UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN
SCHOOL OF MEDICINE
MODULE DESCRIPTION (ANALYTIC PROGRAM)

1. Module Identification code:	
Name of the institution:	Universidad Autónoma de Nuevo León
Name of the school:	School of Medicine
Name of the degree program:	Clinical Chemistry
Name of the course (learning unit):	Basic organic chemistry
Total number of class hours-theory and practice:	120
Class hours per week:	6 hours
Independent study:	60
Course modality:	Face-to-face instruction
Module level:	Third semester
Core/elective module:	Core
Curriculum area:	ACFB
UANL credit points:	6
Create date:	March15th, 2018
Date of last amendment made:	Julu 04th, 2022
Person(s) responsible for the design of module	Dr. C. Noemí Herminia Waksman Minsky, Dr. C. Verónica Mayela Rivas Galindo, Dr. C. Luis Alejandro Pérez López, Dr.C. Jonathan Pérez Meseguer

Person(s) responsible for the design and amendment of the module:	Dr. C. Noemí Herminia Waksman Minsky, Dr.C. Jonathan Pérez Meseguer

2. Presentation:

This learning unit is divided into three stages, and in each one the following topics will be covered:

In the first stage, the fundamentals of organic chemistry and the theoretical aspects that predict its functioning are discussed, such as thermodynamics and kinetics applied to reaction mechanisms to define the course of a reaction, the recognition of the main functional groups present in biomolecules, and the differentiation of various types of isomers.

In the second stage, the behavior of each of the functional groups present in biomolecules is analyzed in order to predict the reaction products of alkanes, alkyl halides, alkenes, dienes, alkynes, alcohols, thiols, ethers, epoxides, sulfides, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives, amines, and aromatic compounds.

In the third stage, the most useful reactions for the synthesis of simple organic compounds are analyzed, allowing the student to develop the Integrative Learning Product, where the acquired knowledge is applied by preparing a written proposal for a solution to the synthesis of simple organic compounds.

3. Purpose:

This learning unit aims to contribute to achieving the graduate profile by mastering the basic knowledge of Organic Chemistry to predict the behavior of biomolecules. This will allow students, in their professional field, to substantiate and understand the development of laboratory tests.

During this learning unit, the student will develop some general competencies, as they will be able to use the learning strategies indicated by the professor for each phase of the program. Additionally, through teamwork, they will demonstrate openness and respect while integrating into workgroups in the environments in which they operate, with the aim of promoting peaceful coexistence. They will assume committed leadership by actively participating in academic activities and taking initiative in the different processes in which they are involved.

They will also develop specific competencies by solving problems through the application of knowledge regarding the physicochemical properties of organic compounds, which will be useful for determining analytes in various matrices.

This learning unit, due to both its content and its placement in the third semester of the program, constitutes a fundamental link within the framework that integrates the Clinical Chemistry curriculum. It is a unit that is related to General Chemistry and Physical Chemistry, as it uses knowledge of the general properties of matter, atomic structure, thermodynamics, and kinetics, and provides the basis for understanding the functional groups present in biologically relevant molecules. This knowledge supports the learning units of Biochemistry and Clinical Biochemistry. The study of functional groups also forms the foundation for laboratory techniques used to manipulate organic molecules in the Organic Techniques learning unit and the specific methods used for their analysis, which are developed in the Organic Analysis and Comprehensive Laboratory of Organic Analysis learning units.

4. Competences of the graduate profile

General competencies to which this module (learning unit) contributes:

- *Instrumental skills:*

  1. To apply autonomous learning strategies at different levels and fields of knowledge that allow them to make timely and relevant decisions in the personal, academic and professional spheres.

- *Personal and social interaction skills:*

  9. To maintain an attitude of commitment and respect towards the diversity of social and cultural practices that reaffirm the principle of integration in the local, national and international context in order to promote environments of peaceful coexistence.

