UCLouvain

lchm1111

2022

General chemistry

11.00 credits	45.0 h + 67.5 h	Q1

Teacher(s)	Devillers Michel ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	The course will familiarize with scientific reasoning, the chemical and physico-chemical phenomena and the rules that they depend on. It will deal with : 1. The classical atomic theory, leading to understanding the constitution, organisation and properties of atoms 2. Mass relationship in chemical reactions and the concept of limiting reagents 3. The description of chemical bonding and the geometry of molecules, 4. The study of the main classes of chemical reactions, 5. An introduction to physical chemistry and its thermodynamic and kinetic aspects, with particular emphasis on chemical equilibrium. The course will cover in detail the acid-base reactions (including pH calculations, acid base titrations and buffer solutions), the reactions of precipitation and complexation, as well as oxido-reduction reactions (including the applications in batteries and electrolysis). Selected illustrations of these concepts will also provide a general overview of mineral chemistry in relation with its main industrial uses and daily life.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 To give the bases of scientific reasoning, first qualitative, then quantitative, allowing to understand, analyse and forecast simple chemical phenomena. To give a global view of general chemistry from the point of view of matter constitution (atomic theory and chemical bonding), the main classes of reactions and chemical equilibrium. To illustrate the fundamental concepts by referring to examples of mineral chemistry linked to daily life and to the present challenges in science and technology.
Evaluation methods	The final grade for General Chemistry is based on : - the grade of a written exam covering the entire subject with theoretical questions and numerical exercises (80% or 16/20); - the mark of the practical work (15% or 3/20) which takes into account the preparation of the laboratory before the session, the knowledge test at the beginning of the session and the laboratory report at the end of the session; - the mark for the written test (5% or 1/20) organized in week 5 and covering part of the subject with theoretical questions and numerical applications. This part of the grade from the continuous assessment will be used for each session and cannot be represented. Participation in the Week 5 quiz is MANDATORY. Participation in the practical work is also MANDATORY. Any REASONED absence (justified by a medical certificate in case of illness, or by an official document in other cases) will result in the recovery of the missed session during the last week of the term. Any NON MOTIVATED absence will be sanctioned by a NEGATIVE mark of 5 POINTS on the final mark of General Chemistry taken into account in the deliberation, and may, depending on the degree of recurrence and the assessment of the situation by the teaching staff, result in a non-negotiable final mark of ZERO out of 20. In the event that the number of unjustified and/or justified absences becomes significant, the professor 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	**Theoretical course** (21 x 2h) : lecture (face-to-face) supported by materials available on Moodleucl or notes on the board. **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. **Laboratory sessions (10 x 3.5h)** : Participation in the laboratory sessions is mandatory. Each student prepares and carries out an individual experiment illustrating a theme of the course. They write a laboratory report. A laboratory manual allows the student to prepare each laboratory session. This mandatory preparation is guided by a preparation questionnaire; it will be checked at the beginning of the session and returned with the laboratory report. **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 and to the practical laboratory work.
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 acids and weak bases. Behavior of salts in water. 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. 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
Faculty or entity in charge	CHIM

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor in Chemistry	CHIM1BA	11		🔍
Minor in Scientific Culture	MINCULTS	11		🔍