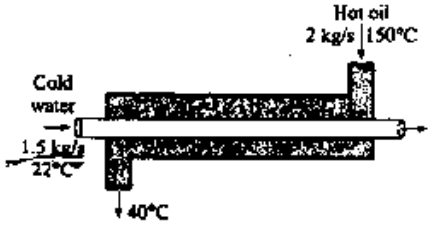
國立中央大學九十一學年度轉學生入學試題卷

機械工程學系　三年級　科目：熱力學　共 / 頁 第 / 頁

1. What are the characteristics of all heat engines? Is it possible for a heat engine to operate without rejecting any waste heat to a low-temperature reservoir? Explain. (10%)
2. A thin-walled double-pipe counter-flow heat exchanger is used to cool oil (C_p = 2.20 kJ/kg^{0}C) from 150^{0}C to 40^{0}C at a rate of 2 kg/s by water (C_p = 4.18 kJ/kg^{0}C) that enters at 22^{0}C at a rate of 1.5 kg/s. Determine the rate of heat transfer in the heat exchanger and the exit temperature of water. (10%)



3. Two Gibbs equations are: $ds = \frac{du}{T} + \frac{Pdv}{T}$, and $ds = \frac{dh}{T} - \frac{vdP}{T}$. Obtain equations for the entropy change of ideal gases under the constant-specific-heat assumption. Prove that the two equations are equivalent. Show that for the isentropic process $\left(\frac{T_2}{T_1}\right) = \left(\frac{P_2}{P_1}\right)^{(k-1)/k}$. (15%)

4. Describe the processes of the ideal vapor-compression refrigeration cycle and why we can not just use a reversed Carnot cycle for the purpose of refrigeration or heat pumping. (20%)

5. Describe the processes of the ideal Diesel cycle and derive the thermal efficiency, which is function of compression ratio and cutoff ratio. (15%)

6. (a) What is the dew-point temperature? (5 %)
   (b) In summer, the outer surface of a glass filled with iced water frequently "sweats." How can you explain this sweating? (5 %)
   (c) What are the higher and lower heating values of a fuel? How do they differ? How is the heating value of a fuel related to the enthalpy of combustion of that fuel? (5 %)

7. (a) Describe the inversion line and the maximum inversion temperature. (5 %)
   (b) Start with the following Maxwell equation, (10 %)

$$\left(\frac{\partial P}{\partial T}\right)_v = \left(\frac{\partial s}{\partial v}\right)_T$$

and the Gibbs equation, $Tds = dh - vdP$, derive the Clapeyron equation

$$\left(\frac{dP}{dT}\right)_{sat} = \frac{h_{fg}}{Tv_{fg}}.$$

參考用