

Intermolecular Forces, Solids, Phase Changes, Concentration Units, and Bond theory

December 6, 2023

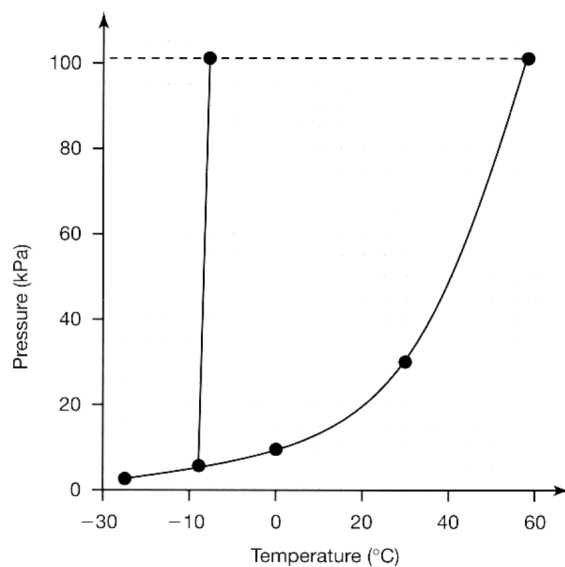
Intermolecular Forces

- 1) List all types of intermolecular forces for the following compounds.
 - a) CH_3CF_3
 - b) CCl_4
 - c) SO_2
 - d) CH_3OH
- 2) Rank from lowest to highest boiling point: CaCO_3 , H_2O , $\text{C}_{10}\text{H}_{22}$, CH_3OCH_3
- 3) Generally, nonmetals have low melting point and exists as a gas at room temperature. However, iodine is a nonmetal that is solid at room temperature. Explain why.

Phase Changes

- 4) For bromine (Br_2), calculate the amount of heat required to heat 20.0g bromine (Br_2) from -15.0°C to 60.0°C . Bromine melts at -7.2°C and evaporates at 58.8°C . The enthalpy of fusion of bromine is 10.57 kJ/mol and the enthalpy of vaporization of bromine is 29.96 kJ/mol. The specific heat of liquid bromine is 0.474 J/(g $^\circ\text{C}$) and the specific heat of solid bromine is 0.226 J/(g $^\circ\text{C}$).

5) Bromine sublimates when the temperature is -25°C and the pressure is 101.3 kPa. The phase diagram for bromine is shown below.



- Label each region as solid, liquid, or gas.
- Label the triple point, melting point, and boiling point at 40 kPa.

Unit Concentrations

- A solution is prepared by mixing 100.0 g of H_2O and 100.0 g of ethanol ($\text{CH}_3\text{CH}_2\text{OH}$). Determine the mole fraction of each substance.

7) Calculate the molality of a solution containing 16.5 g of dissolved naphthalene (C_{10}H_8) in 54.3 g benzene (C_6H_6).

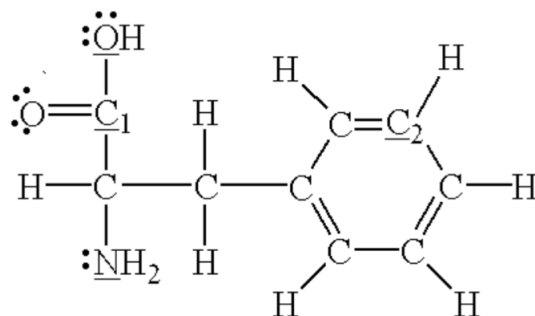
8) Find the molality of 18.0 M H_2SO_4 . This solution has a density of 1.84 g/mL.

Valence Bond Theory

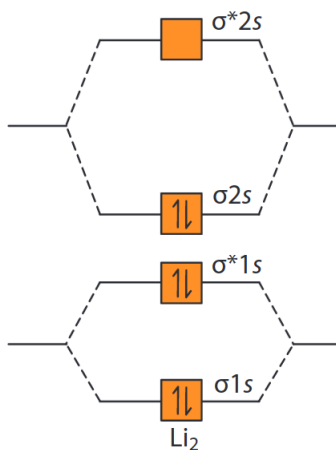
9) Determine the hybridized orbitals of the central atom for each of the following molecules: SO_4^{2-} , PO_3^{3-} , NO_2^- , and CO_2

10) Describe the naunce differences between the Valence Bond Theory and Molecular Orbital Theory.

11) How many sigma and pi bonds are in the molecule below?



12) Use the molecular orbital diagram of Li_2 to sketch the Li_2^+ and Li_2^- ions. Compare the stability, bond strength, and magnetic properties of each ion specie.



Colligative Properties and Osmotic Pressure

13) The freezing point of a glucose solution ($\text{C}_6\text{H}_{12}\text{O}_6$) is -10.3°C . The density of the solution is 1.50 g/mL . What is the molarity of the glucose solution? K_f of water is $1.86^\circ\text{C kg/mol}$.

14) What is the osmotic pressure of a solution prepared by adding 13.65 g of sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) to water to make $250.\text{ mL}$ of solution at 25°C . Hint: Use $\Pi = iMRT$

15) For the image below, there is pure water and glucose solutions separated by a semipermeable membrane. Describe what will happen to the water level of each solution once equilibrium is achieved.

