



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Chimica Generale

2627-1-E2703Q003-E2703Q00301

Aims

The lectures aim at providing a first rigorous alphabetization in chemistry to those students who have just started the study of this discipline. The exercises aim at providing the fundamentals of stoichiometry, i.e. the numerical aspects of the simplest chemical concepts.

- Knowledge and understanding
The student must demonstrate that he/she possesses the basic knowledge and methodological tools necessary to interpret the phenomena underlying chemical transformations. The student must be able to independently identify the substances and the relative mixing proportions with which to prepare systems (typically solutions) with defined chemical-physical properties (e.g. volume, concentration, pH, cell potential). The student must be able to define the thermodynamic quantities and the kinetics of a chemical reaction. The student must familiarize himself/herself with the terms specific to the discipline, and explain to non-experts the basic notions on the property/structure relationships of matter, its transformations and applications to simple systems.
- Applied knowledge and understanding
The student must demonstrate that he/she is able to solve basic problems concerning the manipulation of chemical substances, predicting their ability to transform, their reactivity and their behavior in aqueous solutions.
- Autonomy of judgment
The student has the ability to collect and interpret data deemed useful to determine the answer to a given quantitative or qualitative problem, including reflection on issues of reactivity and chemical and physical behavior of substances.
- Communication skills
The student is able to communicate information, ideas, problems and solutions to specialist and non-specialist interlocutors.
- Learning ability
The student develops those learning skills that are necessary to undertake subsequent studies with a high degree of autonomy.

Contents

Matter. Atoms and atomic theory. Isotopes. Chemical compounds. Chemical reactions. Redox reactions. Gases. Thermochemistry. Electrons in atoms. Periodic Table. Chemical bond. Intermolecular forces. Liquids. Solids. Phase diagrams. Solutions. Chemical kinetics. Equilibrium. Acids and basis. Electrochemistry.

Detailed program

Matter: properties and measure, error, significant figures.

Atoms and atomic theory. Isotopes.

Chemical compounds: formulas, moles, oxidation states, nomenclature.

Chemical reactions: equations, types and balancing.

Redox reactions

Gases: gas laws, ideal gas, real gas, equations, kinetic-molecular theory, gas mixtures.

Thermochemistry: terminology, heat, enthalpy, enthalpy changes, Hess law, spontaneous processes, free energy.

Electrons in atoms: basic concepts in quantum chemistry, atomic spectra, orbitals, atomic configurations.

Periodic Table: groups, periods, periodicity of properties (IP, EA, electronegativity and atomic radius).

Chemical bond: covalent, polar covalent, ionic, metallic, Lewis formulas, VSEPR, hybridization.

Intermolecular forces.

Liquids: vapour pressure.

Solids; types of solids, crystalline systems, cubic lattices, coordination, x-ray diffraction.

Phase diagrams.

Solutions: solubility, concentration, mixing, dilution, colligative properties.

Chemical kinetics: collisions theory, kinetic constants, reaction order, Arrhenius, catalysis.

Equilibrium: homogeneous, heterogeneous, constant, quotient reaction, Le Chatelier principle.

Acids and basis: Arrhenius and Bronsted-Lowry theories, self-ionization of water, strong, weak, polyprotic, approximations, hydrolisis, buffer, titration curves.

Electrochemistry: batteries, standard potential, hydrogen reference electrode, Nernst equation, electrode potential, relation with equilibrium constant, electrolysis.

Prerequisites

Basic knowledge of mathematics.

Teaching form

32 two-hour in-person lectures (General Chemistry) + 18 two-hour in-person sessions (Esercitazioni), Direct Teaching, Delivered Didactics

Textbook and teaching resource

Suggested textbooks:

Chimica Generale Petrucci, Herring, Madura, Bissonnette (Piccin) + Soluzione degli esercizi.

Chimica Moderna, Oxtoby, Gillis, Butler (Edises).

Stechiometria, Caselli, Rizzato, Tessore (Edises).

Stechiometria, Bertini, Luchinat, Mani (Casa Editrice Ambrosiana).

Stechiometria per la chimica generale, Michelin Lausarot, Vaglio (Piccin).

Semester

First semester

Assessment method

Assessment for the General Chemistry and Laboratory course results in a single final grade, calculated as the weighted average of the grades of the written test (3 CFU), the oral test (8 CFU), and the laboratory (3 CFU).

The written test can also be replaced by two partial written tests:

the first partial written test is carried out in the didactic break in November and consists of 3 stoichiometry exercises on the topics developed during the part of the course up to the teaching break and a chemical nomenclature exercise (compound name given the formula or formula given the name of the compound);

the second partial written test takes place immediately after the end of the course and consists of 3 exercises of stoichiometry on the topics developed in the second part of the course after the teaching break in November.

Only those who have passed the first partial written test with a grade higher than or equal to 18/30 are admitted to the second partial test.

As an alternative to the two partial tests or for those who have not passed them, we propose a total written test consisting of 5 exercises of stoichiometry on all the topics developed during the course. At every exam session, throughout the year, it is possible to carry out the total test.

Those who have passed the two partial tests with a grade greater than or equal to 18/30 and who are in compliance with the attendance of the laboratory course and the delivery of laboratory reports, are admitted to the oral examination.

The oral examination can be carried out in the same exam session in which the written test took place (or the first appeal for those who passed the partial tests) or in the next two appeals (the second or the third for those who passed the partial tests).

In the event that the candidate does not show up for the oral examination or does not pass on these three occasions, he will have to play and pass the written test again to be admitted again to the oral test.

The oral test consists of a first question of nomenclature, determination of atomic configuration or molecular geometry. Then, some open questions on the various topics in the General Chemistry course follow.

The positive evaluation (18-30L) is established according to the following criteria:
18-19: preparation on a small number of topics in the course program, with limited discussion and analysis skills that, in the case of the oral exam, emerge only following the teacher's help and questions; expository skills and vocabulary that are not always correct, with limited critical processing skills;

20-23: preparation on a part of the topics in the course program, independent analysis skills only on purely practical and executive issues, use of correct vocabulary even if not entirely accurate and clear and an expository skill that is at times uncertain;

24-27: preparation on a large number of topics in the course program, ability to independently carry out argumentation and critical analysis, ability to apply knowledge to contexts and connect themes to concrete cases, use of correct vocabulary and competence in the use of disciplinary language;

28 - 30/30L: complete and exhaustive preparation on the topics in the exam program, personal ability to deal independently and critically analyze the topics, ability to reflect and self-reflect and to connect the topics to concrete cases and different contexts, excellent ability to think critically and autonomously, full mastery of the disciplinary vocabulary and a rigorous and articulated ability to present, ability to argue, reflect and self-reflect, ability to make connections to other disciplines.

Office hours

The professor receives by appointment.

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY | RESPONSIBLE CONSUMPTION AND PRODUCTION
