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 K

T_3 = 972 K

$T_9 = T_1$

$(\Delta T_p)_1$ = pinch point of heat exchanger #1 = 15°C = T4-T7

All turbine and compressors in both cycles are ideal

r_p for the simple Brayton cycle = 4.0

c_p for both cycles = 5230 J/kg K

γ 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

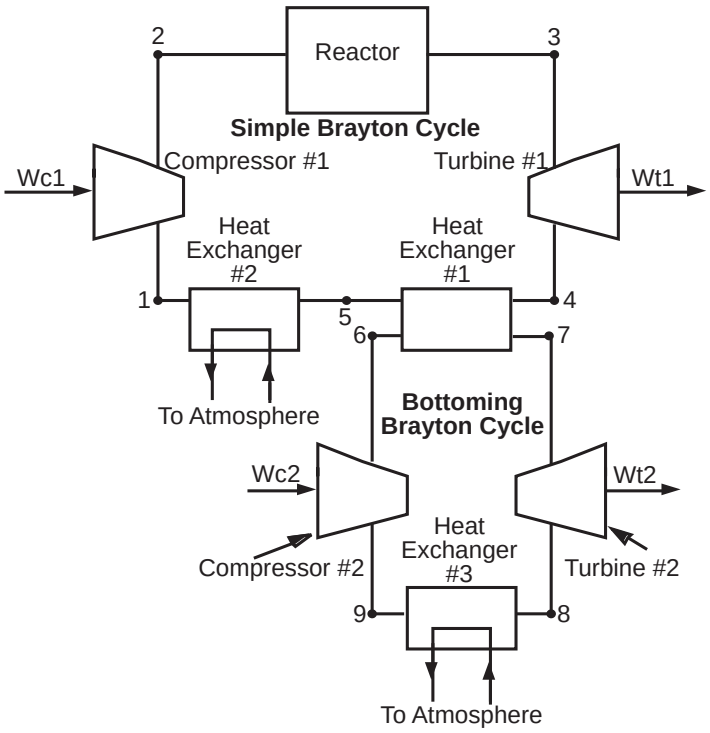

Figure 1

Rev August 29, 2000

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?