CHM 112 Worksheet and Study Guide

Purpose: This is a guide for your as you work through the chapter. The major topics are provided so that you can write notes on each topic and work the corresponding problems.

This should serve a s a study guide as you go on to do the problems in Sapling and take the quizzes and exams.

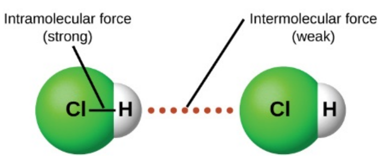
The Problems are embedded in the Topics and Space for Notes

Section 1: Intermolecular Forces and Properties of Liquids

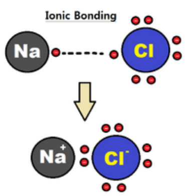
By the end of this section, you will be able to:

- Describe the types of intermolecular forces possible between atoms or molecules in condensed phases (dispersion forces, dipole-dipole attractions, and hydrogen bonding)
- Identify the types of intermolecular forces experienced by specific molecules based on their structures
- Explain the relation between the intermolecular forces present within a substance and the temperatures associated with changes in its physical state

1. Intermolecular Forces vs. Intramolecular Forces

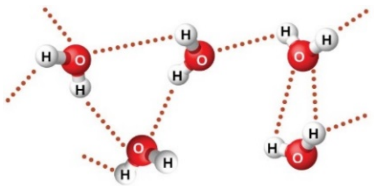


Covalent vs. Ionic bonding

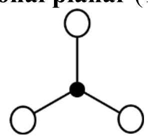
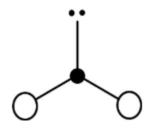
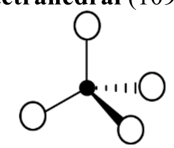
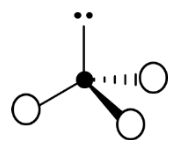
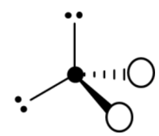
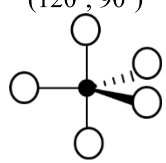
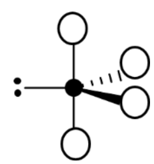
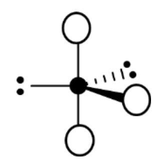
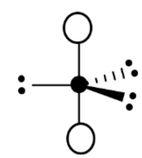
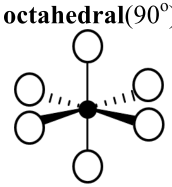
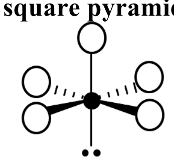
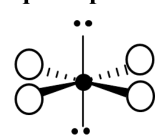
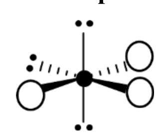


2. Forces working in a covalent bond

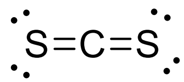
- Dipole-Dipole
- London Dispersion Forces (induced dipole-induced dipole)
- Hydrogen Bonding



Review Lewis Structures, Molecular Geometries and Polarity

Electron Groups	Hybridization	0 Lone Pairs	1 Lone Pair	2 Lone Pairs	3 Lone Pairs	4 Lone Pairs
2	sp	**linear** (180^o) 				
3	sp^2	**trigonal planar** (120^o) 	**bent** 			
4	sp^3	**tetrahedral** (109^o) 	**trigonal pyramid** 	**bent** 		
5	sp^3d	**trigonal bipyramid** (120^o, 90^o) 	**seesaw** 	**T-shaped** 	**linear** 	
6	sp^3d^2	**octahedral**(90^o) 	**square pyramid** 	**square planar** 	**T-shaped** 	**linear** 

3. What will be the geometry about each central atom in the following molecules? Draw a sketch of the molecule. Is the molecule polar?

Formula	Structure	Shape	Angle	Polar? Y/ N	IMF
CS_2		linear	180°	N	dispersion
SBr_2					
HOF (O is central)					
SO_3					
COH_2 (C is central)					
CF_4					

C_3H_8					
NH_2CO_2H (both O atoms are attached to the C)					
$HOCH_2CH_2OH$					

Section 2:

By the end of this section, you will be able to:

- Distinguish between adhesive and cohesive forces
- Define viscosity, surface tension, and capillary rise
- Describe the roles of intermolecular attractive forces in each of these properties/phenomena

4. Define each of these properties of Liquids

(A) Boiling Point.

