淡江大學九十一學年度日間部轉學生招生考試試題

系別：化學工程學系三年級　　科目：物 理 化 學

准帶項目請打「○」否則打「×」
計 算 機
○

所有單位一律使用 **SI unit; R= 8.314 J mol^{-1}K^{-1}**

1. A Carnot cycle uses 1 mol of an ideal gas for which Cv = 25 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 and then adiabatically reaches a most expended state at a temperature of 300 K. (20%)
   (a) Obtain numerical values for ΔU_{therm}, ΔU_{mech} for each stroke, (b) calculate the efficiency of the cycle, (c) plot the Carnot cycle on a graph of P versus V, (d) plot the Carnot cycle on a graph of T versus S.

2. For the reaction, CO_2 (g, 1 bar) + H_2 (g, 1 bar) = CO (g, 1 bar) + H_2O (g, 1 bar) at 25 °C; (20%)

	$CO_{2\,(g)}$	$CO_{(g)}$	$H_2O_{(g)}$
ΔH°_f kJ/mole	-393.52	-110.53	-241.83
ΔG°_f kJ/mole	-394.39	-137.16	-228.58

   (a) Calculate the enthalpy change of the reaction ΔH and the equilibrium constant for this reaction.
   (b) Assume a constant ΔH value, estimate the equilibrium constant at 120 °C.

3. Component A, with a molar mass of 200 g and a density of 1.500 g/mL, and component B, with a molar mass of 100 g and a density of 1.000 g/mL, form ideal solutions at 25 °C. Calculate ΔV_{mix}, ΔH_{mix}, $T\Delta S_{mix}$, ΔG_{mix} with a solution of 40 % in weight of B. (20%)

4. Some of the data of the reaction $(CH_3)_3CBr + H_2O \rightarrow (CH_3)_3COH + HBr$ in a water-acetone solvent at 25 and 50 °C are as follows: (20%)

At 25 °C		At 50 °C	
Time (min)	$(CH_3)_3CBr$ mol/L	Time (min)	$(CH_3)_3CBr$ mol/L
0	0.1039	0	0.1056
370	0.0776	18	0.0856
600	0.0639	27	0.0767
1100	0.0353	54	0.0536
1850	0.0207	105	0.0270

   (a) Verify that the reaction is first-order, and deduce the values of the rate coefficient at the two temperatures.
   (b) In addition, estimate the activation energy.

5. The following molar conductances of sodium propionate (C_2H_5COONa) at 25 °C have been reported.

C (mol/L)	0.002178	0.004180	0.007870	0.01427	0.02597
Λ, $\Omega^{-1}m^2mol^{-1}$	0.008253	0.008127	0.007972	0.007788	0.007564

   (a) What is the limiting molar conductance of sodium propionate? (b) What is the limiting conductance of propionic acid (C_2H_5COOH) ? (the limiting molar conductance of HCl and NaCl are 0.042616 and 0.012645 $\Omega^{-1}m^2mol^{-1}$) (c) At a concentration of 1 M, the molar conductance Λ of propionic acid is 1.4 x 10^{-4} $\Omega^{-1}m^2mol^{-1}$. What is the degree of dissociation of propionic acid in this solution? (d) Deduce dissociation constant for propionic acid. (20%)