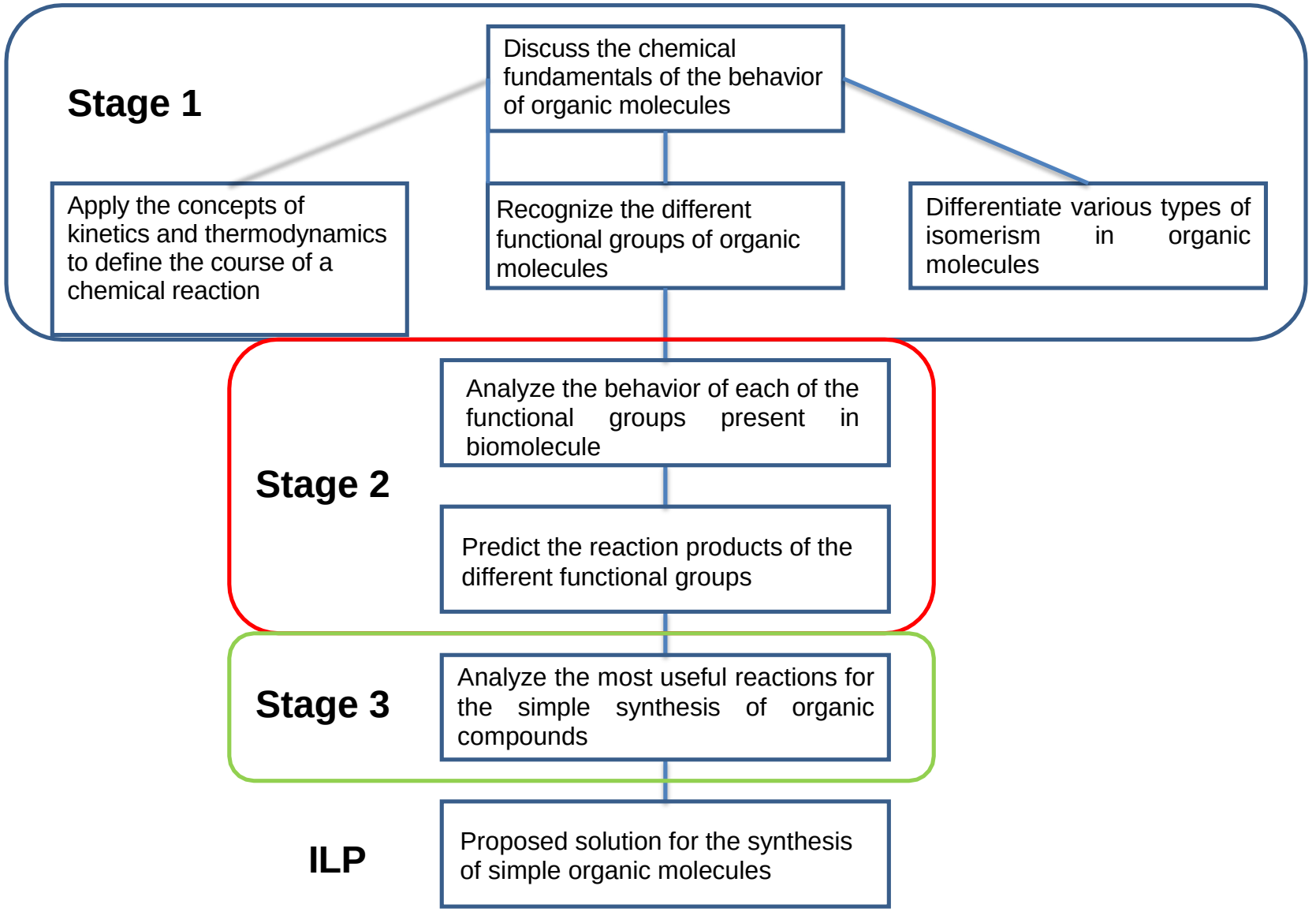
- *Integrative skills:*

  13. To assume leadership roles committed to social and professional needs in order to promote relevant social change.

Specific competences of the graduate profile to which this module (learning unit) contributes:

1. To solve problems by applying knowledge of the chemical composition of matter as well as its physicochemical properties to determine analytes in biological, environmental and food matrices.

