

AP Chemistry: *Viscosity, Surface Tension, and Change of State* WS#2

For each problem below, write the equation and show your work. Always use units and box in your final answer.

1. Name all the possible phase changes that can occur between different states of matter. Which of these are exothermic, and which are endothermic?
2. Explain the following observations:
 - a. During the cold winter months, snow often gradually disappears without melting.
 - b. The heat of fusion of any substance is generally lower than its heat of vaporization.
3. For many years, drinking water has been cooled in hot climates by evaporating it from the surfaces of canvas bags or porous clay pots. How many grams of water can be cooled from 35°C to 22°C by the evaporation of 50 g of water? The heat of vaporization of water in this temperature range is 2.4 kJ/g. The specific heat of water is 4.18 J/g K.
4. Ethanol, C₂H₅OH, melts at -114°C and boils at 78°C. The enthalpy of fusion of ethanol is 5.02 kJ/mol, and its enthalpy of vaporization is 38.56 kJ/mol. The specific heats of solid and liquid ethanol are 0.97 J/g K and 2.3 J/g K, respectively. How much heat is required to convert 75.0 g of ethanol at -120°C to the vapor phase at 78°C?
5. a) What does the critical temperature tell us about the conditions required for liquefaction of gases?

b) Which of the substances listed can be liquefied at room temperature (25°C)?

Substance	Critical Temperature (K)	Critical Pressure (atm)
Ammonia, NH ₃	405.6	111.5
Argon, Ar	150.9	48.0
Carbon dioxide, CO ₂	304.3	73.0
Nitrogen, N ₂	126.1	33.5
Oxygen, O ₂	154.4	49.7
Freon-12™, CCl ₂ F ₂	384.7	39.6
Water, H ₂ O	647.6	217.7

6. Explain how each of the following affects the vapor pressure of a liquid:
- Volume of the liquid
 - Surface area
 - Intermolecular attractive forces
 - temperature
7. Phosphorous trichloride, PCl_3 , is more volatile than arsenic trichloride, AsCl_3 , at 25°C .
- Which substance has the greater intermolecular forces? Explain
 - Which substance has the higher vapor pressure at 25°C ?
 - Which substance will have the higher boiling point?
- 8.
- Two pans of water on different burners of a stove. One pan of water is boiling vigorously, while the other is boiling gently. What can be said about the temperature of the water in the two pans?
 - A large container of water and a small one are at the same temperature. What can be said about the relative vapor pressures of the water in the two containers?
9. Use the vapor-pressure curve in Figure 10.42 to estimate the boiling point of diethyl ether at 400 torr.
10. Mt. McKinley in Alaska is the tallest peak in the United States (20,300 feet). If the barometric pressure at the top of the mountain is 340 torr, at what temperature will water boil there?
11. On a phase diagram why does the line that separates the gas and liquid phases end rather than go to infinite pressure and temperature?

12. What is the significance of the triple point in a phase diagram?
13. Refer to Figure 11.25(a) [text pg 413], and describe all the phase changes that would occur in each of the following cases.
- Water vapor originally at 1.0×10^{-3} atm and -0.10°C is slowly compressed at constant temperature until the final pressure is 10 atm.
 - Water originally at 100.0°C and 0.50 atm is cooled at constant pressure until the temperature is -10°C .
14. Refer to Figure 11.25(b), and describe the phase changes (and the temperatures at which they occur) when CO_2 is heated from -80°C to -20°C at
- constant pressure of 3 atm;
 - a constant pressure of 6 atm.
15. The normal melting and boiling points of xenon are -112°C and -107°C , respectively. Its triple point is at -121°C and 282 torr, and its critical point is at 16.6°C and 57.6 atm.
- Sketch the phase diagram for Xe, showing the four points given above and indicating the area in which each phase is stable.
 - Which is denser, Xe(s) or Xe(l)? Explain
 - If Xe gas is cooled under an external pressure of 100 torr, will it undergo condensation or deposition? Explain.