淡江大學96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

可否使用計算機			
可	V	否	

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P1

Problem One (15 points)

The wavefunction of an electron in the lowest energy state of a hydrogen atom is proportional to e^{-r/a_o}, with a_o a constant and r the distance from the nucleus. Normalize the wavefunction. $\int_0^\infty x^n e^{-ax} dx = \frac{n!}{a^{n+1}}$

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Problem Two (30 points)

Some reactions proceed through the formation of an intermediate, as in the consecutive uni-molecular reactions

$$A \xrightarrow{k_a} I \xrightarrow{k_b} P$$

Each step of the reaction is first order. Derive the following relations:

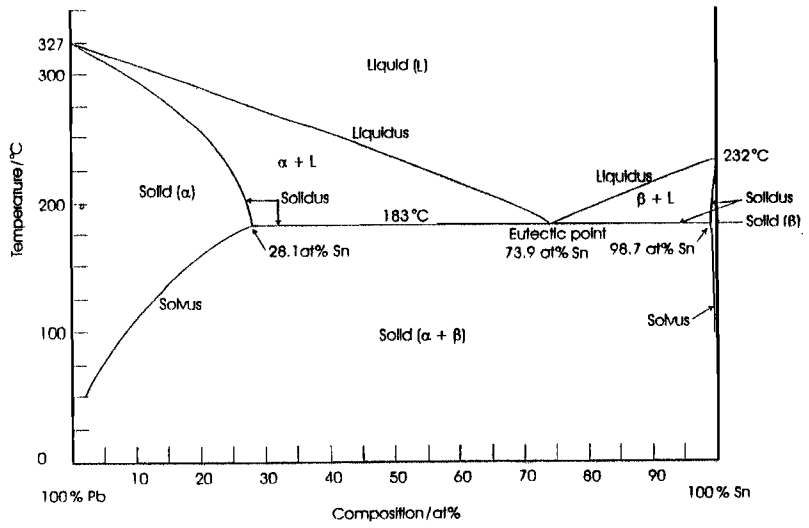
(a) $[A] = [A]_0 e^{-k_a t}$, $[A]_0$ is the initial concentration of A.

(b) $[I] = \frac{k_a}{k_b - k_a}\left(e^{-k_a t} - e^{-k_b t}\right)[A]_0$

(c) $[P] = \left\{1 + \frac{k_a e^{-k_b t} - k_b e^{-k_a t}}{k_b - k_a}\right\}[A]_0$

Problem Three (30 points)

With respect to the lead-tin phase diagram shown below, the sample made up with 40 at% tin is cooled slowly to 250 °C. (a) What phases are present at 250 °C; (b) What is the composition of each phase? (c) How much of each phase is present?



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46-2

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可否使用計算機			
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Problem Four (25 points)

P2

(a) Calculate the change in entropy when 25 kJ of energy is transferred reversibly and isothermally as heat to a large block of iron at 100 °C.

(b) Calculate the molar entropy of a constant-volume sample of neon at 500 K given that the entropy is 146.22 $JK^{-1}mol^{-1}$ at 298 K. $C_{p,m} = 20.786\ JK^{-1}mol^{-1}$

(c) Calculate ΔS (for the system) when the state of 3 mol of perfect gas atoms, for which $C_{p,m} = \frac{5}{2}R$, is changed from 25 °C and 1 atm to 125 °C and 5 atm.

(d) Calculate ΔH and ΔS_{tot} when two copper blocks, each of mass 10 kg, one at 100 °C and the other at 0 °C, are placed in contact in an isolated container. The specific heat capacity of copper is 0.385 $JK^{-1}g^{-1}$ and may be assumed constant over the temperature range involved.