CYL110 II Semester 2009 - 2010
Minor Exam I

Date: Feb. 05, 2010 Marks: 100 Time: 1 hour

1. Rubber is composed of a long polymer which is normally tangled together in a random manner. When the rubber is stretched, these long molecules tend to align along the direction of extension.

   (a) A piece of rubber band of length l is stretched by an amount dl at temperature T by applying a force f. Write down the combined form of the first and second law for the rubber band.

   (b) The rubber band is stretched reversibly and isothermally. Does the entropy of the rubber band increase, decrease, or stay the same in this process? Justify.

   (c) Is heat absorbed or released by the rubber band in this process? Why?

2. Consider a system whose Gibbs free energy is given by $G(P,T) = ATP - BT^2$. Derive an expression for the Helmholtz energy $A(P,T)$ for this system.

3. Starting from the differential form of $S(T,V)$, expressed in terms of its partial derivatives, derive an expression for the entropy of an ideal gas as a function of temperature T and volume V in terms of the heat capacity C_v and the entropy S_0 at some reference temperature T_0 and volume V_0.

4. A well-insulated box of volume 6 m^3 is divided into two equal volumes by a partition which contains a valve. The left-hand cell is initially filled with air at 100 ℃ and 2 bar, and the right hand-cell is initially evacuated. The valve connecting the two cells is opened so that the gas slowly passes from the left cell to the right. The wall connecting the two cells conducts heat sufficiently well that the temperature f the gas in the two cells is always the same. Plot on the same graph (1) the pressure in the second tank versus the pressure in the first tank, and (2) the change in the total entropy of the system versus the pressure in tank 1. (3) State any approximations that you made in arriving at the results in (1) and (2). (4) From your above plots argue what is the equilibrium state of the system and why?