

淡江大學 100 學年度碩士班招生考試試題

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系別：航空太空工程學系

科目：熱 力 學

考試日期：2 月 28 日(星期一) 第 4 節

本試題共 5 大題， 1 頁

20 points each.

You might need these:

The gas constant R of air is $0.287 \text{ kPa}\cdot\text{m}^3/\text{kg}\cdot\text{K}$, and $k = 1.4$. The constant pressure specific heat of air at room temperature is $c_p = 1.005 \text{ kJ}/\text{kg}\cdot\text{K}$. The constant volume specific heat of air at room temperature is $c_v = 0.718 \text{ kJ}/\text{kg}\cdot\text{K}$.

The specific heat of water is $4.18 \text{ kJ}/\text{kg}\cdot\text{K}$

1. Carbon dioxide contained in a piston-cylinder device is compressed from 0.3 to 0.1 m^3 . During the process, the pressure and volume are related by $P = aV^{-2}$, where $a = 8 \text{ kPa m}^3$. Calculate the work done on the carbon dioxide during this process.
2. A chilled-water heat-exchange unit is designed to cool $5 \text{ m}^3/\text{s}$ of air at 100 kPa and 30°C to 100 kPa and 18°C by using water at 8°C . Determine the maximum water outlet temperature when the mass flow rate of the water is $2 \text{ kg}/\text{s}$.
3. A constant-volume tank contains 5 kg of air at 100 kPa and 327°C . The air is cooled to the surroundings temperature of 27°C . Assume constant specific heats at 300 K . (a) Determine the entropy change of the air in the tank during the process, in kJ/K . (b) Determine the net entropy change of the universe due to the process, in kJ/K .
4. Determine the mean effective pressure of an ideal Otto cycle that uses air as the working fluid; its state at the beginning of the compression is 96 kPa and 17°C ; its temperature at the end of the combustion is 817°C ; and its compression ratio is 9 . Use constant specific heats at room temperature.
5. A pure jet engine propels an aircraft at $300 \text{ m}/\text{s}$ through air at 60 kPa and 0°C . The inlet diameter of the engine is 2 m , the compressor pressure ratio is 10 , and the temperature at the turbine inlet is 450°C . Determine the velocity at the exit of the engine's nozzle and the thrust produced. Assume ideal operation for all components and constant specific heats at room temperature.