MINIATURIZED THERAPEUTIC AND REGENERATIVE SYSTEM

LEONARDO RICOTTI

MAST...
Tel. 050 83...
Cell. 388 983774...

OBSECTIVE OF THE COURSE

We want to study phenomena at the milli, micro and nanoscale, to invent new solutions and to engineer processes at such scales; in order to develop advanced technological components and to enable minimally invasive therapies.
At centimeter scale, we can think on artificial organs, at milli and micro on robots for targeted therapies. At $10^{-6} \div 10^{-4}$ scale we can explore technologies for tissue regeneration.

GOOD PRACTICES IN A CHEMISTRY LABORATORY

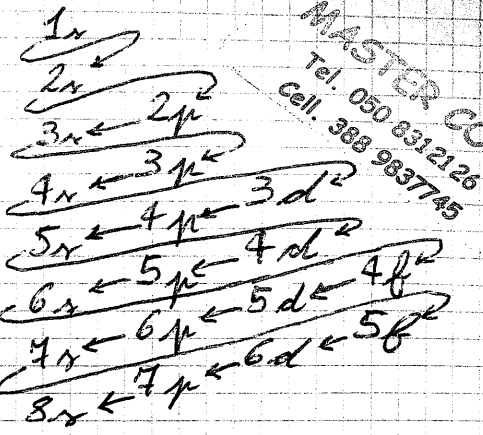
- Static dangers are chemicals, radiations, ecc. Several ones are unknown. Dynamic dangers are your colleagues.
- No open shoes, heels, shorts are allowed to be steady and more protected by chemicals substance
- Always wear a suit, goggles and gloves.

FUNDAMENTALS OF CHEMISTRY

- Bohr's atom: it is composed by a nucleus, surrounded by electrons precisely organized into shells*
- Orbital: region of space, in which an electron has a relatively high probability of being found
- Pauli exclusion principle: no more than two electrons with opposite spins can stay in the same orbital
- Hund's rule: electrons with same energy level tend to occupy empty orbitals, avoiding overlapping with other electrons
- Aufbau: procedure used to infer electronic configurations of all atoms

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Cell. 388 9837745
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- Octet rule: all elements tend to complete a set of 8 electrons in valence orbital. If this octet is filled, we achieve a stable, inert element (with no reactivity), like a noble gas

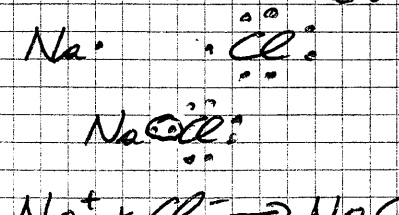


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- Valence orbital: orbital which contains most energetic electrons of an atom
- Ionization energy: energy required to remove the most external electron (the farthest from the nucleus) from the atom. It increases by going from left to right in the periodic table, because the number of protons increases, while distance from nucleus does not. By going down, it decreases instead, since distance from nucleus is greater
- Molecule: ~~of~~ group of atoms bounded together behaving like a single particle
- Compound: pure substance made up of two or more atoms in fixed proportions (that can be ions or molecules)
- Mixture (or solution): combination of ~~two~~ or more substances ~~or~~ (elements or compounds) with variable composition. They can be separated by physical means, while compounds through chemical ones

BONDS

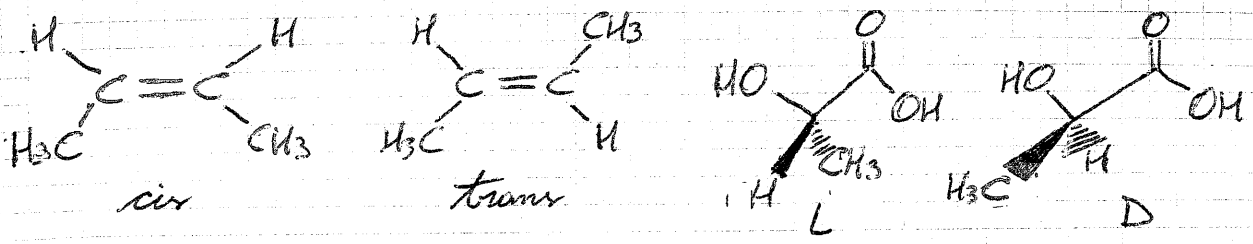
Ionic bond is generated between one atom with low electronegativity and one with high one.
Electronegativity is the property of an atom to attract electrons; so, it is related to ionization energy.
The atom with low one is called donor, while that one with high value acceptor.
Ionic bonds form rigid, solid crystalline structure. They melt



at high temperatures. As solid, they are insulators, while, dissolved in water, they are aqueous and can conduct.
Ionic bonds are made between ions, atoms with more or less electrons than their usual configuration. They are created in plasma, which provides energy through collision with general particles.
A covalent bond is established between atoms with same ~~elect~~ or similar electronegativity. If this last is different in the atoms involved, we talk about polar covalent bonds.
A famous one is water. This difference allows allocation of charges inside the compound.
Most covalent compounds are gas and liquids; while covalent crystals are hard, brittle and incapable of bending. Covalents substances do not conduct electricity, because they do not have free electrons. They are not ~~so~~ soluble in polar solvents, like water, but in ~~apol~~ not polar ones, like benzene and carbon disulphide.
Metallic bonds involves conduction electrons (delocalized from atoms) and positively charged metal ions. This gives property of strength, ductility, thermal and electrical resistance and conductivity.

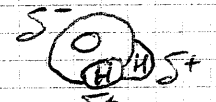
ISOMERS
Tetrahedral orientation of bonds can be arranged in 3D space in two ways, obtaining ~~mir~~ mirrored structures one to each other. This property is called chirality. Molecules with this property are called optical isomers, or stereoisomers. Different conformations changes physical properties and gives different reactivities to other substances.

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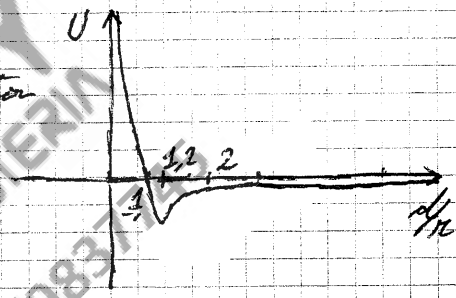


WEAK INTERACTIONS

Hydrogen bond is the interaction of a partially positively charged hydrogen atom in a molecular dipole with unpaired electrons of other atoms.



Van der Waals interactions are established among neutral atoms, not charged. When close, they can perturb, generating temporary charge displacement, and by that, dipoles and interactions. If distance is greater than twice the diameter of atoms, the interaction is negligible. Greatest attractive force is at 1,2 the diameter, but becomes repulsive after less than once the diameter.



Besides Van der Waals interaction, if you have two non polar molecules in water, they prefer to stay together surrounded by water than being separated by two sheats of it. It is called hydrophobic effect.

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SOLUTIONS AND MOLES

A solution is a homogeneous mixture of two or more substances, typically a solvent and a solute

Relative atomic mass is a dimensionless quantity.

Molar mass is the atomic mass of a given mass divided by the amount of substance. So, its unit measure is [g/mol].

Molarity of a solution is ratio between number of moles of solute and volume of solvent.

A 1% W/V solution means 1 g of solute in 100 ml of solvent.