloride ions, he uses a reaction with a solution:
   A. silver nitrate;
   B. ammonium oxalate;
   C. barium chloride;
   D. sodium hydroxide;
   E. potassium iodide.
4. The chemical name of the active substance must be given in the registration file for the medicinal product. Enter the chemical name of the antihistamine - diphenhydramine hydrochloride:

A. 2-(diphenylmethoxy)-N,N-dimethylethanamine hydrochloride;
B. (2S)-2-aminopentanedioic acid;
C. 5-nitro-2-furaldehyde semicarbazone;
D. 4-(2-aminoethyl)benzene-1,2-diol hydrochloride;
E. 4-butyl-1,2-diphenylpyrazolidine-3,5-dione.

5. A pharmacist-analyst performs a reaction to identify diphenhydramine hydrochloride (diphenhydramine). What compound is formed as a result of adding concentrated sulfuric acid to a medicinal product?
   A. oxonium salt;
   B. auric dye;
   C. azo dye;
   D. picrate;
   E. indophenol dye.
6. The antihistamine "Diphenhydramine hydrochloride" is an ether. The pharmacist-analyst identifies the compound by the reaction of the formation of an oxonium salt, when adding:
   A. concentrated sulfuric acid;
   B. solution of hydroxylamine hydrochloride;
   C. solution of iron (III) chloride;
   D. dilute nitric acid;
   E. potassium pyroantimonate solution.
7. The State Inspection for Quality Control of Medicinal Products conducts a quantitative analysis of the substance diphenhydramine hydrochloride. The presence of which functional group determines the possibility of titration with a solution of perchloric acid in a non-aqueous medium?
   A. tertiary nitrogen;
   B. phenolic hydroxyl;
   C. carboxyl group;
   D. alcohol hydroxyl;
   E. aromatic amino group.

8. The pharmacist-analyst identifies the antihistamine "Diphenhydramine hydrochloride" by the reaction of the formation of an oxonium salt with concentrated sulfuric acid. What functional group determines the possibility of carrying out this reaction?
    A. ethereal;
    B. aldehyde;
    C. sulfamide;
    D. amide;
    E. carboxylic
9. The 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.
10. When administered intravenously, it is forbidden to mix medicinal products, as a result of which a precipitate may form and/or bioavailability may change. The solution cannot be mixed with medicinal products that are hydrochlorides (procaine hydrochloride, diphenhydramine hydrochloride, etc.):
    A. metamizole sodium;
    B. atropine sulfate;
    C. calcium chloride;
    D. ascorbic acid;
    E. magnesium sulfate.

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the content of diphenhydramine (M.m. 291.82) in the substance, if 10.49 ml of 0.1 N perchloric acid solution (CF = 1.0018) was used for the titration of a weight of 0.2976 g.

Task 2. Determine the weight of papaverine hydrochloride (M.m. 375.86), if 8.55 ml of 0.1 M perchloric acid solution (CF = 0.9886) was spent on its titration. The percentage content of papaverine hydrochloride in the medicinal product is 99.60%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of Diphenhydramine hydrochloride.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 170 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students got acquainted with the peculiarities of pharmaceutical analysis of antihistamine drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.

5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 44

Topic: Laboratory work: Analysis of Diphenhydramine solution d/in. 1% 1 ml.

Goal: Generalize practical skills in identification and quantification of diphenhydramine hydrochloride.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. An analytical chemist performs quantitative determination of the antihistamine diphenhydramine hydrochloride by the method of alkalimetry. A solution is used as a titrant:
   A. sodium hydroxide;
   B. ammonium thiocyanate;
   C. sodium nitrite;
   D. silver nitrate;
   E. potassium bromate.
2. The process oficrosomal oxidation in the liver is an important component of drug biotransformation. Which of the following substances is oxidized with the formation of N-oxide:
   A. diphenhydramine hydrochloride;
   B. benzoic acid;
   C. phenol;
   D. vikasol;
   E. prednisone
3. A VTK analyst of a pharmaceutical enterprise analyzes the substance diphenhydramine hydrochloride. To identify chloride ions, he uses a reaction with a solution:

A. silver nitrate;

B. ammonium oxalate;

C. barium chloride;

D. sodium hydroxide;

E. potassium iodide.

4. The chemical name of the active substance must be given in the registration file for the medicinal product. Enter the chemical name of the antihistamine - diphenhydramine hydrochloride:

   A. 2-(diphenylmethoxy)-N,N-dimethylethanamine hydrochloride;

   B. (2S)-2-aminopentanedioic acid;

   C. 5-nitro-2-furaldehyde semicarbazone;

   D. 4-(2-aminoethyl)benzene-1,2-diol hydrochloride;

   E. 4-butyl-1,2-diphenylpyrazolidine-3,5-dione.

5. A pharmacist-analyst performs a reaction to identify diphenhydramine hydrochloride (diphenhydramine). What compound is formed as a result of adding concentrated sulfuric acid to a medicinal product?

