國立臺北科技大學

九十三學年度冷凍空調工程系碩士班入學考試

熱力與熱傳試題

填准考證號碼

注意事項：

1. 本試題共四題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

熱力與熱傳試題每題 25 分共四題

1. A combination of a heat engine driving a heat pump (see Fig. 1) takes waste energy at 50°C as a source $\dot{Q}_{W1}$ to the heat engine rejecting heat at 30°C. The remainder $\dot{Q}_{W2}$ goes into the heat pump that delivers a $\dot{Q}_H$ at 150°C. If the total waste energy is 5 MW find the rate of energy $\dot{Q}_H$ delivered at the high temperature.

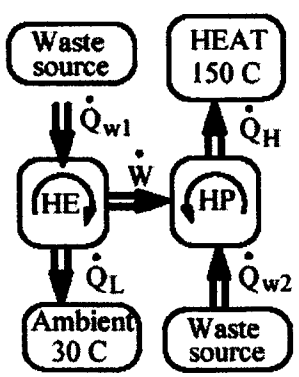

Fig. 1

2. A cylinder/piston contains 100L of air at 110 kPa, 25° C. The air is compressed in a reversible polytropic process to a final state of 800 kPa, 200° C. Assume the heat transfer is with the ambient at 25° C and determine the polytropic exponent n and the final volume of the air. Find the work done by the air, the heat transfer and the total entropy generation for the process. (For air: gas constant R=0.287kJ/kg-K, constant-volume specific heat C_v=0.717 kJ/kg-K)

3. Steam flowing through a long, thin-walled pipe maintains the pipe wall at a uniform temperature of 500 K. The pipe is covered with an insulation blanket comprised of two different materials, A and B (see Fig. 2).

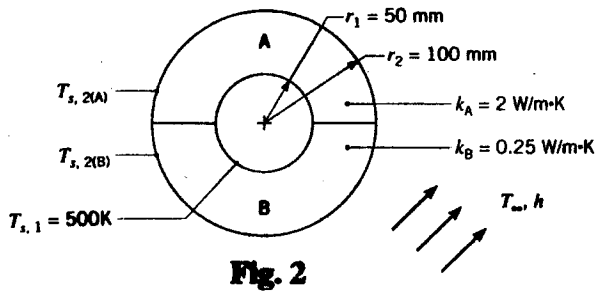

Fig. 2

The interface between the two materials may be assumed to have an infinite contact resistance, and the entire outer surface is exposed to air for which T_∞ =300K and h=25W/m^2-K. Determining:

(a) Sketch the thermal circuit of the system. Label (using the above symbols) all pertinent nodes and resistances.

(b) For the prescribed conditions, what is the total heat loss from the pipe? What are the outer surface temperatures $T_{s,2(A)}$ and $T_{s,2(B)}$.

4. Consider a very long, concentric tube heat exchanger having hot and cold water inlet temperatures of 85 and 15℃. The flow rate of the hot water is twice that of the cold water. Assuming equivalent hot and cold water specific heats, determine the hot water outlet temperature for the following modes of operation: (a) counterflow and (b) parallel flow.