

國立成功大學

113學年度碩士班招生考試試題

編 號： 135、159

系 所：航空太空工程學系
能源工程國際碩士學位學程

科 目：熱力學

日 期：0201

節 次：第 1 節

備 註：不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. An isolated system of total mass m is formed by mixing two equal masses of the same liquid initially at the temperatures T_1 and T_2 . Eventually, the system attains an equilibrium state. Each mass is incompressible with constant specific heat C .

(a) Show that the amount of entropy produced is $S_{gen} = mC \ln \left[\frac{T_1 + T_2}{2(T_1 T_2)^{1/2}} \right]$ (20%)

(b) Demonstrate that S_{gen} must be positive. (10%)

2. For a gas obeying the van der Waals equation of state $(p = \frac{\bar{R}T}{\bar{v}-b} - \frac{a}{\bar{v}^2})$,

(a) show that $(\frac{\partial c_v}{\partial v})_T = 0$. (5%)

(b) show that $(s_2 - s_1)_T = R \cdot \ln \frac{v_2 - b}{v_1 - b}$. (10%)

(c) develop expression for $c_p - c_v$. (5%)

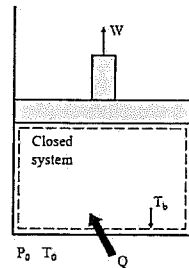
3. (a) Draw T-s diagram and indicate each state for the air-standard ideal Brayton cycle. (5%)

(b) Determine the pressure ratio across the compressor of an ideal Brayton cycle for the maximum net work output per unit of mass flow if the state at the compressor inlet (state 1) and the temperature at the turbine inlet (state 3) are fixed. Use a cold air-standard analysis and ignore kinetic and potential energy effects. Assume the specific heat c_p , and the specific heat ratio k are constant. (20%)

4. (a) Starting with the following energy and entropy balances, derive the general exergy balance relation for a closed system when it undergoes a process from state 1 to state 2. (10%)

$$E_{in} - E_{out} = \Delta E_{system}$$

$$S_{in} - S_{out} + S_{gen} = \Delta S_{system}$$



(b) A 200-m³ rigid tank contains compressed air at 1 MPa and 300 K. Determine how much work can be obtained from this air if the environment conditions are 100 kPa and 300 K. (ln10 ≈ 2.3) (15%)