系所組別：機械工程學系甲組
考試科目：熱力學

※ 考生請注意：本試題可使用計算機

1. For a steady-state single flow, the change of entropy is either zero or greater than zero. Is that true? Explain your answer. (10%)

2. Answer "increase", "decrease" or "constant." Assume air is ideal gas. (20%)

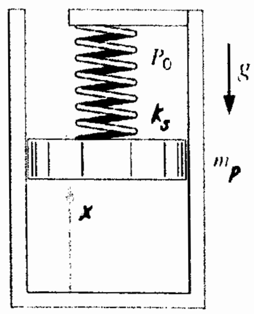
   (a) A fixed amount of air goes through an isothermal, reversible, heat addition process. What is the change in entropy?

   (b) A fixed amount of air goes through an isothermal, reversible, compression process. What is the change in entropy?

   (c) Liquid water is compressed by a pump in a reversible, steady-state, adiabatic process. What is the change in temperature?

   (d) Air is compressed by a compressor in a reversible, steady-state, adiabatic process. What is the change in temperature?

3. A frictionless piston/cylinder setup, as shown in the following figure, is loaded with a mass, m_p, the outside atmosphere P_0, and a linear spring with the spring constant k_s. The piston cross-sectional area is A. The piston traps the gas inside with a pressure P. The piston position for a relaxed spring is x_0, which depends on how the spring is installed. Please show that the gas pressure is a linear function of the volume and determine the slope of the line. (20%)



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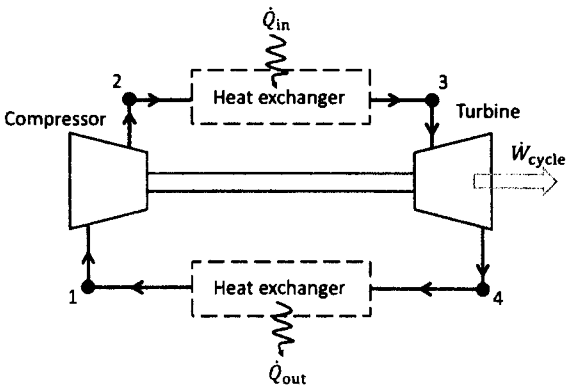
4. Consider a system consisting initially of ideal gasses n_A moles of gas A, n_B moles of gas B, and n_C moles of gas C. All of them are at the same pressure p and temperature T, but they are split by separations.

(a).The gasses are allowed to mix with no heat or work interactions with the surroundings. The final equilibrium pressure and temperature are p and T, respectively, and the mixing occurs with no change in total volume. Evaluate the amount of entropy produced in the process. (10%)

(b). What are assumptions you need to obtain the answer above? (5%)

(c). What will the answer be if gasses A and B are actually the same gas? (5%)

(d). Explain the reason of irreversibility. (5%)



5. (a). A schematic diagram of an air-standard gas turbine is shown above. Draw the p-v diagram of air-standard ideal Brayton cycle. Mark points 1, 2, 3, and 4. Specify the cycle direction in the diagram. (10%)

(b). Express the thermal efficiency (η) and back work ratio (bwr) with h_1, h_2, h_3, and h_4. (5%)

(c). Draw the thermal efficiency as a function of compressor pressure ratio for the cold air-standard ideal Brayton cycle. Specify the mathematical (symbolic) expression of the curve. Define symbols and employed numbers clearly. (10%)