5. Course roadmap



6. Structuring into stages or phases:

Stage 1. Structure and reactivity of biomolecules

Component (s) of competence:

1. Discuss the fundamentals of organic chemistry, considering thermodynamic and kinetic aspects, functional groups, and stereochemistry, in order to predict the behavior and reactivity of biomolecules.

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
1. Written partial evaluation on functional groups, chemical structure, physicochemical properties, stereochemistry, reactions of organic molecules, kinetics, and thermodynamics	The evaluation includes: functional groups, chemical structure, physicochemical properties, stereochemistry, reactions of organic molecules, kinetics, and thermodynamics applied to reaction mechanisms. Solve in writing and individually.	At the beginning of the topic, the student receives study guides with the schedule of the topics to be covered and the weighted activities to complete the evidence. The teacher provides digital resources and bibliographic references for the topics to be reviewed on the scheduled dates.	a) Functional groups, chemical representation, and nomenclature (IUPAC and very general common nomenclature): • Hydrocarbons • Oxygenated compounds • Nitrogenous compounds • Halogenated compounds • Physicochemical properties • Atomic structure • Molecular structure Polarity	• Textbook: Organic Chemistry, L. G. Wade, Chapter 3. • Reference book • Class outlines • Digital platforms: Moodle or Microsoft Teams and Examsoft • University email • Computer or smart device

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
	Submit on the date assigned by the teacher. Present in the provided format. Answer the open-ended questions correctly and justify your answer when required.	The student, individually or in a group, reviews the material provided by the teacher prior to the class, whether in the form of a video, presentation, or any other resource, on the relevant topic. The student attends classes where the topics and sample problems are reviewed, using audiovisual material and, when applicable, utilizing molecular models. The student resolves, individually or in groups, in digital format and virtually on the indicated platform or in person, the quizzes and problems included in the guide (**weighted activities 1, 2, and 3**).	• Molecular interactions • Solubility • Resonance hybrids • Acidity b) Stereochemistry c) General reactions of organic molecules d) Kinetics and thermodynamics	• Chem Draw software • Molecular models • Digital resources, audiovisual or digital reading materials provided • Instructional guide .

Stage 2. Physical and chemical properties and chemical behavior of functional groups.

Competency element:

Analyze the structure and physicochemical properties of organic molecules, based on the functional groups they possess, to predict their reactivity.

Evidence of student learning	**Performace criteria**	**Learning activities**	**Content**	**Resources**
2. Written partial evaluation on the structure, nomenclature, physicochemical properties, and reactivity of alkanes and alkyl halides.	The evaluation includes: content related to alkanes and alkyl halides. Solve in writing and individually. Submit on the date assigned by the teacher. Present in the provided format. Answer the open-ended questions correctly and justify your answer when required.	The student receives at the beginning of the topic study guides with the schedule of topics to be covered and the weighted activities to complete the evidence. The teacher provides digital resources and bibliographic references for the topics to be reviewed on the scheduled dates. The student, individually or in a group, reviews the material delivered by the teacher prior to the class, whether in the form of a video, presentation, or any other resource related to the topic. The student attends	**a) Alkanes:** • Nomenclature, physical properties, uses, and applications of alkanes • Conformational analysis of alkanes • Reactivity of alkanes **b) Alkyl Halides:** • Nomenclature • Uses • Substitution and elimination reactions: • Second-order nucleophilic substitution • First-order nucleophilic	• Textbook: Organic Chemistry, L. G. Wade, Chapter 3. • Reference book • Class outlines • Digital platforms: Moodle or Microsoft Teams and Examsoft • University email • Computer or smart device • Chem Draw software • Molecular models • Digital, audiovisual, or digital reading resources provided • Instructional guide.

