VSEPR

Polarity / Biomimicry

Dr. Ron Rusay

Lewis Structures → Molecular Shapes

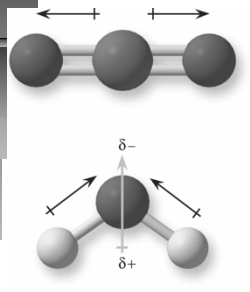
Classic Worldwide Model: VSEPR

"Valence Shell Electron Pair Repulsion"

http://chemconnections.org/general/movies/VSEPR.MOV

Basis of the model: Molecular structure's shape is determined by minimizing electron pair repulsions through maximizing separations.

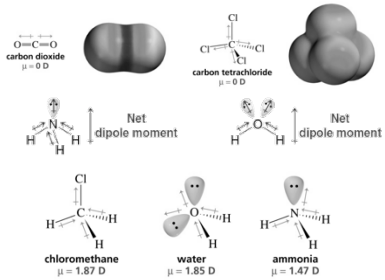
Molecular Polarity & Dipole Moment



When identical polar bonds point in opposite directions, the effects of their polarities cancel, giving no net dipole moment. When they do not point in opposite directions, there is a net effect and a net molecular dipole moment, designated δ.

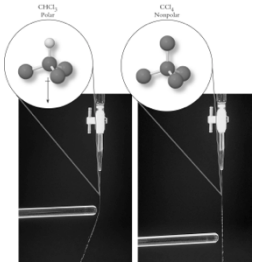
Molecular Dipole Moment

The vector sum of the magnitude and the direction of the individual bond dipole determines the overall dipole moment of a molecule



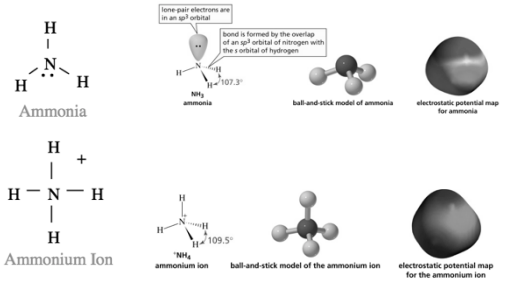
Polarity & Physical Properties

Chloroform (polar) vs. Carbon tetrachloride (non-)

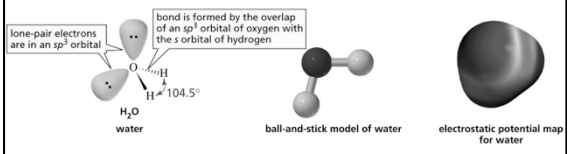


An electrically charged rod attracts a stream of chloroform but has no effect on a stream of carbon tetrachloride.

Ammonia and in the Ammonium Ion

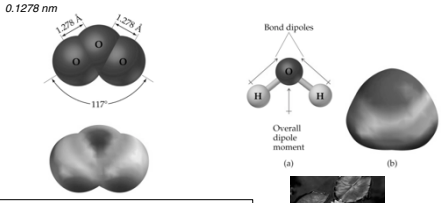


Water



Polarity & Physical Properties

Ozone and Water



- *Resultant Molecular Dipoles > 0*
- *Solubility: Polar molecules that dissolve or are dissolved in like molecules*

- *The Lotus flower*
- *Water & dirt repellancy: solubility?*

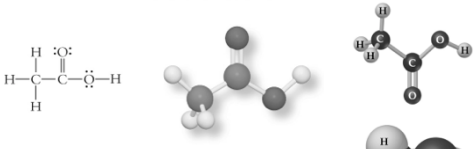
Polarity & Physical Properties

Solubility

Generally likes dissolves like:

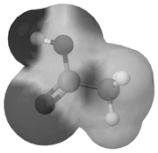
- *Polar compounds dissolve other polar compounds & ionic compounds. Eg. ethanol and water, sodium chloride and water, sugar and water*
- *Nonpolar compounds are soluble in other nonpolar compounds. Eg. carbon tetrachloride and oil, diesel and gasoline*

Acetic acid



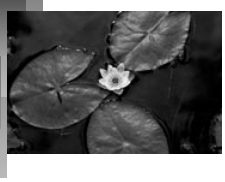
- *Is acetic acid polar or non-polar?*
- *Will acetic acid be miscible (dissolve) in water?*

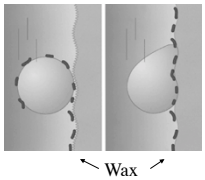
Based on the Molview model?



The "Lotus Effect"

Biomimicry

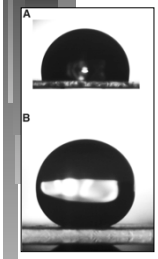




- *Water not only dissolves some dirt, but attracts and removes it like a snowball rolling downhill.*
- *Lotus petals have micrometer-scale roughness, resulting in water contact angles up to 170°*

The "Lotus Effect"

Biomimicry



- *Isotactic polypropylene (i-PP) melted between two glass slides and subsequent crystallization provided a smooth surface. Atomic force microscopy tests indicated that the surface had root mean square (rms) roughness of 10 nm.*
- *A) The water drop on the resulting surface had a contact angle of 104° ± 2*
- *B) the water drop on a superhydrophobic i -PP coating surface has a contact angle of 160°.*

Science, 299, (2003), pp. 1377-1380, H. Yldrm Erbil, A. Levent Demirel, Yonca Avc, Olcay Mert

http://www.sciencemag.org/cgi/content/full/299/5611/1377/DC1