

國立臺北科技大學
九十七學年度研究所碩士在職專班(含 EMBA)入學考試

化學工程研究所
乙組：物理化學試題

填准考證號碼

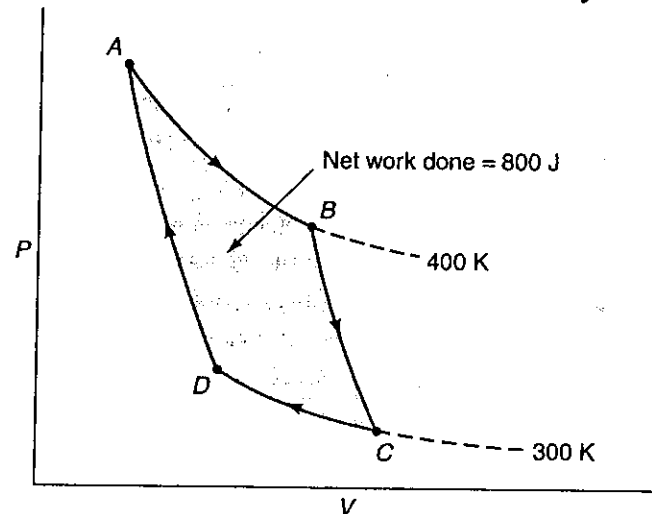
第一頁 共一頁

| | | | | | |
|--|--|--|--|--|--|
| | | | | | |
|--|--|--|--|--|--|

注意事項：

1. 本試題共 6 題，配分共 100 分。第 1 題 30 分，第 2~6 題各 14 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。

1. The following diagram represents a reversible Carnot cycle for an ideal gas:



- (a) What is the thermodynamic efficiency of the engine?
- (b) How much heat is absorbed at 400 K?
- (c) How much heat is rejected at 300 K?
- (d) What is the enthalpy change in the process $A \rightarrow B$?
- (e) What is the enthalpy change in the entire cycle?
- (f) What is the entropy change in the process $A \rightarrow B$?
- (g) What is the entropy change in the process $B \rightarrow C$?
- (h) What is the entropy change in the entire cycle?

- (i) What is the Gibbs energy change in the process $A \rightarrow B$?
- (j) In order for the engine to perform 3 kJ of work, how much heat must be absorbed?

2. A balloon is 25 cm in diameter and contains air at 25°C and 1 bar pressure. It is then filled with air isothermally and reversibly until the pressure reaches 6 bar. Assume that the pressure is proportional to the diameter of the balloon, and calculate (a) the final diameter of the balloon and (b) the work done in the process.
3. Calculate the activities and activity coefficients for an acetone-chloroform solution in which $x_2 = 0.6$. The vapor pressure of pure chloroform at 50°C is $P_2^* = 98.6$ kPa and the vapor pressure above the solution is $P_2 = 53.3$ kPa. For acetone, the corresponding values are $P_1^* = 84.0$ kPa and $P_1 = 26.6$ kPa.
4. Suppose that a liter of a solution of sodium palmitate at concentration 0.02 M is separated by a membrane from a liter of solution of sodium chloride at concentration 0.06 M. If the membrane is permeable to sodium and chloride ions, but not to palmitate ions, what are the final concentrations after the Donnan equilibrium has become established?
5. a. Write both electrode reactions and the overall reaction for the cell

$$\text{Ti} \mid \text{TiCl(s)} \mid \text{CdCl}_2(0.10\text{m}) \mid \text{Cd}$$
 b. calculate E and E° for this cell at 25°C from the following information:

$$\text{Ti}^+ + e^- \rightarrow \text{Ti} \quad E^\circ = -0.34 \text{ V}$$

$$\text{Cd}^{2+} + 2e^- \rightarrow \text{Cd} \quad E^\circ = -0.40 \text{ V}$$
 The solubility product for TiCl is $1.6 \times 10^{-3} (\text{mol/L})^2$ at 25°C.
 ($\log 2 = 0.30103$)
6. The reaction

$$2 \text{NO(g)} + \text{Cl}_2(\text{g}) \rightarrow 2 \text{NOCl(g)}$$
 is second order in NO and first order in Cl_2 . In a volume of 2 L, 5 mol of nitric oxide and 2 mol of Cl_2 were brought together, and the initial rate was $2.4 \times 10^{-3} \text{ mol/L}\cdot\text{s}$. What will be the rate and rate constant when 30% or 60% of the chlorine has reacted?