淡江大學九十二學年度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

准帶項目請打「○」否則打「×」	
○	簡單型計算機

R = 8.314 J mol^{-1} K^{-1}, h = 6.626 x 10-34 J s

1. From Schrödinger equation, derive the wavefunction for a particle in a one-dimensional square-well potential of length L. Calculate the expectation values of p and p^2 in the state n = 2. 20%

2. Using the Stirling's approximation $\ln x! = x\ln x - x$, derive that $\ln W = N\ln N - \sum_i n_i \ln n_i$, where W is the weight of the configuration $\{n_0, n_1, n_2, \ldots\}$. And then, employing the method of undetermined multipliers for solving the dominating configuration as follows

$d\ln W = \sum_i \left(\frac{\partial \ln W}{\partial n_i}\right) dn_i + \alpha \sum_i dn_i - \beta \sum_i \varepsilon_i dn_i$, derive the Boltzmann distribution relation

$\frac{n_i}{N} = e^{\alpha - \beta\varepsilon_i}$. 20%

3. A sample consisting of 2.00 mol He is expanded isothermally at 22°C from 22.8 liter to 31.7 liter (a) reversibly, (b) against a constant external pressure equal to the final pressure of the gas, and (c) freely (against zero external pressure). For the three processes calculate q, w, ΔU and ΔH. 20%

4. Calculate the maximum non-expansion work per mol that may be obtained from a fuel cell in which the chemical reaction is the combustion of methane. Given that $\Delta_f G_m^o$ for methane, carbon dioxide and water are –50.72, -394.36 and –237.13 kJ mol^{-1} at 25°C respectively. 20%

5. The molar mass of an enzyme was determined by dissolving it in water, measuring the osmotic pressure at 20°C, and extrapolating the data to zero concentration. The following data were obtained:

c/(mg cm^{-3})	3.221	4.618	5.112	6.722
h/cm	5.746	8.238	9.119	11.990

Calculate the molar mass of the enzyme. 20%