

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：0225 · 節次：1

1. Please answer the following questions: (15 分).

Consider two identical fans, one at sea level and the other on top of a high mountain, running at identical speeds. How would you compare (a) the volume flow rates and (b) the mass flow rates of these two fans at two different locations?

(2). Please explain the thermal mechanism of Carbon Dioxide as a Greenhouse Gas to the global warming.

(3). Describe the ideal process for an (a) adiabatic turbine, (b) adiabatic compressor, and (c) adiabatic nozzle, and define the isentropic efficiency for each device.

2. A 40-L electrical radiator containing heating oil is placed in a  $30 \text{ m}^3$  room. Both the room and the oil in the radiator are initially at  $15^\circ\text{C}$ . The radiator with a rating of 2.0 kW is now turned on. At the same time, heat is lost from the room at an average rate of 0.5kJ/s. After some time, the average temperature is measured to be  $24^\circ\text{C}$  for the air in the room, and  $55^\circ\text{C}$  for the oil in the radiator. Taking the density and the specific heat of the oil to be  $950 \text{ kg/m}^3$  and  $2.3\text{kJ/kg} \cdot ^\circ\text{C}$ , respectively, determine how long the heater is kept on. (15 分)

3. A Carnot heat pump is to be used to heat a house and maintain it at  $21^\circ\text{C}$  in winter. One day when the average outdoor temperature remains at about  $5^\circ\text{C}$ , the house is estimated to lose heat at a rate of 75000kJ/h. If the heat pump consumes 6kW of power while operating, determine (a) how long the heat pump ran on that day; (b) the total heating costs, assuming an average price of NT\$2.3/kWh for electricity; and (c) the heating cost for the same day if resistance heating is used instead of a heat pump; (d) make some comments about the results. (20%)

- 4 Please use T-s diagram to explain and illustrate that a vapor power Carnot cycle possesses better thermal efficiency than any ideal Rankine cycle that operate between the same hot reservoir and cold reservoir. 20%

- 5 What is the basis of utilizing cogeneration to reduce energy consumption? 15%

- 6 Using ideal Brayton cycle to model gas turbine engines, please identify the method to raise the thermal efficiency of engine. And, what is the tradeoff to raise the thermal efficiency in practical? 15%