

國立中央大學100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 二 頁 第 一 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。

選擇題為單選或複選請自行判斷，必須全部答對才給分。

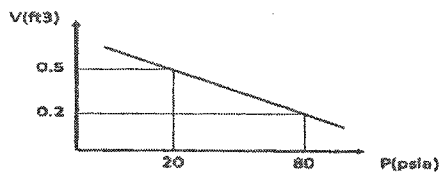
1. (15 %) A steam heating system for a building 435 ft high is supplied from boilers 30 ft below ground level. Saturated water vapor leaves the boiler at 30 psia, and it reaches the 435-ft elevation above ground at 20 psia. Heat transfer from the supply pipe to the surroundings is 50 Btu/lbm. Neglecting kinetic-energy effects, (a) find the quality of the steam at the 435-ft elevation, and (b) find the percent reduction in heat transfer necessary to assure that saturated vapor is present at the 435-ft level.

Hint: (1) water at 30 psia: $h_f=218.93$ Btu/lbm, $h_g=1164.3$ Btu/lbm

at 20 psia: $h_f=196.26$ Btu/lbm, $h_g=1156.1$ Btu/lbm

(2) 1 Btu = 778.2 lbf-ft

2. (20 %) A piston-cylinder machine contains air initially at 20 psia, 240 °F, and 0.5 ft³. The piston moves slowly and with negligible friction until the pressure rises to 100 psia. The process is described by the following diagram, where V is in cubic feet and p is in psia. (a) what is the final temperature, in Rankine degree, R, (b) what mass of air is present? (c) determine the work done, in lbf-ft, (d) determine the heat transfer, in Btu. Note that gas constant for air is 53.3 lbf.ft/(lbm.R)



3. (2 %) Which devices use air as the working fluid?
 (a) diesel engine, (b) steam turbine, (c) gasoline engine, (d) vapor-compression refrigerator, (e) Bryton cycle.
4. (4 %) (a) Explain the use of the second law of thermodynamics.
 (5 %) (b) Explain the statement of Kelvin-Planck and its relations with the second law of thermodynamics.
5. (10 %) Compare the exergy and entropy in terms of (a) the balance equation of a system, (b) the transfer mechanism.
6. (4 %) Describe the meaning of the area enclosed by the pressure-volume and the temperature-entropy plots for a thermodynamic cycle.
7. (10 %) Briefly describe the characteristics of the ideal vapor power cycle in terms of (a) its working fluid, (b) typical fuel used (lists two), (c) the temperature-entropy plot.

注意：背面有試題

參考用

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8. (5%) A substance whose Joule-Thomson coefficient is negative is throttled to a lower pressure. During this process, (select the correct statements)

- (a) the temperature of the substance will increase.
- (b) the temperature of the substance will decrease.
- (c) the entropy of the substance will remain constant.
- (d) the flow energy of the substance will increase.
- (e) the enthalpy of the substance will decrease.

9. (5%) Of the reactions given below, the reaction whose equilibrium composition at a specified temperature is not affected by pressure is

- (a) $\text{CH}_4 + 2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{CO}_2$
- (b) $\text{CO} + \frac{1}{2}\text{O}_2 \rightarrow \text{CO}_2$
- (c) $\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}$
- (d) $\text{N}_2 \rightarrow 2\text{N}$
- (e) all of the above.

10. (7%) Plot the psychrometric charts along with the following curves: (1) relative humidity, $\phi = \text{const.}$, (2) wet bulb temperature, $T_{wb} = \text{const.}$, (3) enthalpy $h = \text{const.}$, (4) dry bulb temperature, $T_{db} = \text{const.}$, (5) specific humidity $\omega = \text{const.}$

11. (13%) You have 3 different heaters, a radiating heater, a ceramic heater with built-in fan, and a heat pump.

- (6%) (a) What are the typical energy efficiency ratings (EER) of the 3 heaters?
- (7%) (b) Which heater should you use? Why?

參考用

注意：背面有試題