朝陽科技大學 100 學年度碩士班招生考試試題

系（所）別：應用化學系　　滿分：50 分

組　　別：一般生

科　　目：物理化學

1.(15 分) (a) Calculate the standard Gibbs energy change of the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ at 298.15 K. (b) Calculate the equilibrium constant of the same reaction at 298.15 K. (c) Using the Gibbs-Helmholtz equation, $\frac{\Delta G(T_2)}{T_2} - \frac{\Delta G(T_1)}{T_1} = \Delta H \cdot \left(\frac{1}{T_2} - \frac{1}{T_1}\right)$, calculate the Gibbs energy change of the same reaction at 500.0 K.

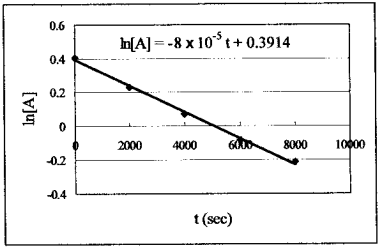
	$N_2(g)$	$H_2(g)$	$NH_3(g)$
Standard enthalpy of formation (298.15K), $\Delta_f H°$ (kJ/mol)	0	0	−46.11
Standard Gibbs energy of formation (298.15K), $\Delta_f G°$ (kJ/mol)	0	0	−16.45

2.(5 分) The energy levels of Hydrogen atoms are given by $E_n = -\frac{2.18 \times 10^{-18}}{n^2}$ J. Calculate the wavelength of radiation required to excite the electron of a Hydrogen atom from 1s orbital to 2p orbital. ($h = 6.626 \times 10^{-34}$ J s)

3.(5 分) Consider the vibrational spectra of diatomic molecules, A—B, with the permitted vibration energy levels $E_n = \left(n + \frac{1}{2}\right)h\nu$, where n = 0, 1, 2, ...; $\nu = \frac{1}{2\pi}\sqrt{\frac{k}{\mu}}$, k is the force constant of the bond, μ is the reduced mass, $\frac{1}{\mu} = \frac{1}{m_A} + \frac{1}{m_B}$. If the frequency of the fundamental vibrational transition of $^1H—^1H$ is 1.32×10^{14} Hz, calculate the frequency of the fundamental vibrational transition of D—D (i.e. $^2H—^2H$) on the assumption that the force constants of $^1H—^1H$ and D—D are the same.

4.(15 分) The thermal decomposition of an organic compound, A → B + C, produced the following data; determine the order of the reaction, the rate constant, and the half-life of the compound A.

t (sec)	0	2000	4000	6000	8000
[A] (M)	1.5	1.26	1.07	0.92	0.81



5.(10 分) The Michaelis-Menten mechanism of enzyme catalysis consists of

(i) $E + S \underset{k2}{\overset{k1}{\rightleftharpoons}} ES$, (ii) $ES \xrightarrow{k3} P + E$, where E is the enzyme, S the substrate, and ES the enzyme-substrate complex.

(a) Calculate the concentration of ES by invoking the steady-state approximation;

(b) Using the result of (a), deduce the rate law for the reaction, i.e. $\frac{d[P]}{dt} = ?$