Intermolecular Forces

1. Define the term *equilibrium vapor pressure*.

   a. Use a vapor-pressure table (in your text or some other reference book) to look up the equilibrium vapor pressure of a sample of water at 28 ˚C.

   b. Consider a closed container partially filled with liquid water at 28 ˚C. Can the pressure of water vapor in the gas phase ever exceed the equilibrium vapor pressure at this temperature? Explain why or why not.

2. Write the Clausius-Clapeyron equation in the space below and define each term.

3. Given the vapor pressure of ammonia is 164 mmHg at -56 ˚C, calculate the vapor pressure at -45 ˚C.

$\Delta H^\circ_{vap} = 28.0 \frac{kJ}{mol}$.

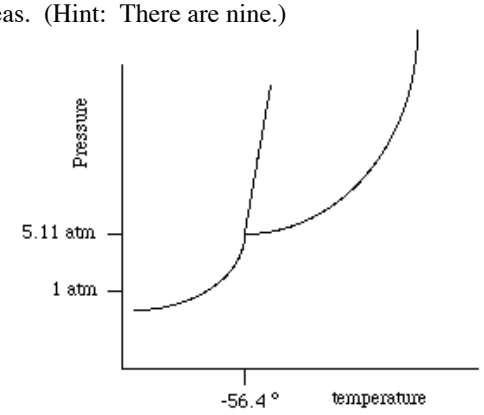
4. Calculate the normal boiling point of ammonia knowing the vapor pressure at –38 ˚C is 538 mmHg.

$\Delta H^\circ_{vap} = 28.0 \frac{kJ}{mol}$

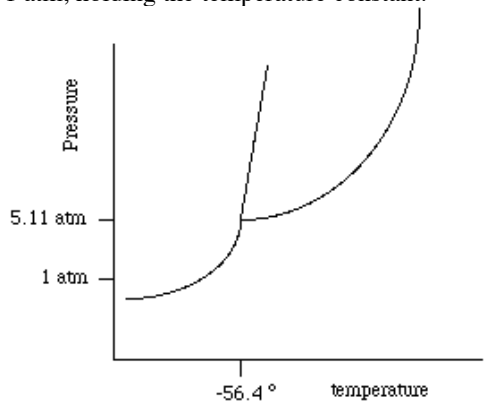
5. Sketch the orientations of molecules and/or ions involved in the following intermolecular attractive forces. Include at least one specific example where each attractive force is important. For each one, tell what causes the force and describe its strength relative to the others.

   a) ion- dipole forces
   b) dipole-dipole forces
   c) London dispersion forces

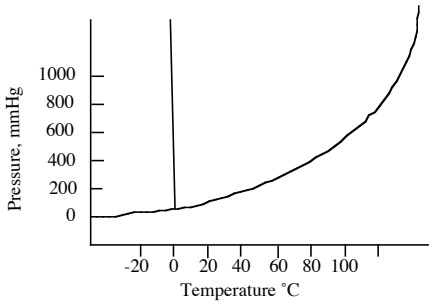
6. The phase diagram for carbon dioxide is shown below. Complete the diagram by identifying all of the important points, lines and areas. (Hint: There are nine.)



7. Describe the changes that occur in a sample of carbon dioxide at -52 ˚C as the pressure is increased from 1 atm, holding the temperature constant.



8. In the phase diagram for water shown below;



a) At 400 mmHg what is the approximate temperature needed to convert water from a solid to a liquid?

b) What is the approximate pressure at which water changes from a liquid to a gas at 80 ˚C?

9. Indicate what change, if any, should occur in each of the following properties as a result of an increase in the strength of intermolecular forces:

a) vapor pressure;
b) normal boiling point;
c) normal melting point
d) surface tension;
e) viscosity;
f) heat of fusion;
g) heat of vaporization;
h) molecular weight.

10. Indicate all the various types of intermolecular attractive forces that may operate in each of the following:

a) $CH_3OH(l)$;
b) $Xe(l)$;
c) $H_2S(l)$;
d) $ClF(l)$
e) $Ca(NO_3)_2(s)$