113RA03

國立臺北科技大學113學年度碩士班招生考試

系所組別：1420 能源與冷凍空調工程系碩士班乙組

第二節　熱力學　試題

注意事項：

1. 本試題共 5 題，每題 20 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. When an ideal gas with constant specific heats proceeds an isentropic process, please prove the following relation is valid.

$$Pv^k = \text{constant}$$

where P is the pressure, v is the specific volume, and k is the specific heat ratio.

2. A 25-L tank, shown in Fig. 1, that is initially evacuated is connected by a valve to an air supply line flowing air at 20 °C and 800 kPa. The valve is opened, and air flows into the tank until the pressure reaches 600 kPa. Determine the final temperature and mass inside the tank, assuming the process is adiabatic. Develop an expression for the relation between the line temperature and the final temperature using constant specific heats.
Note: Specific heat ratio of air=1.4.

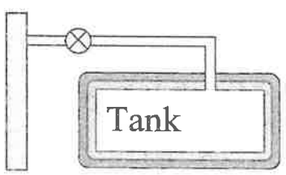

Fig. 1

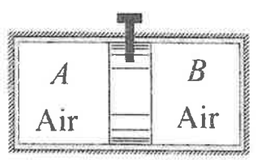

Fig. 2

3. An insulated cylinder is divided into two parts of 1 m^3 each by an initially locked piston, as shown in Fig. 2. Side A has air at 200 kPa, 300 K, and side B has air at 1.0 MPa, 1000 K. The piston is now unlocked so that it is free to move, and it conducts heat so that the air comes to a uniform temperature T_A=T_B. Find the mass in both A and B, and the final temperature and pressure. Assume the constant-volume specific heat of air is constant.

4. As shown in Fig. 3, the air in an insulated piston/cylinder setup is at 200 kPa, 360 K, with a volume of 0.1 m^3. There is a constant force on the piston. The air runs out through a nozzle and the exit temperature is measured to 300 K. The process continues to a final air volume of 0.01 m^3. Please find the exit velocity. Assume the constant-volume specific heat of air= 0.717 kJ/kg•K.

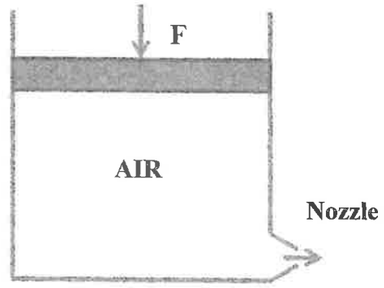

Fig. 3

5. The refrigerator shown in Fig. 4 operates at a steady state with a coefficient of performance (β) of 4.5 and a power input of 0.8 kW ($\dot{W}_R$). Energy ($\dot{Q}_H$) is rejected from the refrigerator to the surroundings at 20°C by heat transfer from metal coils attached to the back. Please determine

(a) the rate energy is rejected, in kW. (10%)

(b) the lowest theoretical temperature inside the refrigerator, in K. (10%)

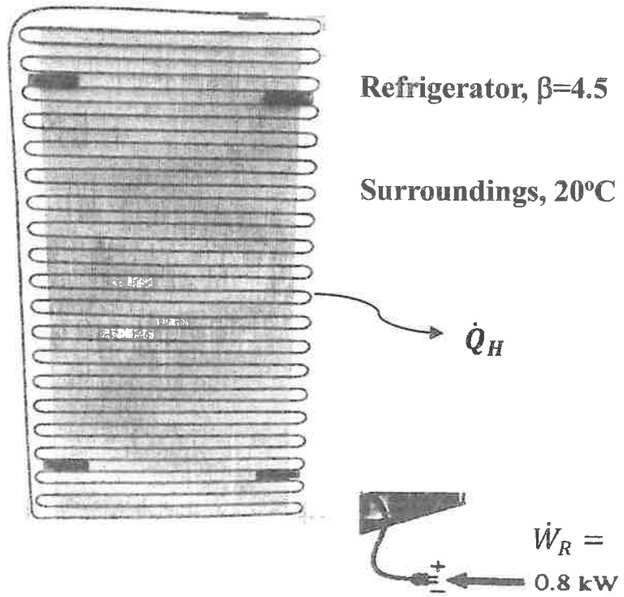

Fig. 4