

國立臺北科技大學九十八學年度碩士班招生考試

系所組別：1203 製造科技研究所不分組

第二節 熱力學 (選考) 試題

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注意事項：

1. 本試題共 5 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。

Problem 1. (20%)

A piston-cylinder device initially contains 0.5m^3 of unknown ideal gas at 100 kPa and 80°C . The gas is now compressed to 0.1m^3 in such a way that the temperature inside the cylinder remains constant.

- a) (10%) Determine the work done during this process.
- b) (10%) Determine the entropy change during the process.

Problem 2. (20%)

Air is compressed by an adiabatic compressor from 200 kPa and 12°C to a pressure 900 kPa at a steady rate of 0.3 kg/s . If the isentropic efficiency of the compressor is 80 percent, determine

- a) (10%) the exit temperature of the air.
- b) (10%) the required power input to the compressor.

Problem 3. (20%)

Consider a large furnace that can transfer heat at a temperature of 1100 K at a steady rate of 2500 kW . Determine the rate of exergy flow associated with this heat transfer. Assume an environment temperature of 25°C .

Problem 4. (20%)

An ideal Otto cycle has a compression ratio of 10. At the beginning of the compression process, air is at 100 kPa and 17°C , and 800 kJ/kg of heat is transferred to air during the constant volume heat addition process, please determine

- a) (5%) the maximum temperature and pressure that occur during the cycle.
- b) (5%) the net work output.
- c) (5%) the thermal efficiency.
- d) (5%) the mean effect pressure for the cycle.

Problem 5 (20%)

According the following state equation

$$p = \frac{RT}{v-b} - \frac{a}{v^2T} \quad \text{where a, b are empirical constants.}$$

Please derive an expression of

- a) (10%) the constant pressure expansion coefficient.
- b) (10%) the isothermal compressibility.