淡江大學 105 學年度日間部寒假轉學生招生考試試題

系別：化學工程與材料工程學系三年級　　科目：物理化學　　33－1

考試日期：12 月 3 日(星期六) 第 2 節　　本試題共 5 大題，1 頁

1. (20%) A sample consisting of 1.0 mol of an ideal gas molecules with C_v = 20.8 J/K is initially at 4.0 atm and 300 K. It undergoes reversible adiabatic expansion until its pressure reaches 2.0 atm. Calculate (a) the final volume, (b) the final temperature, (c) the heat transferred (Q), (d) the work done (W), (e) the change in internal energy (ΔU), (f) the change in entropy of the system (ΔS).

2. (20%) When 0.50 mol C_6H_{14} (hexane) is mixed with 2.0 mol C_7H_{16} (heptane) at 298 K, calculate the Gibbs energy (ΔG_{mix}), entropy (ΔS_{mix}), and enthalpy of mixing (ΔH_{mix}). Assume the mixing solution is an ideal.

3. (20%) The equilibrium constant for the reaction $N_2(g) + O_2(g) \leftrightarrows 2\,NO(g)$ is $1.69\text{x}10^{-3}$ at 2300 K. A mixture consisting of 5.0 g of nitrogen and 2.0 g of oxygen in a container of volume 1.0 dm^3 is heated to 2300 K and allowed to come to equilibrium. Calculate the mole fraction of NO at equilibrium.

4. (20%) The rate constant for the first-order decomposition of N_2O_5 in the reaction $2\,N_2O_5\,(g) \rightarrow 4\,NO_2(g) + O_2(g)$ is $\mathbf{k_r} = 3.38\times10^{-5}\ s^{-1}$ at 25°C. (a) What is the half-life of N_2O_5? (b)What will be the pressure, initially 500 Torr, after 50 s, (3) What will be the pressure, initially 500 Torr, after 20 min?

5. (20%) Atomic sodium produces a yellow glow (in some street lamps) resulting from the emission of radiation of 590 nm. Regarding the photon emission, the energy of emission can be described by Bohr frequency condition as below:

$$\Delta E = h\,\nu$$

where h is Plank's constant ($h = 6.626\text{X}10^{-34}$ J s); ν is radiation frequency.
In general, $\nu = c/\lambda$, c is the speed of light in a vacuum ($c = 3.0\times10^8$ m/s); λ is the wavelength.
(1) Calculate the energy per photon for radiation of this yellow glow.
(2) If a proton is accelerated, to what speed (**u**) must be for this proton to have a wavelength of 3.0 cm? (Note: using the de Broglie relation: $\lambda = h/P$, P is the linear momentum, $P = m_p\,\mathbf{u}$; where m_p is the mass of a proton of $1.673\text{X}10^{-27}$ kg.