   A. oxonium salt;

   B. auric dye;

   C. azo dye;

   D. picrate;

   E. indophenol dye.

6. The antihistamine "Diphenhydramine hydrochloride" is an ether. The pharmacist-analyst identifies the compound by the reaction of the formation of an oxonium salt, when adding:

   A. concentrated sulfuric acid;

   B. solution of hydroxylamine hydrochloride;

   C. solution of iron (III) chloride;

   D. dilute nitric acid;

   E. potassium pyroantimonate solution.

7. The State Inspection for Quality Control of Medicinal Products conducts a quantitative analysis of the substance diphenhydramine hydrochloride. The presence of which functional group determines the possibility of titration with a solution of perchloric acid in a non-aqueous medium?
    A. tertiary nitrogen;
    B. phenolic hydroxyl;
    C. carboxyl group;
    D. alcohol hydroxyl;
    E. aromatic amino group.
8. The pharmacist-analyst identifies the antihistamine "Diphenhydramine hydrochloride" by the reaction of the formation of an oxonium salt with concentrated sulfuric acid. What functional group determines the possibility of carrying out this reaction?
    A. ethereal;
    B. aldehyde;
    C. sulfamide;
    D. amide;
    E. carboxylic
9. The 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.
10. When administered intravenously, it is forbidden to mix medicinal products, as a result of which a precipitate may form and/or bioavailability may change.

The solution cannot be mixed with medicinal products that are hydrochlorides (procaine hydrochloride, diphenhydramine hydrochloride, etc.):

A. metamizole sodium;

B. atropine sulfate;

C. calcium chloride;

D. ascorbic acid;

E. magnesium sulfate.

3. Formation of professional skills and abilities:

− Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the content of diazoline in the substance, if 13.70 ml of 0.1 N perchloric acid solution (CF = 1.0018) was used for the titration of a 0.5001 g sample.

Task 2. Determine the mass of diprazine sample, if 10.15 ml of 0.1 N perchloric acid solution (CF = 0.9886) was spent on its titration. The percentage content of diprazine in the medicinal product is 99.60%.

− Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of Diphenhydramine hydrochloride.	Calculate the equivalence factor in quantification reactions.	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 170 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, the students generalized practical skills in the identification and quantification of diphenhydramine hydrochloride.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне

підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.

Practical lesson No. 45

Topic: Thematic control work on the topic: "Vomiting and antiemetics. Means for the treatment of cough. Nootropic drugs. Antihistamines".

Goal: Generalize practical skills for identification and quantification: emetic and antiemetic drugs; Means for the treatment of cough. Nootropic drugs. Antihistamine drugs.

Basic concepts: State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, pharmaceutical analysis, express analysis, monograph.

Equipment: visual material, multimedia projector.

Plan:

1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).

2. Control of basic knowledge (written work, written test, frontal survey, etc.):

– Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General classification of medicines.
- ✓ Methods of qualitative cation and anion analysis.
- ✓ Functional analysis.
- ✓ Methods of physical and chemical methods of quantitative analysis.
- ✓ Methods of titrimetric methods of quantitative analysis.

The student should be able to:

- ✓ Carry out a qualitative analysis of the substance.
- ✓ Conduct functional analysis of the substance.
- ✓ Define chromophoric, auxochromic and pharmacophoric groups in the structure.
- ✓ Conduct an analysis of the maximum content of impurities in the substance.

List of didactic units:

- ✓ textbook text;
- ✓ bank of test tasks.

– Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The antihistamine "Diphenhydramine hydrochloride" is an ether. The pharmacist-analyst identifies the compound by the reaction of the formation of an oxonium salt, when adding:
   A. concentrated sulfuric acid;
   B. solution of hydroxylamine hydrochloride;
   C. solution of iron (III) chloride;
   D. dilute nitric acid;
   E. potassium pyroantimonate solution.

