

國立中央大學104學年度碩士班考試入學試題

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

*請在答案卷(卡)內作答

考生作答須寫明題號，儘可能按照題號順序作答。

1. Can the entropy of a closed system increase? Explain. (5%)
2. What is the physical meaning of "exergy destruction"? How is it related to "irreversibility"? (5%)
3. (a) Give the definition of the first-law efficiency and the second-law efficiency for a power plant. (4%)
(b) Give the definition of the isentropic efficiency and the second-law efficiency for a turbine. (4%)
4. We often hear that a diesel engine is more efficient than a gasoline engine. Is this true or false? Explain. (8%)
5. 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? (3%)
(b) To heat a whole living room, which heater would you recommend to use? Why? (6%)
6. Water at 80 psia and 250°F enters a heat exchanger at a rate of 500 lbm/min and leaves at 75 psia and 100°F. The water is cooled by passing air through the heat exchanger at an inlet volume flow rate of 35,400 ft³/min. The air initially is at 14.8 psia and 80°F, and the exit pressure is 14.6 psia. Determine (a) the exit air temperature, (b) the inlet area for airflow in ft², if the inlet air velocity is 100 ft/s, and (c) the inlet water velocity, in ft/s, if the inlet-pipe diameter is 4 inches. (20%)

Supplementary data:

- (1) For compressed liquid at 80 psia, 250°F: $h=218.6$ Btu/lbm, $v=0.017$ ft³/lbm, at 75 psia, 100°F: $h=68.05$ Btu/lbm.
 - (2) For air near atmospheric pressure: 70°F: $h=126.6$ Btu/lbm
80°F: $h=129.1$ Btu/lbm
300°F: $h=182.08$ Btu/lbm.
 - (3) Universal gas constant = 10.73 psia.ft³/(lbmol.R), Molecular weight of air = 29.
7. A system consisting of 2 lbm of H₂O undergoes a cycle composed of the following processes:
1-2: adiabatic compression from $p_1=200$ psia, $x_1=0.9$ to $p_2=600$ psia, $T_2=500$ °F,
2-3: isothermal expansion process with work out of 236.2 Btu to $p_3=200$ psia,
3-1: constant pressure process.

Neglect kinetic and potential energy effects, determine the net work for the cycle and the heat transfer for each process, all in Btu. (15%)

Supplementary data:

For steam:

At $p=200$ psia: $u_f=354.9$ Btu/lbm, $u_g=1114.6$ Btu/lbm,
 $v_f=0.01839$ ft³/lbm, $v_g=2.289$ ft³/lbm.
At $p=600$ psia, $T=500$ °F: $v=0.795$ ft³/lbm, $u=1128$ Btu/lbm.
At $p=200$ psia, $T=500$ °F: $v=2.724$ ft³/lbm, $u=1168$ Btu/lbm.

8. Consider a gas whose equation of state is $P(v - a) = RT$, where a is a positive constant. Is it possible to cool this gas by throttling? (10%)
9. Somebody claims that the mass and mole fractions for a mixture of CO₂ and N₂O gases are identical. Is this true? Why? (5%)
10. What is sensible heat? How is the sensible heat loss from a human body affected by the (a) skin temperature, (b) environment temperature, and (c) air motion? (10%)
11. 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 (5%)
(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.

參考用