PHY3063 Fall 2018

HOMEWORK VI

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Due: October 29, 2018

1. Prob. 7.1.

2. Prob. 7.2.

3. Prob. 7.4.

4. Prob. 7.5.

5. Prob. 7.8.
$dG = dH - TdS$. The final product is two moles of ammonia.

6. Prob. 7.10.

7. A rubber band can eb described by the following equation of state:

$$f = \alpha T\{\frac{L}{L_o} - (\frac{L_o}{L})^2\},$$

where α is a positive constant, f is the tension applied, and L_O is the original length.

(a) Write down the central equation of thermodynamics for this system which corresponds to $dU = TdS - PdV$ for an ideal gas.

(b) One can derive the energy equation for this system:

$$(\frac{\partial U}{\partial L})_T = f - T(\frac{\partial f}{\partial T})_L.$$

Using this relation show that the internal energy of this system is the function of T only.

(c) Derive four Maxwell's relations for this system.
$U = U(S, L)$; $H = H(S, f)$; $F = F(T, L)$; $G = G(T, f)$.

(d) The rubber band is isothermally at T_o and reversibly stretched to $2L_o$ from its original length. Calculate the change in heat ΔQ.

(e) The rubber band is released adiabatically but freely from $3L_o$ at T_o to $2L_o$. What is the change in entropy?

(f) Does the temperature change in the process described in (e)?

8. In a reversible process occurring at 0.1 MPa and 300 K, enthalpy of the system has increased by 3,400 J. How much change in entropy has occurred in this process?

9. A system underwent a volume increase of 10^{-3} m^3 at 300 K and 0.1 MPa pressure. What is the change in Helmholtz free energy?

10. The Gibb's free energy of a system with N particles is given by

$$G(T, P) = -Nk_BT \ln\left(\frac{aT^{5/2}}{P}\right),$$

where a is a positive constant.

(a) Express dG.

(b) Extract the equation of state for this system (relation between P, T, and V).