國立成功大學

111學年度碩士班招生考試試題

編　號：137、164

系　所：航空太空工程學系
能源工程國際碩士學位學程

科　目：熱力學

日　期：0219

節　次：第 1 節

備　註：不可使用計算機

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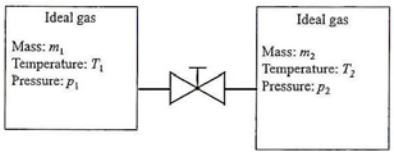
※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

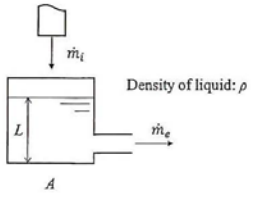
1. Each line in the table below gives information about a process of a closed system from state #1 to state #2. Each entry has the same energy units. Determine the values of all Greece alphabets in the table. (10%)

Process	Q	W	E_1	E_2	ΔE
A	+50	-20	+20	α	β
B	γ	+20	δ	+50	+30
C	-25	-80	ε	+160	ζ
D	η	-90	+50	θ	0
E	κ	+150	+20	λ	-100

2. Two tanks are connected by a valve. One tank contains m_1 of ideal gas at T_1 and P_1. The other tank holds m_2 of ideal gas at T_2 and P_2. The valve is opened and the gases are allowed to mix while receiving energy by heat transfer from the surrounding. The specific heat is c_v, and the final equilibrium temperature is T_f. Derive formulas for the final equilibrium pressure, p_f, and the heat transfer for the process. (20%)



3. Liquid flows at a constant mass flow rate of $\dot{m}_i = 6\,kg/s$ into a vertical cylindrical tank. Liquid exits the tank with a mass flow rate proportional to the height of the liquid in the tank: $\dot{m}_e = 1.2L\,kg/s$, where L is the instantaneous liquid height, in m. The area of the circular base is $A = 0.2m^2$. The liquid density is constant at $1000\,kg/m^3$. The tank is empty initially.
   a. Determine the variation of the liquid height with time. (15%)
   b. Determine L as $t \to \infty$. (5%)



4. A vertical cylindrical water tank (diameter is D_{tank}) whose top is open to the atmosphere is initially filled with water. Now the discharge plug near the bottom of the tank is pulled out, and a water jet whose diameter is D_{jet} streams out. The average velocity of the jet is approximated as $V = \sqrt{2gh}$, where h is the height of the water in the tank. From the center of the hole and g is the gravitational acceleration. Derive the formula of the time (t) required from t =0 ($h = h_0$) to $t = t$ with h_t. If D_{tank}=0.9 m, D_{jet}=0.009 m, h_0=0.36 m, and h_t=0.04 m, what is t (second)? (15%)
5. Derive the Bernoulli equation from the first law of thermodynamics and show all assumptions. (15%)
6. From $h = u + Pv$, under what conditions, you can get $\left(\frac{T_2}{T_1}\right) = \left(\frac{v_1}{v_2}\right)^{k-1}$? Derive it. What is k? Under the same conditions, also the derive the relations between T and v, as well as P and v. (20%)