國立成功大學 105 學年度碩士班招生考試試題

系　　所：機械工程學系

考試科目：熱力學

考試日期：0227，節次：2

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. For an ideal gas, prove that through a point in *T-s* diagram, the constant specific volume line has a steeper slope than the constant pressure line. (10%)

2. Air initially at 1.5 MPa, 1000 K undergoes an internally reversible process to 100 kPa in a piston/cylinder assembly. Assume air is an ideal gas with constant specific heats, C_v = 0.717 kJ/kg-K, C_p = 1.004 kJ/kg-K, k = 1.4 and R = 0.287 kJ/kg-K. For each of the following cases, determine for 0.5 kg of air the heat transfer and the work, each in kJ. (20%)

   Please draw the following table with your answers on the answer sheet !!!

Process	isothermal	adiabatic	constant volume
Q			
W			

3. (a) Air is stored in a closed vessel at temperature 35°C and pressure 100 kPa. The system is at rest and zero elevation relative to an availability (exergy) reference environment at pressure 100 kPa and temperature 25°C. Assume air is an ideal gas with constant specific heat, C_p = 1.004 kJ/kg-K. Find the specific availability (exergy) in kJ/kg. (15%)

   (b) Repeat problem (a) for the other gas helium. It has the same amount of mass. Air or helium, which has the greater value for specific availability (exergy) to the same reference environment? Assume helium is an ideal gas with constant specific heat, C_p = 5.193 kJ/kg-K. (5%)

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4. A air-standard cycle consists of constant volume heat addition, isentropic expansion, and constant pressure compression. At the beginning of constant volume heat addition, T_1=350K and P_1=120 kPa. The maximum cycle temperature is T_2=900K (at the beginning of isentropic expansion). Assuming c_v=0.742kJ/kg·K and c_p=1.031kJ/kg·K, determine the thermal efficiency and sketch the *T-s* diagram for the cycle. (15%)

5. One kmol of neon at 400 K is initially confined to one side of a rigid, insulated container divided into (two) equal volumes of 0.4 m^3 by a partition. The other side is initially evacuated. The partition is removed and the neon expends to fill the entire container. Using the van der Walls equation of state, determine the final temperature of the neon, in K. The critical temperature and pressure of the neon are, respectively, T_c=44.5K and P_c=27.3 bar. (15%)

6. Show that the Gibbs function *g* can be determined from the specific internal energy expressed as $u = u(s, v)$. That is, the specific internal energy is a fundamental thermodynamic function. (20%)