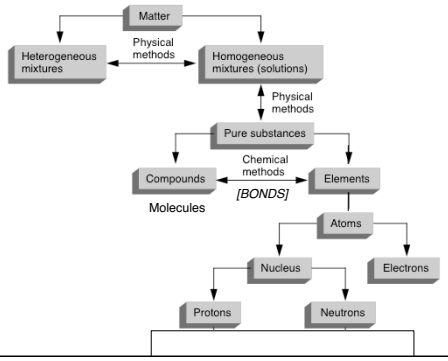
CHEM 108

Molecules/ Compounds/ Bonds and The Periodic Table

Atoms & Molecules



Compounds & Chemical Bonds

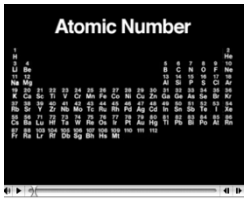
Atoms in a compound (molecule) are in ratios of whole numbers with specific 3-dimensional arrangements due to attractive inter-atomic forces (Bonds). These provide favorable energy states & spatial positions (lower energy & farther apart are better), which result in molecules having new chemical, physical, and biological properties.

Electrons, Configurations, & Bonds

Noble Gases and The Rule of Eight

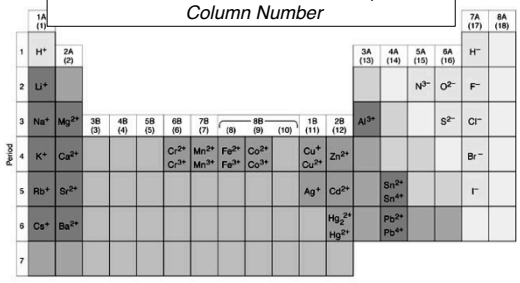
- *When a nonmetal and a metal combine, they form an **ionic bond**: Valence electrons of the metal are lost and the nonmetal gains these electrons to achieve a Noble gas electron configuration.*
- *When two nonmetals combine, they form a **covalent bond**: They share electrons to achieve a Noble gas electron configuration.*

Periodic Properties



http://chemconnections.org/general/movies/periodic-prop.MOV

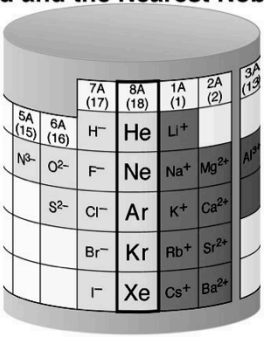
Number of Valence Electrons for Elements in the "A" lettered Vertical Columns Equal the Column Number



Ionic Bonds

- *Result from electrostatic attractions of closely packed, oppositely charged ions.*
- *Form when an atom which can easily lose electrons reacts with one which has a high electronegativity (electron affinity), that is, it can easily gain electrons.*
- *Eg. Mg and Cl; K and O*

The Relationship Between Ions Formed and the Nearest Noble Gas



Electron Configurations

Ionic Compounds

- *Neutrally Charged*
- *Eg. Salt: NaCl → 1 Na^+ and 1 Cl^-*
- *What is the proportion of ions for a compound formed from Mg ion and chlorine?*
- *Mg^{2+} and Cl^-*
- *1 Mg^{2+} combines with 2 Cl^-*

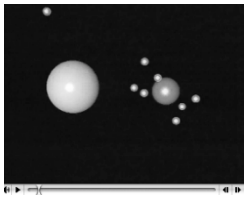
$MgCl_2$

QUESTION

Predict the formula for the binary ionic compound formed by aluminum and oxygen.

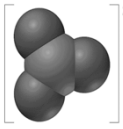
A) Al_2O_3 ***B) Al_3O_2*** ***C) Al_2O*** ***D) AlO_2***

Ionic vs. Covalent Bonding



http://chemconnections.org/general/movies/ionic-covalent.mov

Polyatomic Ions



Carbonate ion
CO_3^{2-}

Common Polyatomic Ions

Ion	Name	Ion	Name
Hg_2^{2+}	Mercury(I)	NCS^-	Thiocyanate
NH_4^+	Ammonium	CO_3^{2-}	Carbonate
NO_2^-	Nitrite	HCO_3^-	Hydrogen carbonate (bicarbonate is a widely used common name)
NO_3^-	Nitrate		
SO_3^{2-}	Sulfite		
SO_4^{2-}	Sulfate	ClO^-	Hypochlorite
HSO_4^-	Hydrogen sulfate (bisulfate is a widely used common name)	ClO_2^-	Chlorite
		ClO_3^-	Chlorate
		ClO_4^-	Perchlorate
OH^-	Hydroxide	$C_2H_3O_2^-$	Acetate
CN^-	Cyanide	MnO_4^-	Permanganate
PO_4^{3-}	Phosphate	$Cr_2O_7^{2-}$	Dichromate
HPO_4^{2-}	Hydrogen phosphate	CrO_4^{2-}	Chromate
$H_2PO_4^-$	Dihydrogen phosphate	O_2^{2-}	Peroxide
		$C_2O_4^{2-}$	Oxalate

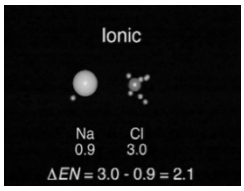
http://chemconnections.org/general/chem120/polyatomics.html

QUESTION

Which formula containing polyatomic ions is correct?

A) $MgNO_3$ B) NH_4CO_3 C) $Na(PO_4)_3$ D) $Al_2(SO_4)_3$

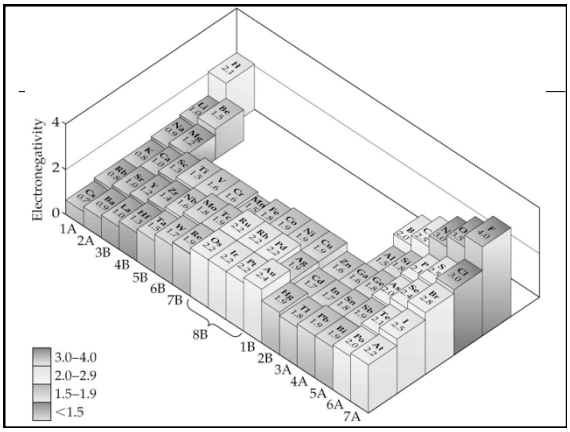
Electronegativity



http://chemconnections.org/general/movies/electronegativity.mov

Electronegativity

http://chemconnections.org/general/movies/Periodic-e.n.MOV



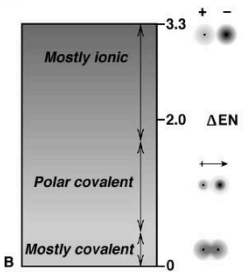
QUESTION

For the elements Rb, F, and O, the order of increasing electronegativity is:

A) Rb < F < O.
B) Rb < O < F.
C) O < F < Rb.
D) F < Rb < O.
E) none of these.

Boundary Ranges for Classifying Ionic Character of Chemical Bonds

ΔEN	IONIC CHARACTER
>1.7	Mostly ionic
0.4-1.7	Polar covalent
<0.4	Mostly covalent
0	Nonpolar covalent



QUESTION

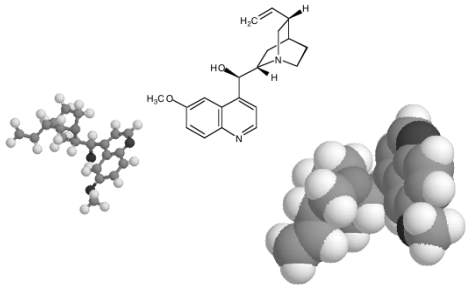
Atoms having greatly differing electronegativities are expected to form:

1) no bonds.
2) polar covalent bonds.
3) nonpolar covalent bonds.
4) ionic bonds.
5) covalent bonds.

Chemical Formulas & Molecular Representations

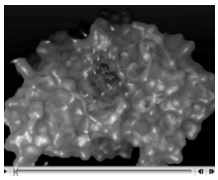
http://chemconnections.org/general/movies/Representations.MOV

Structural Representations of Quinine



Proteins & Small Molecules

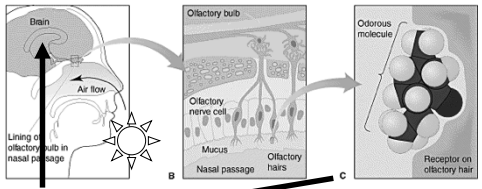
The interaction of a large protein bio-polymer, acetylcholinesterase, with a relatively small molecule of acetylcholine. A general process similar to the way that scientists that think we smell and many physiological processes.



http://chemconnections.org/general/movies/richard.mpg

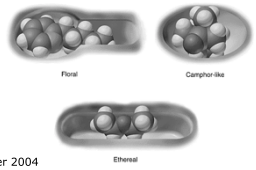
Detecting stuff we cannot see: the Sense of Smell Models, Theories & Interactions

http://chemconnections.org/organic/chem226/Labs/Smell/smell-links.html



Structure-Odor Relationships
Karen J. Rossiter, *Chem. Rev.*, 1996, *96*, 3201-3240

Historical view of a few smell receptors.



4 October 2004

The Nobel Assembly at Karolinska Institutet has today decided to award

The Nobel Prize in Physiology or Medicine for 2004

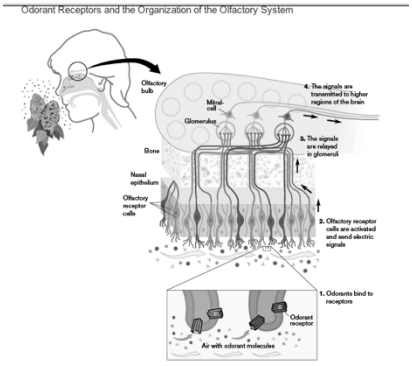
jointly to

Richard Axel and **Linda B. Buck**

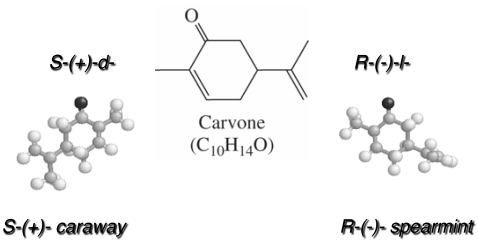
for their discoveries of

"odorant receptors and the organization of the olfactory system"

http://chemconnections.org/organic/chem226/Labs/Smell/ChemComm.html



Shapes & Interactions: Mirror Images & Smell



S-(+)- caraway ***R-(-)- spearmint***

http://chemconnections.org/organic/chem226/Labs/Smell/Smell-Stereochem.html