SVENSKA KEMISAMFUNDET
Sektionen för oorganisk kemi

Preamble

Inorganic chemistry plays a crucial role in shaping our society. Inorganic chemistry is central to a diverse range of fields, including nanotechnology, energy, materials science, mining, environmental science, catalysis, biological systems and more.

The Division of Inorganic Chemistry of the Swedish Chemical Society has therefore prepared[1] the following list of inorganic topics which should be taught as part of any Chemistry undergraduate major in Sweden.

Central Topics

A chemistry undergraduate program is expected to cover the majority, if not all, of the following topics. These topics may be integrated into courses that encompass other chemical disciplines, such as General Chemistry, Physical Chemistry, and Organic Chemistry.

Atomic Structure: This topic includes atomic orbitals and periodicity in orbital energy, ionization energy, electron affinity, shielding and effective nuclear charge.

Molecular Structure: Students should learn about various types of bonding between atoms (ionic, covalent, polar), molecular geometries, symmetry point groups, molecular orbital theory (including multi-centered MO using group theory), electron-deficient molecules, π-donor and acceptor ligands, and acid-base chemistry.

Main Group Elements: The synthesis, structure, physical properties, bonding motifs, acid-base characteristics, and reactivities of elements and their compounds within the main group should be covered.

Transition Elements and Coordination Chemistry: Topics within this area include ligands, coordination number, bonding motifs (including dative bonds), nomenclature, ligand field and molecular orbital theories using group theory, crystal field theory, Jahn-Teller effects, magnetic properties, electronic spectroscopy (spectrochemical series), thermodynamic aspects (formation constants, hydration enthalpies, chelate effect), kinetic aspects (ligand substitution, electron transfer, fluxional behavior), lanthanides, actinides, superheavy elements, and redox chemistry of coordination complexes. Deviations from periodicity should also be explored.

Organometallic Chemistry: This topic covers metal carbonyls, hydrocarbon and carbocyclic ligands, the 16 and 18-electron rule (saturation and unsaturation), synthesis and properties, patterns of reactivity (substitution, oxidative addition and reductive

[1] The list is based in large part on a document of similar intent prepared by the American Chemical Society Approval Program, with their permission.

elimination, insertion and de-insertion, nucleophilic attack on ligands, isomerization, transmetallation, stereochemical nonrigidity).

Solid State Materials: Students should learn about the structure of solid-state materials at the atomic level, metallic bonding, band theory, magnetic properties, conductivity, semiconductors, insulators, and defects.

Special topics. In addition to the central topics, it is important to cover special topics that have significant relevance in the field of inorganic chemistry. These may include catalysis and important industrial processes, bioinorganic chemistry, condensed materials containing chain, ring, sheet, cage, and network structures, supramolecular structures, nanoscale structures and effects, surface chemistry, environmental and atmospheric chemistry, metallurgy and nuclear chemistry.

Practical Topics

Students also need to be familiar with common laboratory techniques for the synthesis, isolation, and analysis of inorganic molecules and materials. Some examples of these methods include:

Synthetic Methods: Students should learn techniques such as working in inert atmospheres using dry boxes/bags and Schlenk methods, operating a high-temperature furnace/heated tube, utilizing a vacuum line, working with high-pressure and autogenic-pressure autoclaves, and employing electrochemical apparatus.

Purification Methods: Students should be trained in purification techniques such as column/ion exchange chromatography, different types of extraction, sublimation, and recrystallization.

Characterization Methods: This topic includes measurements of magnetic susceptibility, conductivity, oxidation/reduction potentials, X-ray diffraction and electron microscopy, IR, UV-Vis, NMR (variable temperature, multinuclear, multidimensional), ESR, Mössbauer, and mass spectrometry, electronic properties (bandgaps, conductivity, etc.).