

The Quantum Mechanical Model and Covalent Bonding

Valence Bond Theory

- Developed by Linus Pauling
- A covalent bond is formed when two half-filled orbitals (one from each atom) overlap (share the same space) to produce a new combined orbital containing two electrons of opposite spin
- This arrangement decreases the energy of the atoms in the bond making them more stable

Examples:



Try #3 and 4 on page 232

Hybrid Orbitals

- Is an atomic orbital obtained by combining at two different orbitals
- Are formed when the number of bonds an atom forms exceeds the number of half-filled orbitals for that atom (as seen with carbon in CH_4)

Draw the orbital diagram for carbon

Draw the structural diagram for CH_4

- Since 4 half-filled orbitals are needed to make the 4 bonds, the valence bond theory says that one electron from the s will be promoted to the empty p orbital. The energy that the atom puts out to promote the electron will be more than gained back when the bond forms.
- Experimental evidence shows that shape and energy of all 4 bonds is identical. How is this possible when one orbital is s and the other 3 are p's?
- The valence bond theory states that the s and 3 p's no longer exist but that 4 new hybrid orbitals exist, all with the same shape and energy.

- The carbon atom will not hybridize unless it is in the process of forming bonds - i.e. the atom would have nothing to gain by the expenditure of energy
- A similar process occurs in BF_3 and in BeH_2 :

DARLENE WALL.CA

Try: #8-14 on page 235