Chapter 12—Intermolecular Forces and Liquids and Solids

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After this chapter, you should be able to…

- Sketch the arrangement of atoms/ions/molecules in a solid, liquid, and a gas.
    - Explain how the arrangement of particles in the solid/liquid/gas determines its properties (compressibility, density, volume, etc…)
- Define "Intermolecular Forces"
- Explain the difference between intramolecular and intermolecular forces, and their approximate difference in energies
- Explain what are meant by the van der Waals forces
- Explain the cause, approximate magnitude, and importance of the following intermolecular forces:
    - Dipole-Dipole
    - Ion-Dipole
    - Dispersion (London)
    - Hydrogen Bond
- Be able to recognize which intermolecular forces exist in a given compound
    - Be able to sketch the cause of each intermolecular force between a pair of molecules/ions
    - Explain the biological importance of hydrogen-bonding
- Explain the difference between an amorphous and a crystalline solid (be able to give examples of each type)
- Explain what is meant by a unit cell, and a lattice point
    - Sketch and name the three common types of cubic unit cells
    - Explain how many atoms exist within a given unit cell, based on examination of the number of atoms at corners (1/8), edges (1/4) and faces (1/2)
- Calculate the density of a compound given its unit cell geometry (simple/body/face) and the length of the unit cell (See example 12.3)
- Calculate the length of the unit cell, or the diameter/radius of each atom in a solid whose density and type of unit cell is specified (See practice exercise 12.3, and problem 12.48)

- Explain why molecular crystals how low melting points. Be able to give examples of a molecular solid.
- Explain why network covalent solids have high melting point. Be able to give examples of network covalent solids, and be able to sketch or recognize their 3-d structure
- Explain the arrangement of the valence electrons in a metallic crystal, and why they tend to have high electrical conductivities
- Define what is meant by a phase change
    - Name the six common phase changes
- Explain what is meant by vapor pressure, and why it is a dynamic equilibrium
    - Explain how vapor pressure may be measured
- Sketch a graph of vapor pressure vs. temperature
    - Explain what the graph will look like for a volatile, or a non-volatile liquid
    - Explain how a liquid's volatility is determined by the intermolecular forces (IMFs) between the molecules
    - Predict which compound will have the highest/lowest vapor pressure given its formula (from consideration of the types of IMFs present)
- Explain how a graph of vapor pressure vs. Temp. can be used to determine the boiling point of a compound. Explain how boiling point varies with external pressure, and the meaning of the term "normal boiling point", nbp
- Explain when a liquid and a solid are in equilibrium with each other
- Explain when a solid and a vapor are in equilibrium with each other
    - Write thermochemical equations corresponding to: ΔH_{vap}, ΔH_{fus} and ΔH_{sub}. Explain how ΔH_{sub} is related to ΔH_{fus} and ΔH_{vap}.
- Use a phase diagram to predict the most stable phase of a compound at a specified temperature and pressure
- Use a phase diagram to explain how the boiling point/melting point/sublimation point of a compound varies with pressure
- Explain what is meant by the triple-point
- Make sure you can answer all the assigned homework problems!