

IMF's, Liquids, & Solids

STUDY LIST From Paul Groves

I can...

Types of Solids

- classify any substance into the four solids:
 - molecular
 - metals
 - ionic
 - covalent network
- list the eight examples of covalent network solids
- determine whether a molecule is polar or nonpolar from its formula & structure
- explain that acids (e.g. HCl) are a **molecular** substance (not an ionic substance) even though they form ions in solution

Bonding and Properties

- describe the bonding in:
 - metals
 - ionic solids, and
 - covalent network solids
- list and explain the properties of the above three types of substances, including
 - melting point/boiling point
 - conductivity as (s), (l), (g), & (aq)
 - brittleness or malleability
- give examples of each of the types of solids
- use lattice energy ideas to compare the strength of bonding in various ion pairs

Intermolecular Forces of Attraction

- make the distinction between inter- and intra-molecular forces of attraction such as in a gaseous sample of HCl.
- list and describe the IMF's associated with polar molecules, non-polar molecules, and noble gases
 - London dispersion forces (LDF)
 - dipole-dipole attractions
 - hydrogen bonding
- state how the strength of IMF is related to MP, BP, ΔH_{vap} , ΔH_{fus} , & vapor pressure

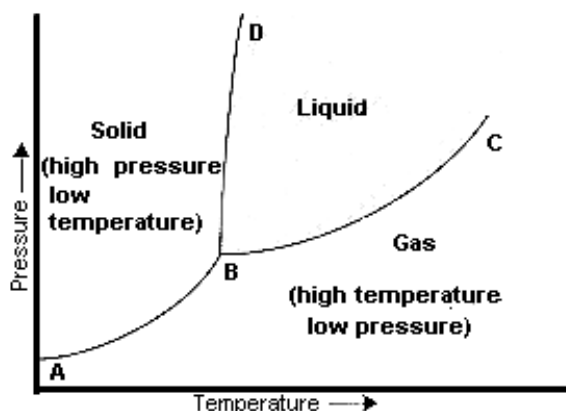
- predict the strength of London dispersion forces (LDF) in terms of the "polarizable electron clouds" available in the two molecules.
- predict the strength of dipole-dipole interactions based on the polarity of the bonds in two polar molecules
- explain why H-O, H-N, and H-F are placed in a separate category called "hydrogen bonding" (i.e., why N, O, and F).
- explain that during a phase change, the IMF's are broken, not the *intra*-molecular bonds.
- predict the miscibility of two substances based on the similarity or differences between their IMF's.
- explain that the stronger a molecule's IMF, the more it deviates from ideal behavior.

Vapor Pressure & Boiling

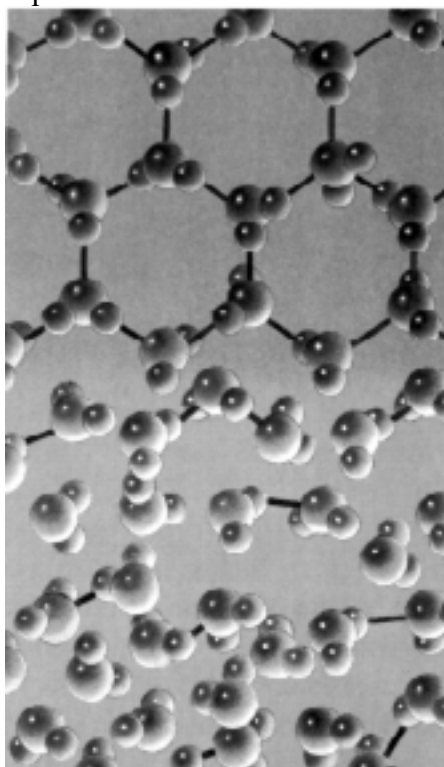
- explain that equilibrium vapor pressure is associated with the liquid-vapor dynamic equilibrium measured in a closed container
- state that temperature is the only variable that changes the vapor pressure of any liquid (not the amount of liquid, pressure above the liquid, or volume of the closed container)
- infer the relative strength of IMF's of two liquids given their vapor pressures
- explain that a liquid will boil when its vapor pressure matches the pressure above the liquid
- explain that a liquid can be made to boil by heating the liquid or by reducing the pressure above the liquid
- define "normal boiling point" as the temperature at which a liquid will boil at sea level (1 atm = 760 mmHg = 101.3 kPa, etc.)
- explain that vapor pressure is a result of the balance between the kinetic energy of the molecules and the strength of their IMF's.

Phase Changes

- list the names of the phase changes between (s), (l), and (g)
- sketch a “phase diagram” for a substance and label
 - the three phases
 - the triple point
 - the critical point

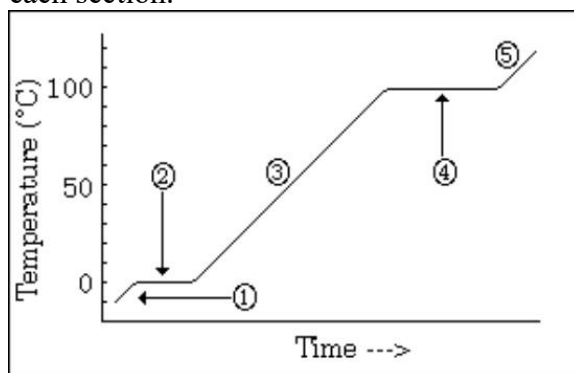


- explain why water’s solid-liquid line has a negative slope in terms of the density of liquid and solid water.



- calculate the energy involved in a phase change given values for ΔH_{vap} and ΔH_{fus} .

- list the type of energy change (kinetic or potential) that occurs during each section of a heating curve. Label the phase(s) present in each section.



Surface Tension

- explain that a non-surface molecule is more stable (lower potential energy) than a surface molecule because it has the maximum number of neighbors. Liquids tend to minimize the number of high-energy surface molecules. This is called surface tension. The shape with the minimum surface area for its volume is a sphere.

