

元智大學 103 學年度研究所 碩士班 招生試題卷

系(所)別： 化學工程與材料
科學學系碩士班

組別： 不分組-選考B

科目： 物理化學

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●可使用現行『國家考試電子計算器規格標準』規定第二類之計算機

1. Discuss and explain the following terminologies: (a) chemical potential μ ; (b) activity a ; (c) lower critical solution temperature T_{lc} ; (d) LeChatelier's principle. (20 points total and 5 points for each term)
2. 1.00 mol of perfect gas molecules is expanded isothermally from an initial state of pressure P_i and temperature T to a final pressure of P_f . Determine the values of (a) heat q , (b) work w , (c) the internal energy change ΔU , (d) the enthalpy change ΔH , and (e) the Gibbs free energy change ΔG in system. (25 points total and 5 points for each term)
3. Calculate the entropy change in system ΔS , in surrounding ΔS_{sur} and the total change ΔS_{total} of a perfect gas expands (a) isothermally and reversibly (10 points); or (b) isothermally but freely from V_i to V_f (10 points).
4. Devise the rate law for the decomposition of N_2O_5 using the steady-state approximation,

$$2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$$
 on the basis of the following mechanism: (15 points)

$N_2O_5 \rightarrow NO_2 + NO_3$	k_a
$NO_2 + NO_3 \rightarrow N_2O_5$	k_a'
$NO_2 + NO_3 \rightarrow NO_2 + O_2 + NO$	k_b
$NO + N_2O_5 \rightarrow NO_2 + NO_2 + NO_2$	k_c
5. For the Langmuir isotherm, the free gas and the monolayer adsorbed gas are in dynamic equilibrium: $A_{(g)} + M_{(surface)} \rightleftharpoons AM_{(surface)}$ with rate constant k_a for adsorption and k_d for desorption. (a) Derive the Langmuir isotherm $\theta = \frac{Kp}{1+Kp}$ for the variation of the fractional coverage θ with pressure at a chosen temperature where θ depends on the pressure p of the overlying gas and the equilibrium constant K equals to k_a/k_d (10 points). (b) At constant temperature, various adsorbed gas volume V according to different pressures p fits the Langmuir isotherm. How to obtain V_∞ the volume corresponding to complete coverage and the equilibrium constant K ? (10 points)

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