國　立　清　華　大　學　命　題　紙

96 學年度＿動力機械＿系（所）＿甲＿組碩士班入學考試

科目＿熱流學(一)＿ 科目代碼＿1002＿共＿2＿頁第＿1＿頁 *請在【答案卷卡】內作答

1. (1)Please describe the possible spontaneous and reverse processes based on the first and second laws of thermodynamics, respectively, after the partition separating the N_2 and O_2 gases in Fig. A is removed. (2)Consider 1 kmol of O_2 and 2 kmol of N_2 both at 298K and 1atm separated by a partition (Fig. A). The partition is removed and the O_2 and N_2 mix. Determine the entropy change associated with this mixing process. Illustrate whether the process is reversible or not. (3)What if we were to perform the same mixing process, but replacing the N_2 in Fig. A by O_2 ? ((1)8%、(2) 16%、(3)6%)

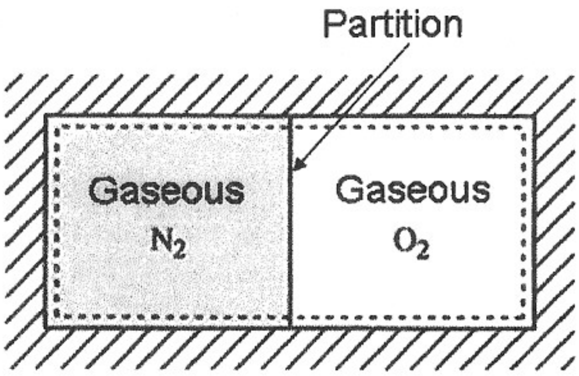

Fig. A

2. (1)Internal energy has its origins with the microscopic nature of matter. Please define internal energy. (2) Please define temperature from both macroscopic and microscopic viewpoints. ((1)5%、(2) 5%)

3. **Power Cycle** (20%)

All that could be read from the notes taken by a student for an ***Ideal Diesel Cycle*** was the following table:

Stage	P (bar)	v (m^3/kg)	T (K)
Inlet (1)	0.9	1.0000	313
Compressed (2)		0.0625	
Burnt (3)		0.1110	
Expanded (4)		1.0000	

Complete the unknowns in the table (12%, 2% each) and **work out** the thermodynamic efficiency of the cycle (8%). Take C_p = 1.005 kJ/kgK and R = 0.287 kJ/kgK. (1bar = 100 kPa and 1 kJ = 1000 Nm = 1 kPa-m^3)

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4. For a steady, uniform laminar flow entering a two-dimensional converging duct, a thin boundary layer is formed on each duct wall, as shown in Fig. B.

(a) Draw the velocity profile $u(y)$ at the duct outlet.

(b) What is the mathematical expression (in terms of $u(x,0)$) for calculating the flow acceleration along the central plane ($y=0$)?

(c) Discuss on the sign (negative, zero, or positive) of vorticity within the two boundary layer regions and the potential core region, respectively.

(d) A pressure drop is present between the inlet and outlet. In the sense of momentum conservation, what is the pressure drop to be balanced by? (Hint: You may consider the structure of Navier-Stokes equations) (5% each)

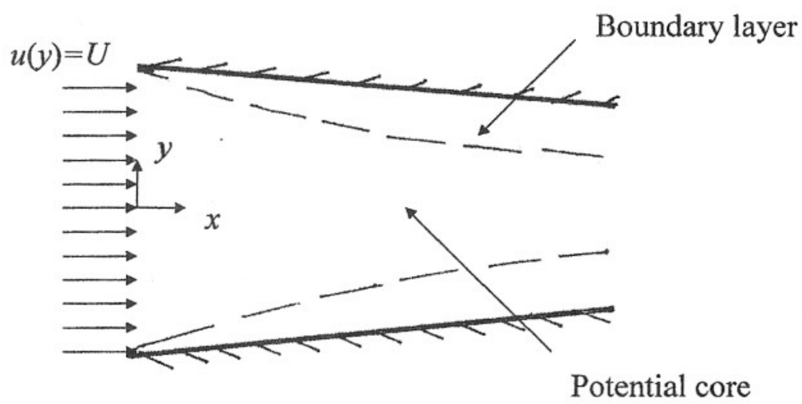

Fig. B

5. If we want to calculate the drag force on the flow by the duct shown in Fig. B, we may use either integral or differential analysis.

(a) Discuss on the principle of the integral analysis for drag calculation, and also derive the equation of drag calculation in an integral form of velocity distribution and other properties.

(b) Discuss on the basic procedure of the differential analysis for drag calculation. In your discussion, please write out the mathematical equations or relations required. (10% each)