國立成功大學 76 學年度 化學工程研究所 甲組 考試(物理化學試題) 共 1 頁 第 1 頁

1). The combustion of $C_2H_5OH(l)$ in a constant-volume calorimeter produces 1364.34 kJ mol^{-1} at 25°C. What is the value of ΔH° for the reaction

$$C_2H_5OH(l) + 3O_2(g) = 2CO_2(g) + 3H_2O(l)$$ (12%)

2). Ten moles of H_2 and two moles of D_2 are mixed at 25°C. What is the value of ΔS°? (10%)

3). For a solution of ethanol and water at 20°C which has a mole fraction of ethanol of 0.2, the partial molar volume of water is 17.9 cm^3 mol^{-1} and the partial molar volume of ethanol is 55.0 cm^3 mol^{-1}. What volumes of pure ethanol and water are required to make a liter of this solution? At 20°C the density of ethanol is 0.789 g cm^{-3} and the density of water is 0.998 g cm^{-3}. (14%)

4). Calculate the solubility of p-dibromobenzene in benzene at 40°C assuming ideal solution is formed. The enthalpy of fusion of p-dibromobenzene is 13.22 kJ mol^{-1} at its melting point (86.9°C) (12%)

5) At 1273 K and at a total pressure of 30.4 bar the equilibrium in the reaction $CO_2(g) + C(s) = 2CO(g)$ is such that 17 mole% of the gas is CO_2. (a) What percentage would be CO_2 if the total pressure were 20.3 bar? (b) What would be the effect on the equilibrium of adding N_2 to the reaction mixture in a closed vessel until the partial pressure of N_2 is 10 bar? (c) At what pressure of the reactants will 25% of the gas be CO_2? (14%)

6) (a) Write the reaction that occurs when the cell

$$Zn|ZnCl_2(0.555\ mol\ kg^{-1})|AgCl|Ag$$

delivers current and calculate (b) ΔG, (c) $\Delta S'$, and (d) ΔH at 25°C for this reaction. At 25°C $E = 1.015$ V and $(\partial E/\partial T)_p = -4.02 \times 10^{-4}$ V K^{-1} (14%)

7). The molecular diameter of nitrogen is 0.375 nm. What is the mean free path of nitrogen at 1 bar and 25°C? What is the average time between collisions? (12%)

8). The reaction $2NO + O_2 \longrightarrow 2NO_2$ is believed to occur by the mechanism

$$2NO \xrightarrow{k_1} N_2O_2$$
$$N_2O_2 \xrightarrow{k_{-1}} 2NO$$
$$N_2O_2 + O_2 \xrightarrow{k_2} 2NO_2$$

Assume N_2O_2 to be in a steady state and derive the rate equation. Under what conditions does the rate equation reduce to second-order kinetics in NO and first-order kinetics in O_2? (12%)