

國立臺北科技大學 101 學年度碩士班招生考試

系所組別：1330 車輛工程系碩士班丙組

第一節 熱力學 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。

1. A cylinder fitted with piston has an initial volume of 0.2 m^3 and contains nitrogen at 250 kPa, 25°C . The piston is moved, compressing the nitrogen until the pressure is 1.25 MPa and temperature 150°C . During this compression process heat is transferred from the nitrogen, and the work done on the nitrogen is 20 kJ. Determine the amount of this heat transfer. (20%)
(nitrogen $C_v = 0.745 \text{ kJ/kg-K}$, $R = 0.2968 \text{ kJ/kg-K}$)

2. Two steady flows of air enter a control volume. One is 0.03 kg/s of flow at 300 kPa, 250°C , and the other enters at 450 kPa, 10°C . A single flow exits at 100 kPa, -35°C . The control volume rejects 1.2 kW of heat to the surroundings and produces 4 kW of power output. Neglect kinetic energies and determine the mass flow rate of the enter at 450 kPa, 10°C . (20%) (air $C_p = 1.004 \text{ kJ/kg-K}$)

3. We propose to heat a house in the winter with a heat pump. The house is to be maintained at 25°C at all times. When the ambient temperature outside is -15°C , the rate at which heat is lost from the house is estimated to be 30 kW. What is the minimum electrical power required to drive the heat pump? (20%)

4. A mass of 1 kg of air contained in a cylinder at 2 MPa and 1000 K expands in a reversible isothermal process to a volume 12 times larger. Calculate the change of entropy of the air (20%)

5. Two flows of air are both at 200 kPa; one has 1 kg/s at 350 K, and the other has 2 kg/s at 280 K. The two flows are mixed together in an insulated box to produce a single exit flow at 200 kPa. Find the total rate of entropy generation (20%)