國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：物理化學【材光系碩士班甲組】

1. Show that, if S is regarded as a function of T and V, then
$$\Delta S = nC_v \ln(\frac{T_2}{T_1}) + nR\ln(\frac{V_2}{V_1})$$ (10%)

2. Derive the Maxwell relation below $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$ (10%)

3. The osmotic pressure of solution of poly(vinyl chloride), PVC, in cyclohexane at 298 K are given below. The pressure are expressed in terms of the highest of solution (mass density = 0.98 g/cm^3) in balance with the osmotic pressure. Determine the molar mass of polymer by following data

c(gL^{-1})	1.0	2.0
h/cm	0.28	0.71

(10%)

4. (a) Explain the term "surface tension" and give its definition
(b) In a capillary tube of radius r, you have a liquid density d, and surface tension σ. The rise of liquid level is h. Please derive the following equation $h = \frac{2\sigma}{dgr}$ (10%, each 5%)

5. Suppose that in an industrial batch process a material A produces the desire material B (the rate constant is k_a) which goes on to decay a worthless product C (the rate constant is k_b), each step of reaction being first order.
(a) Derive the expression for the variations of [A], [B], and [C] with time. (10%)
(b) At what time does the concentration of B reach a maximum? (5%)

6. Show that the Dieterici equation $P = \frac{RT}{V_m - b}\exp(-\frac{a}{RTV_m})$ is mathematically similar to van der Waals equation at high temperature or low density (i.e. when $\frac{a}{RTV_m} << 1$) (15%)

7. Helium is compressed isothermally and reversibly at 100 °C from a pressure of 2 to 10 bar. Calculate (a) heat, q, (b) work, w, (c) △G, (d) △H, and (e) △S per mole, assuming Helium is an ideal gas. (15%, each 3%)

8. When 1 mole of water supercooled to -10 °C freezes isothermally, what are the entropy change of the system and surroundings? Give the molar enthalpy of the melting of ice at 0 °C is 6025 J/mol, the molar heat capacities of ice and water are 37.3 and 75.3 J/mol.K, respectively. (15%)