100 學年度四年制二、三年級轉學生招生考試

四技三年級 化學工程與生物科技系

第三節 專業科目（二）物理化學 試題

注意事項：

1.本試題共 7 題，配分共 100 分。
2.請標明大題、子題編號作答，不必抄題。
3.全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Nitrogen and oxygen are held in a 5.00 m^3 container maintained at 30°C at partial pressures of $P_{N_2} = 81$ kPa and $P_{O_2} = 22$ kPa. If the collision diameters are $d_{N_2} = 3.74\times10^{-10}$ m and $d_{O_2} = 3.57\times10^{-10}$ m. Calculate Z_A, the average number of collisions experienced in unit time by one molecule of nitrogen and by one molecule of oxygen. Also calculate Z_{AB}, the average number of collisions per unit volume per unit time. At 30°C, $(u_{N_2}^2 + u_{O_2}^2)^{1/2}$ is 630 m s^{-1}. (15%)

2. Find the enthalpy change for the reaction $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$ at 900 K.

The data are: $\Delta H°(H_2O_{(g)}, 298K) = -241.826$ kJ mol^{-1}

$$C_{p,m}(H_{2(g)}) = 27.28 + 3.26\times10^{-3}\,T + 5.0\times10^{4}\,T^{-2}$$
$$C_{p,m}(O_{2(g)}) = 29.96 + 4.18\times10^{-3}\,T - 1.67\times10^{5}\,T^{-2}$$
$$C_{p,m}(H_2O_{(g)}) = 30.54 + 10.29\times10^{-3}\,T \quad (15\%)$$

3. Calculate the standard entropy for the dissociation of $H_{2(g)}$ into atomic hydrogen $2[H_{(g)}]$ at 298.15 K and 900°C. The data are:

$S°(H_{2(g)}) = 130.68$ J K^{-1} mol^{-1}
$S°(H_{(g)}) = 114.717$ J K^{-1} mol^{-1}
$C_p°(H_{2(g)}) = 28.824$ J K^{-1} mol^{-1}
$C_p°(H_{(g)}) = 20.784$ J K^{-1} mol^{-1} (15%)

4. The apparent value of K_f in 1.60-molal aqueous sucrose ($C_{12}H_{22}O_{11}$) solution is 2.17 K kg mol^{-1}. The solution does not behave ideally; calculate its activity and activity coefficient. ($\Delta_{fus}H° = 6009.5$ J mol^{-1}) (15%)

5. Calculate the emf of the cell: (8%)

$$Pt, H_2(1\ bar) \mid HCl(0.1\ m) \parallel HCl(0.25\ m) \mid Pt, H_2(12\ bar)$$

6. Assuming the Born equation to apply, make an estimate of the reversible work of charging 0.1 mol of Na^+Cl^- in aqueous solution at 25°C ($\varepsilon = 78$), under the following conditions: (a) The electrolyte is present at infinite dilution. (b) The electrolyte is present at such a concentration that the mean activity coefficient is 0.86. The ionic radii are 95 pm for Na^+ and 181 pm for Cl^-. (16%, each 8%)

7. Suppose that a reaction of stoichiometry A + 2B = Y + Z is according to the mechanism

$$A + B \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} X$$

$$X + B \xrightarrow{k_2} Y + Z$$

Apply the steady-state treatment and obtain an expression for the rate. To what expressions does the general rate equation reduce if (a) The second reaction is slow, the initial equilibrium being established very rapidly ? (b) The second reaction is very rapid compared with the first reaction in either direction ? (16%, each 8%)