Admission Test to the Master Program in Biotechnological and Chemical Sciences in Diagnostics

The test will consist of:
- 50 multiple-choice questions on the following disciplines:
General, Inorganic and Organic Chemistry (30)
Basis of Cellular Biology, Molecular Biology and Genetics (15)
Basic Mathematics (5)
Total time: 60 minutes

Each correct answer holds 1 point.
To be admitted, the candidate must reach a final evaluation ≥ 30/50 points.
No penalties will be assigned for the incorrect answers.

The candidates must be connected using two devices:
Device 1: smartphone/tablet with video connection
Device 2: PC/laptop with Internet connection

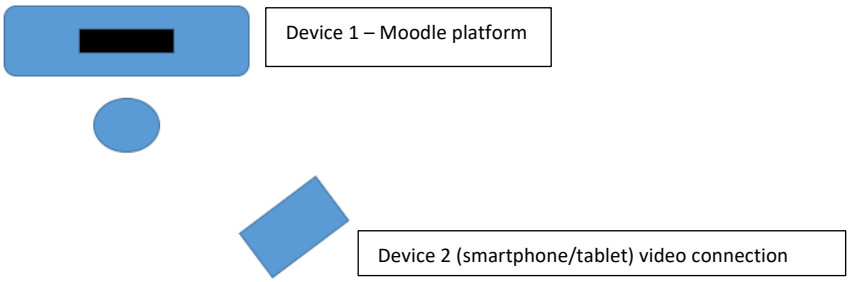
At the time indicated for the test, candidates must connect to a Webex virtual room with Device 1.

First, candidates will be asked to show a valid ID.
Once the identification procedure has been completed, candidates will be asked to access the test through the Exams Platform of the University of Torino (Moodle platform) with Device 2.

Both the Webex and the Moodle links will be notified by email the day before the test.

Make sure that both your devices are charged for all the time required for the test.

IMPORTANT:
• The work desk must be viewable from Device 1 as shown in the Figure:



• Only the Exams Platform must be open on Device 2.
• Besides the computer, there should be nothing else on the work desk, except a periodic table and a paper sheet for taking notes during the test.
• No one must enter the room where the candidate will take the exam until the exam is completed (it is strongly recommended to frame the door to the room from the device)

The exam session will be recorded.

Results will be notified to the candidates by the International Students Office of UniTO.

Syllabus

The following knowledges are required for the preparation to the admission text

General, Inorganic and Organic Chemistry

- The matter: states of aggregation; heterogeneous systems and homogeneous systems; compounds and elements;
- Laws of perfect gases;
- The structure of the atom: elementary particles, atomic number and mass, isotopes, electronic structure of the atoms of the various elements;
- Periodic system of elements: groups and periods, transition elements. Periodic properties of the elements: atomic radius, ionization potential, electron affinity, metallic properties. Relations between electronic structure, position in the periodic system and properties of the elements;
- Chemical bonds: ionic, covalent (Lewis structures, VSEPR theory, hybrid orbitals) and metallic. Bond energy. Polarity of the bonds. Electronegativity. Intermolecular bonds;
- Nomenclature of inorganic compounds;
- Chemical reactions and stoichiometry: atomic and molecular mass, Avogadro's number, concept of mole and its application, elementary stoichiometric calculations, balancing of simple reactions, the different types of chemical reaction;
- Solutions: Solvent properties of water, solubility, main ways of expressing the concentration of solutions, colligative properties;
- Equilibria in aqueous solution. Le Chatelier principle;
- Oxidation and reduction: oxidation number, concept of oxidant and reducing agent. Balancing of simple redox reactions;
- Acids and bases: the concept of acid and base. Acidity, neutrality and basicity of aqueous solutions. The pH. Hydrolysis. Buffer solutions;

- Fundamentals of organic chemistry: Molecular structure of organic compounds;
- Notions of stereoisomerism;
- Electronic structure of organic compounds (hybrid orbitals, σ and π bonds);
- Resonance and aromaticity;
- Electronic (inductive and mesomeric) and steric effects of substituents;
- Nomenclature of the main classes of organic compounds: Aliphatic, alicyclic and aromatic hydrocarbons;
- Functional groups: alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, amides;
- Reactivity: Short-lived reactive intermediate species: carbocations (classical and non-classical), carbenes, free radicals, carbanions and organometallic species;

- Reaction mechanisms: Addition (electrophilic and nucleophilic) to multiple bonds; Substitution (aliphatic and aromatic); Elimination; Stereochemistry (stereoselectivity and stereospecificity);
- Generalities on biological macromolecules, structure and function of polypeptides and proteins, carbohydrates, lipids, nucleic acids.

Basis of Cellular Biology, Molecular Biology and Genetic

- The chemistry of living organism;
- The biological importance of weak interactions;
- The organic molecules present in living organisms and their functions;
- The role of enzymes;
- The cell as the basis of life. Cell theory. Cell size. The prokaryotic and eukaryotic, animal and plant cell. Viruses and prions;
- The cell membrane: structure and functions; transport through the membrane;
- Cellular structures and their specific functions;
- Bioenergetics. The energy of cells: ATP. Redox reactions in living organisms. Energy processes: photosynthesis, glycolysis, aerobic respiration, and fermentation;
- Cell cycle and cell reproduction: mitosis and meiosis, structure of chromosomes and chromosomal maps;
- Reproduction and inheritance;
- Life cycles. Sexual and asexual reproduction;
- Mendelian genetics: Mendel's laws and their applications;
- Classical genetics: chromosomal theory of inheritance - models of inheritance;
- Molecular genetics: structure and duplication of DNA, the genetic code, protein synthesis;
- The DNA of prokaryotes. The structure of the eukaryotic chromosome. Genes and the regulation of gene expression;
- Human genetics: transmission of mono- and polyfactorial characters; autosomal and X-linked hereditary diseases;
- Mutations. Natural and artificial selection. Evolutionary theories. The genetic basis of evolution. Inheritance and the environment;
- Basis of Biotechnologies: recombinant DNA technology and its applications.

Basic Mathematics

- Main types of statistical graphs: line, bar, and pie graphs. Definition and identification of the parts of a line, bar and pie graphs, examination and interpretation of information from line, bar and pie graphs;
- Descriptive statistics: mean, median, mode;
- Direct and inverse proportionality, percentages;
- Elementary functions and their graphs: algebraic, integer and fractional, exponential, logarithmic, goniometric, composite and inverse functions. Geometric transformations of functions;
- Arithmetic and geometric progressions;
- Differential calculus: derivatives and linear approximations, increasing and decreasing functions over intervals, minima and maxima, convexity and concavity;

- Examination and interpretation of information from graphs of functions;
- Definite integral of a function over an interval, fundamental theorem of calculus.