UCLouvain

lchm1111a

2021

General chemistry

6.00 credits	45.0 h + 30.0 h	Q1

Teacher(s)	Devillers Michel ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	The teaching will familiarize students with scientific reasoning, chemical and physical-chemical phenomena and the laws that govern them. It will cover : 1. Classical atomic theory, leading to an understanding of the constitution, organization and properties of atoms, 2. Reaction balances and the study of the major categories of chemical reactions, 3. The description of chemical bonding and the geometry of molecules, 4. An introduction to physical chemistry in its thermodynamic and kinetic aspects, with special emphasis on the concept of chemical equilibrium, 5. The application of these concepts to acid-base and redox reactions. The course will make sure to relate these concepts to everyday life and the main industrial processes.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 To provide the basis for scientific reasoning, first qualitative, then quantitative, allowing to understand, analyze and predict simple chemical phenomena. To give a global vision of general chemistry from the point of view of the constitution of matter (atomic theory and chemical bonds), the major classes of reactions and chemical equilibrium. To illustrate the fundamental concepts with examples of inorganic chemistry related to daily life and to current challenges in science and technology. *The contribution of this course to the development and mastery of the skills and knowledge of the program(s) is available at the end of this document, in the form of.*
Evaluation methods	The final grade for General Chemistry is based on : - the mark of a written exam covering the whole subject with theoretical questions and numerical exercises (95% or 19/20); - the mark of the written examination (5% or 1/20) organized in week 5 and covering a part of the subject with theoretical questions and numerical applications. Participation in the week 5 exam is MANDATORY. If the number of unjustified and/or justified absences becomes significant, the holder reserves the right to activate the articles of the RGEE allowing the jury to prohibit the student from registering for the corresponding exam.
Teaching methods	**Theory course (20 x 2h) :** Lecture (face-to-face) supported by materials available on Moodleucl or blackboard notes. **Exercise sessions (12 x 2 h) :** Solving theoretical problems and numerical exercises in the presence of assistants. The exercises, communicated about a week before each session, must be prepared before the session. **Supervision :** weekly individualized contacts with the teaching staff, in order to answer specific questions It is essential to bring a simple scientific calculator to the exercise sessions.
Content	The teaching will familiarize students with scientific reasoning, chemical and physical-chemical phenomena and the laws that govern them. It will cover : (1) classical atomic theory, leading to an understanding of the constitution, organization and properties of atoms, (2) reaction balances and the study of the major categories of chemical reactions, (3) the description of chemical bonding and the geometry of molecules, (4) an introduction to physical chemistry in its thermodynamic and kinetic aspects, with particular emphasis on the concept of chemical equilibrium (5) the application of these concepts to acid-base and redox reactions. The course will make sure to relate these concepts to daily life and to the main industrial processes. I - Matter (1): microscopic aspect. Mixtures and pure bodies. Elements, atoms, molecules and compounds. Atomic theory and constitution of the atom. Isotopes. Mendeleev's periodic table. Chemical formulas and nomenclature.

	II - Matter (2): macroscopic aspect. Mole and molar mass. Experimental determination of chemical formulas. Solutions: notion of concentration, dilution. Properties of gases: gas laws, gas mixtures. III - Chemical reactions (1): Stoichiometry and reaction balances. IV - Chemical reactions (2): Main types of reactions. Periodicity of chemical properties and concept of electronegativity. Dissolution and precipitation reactions: Solubility and precipitation, strong and weak electrolytes, ionic reactions and spectator ions. Rule of solubility. Acid-base reactions: Acids and bases in aqueous solution, Brönsted and Lowry's acid-base concept, strength of acids and bases, acidic and basic character of oxides, neutralization reactions. Redox reactions: oxidation and reduction, oxidation number. Oxidants and reducers. Equilibration of redox reactions. V - Chemical equilibrium. Reversibility of chemical reactions. Equilibrium constant. Law of mass action. Use of equilibrium constants. Le Chatelier's principle. Prediction of the spontaneity of a reaction. Applications to acid-base reactions: Autoprotolysis of water. Dissociation of weak acids and bases. Polyfunctional acids and bases. Prediction of acid-base reactions. Leveling effect. Applications to precipitation reactions: Molar solubility and solubility product, common ion effect, precipitation prediction, dissolution of precipitates. Applications to redox reactions: Batteries. Electromotive force and standard reduction potential. Redox scale. Prediction of redox reactions. Dismutation. Nernst equation. VI - Thermochemistry. Notion of enthalpy and state function. Hess's law. Enthalpy of chemical transformations. Prediction of the spontaneity of a reaction. Notion of free enthalpy and link with the equilibrium constant. VII - Electronic structure and periodicity of properties. Atomic spectra and energy levels. Wave properties of matter. Introduction to the quantum model of the atom. Heisenberg's uncertainty principle. Atomic orbitals and quantum numbers. Spin of the electron. Electronic configuration of atoms and ions. Aufbau Prinzip. Pauli's principle. Hund's rule. Link with the periodicity of atomic properties. Screen effects. Atomic and ionic rays. Ionization energy and electronic affinity. VIII - Chemical bonds. Ionic bonding. Covalent bond: octet rule, Lewis structures, resonance, formal charges, hypervalence, Lewis acids and covalent coordination bond, polarization of bonds. Relationship between acid strength and molecular structures. IX - Shape and geometry of molecules. The VSEPR model. Shape and polarity of molecules. Dipole moment. Hydrogen bonding. Binding energy. Relations between orbitals, bonds and geometry. Hybridization of orbitals. Single and multiple bonds. X - Complements on acid-base reactions. pH scale. Behavior of salts in water. Acid-base titrations and balance diagrams. Equilibrium concentration calculations. Hydrolysis of salts. Buffer mixtures. Neutralization curves. XI - Introduction to chemical kinetics. Reaction speed. Influence of temperature. Catalysis.
Inline resources	Moodleucl
Bibliography	• Livre de P. Atkins, Laverman et Jones : "Principe de chimie", Trad. Française de A. Pousse (De Boeck SUPERIEUR), ou édition anglaise originale correspondante. Fascicule d'exercices.
Faculty or entity in charge	CHIM

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Minor in Scientific Culture	MINCULTS	6		🔍
Bachelor in Geography : General	GEOG1BA	6		🔍