

國立成功大學

113學年度碩士班招生考試試題

編 號：151

系 所：生物醫學工程學系

科 目：熱力學

日 期：0201

節 次：第 1 節

備 註：可使用計算機

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※ 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. Define each of the four laws of thermodynamics and provide a practical example where each law is applied. (20 pts)
2. Describe a Carnot refrigeration cycle operating between two reservoirs at temperatures T_H and T_L . Derive the expression for the coefficient of performance (COP) of the cycle and discuss how it compares to the efficiency of a Carnot heat engine. (15 pts)
3. Prove that for an ideal gas undergoing an adiabatic process, the relation $PV^n = \text{constant}$ holds, where P is the pressure, V is the volume, and n is the heat capacity ratio of C_p/C_v . Discuss the physical meaning of n and its effect on the adiabatic process. (15 pts)
4. For a steady-flow process, derive the energy equation (steady-flow version of the first law of thermodynamics) for a control volume including heat transfer, work done, and changes in kinetic and potential energies. (15 pts)
5. Using the van der Waals equation of state, derive an expression for the compressibility factor of a real gas at its critical point. Discuss the significance of the compressibility factor in real gas behavior. (15 pts)
6. A gas undergoes a reversible cyclic process consisting of three stages: isobaric expansion, isothermal compression, and adiabatic return to the initial state. Sketch the process on a P - V diagram, where P is the pressure, V is the volume, and calculate the net work done over the cycle, given appropriate data for each stage. (20 pts)