

※ 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. Please plot the schematic diagram of

- (1) Combined gas-vapor power cycles. (7%)
- (2) Co-Generation. (4%)
- (3) Rankine cycle with open feedwater heater. (7%)
- (4) Brayton cycle with intercooler, reheater, and regenerator. (7%)

Please label all the components in your plot.

2. 是非題,每一小題 5 分。答對「是」或「非」者得 2 分；若答對「是」，且加以正確地證明或計算者得 3 分；若答對「非」，且加以推導正確列式或敘述明確者，再得 3 分。

(1) In an ideal gas, change of entropy can be expressed as $ds = C_p \frac{dT}{T} + R \frac{dP}{P}$

(2) A mass m of a liquid at temperature T_1 is mixing with the same amount of mass at temperature T_2 in an insulated system. Then, the entropy change of mixing is $\Delta s = 2mC_p \ln \frac{T_1 T_2}{2\sqrt{T_1 + T_2}}$

(3) Because of no change in enthalpy, the throttling process is reversible.

(4) For an ideal gas with constant C_p and C_v , the heat transferred per unit mass in a polytropic process of index n is $q = C_n(T_2 - T_1)$, where $C_n = \frac{C_p - nC_v}{1 - n}$.

(5) Entropy is produced in every internally reversible process of a closed system.

3. Air is confined to one side of a rigid container divided by a partition and the other side is initially evacuated. The air is initially at $p_1 = 10$ bar, $T_1 = 700^\circ\text{C}$, and $V_1 = 5.2$ m³. When the partition is removed, the air expands to fill the entire chamber. Measurements show that $V_2 = 2V_1$ and $p_2 = 0.2 p_1$. Determine (a) the final temperature, (b) the heat transfer. (c) the work transfer. (d) the entropy transfer (e) the entropy production during this process. (25%)

4. Air at 600 kPa, 700 K and a mass flow of 600 kg/h enters a pipe passing overhead in a factory space. At the pipe exit, the pressure and the temperature of the air are 570 kPa and 550 K, respectively. Determine at steady state (a) the rate of heat transfer for a control volume comprising the pipe and its contents, (b) the rate of entropy production, in kW/K, for an enlarged control volume that includes the pipe and enough of its surroundings that heat transfer occurs at the ambient temperature, 300 K.

(25%)