系所組別：航空太空工程學系甲、丁組

考試科目：熱力學

考試日期：0223，節次：1

※ 考生請注意：本試題不可使用計算機

1. An insulated cylinder is initially divided into halves by a frictionless, thermal conducting piston. On one side of the piston is 1 $m^3$ of a gas at 300 K, 2 bar. On the other side is of the same gas at 300 K, 1 bar. The piston is released and equilibrium is attained, with the piston experiencing no change of state. Employing the ideal gas model for the gas, determine

(a) the final temperature.

(b) the final pressure.

(c) the amount of entropy produced, in kJ/kg. (25%)

2. (a)An inventor claims to have developed a power cycle operating between hot and cold reservoirs at 1200 K and 300 K, respectively, that develops net work equal to multiple of the energy, $Q_C$, rejected to the cold reservoir, i.e., $W_{power\ cycle} = N\ Q_C$. What is the maximum theoretical value of the number, N, for such cycle?

(b)A heat pump operating between hot and cold reservoirs at 300 K and 225 K, respectively, that rejected an amount of energy $Q_H$ by heat transfer to the hot reservoir that is a multiple of the net work input from the power cycle described in (a), i.e. $Q_H = M\ W_{power\ cycle}$ . Determine the maximum theoretical value of the number M for such cycle.

(c)Please give your comment about the benefit of the design of the combined system described in (a) and (b). (25%)

3. Please show in both a schematic diagram of the system and a T-s diagram of the cycle for a regenerative gas turbine engine with a intercooling and a reheat. Please explain how the efficiency of the gas turbine engine can be improved by the regenerator, the intercooler and the reheater. (25%)

4. Starting from the Maxwell relation : $\left(\frac{\partial s}{\partial p}\right)_T = -\left(\frac{\partial v}{\partial T}\right)_p$ , please (a) show that s(T, p) – s*(T, p) =

$\int_0^p \left[\frac{R}{p} - \left(\frac{\partial v}{\partial T}\right)_p\right] dp$ where s*(T, p) is the specific entropy assuming ideal gas behavior, and (b) find an expression for s(T, p) – s*(T, p) for the gas with Z=1+Bp where B is a function of the reduced temperature $T_R$. (25%)