淡江大學 95 學年度轉學生招生考試試題

系別：化學工程與材料工程學系三年級　　科目：物 理 化 學

准帶項目請打「∨」	
∨	簡單型計算機

本試題共 1 頁

所有單位一律使用 SI unit; R= 8.314 J mol^{-1}K^{-1}; electron mass, m = 9.110x10^{-31} kg; elementary charge, e = 1.602x10^{-19} C; Plank constant, h = 6.626x10^{-34} J s; 1 eV = 1.602x10^{-19} J; speed of light c = 3.0 x 10^{8} m/s.

1. A Carnot cycle uses 1 mol of an ideal gas for which C_v = 25 J K^{-1} mol^{-1} and C_p = 30 J K^{-1} mol^{-1}, as the working substance and operates from a most compressed state of a 10-bar pressure and 600 K. It expands isothermally to a pressure of 1 bar (step 1) and then adiabatically to a temperature of 300 K (step 2). This expansion is followed by an isothermal compression (step 3), and then an adiabatic compression (step 4) back to the initial state.
   (a) Calculate Q_{total}, W_{total}, ΔU_{total}, ΔH_{total}, ΔS_{total} for the whole cycle. (b) Calculate the efficiency of the cycle, (c) Plot the Carnot cycle on a graph of P versus T, (d) Plot the Carnot cycle on a graph of T versus S. (30 points)

2. (a) Derive the Clausius-Clapeyron equation. The vapor pressure of nitric acid is 14.4 Torr at 0°C and 47.9 Torr at 20°C. Estimate (b) the enthalpy of vaporization, (c) the normal boiling point of nitric acid, (d) the entropy of vaporization at the boiling point. (20 points)

3. Calculate (a) the Gibbs energy, (b) entropy, and (c) enthalpy of mixing when 2.00 mol C_6H_{14} (hexane) is mixed with 3.00 mol C_7H_{16} (heptane) to form an ideal solution at 300 K. (15 points)

4. The variation in the molar concentration of A with time was followed at 300 K.
   The reaction is $2 A \rightarrow P$
   (a) Confirm that the reaction is first-order in A. (b) Find the rate constant at 300 K. (c) What is the half-life of A? (d) What will be the concentration of product P after 1 hour of reaction? (20 points)

Time (sec)	0	1000	2000	3000	4000
[A] (M)	8.20	5.72	3.99	2.78	1.94

5. The work function for metallic cesium is 2.14 eV. Calculate (a) the kinetic energy (J), (b) the speed (m/s) and (c) the de Broglie wavelength (nm) of the electrons ejected by light of wavelength 200 nm. (15 points)