# 國立成功大學 104 學年度碩士班招生考試試題

系所組別：工程科學系戊、己組

考試科目：熱力學

考試日期：0212，節次：1



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

I. Explain the following terms: (40%)

(1) Isolated system

(2) Thermodynamic equilibrium

(3) Pressure

(4) Quasi-equilibrium process

(5) Saturated liquid

(6) Heat

(7) Latent heat

(8) Ideal gas

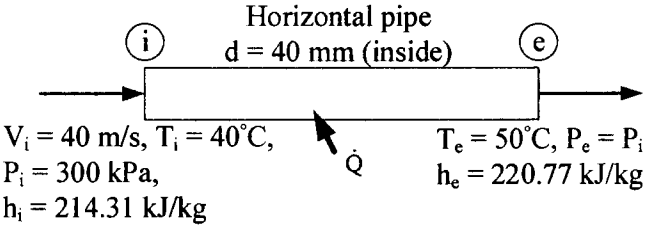
(9) Entropy

(10) Relative humidity

II. A bicycle tire containing air at 0.5 MPa and 25°C (the ambient temperature) leaks rapidly such that in one second the pressure is reduced to ambient, 0.1 MPa. The volume of the tire is 0.001 $m^3$. Assuming air to be an ideal gas with constant specific heats, find the temperature of the air remaining in the tire after one second and find the work done on or by this air remaining in the tire.It is also assumed that the leaking process is adiabatic. The specific heat ratio ($\gamma$) is 1.4. (7%)

III. A 4 $m^3$ rigid cylinder contains helium initially at 10°C and 500 kPa (state 1). More helium is added to the container until conditions reach 40°C and 1.8 MPa (state 2) at which time the inlet valve is closed and the contents cool to the original temperature of 10°C (state 3). Calculate the mass of helium added to the tank and the final pressure in the cylinder.The universal gas constant is equal to 8.314 kPa·$m^3$/(kmol·K) and the atomic mass of helium is 4 kg/kmol or 4 g/mol. (9%)

IV. Refrigerant-12 flows through a 40-mm-diameter horizontal pipe. At a point where the velocity is 40 m/s, the temperature and pressure are 40°C and 300 kPa, respectively. As a result of heat transfer from the surroundings, the temperature at a point downstream reaches 50°C. Assuming a negligible pressure drop, determine the heat-transfer rate to the refrigerant-12. It is also assumed that the specific volume is constant and equals to 0.06821 $m^3$/kg. (7%)




V. Consider a Carnot cycle heat engine using steam as the working fluid and having a thermal efficient of 25%. Heat is transferred to the working fluid at 300°C and during this process the working fluid changes from saturated liquid to saturated vapor. (15%)

(a) Show this cycle on a T-s diagram that includes the saturated-liquid and saturated-vapor lines.

(b) Calculate the quality at the beginning and end of the heat-rejection process.

(c) Calculate the work per kg of steam.

| T (°C) | $s_f$(kJ/kg) | $s_{fg}$(kJ/kg) | $s_g$(kJ/kg) |
|---|---|---|---|
| 145 | 1.7907 | 5.0926 | 6.8833 |
| 150 | 1.8418 | 4.9960 | 6.8379 |
| 155 | 1.8925 | 4.9010 | 6.7935 |
| 160 | 1.9427 | 4.8075 | 6.7502 |
| 300 | 3.2534 | 2.4511 | 5.7045 |

VI. A frictionless piston-cylinder assembly contains 0.2 kg of steam at a quality of 40 percent. The piston is weighted to maintain the pressure of the steam at 900 kPa. Heat transfer to the steam from a thermal-energy reservoir at 600 K continues until the steam reaches saturated-vapor conditions. Determine the heat transfer required and the work produced by the steam. At pressure 900 kPa,$v_f$ = 0.001121 $m^3$/kg, $v_{fg}$ = 0.2138 $m^3$/kg, $v_g$ = 0.215 $m^3$/kg, $u_f$ = 741.92 kJ/kg, $u_{fg}$ = 1838.3 kJ/kg, $u_g$ = 2580.2 kJ/kg. (12%)

VII. Why is thermodynamics important? (10%)