In Example 6-10 it is shown that the cycle thermal efficiency of the simple Brayton cycle shown in Figure 6-24 can be increased by utilizing regeneration. Specifically, it was found that, with the addition of a regenerator of effectiveness 0.75, the cycle thermal efficiency was increased from 42.3% to 48.1%. Another way of improving the efficiency of the simple Brayton cycle is to use a bottoming cycle. To this end, consider the system shown in Figure 1. It shows the simple Brayton cycle with a Brayton bottoming cycle. For this system, the following parameters and information are known:

\[ T_1 = 278 \text{ K} \]
\[ T_3 = 972 \text{ K} \]
\[ T_9 = T_1 \]
\[ (\Delta T_p)_1 = \text{pinch point of heat exchanger #1} = 15^\circ \text{C} = T_4-T_7 \]

All turbine and compressors in both cycles are ideal.

\[ r_p \text{ for the simple Brayton cycle} = 4.0 \]
\[ c_p \text{ for both cycles} = 5230 \text{ J/kg K} \]
\[ \gamma \text{ for both cycles} = 1.658 \]

Mass Flowrate for the simple Brayton cycle = twice the mass flowrate for the Brayton bottoming cycle.

No duct pressure losses in either cycle.

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**Figure 1**

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QUESTIONS

A. Draw the T-S diagram for the entire system.

B. What must be the pressure ratio of Turbine #2 and Compressor #2 such that the cycle thermal efficiency of the entire system is maximized?

C. What is the maximum cycle thermal efficiency?