

homework #2 (page 1 or 2)

1. One mole of copper at a uniform temperature of 0°C is placed in thermal contact with a second mole of copper which, initially, is at a uniform temperature of 100°C . The pressure in the system is maintained at 1 atm. The two moles of copper are thermally insulated from the surroundings. Temperature dependence of the constant pressure heat capacity of solid copper can be described by

$$C_p = 33.64 + 6.28 \times 10^{-3} T \text{ J/mole K.}$$

- (a) Calculate the common temperature of the 2 mole system, which is contained in an adiabatic enclosure, when thermal equilibrium is attained.
- (b) How much heat is transferred between the two parts of the system?
- (c) How much entropy is produced by the transfer?
2. Consider a small cube of silver enclosed in a reservoir so large that small transfer of heat to silver does not change its temperature, 1400 K. Calculate the **total entropy produced in the silver-reservoir system** when 1 mole of superheated crystalline silver spontaneously melts at 1400 K and 1 atm pressure. Assume temperature independent heat capacities $c_p = 32.6 \text{ J/K/mol}$ for solid silver and $c_p = 30.5 \text{ J/K/mol}$ for liquid silver. The equilibrium melting temperature is $T_m = 1234 \text{ K}$, molar heat of melting is $\Delta H_m = 11090 \text{ J/mol}$.

Based on the 2nd law of thermodynamics prove that silver will melt spontaneously at 1400 K.

homework #2 (page 2 of 2)

3. A new gaseous species has been made in the laboratory. The number of atoms in each molecules and molecular structure is unknown. Explain how measurements of molar heat capacity can help to identify the molecules.

Does the molar heat capacity depend on the size (number of atoms) of the molecule?

Does an investigation of the temperature dependence of the heat capacity of the gas gives any additional useful information about the new species? If yes, what is the information?

Does the mass of atoms and strength of the interatomic bonds has any effect on the molar heat capacity or its temperature dependence?

A qualitative answer to this question will be sufficient.