

淡江大學八十九學年度碩士班招生考試試題

40

系別：化學學系

科目：物理化學

本試題共

頁

1. Show that e^{ax} is an eigenfunction of the operator d^n/dx^n . What is the eigenvalue? 10%
2. Calculate the probability that a particle in a one-dimensional box of length a is found to be between 0 and $a/2$. 10%
3. Determine \hat{H} and ψ for Li atom. 10%
4. The rate law for the reaction described by $N_2O_2(g) \rightarrow 2NO(g)$ is first order in the concentration of $N_2O_2(g)$. Derive an expression for the time-dependent behavior of $[NO]$, the product concentration. 15%
5. The decomposition of ozone $2O_3(g) \rightarrow 3O_2(g)$ occurs by the reaction mechanism $M(g) + O_3(g) \xrightleftharpoons[k_{-1}]{k_1} O_2(g) + O(g) + M(g)$, $O(g) + O_3(g) \xrightarrow{k_2} 2O_2(g)$, where M is a molecule that can exchange energy with the reacting ozone molecule through a collision, but M itself does not react. Use this mechanism to derive the rate law for $d[O_3]/dt$ assuming that the intermediate $O(g)$ concentration can be treated by the steady-state approximation. 15%
6. If 0.1500 mol of $O_2(g)$ is placed in an empty container and equilibrium is reached at 3700 K and 895 torr, one finds that 0.1027 mol of $O(g)$ is present. Find K_p^0 and ΔG^0 for $O_2(g) \rightleftharpoons 2O(g)$ at 3700 K. Assume ideal gases. 15%
7. For $CO(NH_2)_2(s)$, $\Delta H_{f,298}^0 = -333.51$ kJ/mol. Find $\Delta U_{f,298}^0$ of $CO(NH_2)_2(s)$. (R = 8.3145 Jmol⁻¹K⁻¹) 10%
8. Please give the normal modes vibration of H_2O molecule. 15%

C_{2v}	E	C_2	$\sigma_v(xz)$	$\sigma_v(yz)$		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz