1.何謂等熵壓縮機 (isentropic compressor)? 若壓縮前後之氣體壓力維持不變,則應如何設計方能減少壓縮機所須要的功? (10%)

2.導出一個可逆,絕熱,穩定流(reversible, adiabatic, and steady flow)經過一個控制體積(control volume)之功為

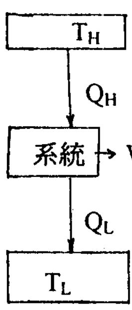
$$w = -\int_i^e v\,dp + [V_i^2 - V_e^2]/2 + g(Z_i - Z_e) \qquad (10\%)$$

3.試導出

$$C_p = \frac{1}{\mu_J}\left[T\left(\frac{\partial v}{\partial T}\right)_p - v\right], \quad \text{where } \mu_J = \left(\frac{\partial T}{\partial p}\right)_h,\ C_p = \left(\frac{\partial h}{\partial T}\right)_p \qquad (10\%)$$

4.如何設計一套系統用來液化氣體. (10%)

5.一個系統(如圖)當運轉一個循環時,試寫出 η_{max} =? 為什麼? (15%)



6.對一個封閉系統(closed system), 試導出 (15%)

$$\Delta A = A_2 - A_1 = \int_1^2 \left(1 - \frac{T_o}{T_b}\right)\delta Q - [W - p_o(V_2 - V_1)] - T_o S_{pro}$$

其中 A: availability

T_o: environmental temperature

T_b: boundary temperature where δQ is received

S_{pro}: entropy production

7.Methane gas(CH_4) at 400 K and 1 atm enters a combustion chamber, where it is mixed with air entering at 500 K and 1 atm. The products of combustion exit at 1800 K and 1 atm with the product analysis CO_2, 9.7%; CO, 0.5%; O_2, 2.95%; and N_2, 86.85%. For operation at steady state, determine the rate of heat transfer from the combustion chamber in kJ per kmol of fuel. Neglect kinetic and potential energy effects. The average value for the specific heat $\bar{c}_p$ of methane between 298 and 400 K is 38 kJ/kmol.K.

enthalpy of formation $\bar{h}_f^o$(kJ/kmol)

CO_2 : -393,520; CO : -110,530; $H_2O_{(g)}$:-241,820; $CH_{4(g)}$:-74,850

enthalpy value $\bar{h}$(kJ/kmol) at

	298 K	500 K	1800 K
O_2	8,682	14,770	60,371
N_2	8,669	14,581	57,651
CO_2	9,364	17,678	88,806
CO	8,669	14,600	58,191
$H_2O_{(g)}$	9,904	16,828	72,513

(20%)

8.Two vessels of equal volume are connected by a short length of pipe containing a valve; both vessels are well lagged. One vessel contains air and the other is completely evacuated. Calculate the change of entropy per kg of air in the system when the valve is opened and the air is allowed to fill both vessels. (R=0.287 kJ/kg.K) (10%)