2. The State Inspection for Quality Control of Medicinal Products conducts a quantitative analysis of the substance diphenhydramine hydrochloride. The presence of which functional group determines the possibility of titration with a solution of perchloric acid in a non-aqueous medium?
    A. tertiary nitrogen;
    B. phenolic hydroxyl;
    C. carboxyl group;
    D. alcohol hydroxyl;
    E. aromatic amino group.
3. The pharmacist-analyst identifies the antihistamine "Diphenhydramine hydrochloride" by the reaction of the formation of an oxonium salt with concentrated sulfuric acid. What functional group determines the possibility of carrying out this reaction?
    A. ethereal;
    B. aldehyde;
    C. sulfamide;
    D. amide;
    E. carboxylic:
4. The process oficrosomal oxidation in the liver is an important component of drug biotransformation. Which of the following substances is oxidized with the formation of N-oxide:
    A. diphenhydramine hydrochloride;
    B. benzoic acid;
    C. phenol;
    D. vikasol;
    E. prednisone
5. A VTK analyst of a pharmaceutical enterprise analyzes the substance diphenhydramine hydrochloride. To identify chloride ions, he uses a reaction with a solution:
    A. silver nitrate;

B. ammonium oxalate;

C. barium chloride;

D. sodium hydroxide;

E. potassium iodide.

6. The chemical name of the active substance must be given in the registration file for the medicinal product. Enter the chemical name of the antihistamine - diphenhydramine hydrochloride:

   A. 2-(diphenylmethoxy)-N,N-dimethylethanamine hydrochloride;

   B. (2S)-2-aminopentanedioic acid;

   C. 5-nitro-2-furaldehyde semicarbazone;

   D. 4-(2-aminoethyl)benzene-1,2-diol hydrochloride;

   E. 4-butyl-1,2-diphenylpyrazolidine-3,5-dione

7. A separate group of nootropics is chemically similar to gamma-aminobutyric acid. What drug is its intramolecular amide?

   A. piracetam;

   B. caffeine;

   C. camphor;

   D. aceclidine;

   E. ampicillin

8. When conducting a qualitative chemical analysis of the piracetam substance, a reaction was carried out, as a result of which ammonia is released when heated. What reagent was used in this case:

   A. Sodium hydroxide solution;

   B. Silver nitrate solution;

   C. Cobalt nitrate solution;

   D. Ammonium oxalate solution;

   E. Potassium iodide solution.

9. A substance of alpha-aminobutyric acid was received in the control and analytical laboratory. What reagent does the pharmacist-analyst use to identify this substance?

A. ninhydrin;

B. sodium nitrate;

C. Ensol;

D. aniline;

E. calcium bromide.

10. A separate group of nootropics is chemically similar to gamma-aminobutyric acid. What drug is its intramolecular amide?

A. piracetam;

B. aceclidine;

C. camphor;

D. caffeine;

E. ampicillin

3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

Task 1. Calculate the volume of 0.1 N perchloric acid (CF 1.0016), which will be used for the titration of the sample = 0.1627 g of aminalon. The content of aminalon in the substance is 97.15%.

Task 2. Determine the volume of a 0.1 M solution of perchloric acid (CF - 0.9985), which will be used for the titration of a weight of 0.1518 g of morphine hydrochloride M.m. 321.80). The percentage content of morphine hydrochloride in the medicinal product is 99.50%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Quantitative determination of Ethylmorphine hydrochloride.	Calculate the equivalence factor in	Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education

		quantification reactions.	closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 425 p.

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

4. Summary:

As a result of the lesson, students generalized practical skills in identification and quantification of: emetic and antiemetic drugs; Means for the treatment of cough. Nootropic drugs. Antihistamine drugs.

5. References:

Basic:

1. Handbook of pharmaceutical chemictry Vol. 117 / L. Ohannesian, Antony J. Streeter. 2016. – 582 p.
2. Pharmaceutical Chemistry I – Laboratory Experiments and Commentary / Attila Almási, Zsuzsanna Rozmer, Pál Perjési. 2014. – 179 p.
3. Introduction to Pharmaceutical Chemical Analysis / S. Hansen, S. Pederson-Bjergaard, K. Rasmussen. 2012. – 496 p.
4. Chemical Analysis Modern Instrumentation Methods and Techniques 2nd Edition / F. Rouessac, A. Rouessac. 2007. – 599 p.
5. Pharmaceutical drug analysis / Addis Ababa. 2005. – 554 p.
6. Analytical Chemistry Series / John M., Chalmers, Alan J. Handley. 2003. – 384 p.
7. HANDBOOK OF MODERN PHARMACEUTICAL ANALYSIS Vol. 3 / Satinder Ahuja, Stephen Scypinski. 2001. – 587 p.
8. Europian Pharmacopoeia 10th. 2019. – 4255 p.

Additional:

1. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
2. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
3. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
4. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
5. Фармацевтична хімія. Загальна та спеціальна фармацевтична хімія. Лікарські засоби неорганічної природи: лабораторно-практичні заняття. Навчальний посібник / Л.Г. Мішина. – Вінниця: ПП «ТД «Едельвейс і К»», 2010. – 384 с.