		classes where the topics and sample problems are reviewed, using audiovisual material and, when applicable, utilizing molecular models. The student resolves, individually or in groups, in digital format on the indicated platform, either virtually or in person, the quizzes and problems included in the guide (weighted activity 4).	substitution • First-order elimination Second-order elimination	

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
3. Written partial evaluation on alkenes and dienes, alkynes, alcohols, and ethers.	The evaluation includes: alkenes and dienes, alkynes, alcohols, and ethers. Solve in writing and individually. Submit on the date assigned by the teacher. Present in the provided format. Answer the open-ended questions correctly and justify your answer when required.	The student receives at the beginning of the topic study guides with the schedule of topics to be covered and the weighted activities to complete the evidence. The teacher provides digital resources and bibliographic references for the topics to be reviewed on the scheduled dates. The student reviews the digital resources, bibliographic references, or material provided by the teacher on the topics to be reviewed before each class. At the beginning of each new functional group class, the student will take a quiz (non-weighted activity) that reflects their level of understanding of the topic; afterward, they will ask the teacher for clarification on any questions about the topic.	**Alkenes** • Characteristics of the double bond: sigma and pi bond structure. • Uses and applications. • Physical properties and stability. • Cis-trans and E-Z nomenclature. • Electrophilic addition. • Ionic and radical addition of HBr. Markovnikov's rule. • Addition of water. • Hydroboration-oxidation. • Catalytic hydrogenation. • Addition of halogens. • Addition of halogens and OH. • Epoxidation and hydroxylation.	• Textbook: Organic Chemistry, L. G. Wade (7th edition), Chapters 6, 7, 8, 9, 10, 11, 14, and 15 • Reference books • Class outlines provided by the teacher • Reference books • Digital platforms: Moodle or Microsoft Teams and Examsoft • University email • Computer or smart device • Chem Draw software • Digital audiovisual or digital reading resources provided • Instructional guide

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
		The student resolves, individually or in groups, in digital format on the indicated platform, either virtually or in person, the quizzes and problems included in the study guides (weighted activities 5, 6, 7, and 8).	• Oxidative cleavage with $KMnO_4$ and O_3 **Dienes:** • Nomenclature • Classification, stability, and uses. • 1,2 and 1,4 addition reactions to conjugated dienes **Alkynes:** • Nomenclature • Uses, physical properties, and acidity • Addition to the triple bond: catalytic hydrogenation, addition of halogens, and hydrogen halides. • Oxidation of alkynes with $KMnO_4$ and O_3. **Alcohols:** • Nomenclature • Physical properties and acidity. • Uses and applications. • Redox reactions.	

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
			a)Cleavage of the C-O bond with: • Hydrogen halides • Phosphorus halides • Thionyl chloride b)Cleavage of the O-H bond: • Tosylation • Acylation • Williamson synthesis • Reaction with metals and sodium amide • Dehydration reactions. **Ethers, Epoxides, and Sulfides:** • Generalities of ethers, epoxides, and sulfides: nomenclature, uses, applications, and physical properties. • Cleavage of ethers with HBr and HI. • Acid-catalyzed and base-catalyzed epoxide opening.	

