國立雲林科技大學 112 學年度 碩士班招生考試試題

系所：化材系

科目：物理化學

1. An ideal solution is made from 3 moles of benzene and 1 mole of toluene. Please calculate ΔG_{mixing} and ΔS_{mixing} at 298 K and 1 bar pressure. Is mixing a spontaneous process? (12%)

2. Please calculate **ionic strength** (***I***) for (a) a 0.05 molar solution of NaCl and for (b) a Na_2SO_4 solution of the same molality. You may use the equation shown below:

   $I = \frac{1}{2}\sum_i (m_i{+}Z_i{+}^2 + m_i{-}Z_i{-}^2)$ Z_i: charge number of an ion i. m_i: molality of an ion. (12%)

3. Given the following reduction reactions and standard cell potential E^o values:

   $Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$ $\quad E^o = +0.771V$

   $Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$ $\quad E^o = -0.447\ V$

   Calculate E^o for the half-cell reaction $Fe^{3+}(aq) + 3e^- \rightarrow Fe(s)$ (14%)

4. The decomposition of N_2O_5 is an important process in tropospheric chemistry. The half-life for the first-order decomposition of this compound is 2.05×10^4 s. How long will it take for a sample of N_2O_5 to decay to 60% of its initial value? (12%)

5. When 1.5 moles of an ideal gas are heated at a constant pressure of 2.0 bar, the temperature increases from 300 K to 325 K. Given that the molar heat capacity at constant pressure is 25.35 J mol^{-1} K^{-1}, calculate q, ΔH and ΔU. (18%)

6. 4.5 moles of He gas expand isothermally at 308 K from 48.0 cm^3 to 547.5 cm^3. Calculate ΔG and ΔA for the process. (20%)

7. The normal boiling point of isopropanol is 355.7 K, while the molar enthalpy of vaporization is 44.0 kJ mol^{-1}. Determine the vapor pressure at 298 K. (12%)