# 國立臺北科技大學九十五學年度研究所博士班招生考試

## 系所組別：1132 機電科技研究所能源組

## 熱力熱傳學(選考）試題

填准考證號碼

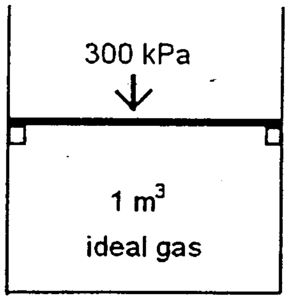


**注意事項：**

1. 本試題共 四 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、(25%) A piston-cylinder device initially contains 1 $m^3$ of an ideal gas [R=0.2 $kPa \cdot m^3/(kg \cdot K)$, $C_v$ = 0.8 kJ/(kg·K)] at 200 kPa and 300 K temperature. At this state, the piston is resting on a set of stops, and a pressure of 300 kPa is required to lift the piston. Heat is now slowly transferred to the gas until the volume is 2 $m^3$. Determine:

1. the P-v diagram of the above processes;
2. final temperature;
3. the work done during this process;
4. the total heat transfer.



二、(25%) 1. Prove the following Clapeyron Equation.

$$\left.\frac{dP}{dT}\right)_{sat} = \frac{h_{fg}}{T_{sat} v_{fg}}$$

where $h_{fg}$ is the latent heat, $v_{fg}$ is the specific difference between liquid and vapor, and $T_{sat}$ is the saturation temperature.

2. Assuming that you have the physical properties at T1 saturation temperature of an ideal gas (gas constant = R), show that you can find the saturation pressure ($P_2$) at another saturation temperature ($T_2$) from the properties at $T_1$ ($h_{fg,1}$, $T_1$, saturation pressure =$P_1$, R, and $v_{fg,1}$).

三、(25%) Uniform flow enters into a heated circular pipe.

1. Qualitatively sketch (1) the hydraulic boundary layer thickness distribution and thermal boundary layer thickness ($\delta$- x and $\delta_t$- x curves) along the tube length. (2) the heat transfer coefficient distribution ($h - x$ curve), and (3) the friction factor distribution ($f - x$ curve).

2. Specify the developing regions on the curves. Briefly explain what the "developing region" is and how the heat transfer and friction factor are influenced by the boundary layer development.

四、(25%) Electronic components are attached to a 10 cm-square, 2 mm-thick aluminum plate, and the backside is cooled by a flow of air. The backside of the plate has aluminum straight fins of 25 mm fin height, 0.3 mm fin thickness at a pitch of 3 mm. If the cooling air is at 20°C and the heat transfer coefficient on the fin is 30 $W/m^2K$, what is the allowable heat dissipation rate if the plate temperature should not exceed 70°C? (Take k = 180 W/mK for the aluminum.)