(B) Surface Tension

(C) Viscosity

(D) Capillary Action

(E) Vapor Pressure

5. As the Intermolecular Forces go up… do these go up or down?

BP

Viscosity

Surface Tension

Capillary Action

6. <u>Identify the IMFs in each substance and then state whether or not they will form a homogeneous solution. (Like dissolves Like!)</u>

A) NaCl and Hg

B) C_3H_8 and H_2O

C) LiF and C_6H_{14}

D) Br_2 and CCl_4

E) NH_3 and CH_3OH

<u>7. Choose the substance out of the pair that has the:</u>

A) Highest boiling point: C_6H_{14} and $C_{10}H_{20}$

B) Lowest Vapor Pressure: LiBr and C_5H_{12}

C) Greatest ΔH vaporization: HF and HCl

Section 3: By the end of this section, you will be able to:

- **Define phase transitions and phase transition temperatures**
- **Explain the relation between phase transition temperatures and intermolecular attractive forces**

- **Describe the processes represented by typical heating and cooling curves, and compute heat flows and enthalpy changes accompanying these processes**
- P = Ae −ΔHvap /RT
- ln P = − ΔHvap/RT + ln A
- q=massC_sΔT
- q=molesΔH

$$\ln \frac{p_2}{p_1} = -\frac{\Delta H_{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Define

A) phase transitions and phase transition temperatures (particularly normal BP and MP; triple point and critical point)

B) Explain the relation between phase transition temperatures and intermolecular attractive forces

C) Describe the processes represented by typical heating and cooling curves, and compute heat flows and enthalpy changes accompanying these processes.

Heating and Cooling Curves:

Define ΔH vaporization and ΔH fusion.

Define specific heat capacity.

Some useful data: C_s H_2O (l) = 4.184 J/g°C. C_s H_2O (g) = 2.02 J/g°C. C_s H_2O (s) = 2.06 J/g°C. ΔH fusion H_2O = 6.02 kJ/mole and ΔH vap = 40.7 kJ/mole.

$q = mass \cdot C_s \cdot \Delta T$ and $q = moles \cdot \Delta H$. (remember the difference between endo and exothermic!)

8. Draw the cooling curve that results when 10.0 g of steam at 100. °C cools to ice at -10. °C.

Calculate the amount of heat released.

9. Sketch a vapor pressure curve for water and diethyl ether. Consider the IMFs. What is the equation for the curve? (Clausius-Clayperyon equation)

10. Determine the vapor pressure of a substance at 55 °C. The substance has a normal boiling point is 82.3°C and a ΔH_{vap} of 39.9 kJ/mol.

Phase Diagrams: Section 4:

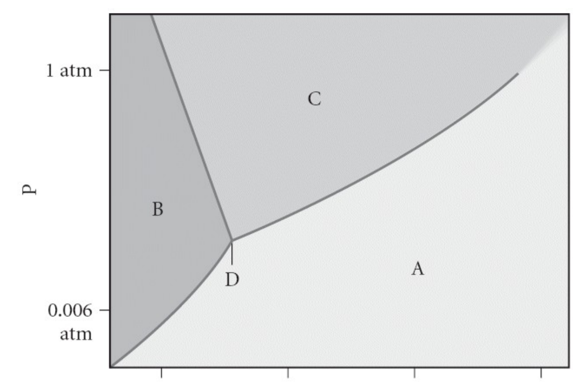
By the end of this section, you will be able to:

- Explain the construction and use of a typical phase diagram
- Use phase diagrams to identify stable phases at given temperatures and pressures, and to describe phase transitions resulting from changes in these properties
- Describe the supercritical fluid phase of matter

A) Explain the construction and use of a typical phase diagram

B) Use phase diagrams to identify stable phases at given temperatures and pressures, and to describe phase transitions resulting from changes in these properties.

11. Assign the appropriate labels to the phase diagram shown below.



Which is more dense? The solid or liquid?

Label normal boiling point and normal melting point.

12. Sketch a phase diagram for benzene and locate these points: the triple point (5.5 ^{0}C and 3.4 mmHg), the normal boiling point (80.1^{0}C), the critical point (288.5^{0}C and 145 atm).

Section 5: By the end of this section, you will be able to:

- Define and describe the bonding and properties of ionic, molecular, metallic, and covalent network crystalline solids
- Describe the main types of crystalline solids: ionic solids, metallic solids, covalent network solids, and molecular solids

13. Define and describe the bonding and properties of ionic, molecular, metallic, and covalent network crystalline solids and give an example of each.