UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

General and Inorganic Chemistry

2021-1-E3201Q067

Aims

To teach the basic concepts of Chemistry, showing Environmental consequences

Contents

Mixtures, compounds, elements. Chemical entities: mole, atomic and molecular masses, isotopes. Formula, percentage composition. Names and classification of compounds, oxidation states. Reactions: acid/base, precipitation, redox. Monoelectronic and polyelectronic atoms; The periodic table, and the periodic properties. Chemical bonds: ionic, covalent, metallic. Molecular geometries (VSEPR). Hybrid orbitals, multiple bonds, resonance. Properties of gas, liquid, solids. Prototypical solid state structures. The chemical equilibrium. Broensted theories of acid and bases. Solubility and precipitation equilibria. Thermochemistry: enthalpy. Electrochemistry: galvanic cells, electrolysis.

Detailed program

Composition of matter - mixtures, Compounds and Elements. Atoms, molecules and ions. Subatomic particles (protons, neutrons, electrons) Isotopes

Chemical quantities - Definition of unified atomic mass unit or dalton. Definition of Mole, Avogadro constant, Atomic, Molecular and Molar Mass (in g/mol) empiric and molecular formula. Percentage composition. Composition of mixtures

Atomic structure - the principles of Quantum Chemistry (Black body, photoelectronic effect, wave-particle duality, uncertainty principle). wave function, quantum numbers, orbitals, electronic density functions. Multielectronic

atoms, aufbau principle, electronic configuration and the Periodic table, periodical properties (effective nuclear charge, Ionization Energy, electronic affinity, Covalent and Ionic atomic radiue, electronegativity)

Chemical reactions - Classification of elements and componds, Names and formulae of binary compounds. Basic and acid oxides. Names of idroxadis, oxoacids, oxoanions. Chemical equations, and their balancing. Net ionic equations. Acid/base neutralization reactions, precipitation reactions, Soluble and insoluble salts. redox equations, and balancing. Meaning of stoichiometric coefficient, weight realtions of reactants and product. Limiting agent and yield

Chemical Bond - Ionic and Covalent bond. Charge separation: Lewis structures, The *Octet* Rule and Its *Exceptions*. Lewis acids and bases. Energy, distance and bond ordere correlations. Multiple bonds, resonance and formal charge. Molecular geometry (VSEPR theory). valence Bond. Hybrid orbitals. ? and ? bonds, isomers.

Thermochemistry - Definition of Energy, work and heat. First principle of thermodinamic. State functions. Enthalpy. Hess's law. Standard Conditions. Reaction, formation and combustion enthalpy

Gas properties - Units of pressure and temperature. Ideal gas law. Mixtures of gaseous componds, partial pressures (Dalton 's law). Stoichiometric calculations using volumes of gases. Cinetic theory of gases.

Solutions - Units of Concentration (molarity, molality, % w/w, mass/volume molar fraction) Dilutions. Titrations, Stoichiometric calculations with Molarity, Colloidal suspensions

Liquids and Solids Intermolecular forces, hydrogen bonds and its relevance. Representative structures of solids : ionic (sodium chloride), covalent (diamond and graphite) molecular (water) metallic. Phase diagrams and phase equilibria, critical parameters.

Equilibrio Chimico – Definizione e calcolo di costanti di equilibrio. Risposta dell' equilibrio alle perturbazioni (principio di Le Chatelier): quantità di materia, pressione, temperatura. Equilibri eterogenei. Grado di avanzamento. Calcoli delle condizioni di equilibrio. Equilibri simultanei.
Acidi e Basi - Definizione di Brønsted-Lowry, pH e pOH. Acidi e basi deboli, acidi poliprotici. Calcolo del pH di soluzioni di: acido forte, base forte, acido debole, base debole. Relazione tra Ka e Kb, l' idrolisi. Grado di dissociazione. Relazioni tra pH e concentrazione.
Le titolazioni di acidi (forti o deboli) con basi (forti o deboli). Le soluzioni tampone.
Solubilità in acqua - Solubilità, saturazione e temperatura. Sali poco solubili e Prodotto di Solubilità. Effetto dello ione comune, del pH e della complessazione.
Termodinamica – I processi spontanei. Entropia. Terzo principio. L'energia libera come criterio di spontaneità di una reazione. relazioni tra Energia libera, Costante di equilibrio e Temperatura.
Elettrochimica - Semireazioni, celle galvaniche, potenziale di cella, potenziali standard di riduzione, pH-metria potenziometrica, celle galvaniche di rilevanza pratica. L'elettrolisi, le sue leggi e le sue applicazioni.

Prerequisites

Basic concept of mechanics

Basic algebric concept and solution of equations

Units, conversion factors and dimensional calculations

Teaching form

Lectures, supported by numerical exercises.

Tutoring activity, organized by the participants

Textbook and teaching resource

Text of typical exercizes, detailed solution of numerical problems, slides shown at lectures

Selected exercizes.

Semester

Second semester

Assessment method

Two written tests, during the semester

OR

Une single test, at the end of the semester

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in any case, there is the possibility to supplement with oral examination

Office hours

Any hours, to be established by phone or Email