

2. 2.0 L of ethanol vapor at 89°C is cooled to 4°C under a constant pressure of 1.00 atm.

Is this process exothermic or endothermic?

Calculate the heat exchanged in the *above* process given that ethanol boils at 78 °C and melts at -114 °C, the heat of vaporization is 38.56 kJ/mol and the heat of fusion is 5.02 kJ/mol, and the specific heats of solid, liquid and gaseous ethanol are 0.97 J/g-K, 2.3 J/g-K and 1.70 J/g-K, respectively.

3. The vapor pressure of water at 55°C is 118.0 torr. Estimate the vapor pressure of a 2.00 M solution of glucose ($C_6H_{12}O_6$) using Raoult's Law, given that the density of the solution is 1.132 g/mL. (HINT: Calculate the mass of water from the mass of solution and the mass of glucose).

Multiple Choice. (1-14, 3 pt each)

1. The height difference of the liquid in a pressure manometer (open end) is *not* depended upon the
 - a. atmospheric pressure.
 - b. identity of the liquid in the manometer.
 - c. diameter of the tubing.
 - d. pressure of the gas in the flask.
 - e. molecular weight of the gas in the flask.
2. If the temperature of an ideal gas confined to a sealed container is doubled the
 - a. pressure of the gas decreases by half.
 - b. pressure of the gas doubles.
 - c. pressure of the gas stays constant.
 - d. pressure of the gas equilibrates to atmospheric pressure.
 - e. the number of moles of gas inside the container doubles.
3. A gas is confined to a gas tight syringe with a movable piston. Under isothermal conditions, the piston is compressed, reducing the volume of the gas by half. In response the
 - a. pressure of the gas doubles.
 - b. pressure of the gas decreases by half.
 - c. moles of gas in the syringe decreases by half.
 - d. pressure of the gas remains constant.
 - e. atmospheric pressure increases slightly.
4. 1.0 L of a gas at 1.00 atm and 300 K is allowed to expand to 2.0 L. The final pressure is 0.75 atm. When the system reaches thermal equilibrium the temperature will be
 - a. 300 K
 - b. 800 K
 - c. 450 K
 - d. 112 K
 - e. 298 K
5. A gas confined to a 1.0 L container at 298 K at a pressure of 0.997 atm was found to weigh 1.628 g. The identity of the gas is most likely to be
 - a. oxygen.
 - b. hydrogen.
 - c. nitrogen.
 - d. argon.
 - e. carbon dioxide.

6. The rate of effusion of hydrogen gas is ____ times the rate of diffusion of oxygen gas.
- 2.0
 - 8.0
 - 4.0
 - 0.25
7. Which substance has the lowest boiling point?
- H₂O
 - CH₃OH
 - CH₃CH₂OH
 - CH₃CH₂CH₂OH
 - HOCH₂CH₂CH₂OH
8. C₄H₁₀ (butane) is a gas at room temperature (1 atm), C₁₀H₂₂ (decane) is a liquid at room temperature and C₂₀H₄₂ (candle wax) is a solid at room temperature and 1 atm. The intermolecular forces present in these molecules that explain these differences consist of
- hydrogen bonds.
 - ion-dipole interactions.
 - London dispersion forces.
 - dipole-dipole interactions.
 - covalent networks.
9. What is the nature of the bonding between the SiO₂ units in silica?
- hydrogen bonds.
 - ion-dipole interactions.
 - London dispersion forces.
 - dipole-dipole interactions.
 - covalent networks.
10. 25 mL of a 0.125 M solution of HCl was added to a 500 mL volumetric flask and diluted to the mark with water. The concentration of the diluted solution is
- 0.0125 M
 - 0.0100 M
 - 0.0625 M
 - 0.00625 M
 - 2.50 mM

11. When 50 mL of methanol is added to 50 mL of water in a 200 mL beaker, the outside of the beaker becomes warm to the touch. Choose the statement that best describes this process.
- The process of mixing the two solvents is exothermic and is associated with an increase in entropy.
 - The process of mixing the two solvents is endothermic and is associated with an increase in entropy.
 - The process of mixing the two solvents is exothermic and is associated with a decrease in entropy.
 - No mixing occurs. When the solution reaches equilibrium, methanol is the lower phase and water is the upper phase because methanol has a greater density.
 - No mixing occurs. When the solution reaches equilibrium, water is the lower phase and methanol is the upper phase because water has a greater density.
12. Estimate the boiling point of a 0.010 m CaCl_2 aqueous solution
- 100.0 °C
 - 110.2 °C
 - 99.5 °C
 - 101.1 °C
 - 89 °C
13. Select the aqueous solution that you would expect to have the highest melting point.
- 0.10 m NaCl
 - 0.10 m sucrose
 - 0.10 m $\text{Ca}(\text{NO}_3)_2$
 - 0.0010 m NaCl
 - 0.20 m Na_3PO_3
14. 1.73 g of KCl is added to 600 g of water. Calculate the molality of the resulting solution.
- 0.0387 m
 - 0.387 m
 - 38.7 m
 - 1.73 m
 - 25.8 m

15. Draw the phase diagram for water. Label the areas representing ice, liquid water and water vapor, the normal boiling point, the normal melting point, the triple point and the critical point. (7 pts)