

PROBLEM 6-15N QUESTION

Cycle Thermal Efficiency Problem Involving A Bottoming Cycle

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:

$$T_1 = 278 \text{ K}$$

$$T_3 = 972 \text{ K}$$

$$T_9 = T_1$$

$$(\Delta T_p)_1 = \text{pinch point of heat exchanger \#1} \\ = 15^\circ\text{C}$$

$$r_p \text{ for the simple Brayton cycle} = 4.0$$

$$c_p \text{ for both cycles} = 5230 \text{ J/kg K}$$

$$\gamma \text{ for both cycles} = 1.658$$

$$\text{Mass Flowrate for the simple Brayton cycle} = \\ \text{twice the mass flowrate for the Brayton} \\ \text{bottoming cycle}$$

All turbine and compressors in both cycles are ideal

No duct pressure losses in either cycle

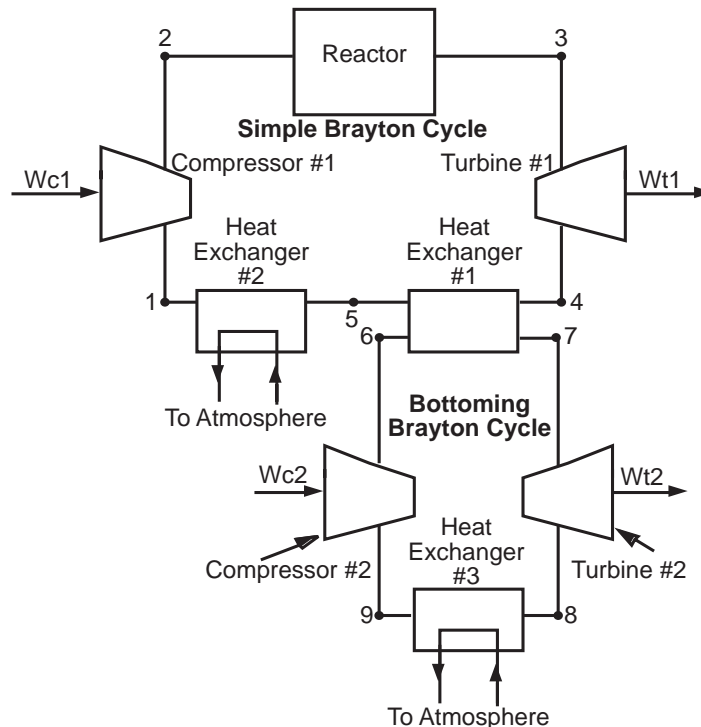


Figure 1

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?