

國立中央大學97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) 科目：熱力學 共 2 頁 第 1 頁

能源工程研究所碩士班

*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。

選擇題為單選或複選請自行判斷，必須全部答對才給分。

1. (5 %) (a) A housewife is cooking chicken soup in a pan that is (i) uncovered, (ii) covered with a light lid, and (iii) covered with a heavy lid. For which case will the cooking time be the shortest? Why?
(5 %) (b) A fixed mass of an ideal gas is heated from 40 to 90 °C (i) at constant volume and (ii) at constant pressure. For which case will the input energy be larger? Why?
(5 %) (c) The kinetic energy of a fluid increases as it is accelerated in an adiabatic nozzle. Where does this energy come from?
2. (10 %) A piston-cylinder device equipped with a set of stops for the piston is initially filled with 6 kg of air at 200 kPa and 27 °C. The mass of the piston is such that a pressure of 400 kPa is required to move it. Heat is inputted into the air until its volume doubles. Show the process on a P-v diagram, and determine the work done by the air and the heat transferred to the air during the process. The gas constant of air is $R = 0.287 \text{ kPa}\cdot\text{m}^3/\text{kg}\cdot\text{K}$.
3. (10 %) An evacuated bottle of volume V is surrounded by the atmosphere at pressure P_0 and temperature T_0 . A valve at the neck of the bottle is opened, and the atmosphere air is allowed to flow into the bottle. Determine the net heat transfer through the wall of bottle in terms of the properties of the system and the surrounding atmosphere when thermal and mechanical equilibrium is established.
4. (6 %) An air-conditioner that consumes 1 kW of electricity when running and has a COP of 4. The rate of cooling or the heating of this air-conditioner will provide to the air in the room when running is:
(a) 4 kJ/s, cooling, (b) 1 kJ/s, cooling, (c) 0.25 kJ/s, heating, (d) 1 kJ/s, heating, (e) 4 kJ/s, heating.
5. (6%) An Otto cycle with air (ratio of specific heat is 1.4) as the working fluid has a compression ratio of 9. Under cold air standard conditions, the thermal efficiency of this cycle is
(a) 12 % (b) 42 % (c) 50 % (d) 58 % (e) 75 %
6. (3%) For specified limits for the maximum and minimum temperatures, the ideal cycle with the lowest thermal efficiency is
(a) Carnot (b) Stirling (c) Ericsson (d) Diesel (e) All are the same
7. (6%) Select the correct statements from the following:
(a) A closed system can experience a decrease in entropy only when there is heat transfer from the system to the surrounding during the process.
(b) Both entropy and entropy generation are thermodynamic properties of a system.
(c) Entropy change is zero during an isentropic process.
(d) Entropy of the working fluid of the Carnot cycle increase during the isothermal heat addition process.
8. (4 %) Select the working fluids which are unrelated to the diesel cycle
(a) Carbon dioxide (b) air (c) refrigerant (d) water (e) gasoline
9. (10 %) Briefly describe the characteristics of the Rankine power cycle in terms of its basic four components and four thermodynamic processes.

注意：背面有試題

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10. (6%) Which statements below are correct regarding the vapor compression refrigeration cycles?
- (a) The evaporator pressure should be lower than the atmospheric pressure.
 - (b) For a household refrigerator, the temperature of the refrigerant in the condenser cannot be higher than the cooling room air.
 - (c) The COP of modern air conditioner can reach 5 or above.
 - (d) Although the COP of a cascade refrigeration cycle is higher than that of a simple system, the compressor work usually increases.
11. (6%) Of the five statements below about the specific heat difference $C_p - C_v$, chose the *wrong* ones:
- (a) The specific heat difference $C_p - C_v$ of a substance is positive or zero.
 - (b) The specific heat difference $C_p - C_v$ at a given absolute temperature T is proportional to T .
 - (c) The specific heat difference $C_p - C_v$ is zero for incompressible substances.
 - (d) The specific heat difference $C_p - C_v$ of an ideal gas is independent of temperature.
 - (e) The specific heat difference $C_p - C_v$ is proportional to isothermal compressibility.
12. (6%) An air stream at a specified temperature and relative humidity undergoes evaporative cooling by spraying water into it at about the same temperature. The lowest temperature the air stream can be cooled to is
- (a) the dry bulb temperature at the given state
 - (b) the wet bulb temperature at the given state
 - (c) the dew point temperature at the given state
 - (d) the saturation temperature corresponding to the humidity ratio at the given state
 - (e) the triple point temperature of water
13. (6%) Methane CH_4 is burned with 50 percent excess air. What is the air-fuel mass ratio for this combustion process?
14. (6%) Which statements below are correct?
- (a) The van't Hoff equation describes the dependence of the equilibrium constant on temperature.
 - (b) The van't Hoff equation describes the dependence of the equilibrium constant on pressure.
 - (c) For an exothermic reaction, the equilibrium constant decreases as temperature is increased.
 - (d) For an exothermic reaction, the equilibrium constant decreases as pressure is increased.

參考用

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