國立臺北科技大學九十七學年度碩士班招生考試

系所組別：1431 能源與冷凍空調工程系碩士班丙組

第二節　熱力學（選考）試題

填 准 考 證 號 碼

注意事項：

1. 本試題共五題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一. **(30%)** Answer the following problems

1. **(6%)** A refrigerator has a COP of 1.5. That is, the refrigerator removes 1.5 kW/h of electricity it consumes. Is this a violation of the first law of thermodynamics? Explain.
2. **(6%)** Is it possible for the entropy change of a closed system to be zero during an irreversible process? Explain.
3. **(6%)** Consider two systems that are at the same pressure as the environment. The first system is at the same temperature as the environment, whereas the second system is at a lower temperature than the environment. How would you compare the exergies of these two systems?
4. **(6%)** What is the second-law efficiency? How does it differ from the first-law efficiency?
5. **(6%)** How does the ideal Diesel cycle differ from the ideal Otto cycle?

二. **(15%)** A hair dryer is basically a duct in which a few layers of electric resistors are placed. A small fan pulls the air in and forces it through the resistors where it is heated. Air enters a 1200-W hair dryer at 100 kPa and 22℃ and leaves at 47℃. The cross-sectional area of the hair dryer at the exit is 60 cm^2. Neglecting the power consumed by the fan and the heat losses through the walls of the hair dryer, determine (a) the volume flow rate of air at the inlet and (b) the velocity of the air at the exit. (See Fig. 1)

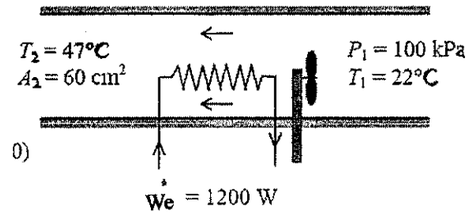

Fig. 1

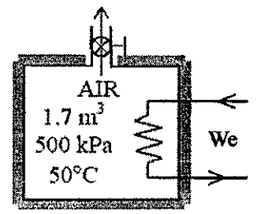

Fig. 2

三. **(15%)** An insulated 1.7-m^3 rigid tank contains air at 500 kPa and 50℃. A valve connected to the tank is now opened, and air is allowed to escape until the pressure inside drops to 200 kPa. The air temperature during this process is maintained constant by an electric resistance heater placed in the tank. Determine the electrical work done during this process. (See Fig. 2)

四. **(20%)** A horizontal cylinder is separated into two compartments by an adiabatic, frictionless piston. One side contains 0.2m^3 of nitrogen and the other side contains 0.1 kg of helium, both initially at 20℃ and 95 kPa. The sides of the cylinder and the helium end are insulated. Now heat is added to the nitrogen side from a reservoir at 500℃ until the pressure of the helium rises to 120 kPa. Determine (1) the final temperature of the helium, (2) the final volume of the nitrogen, (3) the heat transferred to the nitrogen, and (4) the entropy generation during this process. (See Fig. 3)

五. **(20%)** A heat pump receives heat from a lake that has an average winter time temperature of 6℃ and supplies heat into a house having an average temperature of 27℃. (1) If the house loses heat to the atmosphere at the rate of 64000 kJ/h, determine the minimum power supplied to the heat pump, in kW. (2) A heat exchanger is used to transfer the energy from the lake water to the heat pump. If the lake water temperature decreases vby 5℃ as it flows through the lake water-to-heat pump heat exchanger, determine the minimum mass flow rate of lake water, in kg/s. Neglect the effect of the lake water pump. (See Fig. 4)

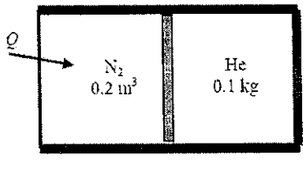

Fig. 3

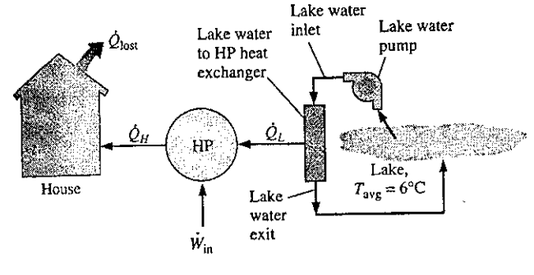

Fig. 4