

〈Summary of Thermodynamics〉

Enthalpy

$$H = U + pV \quad (0.1)$$

Gibbs energy = Maximum non-expansion work

$$G = H - TS \quad (0.2)$$

Gibbs energy change of a closed system (in the absence of non-expansion work)

$$\left(\frac{\partial G}{\partial p}\right)_T = V \quad (0.3)$$

$$\left(\frac{\partial G}{\partial T}\right)_p = -S \quad (0.4)$$

Chemical potential of a pure substance = molar Gibbs energy

$$\mu = \left(\frac{\partial G}{\partial n}\right)_{p,T} = G_m \quad (0.5)$$

Chemical potential of an ideal gas A at a partial pressure p_A [from (0.3)]

$$\mu_A = \mu_A^\circ + RT \ln\left(\frac{p_A}{p^\circ}\right) \quad (0.6)$$

μ_A° : chemical potential at the standard pressure p° ($\equiv 1$ bar)

Chemical potential of B in an ideal solution of molality b_B [from (0.3) & Raoult's law]

$$\mu_B = \mu_B^\circ + RT \ln\left(\frac{b_B}{b^\circ}\right) \quad (0.7)$$

μ_B° : chemical potential at the standard molality b° ($\equiv 1$ mol kg⁻¹)

Chemical potential of A in an ideal solution of mole fraction x_A [from (0.3) & Raoult's law]

$$\mu_A = \mu_A^* + RT \ln x_A \quad (0.8)$$

μ_A^* : chemical potential of a pure substrate A

Chemical potential of an incompressible liquid or solid C at a pressure p [from (0.3)]

$$\mu_C = \mu_C^\circ + V_m(p - p^\circ) \quad (0.9)$$

μ_C° : chemical potential at the standard pressure p° ($\equiv 1$ bar)

〈Thermodynamic Data Source〉

The sources of the thermodynamic data appearing in exercises are as follows:

- (no source shown) "Physical Chemistry, 6th Ed.," P. W. Atkins, Oxford Univ. Press (1998).
 [JANAF] "JANAF Thermochemical Tables, 3rd Ed.," M. W. Chase, Jr., *et al.* *J. Phys. Chem. Ref. Data* **14**, Supplement 1 (1985).

〈Averaged Atomic Weights〉

H: 1.008	C: 12.01	N: 14.01	O: 16.00	F: 19.00	Na: 22.99	Mg: 24.30
Al: 26.98	Si: 28.09	P: 30.97	S: 32.07	Cl: 35.45	K: 39.10	Ca: 40.08

〈Schedule〉

- [1] June 1 (Mon.) 13:00~
- [2] June 3 (Wed.) 8:30~
- [3] June 8 (Mon.) 13:00~
- [4] June 10 (Wed.) 8:30~

* The papers (reports) must be submitted until 17:00 on Friday, July 17, 2009.