國立雲林科技大學
101學年度碩士班暨碩士在職專班招生考試試題

系所：化材系
科目：物理化學

1. 2.0 mol of ammonia gas with $C_{p,m} = 35.06 \text{J K}^{-1} \text{mol}^{-1}$ is initially at 298 K. It undergoes reversible adiabatic expansion from 1.00dm^3 to 4.00dm^3. Calculate the final temperature, the work done and the change of internal energy for the process. (16%)

2. The normal boiling point of naphthalene ($C_{10}H_8$) is 491K. If the vapour pressure of the liquid is 1.3 kPa at 359 K and 5.3 kPa at 392 K. (a) use the Trouton's rule to estimate the enthalpy of vaporization; (b) use the Clausius-Clapeyron equation to calculate the enthalpy of vaporization and the entropy of vaporization at the normal boiling point. (18%)

3. The mass percentage composition of dry air at 298 K is approximately: N_2 = 75.5%; O_2 = 23.2%; Ar = 1.3%. Calculate the Gibbs energy, entropy, and enthalpy of mixing when it is prepared from the pure and perfect gases. (16%)

4. The equilibrium constant of a reaction is found to fit the expression $\ln K = A + B/T + C/T^2$ between 400 K and 600 K with A = –1.76, B = –1368 K, and $C = 1.1 \times 10^5 \text{ K}^2$. Calculate the standard reaction enthalpy and standard reaction entropy at 500 K. (20%)

5. Calculate the change in K_x for the reaction $2\ NH_3(g) <=> 3\ H_2(g) + N_2(g)$ when the total pressure is increased from 1.0 bar to 3.0 bar at constant temperature. (15%)

6. Deduce an expression for the time it takes for the concentration of a substance (A) to fall to one-third its initial value ($[A]_0$) in an nth-order reaction with a rate constant (k). (15%)