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
4. Written partial evaluation on aldehydes, ketones, carboxylic acids, and acid derivatives.	The evaluation includes: aldehydes, ketones, carboxylic acids, and acid derivatives. The student individually responds to the partial evaluation on the date and time assigned by the teacher. Submit in the provided format. Answer the open-ended questions correctly and justify your answer when required. Complete weighted activities 9 and 10 individually and submit via the Microsoft Teams platform or in person on the date indicated by the teacher.	The teacher establishes the conditions for the types of activities to be carried out and the evaluation method. The teacher provides digital resources and bibliographic references for the topics to be reviewed on the scheduled dates. The student performs a preliminary reading of the proposed digital resources, highlighting relevant concepts. The teacher explains the most important concepts of the topic during the virtual class. He/She uses audiovisual materials to facilitate understanding of the information. The teacher asks guiding and contextual questions and clarifies doubts.	**Aldehydes and Ketones** • Nomenclature, physical properties, uses, and applications. • Nucleophilic addition reactions in carbonyl compounds. • Addition-elimination reactions involving ammonia and derivatives in carbonyl compounds. • Reactions involving the acidity of alpha hydrogens to the carbonyl, with an emphasis on keto-enol tautomerism. • Oxidation and reduction reactions of carbonyl compounds. **Carboxylic Acids and Acid Derivatives**	• **Textbook:** Organic Chemistry, L.G. Wade, chapters 18, 20, 21, and 22 • Reference books • Class scripts provided by the teacher • Digital platforms: Moodle or Microsoft Teams and Examsoft • University email • Computer or smart device • ChemDraw program • Digital reading resources • Instructional evidence guide. **Suggested website:**

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
		The teacher provides examples of how to solve typical problems. The student resolves, individually or in groups, in virtual format on the indicated platform or in person, the quizzes and problems included in the guide (weighted activities 9 and 10).	• Nomenclature, physical properties, uses, and applications. • Acidity of carboxylic acids. • Analysis of the nucleophilic substitution mechanism in carboxylic acids and their derivatives. • Reactivity of carboxylic acids and derivatives. • Reactions of carboxylic acids: formation of salts, reduction, formation of acyl halides, alpha halogenation. • Reactions of acid derivatives: hydrolysis, interconversion, reduction, Hofmann degradation, dehydration of amides, and reaction with organometallic reagents.	Khan Academy, A Brief Introduction to Organic Chemistry, retrieved on July 26, 2020. https://es.khanacademy.org/science/organic-chemistry

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
			• Analysis of the structure and reactivity of thioesters.	
5. Written partial assessment on amines and aromatic compounds.	The assessment will include amines and aromatic compounds. Complete it in writing and individually. Submit it on the date and time assigned by the teacher. Present it in the provided format. Answer the open-ended questions correctly and justify your answers when required.	The student receives a study guide at the beginning of the topic, which includes a schedule of the subjects to be covered and the weighted activities to be completed for the assessment. The student reviews at home, prior to the class, the material provided by the teacher, whether in the form of a video, presentation, or other resources, as applicable. At the start of the class, the student takes a quiz (non-weighted activity) that reflects their level of understanding of the topic; subsequently, they will ask the teacher for clarification on any questions related to the topic.	**Amines** • Classification • Nomenclature • Amines as nucleophiles • Amines as bases **Aromatic Compounds** • Concept of aromaticity • Nomenclature • Heterocyclic aromatics • Electrophilic aromatic substitution: nitration, sulfonation, halogenation, alkylation, and acylation. • Limitations of Friedel-Crafts **reactions**	• Textbook: Organic Chemistry, L. G. Wade, Chapters 16, 17, and 19 • Reference Books • Digital Platform: Moodle or Microsoft Teams and Examsoft • University Email • Computer or Smart Device • Audiovisual or Reading Material Provided • Chem Draw Program • Instructional Guide

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
		The student pays attention to the example problem-solving exercises presented by the teacher. The student solves, individually or in groups, in digital format on the indicated platform or in person, the questionnaires and problems included in the guide (weighted activities 11 and 12) and submits them as homework for evaluation.	• Guiding power and activation of functional groups. • Side chain reactions of aromatic nuclei. • Phenols. • Aryl halides. • Aromatic amines. • Diazonium salts, reactions.	

Stage 3. Most Useful Reactions for the Synthesis of Organic Compounds.

Competency element:

Analyze the most important reactions of the main functional groups to design simple syntheses of organic compounds on paper.

