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淡江大學96學年度碩士班招生考試試題

系別：化學學系　　科目：物 理 化 學

准帶項目請打「V」	
	簡單型計算機

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96年碩士班物理化學考試試題

1. Briefly explain the following terms (18%)
   a. zero point energy
   b. tunneling effect
   c. The Born-Oppenheimer approximation for a molecule
   d. Heisenberg uncertainty principle
   e. Pauli exclusion principle
   f. The assumptions of ideal gas
2. Write or complete the following equations. (27%)
   a. Joule-Thomson coefficient, μ_{JT} = ?
   b. dS (entropy) = ?
   c. phase rule, f (degree of freedom) = ?
   d. van der Waals equation of real gas
   e. relationship between cell's standard potential ($\mathcal{E}^{o}$) and free energy (G^{o})
   f. average translational energy per gas molecule, $\langle E_{tr} \rangle$ = ?
   g. Arrhenius equation, the temperature dependence of the rate constant
   h. The equation given by de Broglie to describe the wave-particle duality
   i. Boltzmann distribution law
3. For the reaction aA → product is first-order with $r = k$[A], show that $[A] = [A]_o e^{-akt}$. (10%)
4. Calculate the magnitude of the (a) orbital and (b) spin angular momentum, the z-component of the (c) orbital and (d) spin angular momentum for a (3, 2, 1, −½) electron in the $_{24}$Cr atom. (10%)
5. Use LCAO-MO to write down the ground electronic state wave function of H_2 molecule, including the orbital and spin wave functions. (10%)
6. Draw a pressure-versus-composition liquid-vapor phase diagram for the mixture of H_2O-ethanol. At 1 atm, the azotropic composition is 96% ethanol by weight and the boiling point is 78.2°C. Boiling point of ethanol is 78.4°C. Can you obtain 100 % ethanol by distillation of a dilute aqueous solution of ethanol? (15%)
7. Using Born-Haber cycle to calculate the heat of formation (ΔH_f) of $NaCl_{(s)}$, where

sublimation of solid Na	ΔH = S
ionization of gaseous Na atoms	ΔH = IP
dissociation of Cl_2 molecules	ΔH = D/2
formation of the Cl^- ion	ΔH = EA (electron affinity)
lattice energy of NaCl, $Na^+_{(s)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$	ΔH = U
$Na_{(s)} + \frac{1}{2} Cl_{2(g)} \rightarrow NaCl_{(s)}$	$\Delta H = \Delta H_f$

(10%)