

COUPLED INTERACTIONS

Interactions between vibrations can occur (Coupling) if the vibrating bonds are joined to a single, central atom.


This is because there is mechanical coupling interaction between the oscillators.

Example:

C=O (both symmetric and asymmetric stretching vibrations)

REQUIREMENTS FOR COUPLING

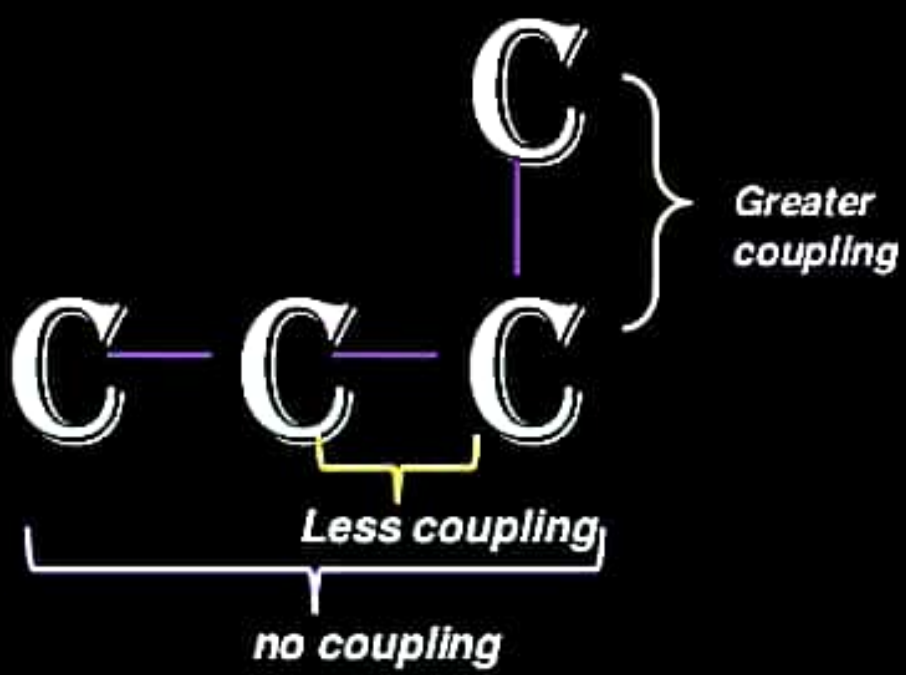
- The vibrations must be of the same symmetry species if interaction is to occur
- Strong coupling of stretching vibrations occurs when there is a common atom between the two vibrating bonds.
- Coupling of bending vibrations occurs when there is a common bond between vibrating groups.



- Coupling is greatest when the coupled groups have approximately equal energies

- Coupling between a stretching vibration and a bending vibration occurs if the stretching bond is one side of an angle varied by bending vibration.

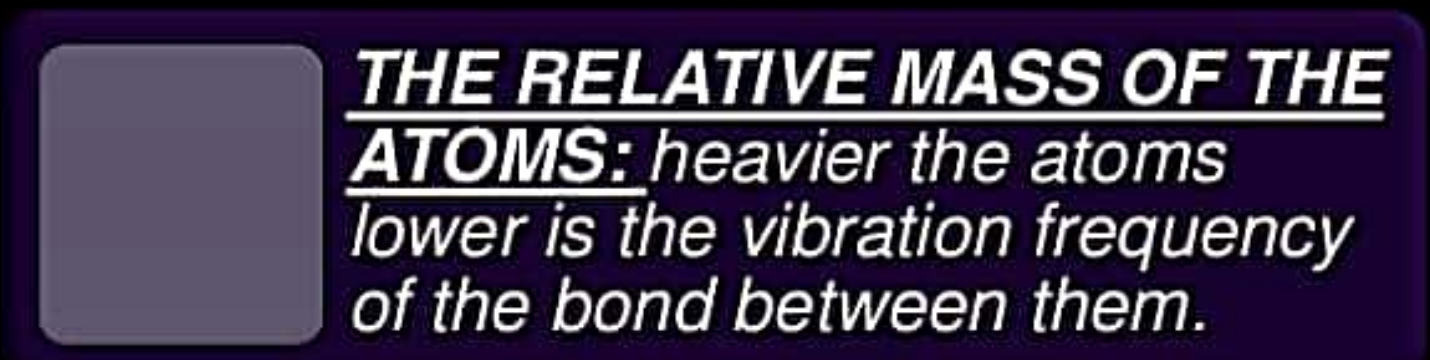
- No coupling is seen between groups separated by two or more bonds



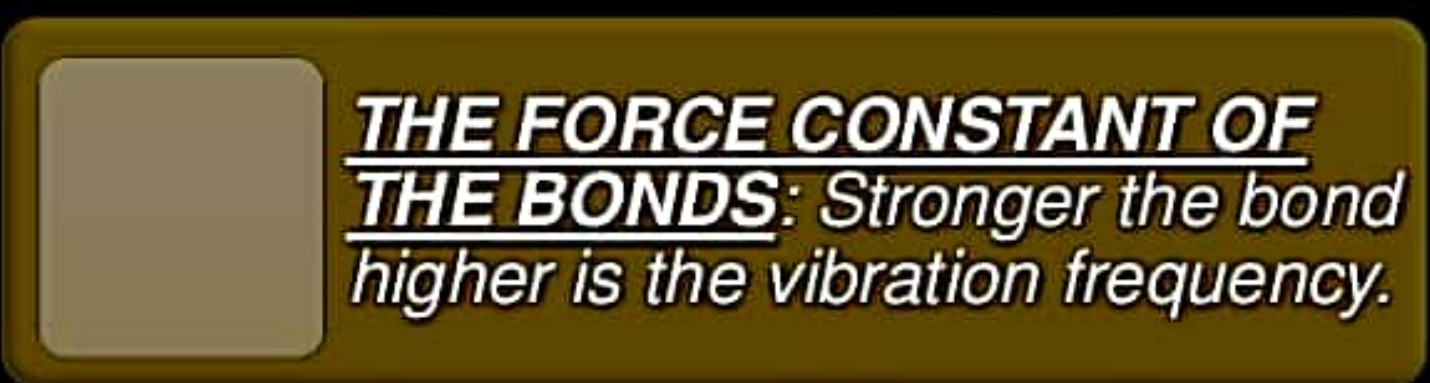
Stronger bonds O-H, N-H & C-H
weaker bonds C-C & C-O bond.

EFFECTS OF BONDS: C=C stretching
is expected to absorb at a higher
frequency than C-C stretching.

Example: C≡C 2200cm⁻¹
C=C 1650cm⁻¹
C-C 1200cm⁻¹



THE RELATIVE MASS OF THE ATOMS: heavier the atoms lower is the vibration frequency of the bond between them.



THE FORCE CONSTANT OF THE BONDS: Stronger the bond higher is the vibration frequency.

Fundamental vibration of molecule depend on degree of freedom

Each atom has 3 degree of freedom depend on x , y ,z

For a molecule containing n number of atom s has 3n degree of freedom

For non linear molecule 3 degree of freedom represent rotational & transational motion

For non linear (3n-6)degree of freedom represent fundamental vibrations

For linear (3n-5)degree of freedom represent fundamental vibrations

All vibrational changes don't appear as band



Only those vibrational changes that result in change in dipole movement appear as band