

淡江大學八十九學年度日間部轉學生招生考試試題

8

系別：化學工程學系三年級

科目：物理化學

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注意：所有單位一律使用 SI unit

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}, h = 6.626 \times 10^{-34} \text{ J s}$$

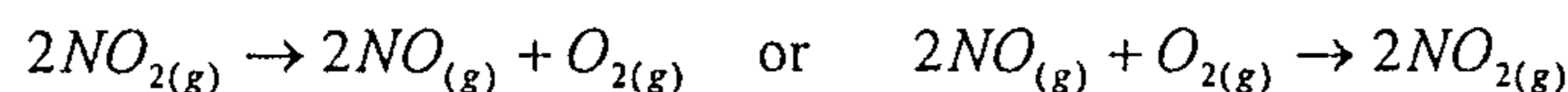
1. Draw a diagram and explain the continuity of states for fluid. (10%)
2. What laws or relations do you need to deduce the quantum energy expression? (5%) Get the result of quantum energy expression for one dimension translational energy. (5%)
3. What is the definition of partition function q ? (5%) Knowing the degeneracy of the energy levels for three dimensional translational motion as $g_n = 1/2 \pi n^2$, calculate q_{trans} by using the integration formula below

$$\int_{-\infty}^{\infty} x^2 e^{-ax^2} dx = \frac{1}{2a} \sqrt{\frac{\pi}{a}} \quad (5\%)$$

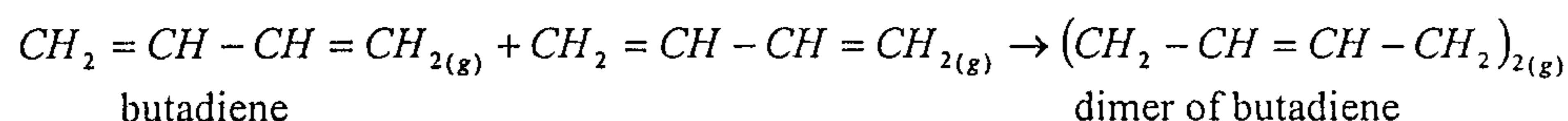
4. Knowing that $U - U_0 = \sum [g_i N_i (\epsilon_i - \epsilon_0)]$, deduce the following relation:

$$U - U_0 = RT^2 \frac{1}{q} \frac{dq}{dT} \quad (10\%)$$

5. Knowing that $S^\circ_{\text{NO}_2} = 240.06 \text{ J K}^{-1} \text{ mol}^{-1}$, $S^\circ_{\text{NO}} = 210.76 \text{ J K}^{-1} \text{ mol}^{-1}$, $S^\circ_{\text{O}_2} = 205.14 \text{ J K}^{-1} \text{ mol}^{-1}$, $\Delta H^\circ_{\text{f, NO}_2} = 33.18 \text{ kJ mol}^{-1}$, $\Delta H^\circ_{\text{f, NO}} = 90.25 \text{ kJ mol}^{-1}$, what is the direction of spontaneous chemical reaction at 25°C with NO_2 , NO and O_2 each at 1 bar of pressure? (10%)



6. If water boils at a temperature at which bubbles of $5 \times 10^{-8} \text{ m}$ diameter can be formed. Estimate the temperature at which boiling will occur at a pressure of 1 bar. Supposing surface tension of water is 0.05885 N m^{-1} and $\Delta H_{\text{vap}} = 44 \text{ kJ mol}^{-1}$. 10%
7. The gaseous dimerization of butadiene has been followed by measurement of total gas pressure at 326 °C. What is the order of the reaction, and the rate constant? 20%



t, min	P, atm	t, min	P, atm	t, min	P, atm
0	(0.8315)	24.55	0.7194	90.05	0.5964
3.25	0.8138	33.00	0.6944	119.00	0.5694
8.02	0.7886	42.50	0.6701	176.67	0.5332
12.18	0.7686	55.08	0.6450	259.50	0.5013
17.30	0.7464	68.05	0.6244	373	0.4698

8. Prove that the Langmuir isotherm relationships of the surface coverage of gas adsorption on solid for two competing gases A and B are as follows:

$$\theta_A = \frac{b_A P_A}{1 + b_A P_A + b_B P_B} \quad \text{and} \quad \theta_B = \frac{b_B P_B}{1 + b_A P_A + b_B P_B} \quad 20\%$$