CHEM 205 section 03

LECTURE #23 Thurs. March 27, 2008

ASSIGNED READINGS:

TODAY'S CLASS: Ch.9…

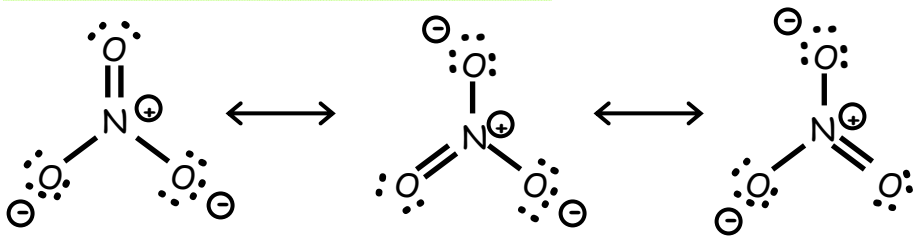
NEXT CLASS: finish Ch.9
(read ahead: 9.7-9.8)

9.10 Bond Properties: bond order, length & strength

BOND ORDER = # of pairs of e⁻s shared by 2 atoms in a molecule

single bond: 1 bonding pair ⇨ B.O. = 1
double bond: 2 bonding pairs ⇨ B.O. = 2
triple bond: 3 bonding pairs ⇨ B.O. = 3

In nitrate: average NO bond order is 1.33



B.O. = (# bonding pairs) / (# pairs of atoms bonded)
= 4 / 3
= 1.33 slightly more than a single bond…

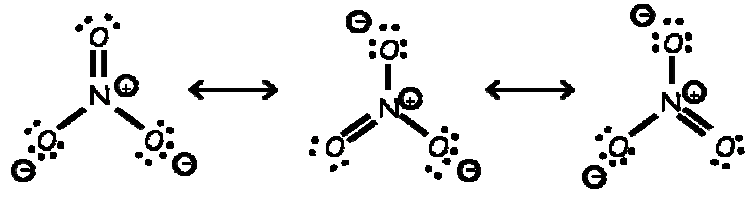
BOND LENGTH = internuclear distance where the system's energy is a minimum
(see Table 9.8)

Bond length is roughly based on sizes of atoms involved
- sum of van der Waals (atomic) radii ≈ approx. length of single bond
- BUT: neighbouring parts of molecule can push/pull on electrons and change bond lengths significantly

NO bonds…
$\Sigma_{radii} = r_N + r_O$
= 71 + 66 pm
= 137 pm

BOND:	N — O	N = O	N ≡ O
BOND ORDER:	1	2	3
BOND LENGTH:	~136 pm	~115 pm	~108 pm

In nitrate (a resonance hybrid): all N-O bonds same length, 125 pm



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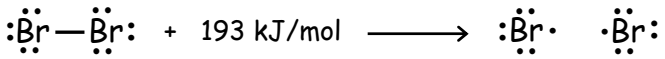
BOND ENERGY = energy required to break bond *homolytically*
(*i.e.*, "*equal cutting*": $1e^-$ goes to each atom)



LARGER BOND ENERGY ⇨ STRONGER BOND

- **Formal name: Bond Dissociation Energy, BDE *or* "D"**
  = energy required to break **1 mole** of the type of bond in question
  - *Kotz goes into much more detail than we will in Chem205*
  - *Not responsible for doing ΔH_{rxn} calculations until Chem206…*

WHAT YOU NEED TO KNOW: bond E correlates with strength
- Energy required to break bonds (*vs.* E released when bonds form)
- Shorter bonds not necessarily stronger (what about atoms' sizes?)
- Same bond order, same elements: similar bond strength (length too)
- Bond energies are affected somewhat by rest of molecule AND affected by whether or not the electrons in the bond are shared equally…

(4)

ASSIGNED READINGS

BEFORE NEXT CLASS:

Read ahead: Ch.9 p.397-399 (especially figures!)

Practice: Lewis structures
resonance
bond orders
bond length / energy

DRAWING LEWIS STRUCTURES IS ESSENTIAL FOR NEXT TOPIC