

國立中央大學103學年度碩士班考試入學試題卷

所別：機械工程學系碩士班 丙組(熱流)(一般生) 科目：熱力學 共 / 頁 第 / 頁
能源工程研究所碩士班 不分組(一般生)

本科考試可使用計算器，廠牌、功能不拘

*請在試卷答案卷(卡)內作答

請按題號順序作答，避免被漏改。若您要先做後面題目，請先在答案本預留空間。

1. A rigid tank contains a hot fluid that is cooled while being stirred by a paddle wheel. Initially, the internal energy of the fluid is 800 kJ. After reaching the steady-flow condition, the fluid loses heat at a rate of 500 kW, and the paddle wheel delivers 100 kW of power to the fluid.
 - (a) Write down the energy balance equation for general cases in the rate form. (5%)
 - (b) Determine the increase rate of the internal energy of the fluid. Neglect the energy stored in the paddle wheel. (5%)
2. An air compressor compresses 15 kg/s of air at 100 kPa and 20°C to 700 kPa steadily and adiabatically.
 - (a) Determine the actual power required to compress this air if the exit temperature is 235°C. (10%)
 - (b) Determine the actual power required to compress this air if the isentropic compression efficiency is 95% and the exit temperature under isentropic process is 235°C. (5%)(The properties of air at the anticipated average temperature are $c_p = 1.013 \text{ kJ/kg}\cdot^\circ\text{C}$ and $c_v = 0.726 \text{ kJ/kg}\cdot^\circ\text{C}$.)
3.
 - (a) What do we call the device that receives heat (Q_L) from a low-temperature reservoir and ejects heat (Q_H) to a high-temperature reservoir? (5%)
 - (b) Assuming you install the device in your house and in the way that the inside of the house is considered as the high-temperature reservoir and the outside of the house is the low-temperature reservoir, derive the appropriate expression for its coefficient of performance (COP) in terms of Q_L and Q_H . The net work input of the device is W_{net} . (5%)
4.
 - (a) What is a Carnot heat engine? (5%)
 - (b) Draw the T - s (temperature-entropy) diagram of a Carnot heat engine cycle and indicate the process directions. (5%)
 - (c) How do you increase the thermal efficiency of a Carnot heat engine? (5%)
5.
 - (a) What is the physical meaning of "entropy"? (5%)
 - (b) What is the physical meaning of "exergy"? (5%)
 - (c) For a process to occur, the exergy of an isolated system should increase or decrease? (5%)
6. A heat engine receives 100 kJ from a heat source at 1000 K and ejects waste heat to a heat sink at 300 K, while producing a work output of 50 kJ. What are the first law efficiency and second law efficiency of the engine? (10 %)
7. What are the differences between an Otto cycle and a Diesel cycle? Compare their performances. (10 %)
8. You have 3 different heaters, a radiating heater, a ceramic heater with built-in fan, and a heat pump.
 - (a) What are the typical COP values for the 3 heaters? (6 %)
 - (b) To heat a living room, which heater would you recommend to use? Why? (9 %)

參考用