國立臺北科技大學 110 學年度碩士班招生考試

系所組別：3520 化學工程與生物科技系化學工程碩士班乙組

第一節　物理化學　試題

注意事項：

1. 本試題共 5 題，每題 20 分，共 100 分。
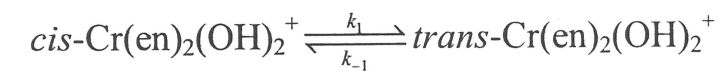2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. An automobile tire was inflated to a gauge pressure of 200 kPa on a winter's day when the temperature was −6°C. What volume and gauge pressure will be found, assuming perfect gas behavior and no leaks have occurred, and that the temperature is 30°C?

   (a) Assume the volume is constant.　(10%)

   (b) Assume the pressure is constant.　(10%)

2. Two moles of an perfect gas ($C_{V,m}$ = 5/2 R) at 25°C is allowed to expanded adiabatically and irreversibly from 2 dm³ to 10 dm³.

   (a) Calculate the final temperature of the gas.　(4%)

   (b) Calculate ΔU, ΔH, ΔS, ΔG, ΔA, w, and q for this system.　(14%)

   (c) Calculate ΔS for the surroundings.　(2%)

3. The volume of an aqueous solution of NaCl at 25°C was measured at a series of molalities b, and it was found that the volume fitted the expression:

   $$V = 1003 + 16.62\,x + 1.77\,x^{3/2} + 0.12\,x^2$$

   where V (cm³) is the volume of a solution formed from 1.000 kg of water and $x = b / b^{\theta}$. Calculate the partial molar volume of the components in a solution of molality 0.100 mol kg⁻¹.　(20%)

4. Use the Debye-Hückel limiting law and the Nernst equation to estimate the potential of the cell at 25°C:

   $$\text{Ag(s)}|\text{AgBr(s)}|\text{KBr(aq,0.05 mol kg}^{-1}) \parallel \text{Cd(NO}_3)_2(\text{aq,0.015 mol kg}^{-1})| \text{Cd(s)}$$

   Given that $E^{\theta}(\text{Cd}^{2+}, \text{Cd})$ = −0.40 V, $E^{\theta}(\text{AgBr, Ag})$ = +0.0713 V.　(20%)

5. The reaction:

   $$\textit{cis-}\text{Cr(en)}_2(\text{OH})_2^{+} \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} \textit{trans-}\text{Cr(en)}_2(\text{OH})_2^{+}$$

   is first order in both directions. At 25°C the equilibrium constant is 0.16 and the rate constant k_1 is 3.3×10^{-4} s⁻¹. In an experiment starting with the pure *trans* form, how long would it take for quarter the equilibrium amount of the *cis* isomer to be formed?　(20%)