Evidence of student learning	Performace criteria	Learning activities	Content	Resources
6. Group Resolution of an Organic Synthesis Problem	Team Resolution of the Assigned Synthesis, Respecting the Time Established by the Professor. All team members must participate during the presentation and cover all the criteria of the rubric.	The student reviews at home the material provided by the professor regarding the most common and useful reactions of each functional group to perform simple syntheses. The professor clarifies any doubts the student has about the reviewed material. The student pays attention to the instructions and examples given by the professor in class on how to design a synthesis. The student consults the provided videos to visualize examples of simple organic syntheses	All the topics covered in the module (Learning Unit). The most important reactions of each functional group reviewed in the course to develop simple laboratory syntheses.	• Textbook • Reference Books • Digital Platforms: Moodle or Microsoft Teams • Computer or Smart Device • Provided Audiovisual Material • Chem Draw Software • Instructional Guide

		The students carry out the assigned synthesis on paper in groups using the Chem Draw program. The group submits the designed synthesis to the professor via the digital platform at least 24 hours before their presentation. The professor sends feedback to the student group. Subsequently, the group presents the proposed synthesis on the designated day to the rest of the class. The group members respond to questions from their classmates and the professor regarding the chosen route and/or proposed alternative routes.		

7. Comprehensive Evaluation of Processes and Products

Evidences	%

1	Written exam on functional groups, chemical structure, physicochemical properties, stereochemistry, reactions of organic molecules, kinetics, and thermodynamics.	10.4
2	Written exam on alkanes and alkyl halides.	10.4
3	Written exam on alkenes and dienes, alkynes, alcohols, and ethers.	10.4
4	Written exam on aldehydes, ketones, carboxylic acids, and acid derivatives.	10.4
5	Written exam on amines and aromatic compounds.	10.4
6	Resolution of a synthesis.	2
Weighted activities		
1	Resolution of questionnaires and complementary problems regarding atomic and molecular structure.	**2**
2	Resolution of questionnaires and complementary problems regarding stereochemistry, general reactions of organic molecules, kinetics, and thermodynamics.	**1**
3	Resolution of questionnaires and exercises on alkanes regarding nomenclature, physicochemical properties, conformational analysis, and reaction mechanisms.	**2**
4	Resolution of questionnaires and complementary problems on alkyl halides regarding nomenclature and the most important reactions.	**2**
5	Comparative table of the reactions of SN1, SN2, E1, and E2 for alkyl halides.	**2**
6	Resolution of questionnaires and complementary problems on alkenes, dienes, and alkynes regarding nomenclature and the most important reactions.	**1**
7	Resolution of questionnaires and complementary problems on alcohols and ethers regarding nomenclature and the most important reactions.	**3**
8	Resolution of questionnaires and complementary problems on aldehydes and ketones regarding nomenclature and the most important reactions.	**2**
9	Resolution of questionnaires and complementary problems on carboxylic acids and acid derivatives regarding nomenclature and the most important reactions.	**3**
10	Resolution of questionnaires and exercises on amines regarding nomenclature, basicity, and the most important reactions.	**3**
11	Resolution of questionnaires and exercises on aromatic compounds regarding nomenclature, physicochemical properties, and reactivity.	**1**
12	Resolution of questionnaires and complementary problems regarding atomic and molecular structure.	**4**
Integrative learning product:		**20**

8. Integrative learning product:
Integrative written assessment where solutions to simple organic compound synthesis problems are proposed.

9. Support and reference sources:

Cambridge Soft Corp. (2012). ChemBioDraw versión 11.0. Cambbride, EUA.

Hart, H. Hart, D.J. and Craine, L.E. (2007) Química Orgánica. Mexico: McGraw-Hill.

Morrison, R. T. and Boyd, R.N. (1998) Química Orgánica. EUA: Fondo Educativo Interamericano México.

Solomons, T.W. (2004) Fundamentos de Química Orgánica. México: editorial Limusa.

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