※ 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. [10%]

Please show that the enthalpy of an ideal gas is dependent of temperature only.

2. [10%]

Water at 25°C flows in a horizontal pipe in which there is no exchange of either heat or work with surroundings. Its velocity is 14 m/s in a pipe with an internal diameter of 6 cm until it flows into a section where the pipe diameter abruptly increases. What is the maximum temperature change for an enlargement in the pipe?

3. [15%]

One mole of an **ideal diatomic gas** is compressed adiabatically in a piston/ cylinder device from 2 bar and 25°C to 7 bar. The process is irreversible and requires 35% more work than a reversible, adiabatic compression from the same initial state to the same final pressure.

(1) What is the constant-volume heat capacity of this ideal diatomic gas? **[3%]**

(2) What is the entropy change of the gas, in unit of J/(mol K)? **[12%]**

4. [15%]

The idealization of the gas-turbine engine is called the Brayton cycle. The working fluid of an ideal Brayton cycle is taken as air, often considered as an ideal gas with constant heat capacities. The ideal Brayton cycle follows the following four distinct processes:

Process A → B: air is reversibly and adiabatically compressed from P_A to P_B.

Process B → C: heat Q_{BC}, replacing combustion, is added at constant pressure, raising the air temperature.

Process C → D: a work-producing isentropic expansion of the air reduces the pressure from P_C to P_D.

Process D → A: air is cooled at constant pressure.

(1) Please sketch the ideal Brayton cycle on a PV diagram and clearly label these four processes mentioned above. **[3%]**

(2) What is the thermal efficiency of the ideal Brayton cycle, in relation to the pressure of the air? **[12%]**

(背面仍有題目,請繼續作答)

編號： 80　　國立成功大學 103 學年度碩士班招生考試試題　　

系所組別：化學工程學系甲組

考試科目：化工熱力學　　考試日期：0222，節次：2

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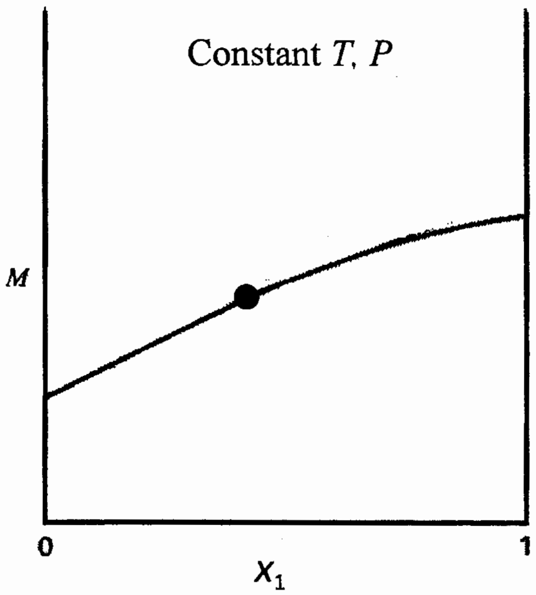
5. [12%]



Please draw the same plot like the left figure on your exam paper, choosing an arbitrary point from the plot (the curve), plot and indicate the following items. **[12%]**

$\overline{M}_1$, $\overline{M}_2$, $\overline{M}_1^{\infty}$, and $\overline{M}_2^{\infty}$

6. [20%]

If $G^E / x_1 x_2 RT = A_{21}x_1 + A_{12}x_2$, please derive from this expression to obtain the expression for $ln\,\gamma_1$ and $ln\,\gamma_2$, also the values of γ_1^{∞} and γ_2^{∞} . **[12 + 8 = 20%]**

7. [18%]

The excess Gibbs energy for a liquid mixture of species 1, 2 at certain fixed T and P is represented by

$$H^E = x_1 x_2 \cdot (20\,x_1 + 10\,x_2)$$

where H^E is in $\mathrm{J \cdot mol^{-1}}$. Determine the expression for $\overline{H}_1^E$ and $\overline{H}_2^E$ as functions of x_1. Also if

$$H = 10 \cdot (2\,x_1 + x_2) \cdot (10 + x_1 x_2)$$

Then, please determine the expression for the heat of mixing as function of x_2.