淡江大學九十四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「V」	
V	簡單型計算機

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1. Evaluate the root mean square distance, $\langle r^2 \rangle^{1/2}$, of the electron from the nucleus in the hydrogen atom. The wavefunction of the electron is $\Psi = \left(\frac{1}{\pi a_o^3}\right)^{1/2} e^{-r/a_o}$ where a_o = 52.9 pm. (Note that $\int_0^\infty x^n e^{-ax} dx = \frac{n!}{a^{n+1}}$.) 25%
2. Calculate the vibrational partition function at 50 °C for HCl molecules, which have the fairly high energy spacing of wave number 2885 cm^{-1}. Given that $q_{vib} = (1 - e^{-\Delta\varepsilon_{vib}/kT})^{-1}$. 25%
3. Three moles of an ideal mono-atomic gas is allowed to expand from an initial pressure of 200 bar to a final pressure of 5 bar, the temperature being maintained at 50°C. For the following three different processes, calculate ΔU_{therm}, ΔU_{mech}, ΔU, and ΔH.
   (a) reversible expansion 10%
   (b) irreversible expansion against a piston that maintains a force equal to a pressure of 5 bar 15%
4. Prove the following relation: $\left(\frac{\partial H}{\partial p}\right)_T = V - T\left(\frac{\partial V}{\partial T}\right)_p$. 25%