Taha Fadla Allah

Reading Assignment 5

5.12) Using the fact that S is a State Function to determine the dependence of S on V and T

- The main idea of this section is to relate S to experimental functions

$$dS = \left(\frac{\partial S}{\partial T}\right)_V dT + \left(\frac{\partial S}{\partial V}\right)_T dV$$

S dependence on Temperature — on Volume

No internal E since not exper. function

$$dS = \frac{C_V}{T} dT + \frac{\beta}{\kappa} dV$$

$\boxed{\text{measurable variables}}$

5.13) The Dependence of S on T & P

- Similar to prev. section but pressure instead of Volume

$$dS = \left(\frac{\partial S}{\partial T}\right)_P dT + \left(\frac{\partial S}{\partial P}\right)_T dP$$

dep. on T — dep. on P

$$dS = \frac{C_P}{T} dT - V\beta \, dP$$

6.1) The Gibbs Energy and the Helmholtz Energy

- The main idea is to introduce two new state functions for the discussion on spontaneity.

For isothermal process: $d(U - TS) \leq đw_{exp} + đw_{conv}$

we define $U - TS$ as Helmholtz energy ~~(#)~~ (A)

$$dA \leq đw_{exp} + đw_{conv}$$

Similarly, $H - TS$ is defined as Gibbs free E (G)

$$\Delta G_R = \Delta H_R - T\Delta S_R$$

6.2) The Differential Forms of U, H, A, and G

- The main idea is to introduce differential forms for the state functions in order to further manipulate them.

Maxwell relations (4):

$$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$$

$$\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$$

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V = \frac{\beta}{\kappa}$$

$$-\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P = V\beta$$

6.3) The Dependence of the Gibbs & Helmholtz Energies on P, V, and T

Helmholtz $\left(\frac{\partial A}{\partial T}\right)_V = -S \quad \left(\frac{\partial A}{\partial V}\right)_T = -P$

Gibbs $\left(\frac{\partial G}{\partial T}\right)_P = -S \, . \, \left(\frac{\partial G}{\partial P}\right)_T = V$