

### <물리화학 Homework #3>

1. The molar heat capacity of ethane is represented in the temperature range 298 K to 400 K by the empirical expression  $C_{p,m}/(\text{J K}^{-1} \text{mol}^{-1}) = 14.73 + 0.1272(T/\text{K})$ . The corresponding expressions for C(s) and H<sub>2</sub>(g) are given in Table 2.2. Calculate the standard enthalpy of formation of ethane at 350 K from its value at 298 K.

**Table 2.2\*** Temperature variation of molar heat capacities,  $C_{p,m}/(\text{J K}^{-1} \text{mol}^{-1}) = a + bT + c/T^2$

	$a$	$b/(10^{-3} \text{ K})$	$c/(10^5 \text{ K}^2)$
C(s, graphite)	16.86	4.77	-8.54
CO <sub>2</sub> (g)	44.22	8.79	-8.62
H <sub>2</sub> O(l)	75.29	0	0
N <sub>2</sub> (g)	28.58	3.77	-0.50

\* More values are given in the Data section.

※ 물리화학 책 뒷부분의 Data section 을 이용해야 풀 수 있습니다. 문제 작성 시 Data section 의 어디 부분에서 찾아왔는지 명시하세요.

2. (a) Express  $(\partial C_V/\partial V)_T$  as a second derivative of U and find its relation to  $(\partial U/\partial V)_T$  and  $(\partial C_P/\partial P)_T$  as a second derivative of H and find its relation to  $(\partial H/\partial P)_T$ . (b) From these relations show that  $(\partial C_V/\partial V)_T = 0$  and  $(\partial C_P/\partial P)_T = 0$  for a perfect gas.
3. Starting from the expression  $C_p - C_V = T(\partial p/\partial T)_V(\partial V/\partial T)_p$ , use the appropriate relations between partial derivatives to show that

$$C_p - C_V = -\frac{T(\partial V/\partial T)_p^2}{(\partial V/\partial p)_T}$$

Evaluate  $C_p - C_V$  for a perfect gas.

4. Derive the Maxwell relations and use them to express the derivatives (a)  $(\partial S/\partial V)_T$  and  $(\partial V/\partial S)_p$  and (b)  $(\partial p/\partial S)_v$  and  $(\partial V/\partial S)_p$  in terms of the heat capacities, the expansion coefficient  $\alpha$ , and the isothermal compressibility,  $\kappa_T$ .

5. With  $\delta$  a constant, it is defined as a process represented by the empirical equation:

$$PV^\delta = \text{constant}$$

- (a) Explain the graph (b) Derive the governing equation with different variables (T,P and T,V) for each case.

