SOME INTERMOLECULAR BONDS

Metallic bond

- Found in most metals
- Consists of the attractions between the semi-positive metallic nuclei and the cloud of valence electrons free to move around the nuclei
- This bond exists because of the low ionization energy of metals
- If you imagine a metallic solid as a Rice Krispie square, the atoms would be the actual Rice Krispies and the marshmallows would be the sea of mobile electrons that holds the whole thing together

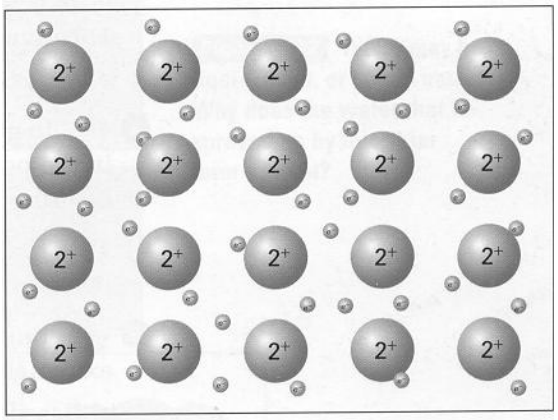
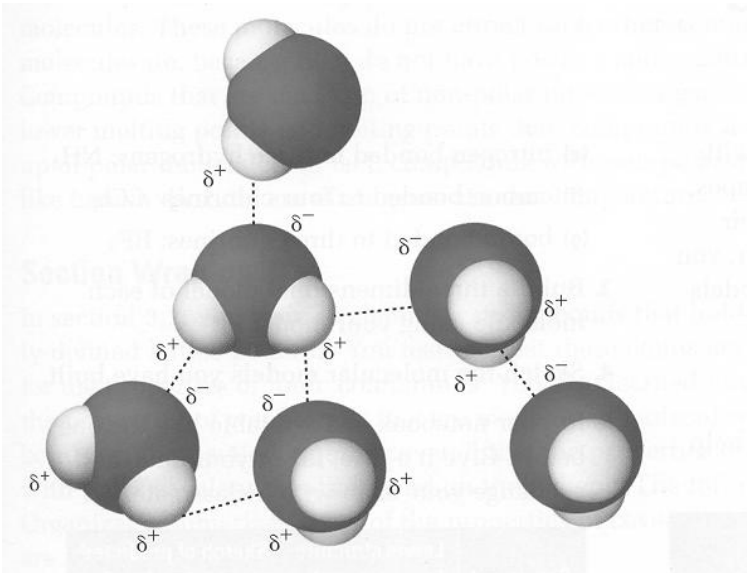


Figure 3.21 In magnesium metal, the two valence electrons from each atom are free to move in an "electron sea." The valence electrons are shared by all the metal ions.

Dipole-Dipole Bond

- This bond is found between **polar molecules** where the δ+ end of one polar molecule is attracted to the δ- end of another polar molecule
- This bond is about 1% as strong as a covalent bond



Hydrogen bond

- This bond is a strong dipole-dipole attraction between neighbouring polar molecules when hydrogen is covalently bonded to a highly electronegative atom such as O, Cl, F and N
- The bond is due to the large ΔE'neg
- The larger the difference in ΔE'neg, the greater the dipole and the stronger the bond
    - H_2O (polar molecule) bp = 100°C and has a ΔE'neg = 1.4
    - NH_3 (polar molecule) bp = -33.4°C with a ΔE'neg = 0.9
- This bond is about 5% as strong as a covalent bond

hydrogen bonding the attraction of hydrogen atoms bonded to N, O, or F atoms to a lone pair of electrons of N, O, or F atoms in adjacent molecules

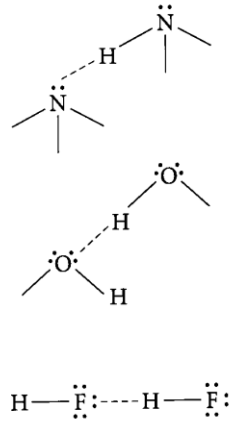


Figure 5
A hydrogen bond (--) occurs when a hydrogen atom bonded to a strongly electronegative atom is attracted to a lone pair of electrons in an adjacent molecule.

Van der Waals/Dispersion/London Forces

- This bond is the electrostatic force of attraction between momentary δδδ- end of a non-polar molecule and the δδδ+ end of another non-polar molecule
- The δδδ- and δδδ+ charges arise because the motion of electrons in one molecule affect the motion of electrons in adjacent molecules
- The electron density works like a pendulum involving all the molecules so that they are all attracted
- Instantaneous dipoles are created
- These forces are quite weak (about 0.1% as strong as a covalent bond)
- Molecules or atoms with large electron clouds experience stronger VDW because the electrons are more easily moved since they are further away from the nucleus
    - C_3H_8 bp = -42°C
    - $C_{10}H_{22}$ bp = 174.21°C (has more spots for VDW)