國立勤益技術學院九十二學年度研究所招生初試試題卷

所別：材化所　組別：　　身分別：一般生及在職生

科目：物理化學　　准考證號碼：□□□□□□□□（考生自填）

考生注意事項：

一、每一科目考試時間為 100 分鐘。

二、請考生自填准考證號碼。

三、計算題不必將答案算出，計算過程請詳細列出。

試題：

一、 Find the $\triangle S_{sur,}$ (the surrounding) and $\triangle S_{univ}$ (the universe) if 2.000mol of super cooled liquid water at –15.00℃ freezes irreversibly at constant pressure of 1.000atm ice at –15.00℃. Assume the molar heat capacity of liquid water to be constant and equal to 76.1$JK^{-1}mol^{-1}$,and that of ice to be constant and equal to 37.15$JK^{-1}mol^{-1}$, and the surrounding remain at equilibrium at –15.00℃. The latent heat of fusion of water is 333.5 Jg^{-1}. (15%)

二、The Half-life of 235U is equal to $7.1x10^{8}$ years (10%)

a. Find the rate constant.

b. Find the time required to a sample of 235U to decay to 10.0% of its original amount.

三、(a) Calculate the work done on a closed system consisting of 50.00 g of argon, assumed ideal, when it expands reversibly from a volume of 5.000 L to a volume of 10.00 L at a constant temperature of 298.15 K. (5%)

(b) A system consisting of 2.00 mole of argon, assumed ideal with Cv equal to 3nR/2, expands adiabatically and reversibly from a volume of 5.00 L and a temperature of 373.15 K to a volume of 20.00 L. Find the final temperature and the work. (8%)

四、(a) Write the cell symbol, the cell reaction equation, and the Nernst equation for the cell with the half-reactions

$$2Hg_{(l)} + 2Cl^{-} \rightarrow Hg_2Cl_{2\,(s)} + 2e^{-}$$

$$Cl_{2\,(g)} + 2e^{-} \rightarrow 2Cl^{-}$$

(b) Find the potential difference of the cell at 298.15 K if P (Cl_2) = 0.950 atm and a(Cl^{-}) = 0.500, E^{0} = 1.091 V. (10%)

五、Find the boiling elevation constant for water and the boiling temperature at 1.00 atm of a solution of sucrose with 10.00 g of sucrose in 1.000kg of water. The molar enthalpy change of vaporization is 40.67$KJmol^{-1}$ (sucrose,$C_{12}H_{22}O_{11}$, 342.3 g/mol). (12%)

六、Use the cycle rule to show the this equation $\left(\frac{\partial H}{\partial P}\right)_{T,n} = -C_P \mu_{J.T.}$,where $\mu_{J.T.} = \left(\frac{\partial T}{\partial P}\right)_{H,n}$ is the Joule-Thomson coefficient.(12%)

七、(a) Show that $\left(\frac{\partial U}{\partial V}\right)_{T,n} = 0$ for an ideal gas, using only the thermodynamic equation of state and $PV = nRT$

(b) Find an expression for $\left(\frac{\partial U}{\partial V}\right)_{T,n}$ for a gas obeying the van der Waals equation. (13%)

八、Show that the following scheme proposed by R. Ogg, *J. Chem. Phys.*, **15,** 337(1947) is consistent with, and can explain, the observed first-order decomposition of N_2O_5. (15%)

$$N_2O_5 \underset{k_2}{\overset{k_1}{\Leftrightarrow}} NO_2 + NO_3 \qquad (1)$$

$$NO_2 + NO_3 \xrightarrow{k_3} NO + O_2 + NO_2 \qquad (2)$$

$$NO + NO_3 \xrightarrow{k_4} 2NO_2 \qquad (3)$$