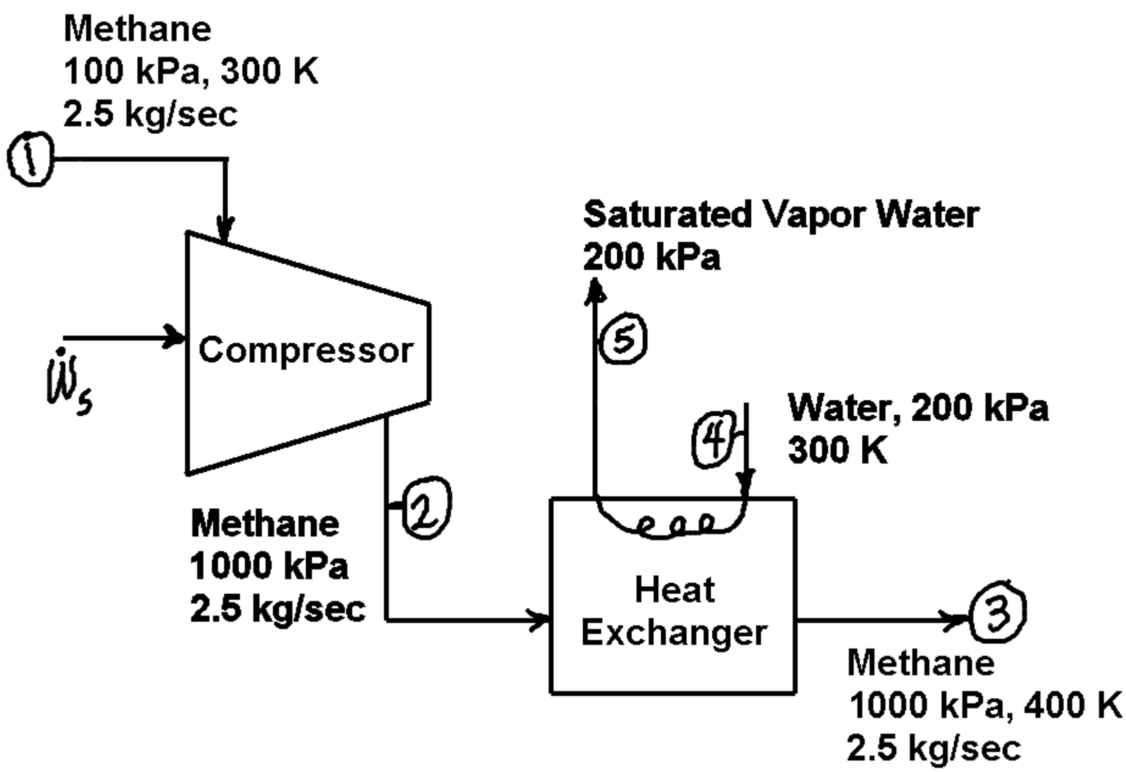
ES 3053 **EXAM II** **April 1, 2002**

Open Books and Notes

Methane is compressed from State 1 (100 kPa and 300 K) to State 2 (1000 kPa) in a compressor, then it is cooled to State 3 (400 K, 1000 kPa) in a heat exchanger that uses water for coolant and produces saturated steam at 200 kPa. See the diagram below. The following assumptions may be made:

1. The thermal efficiency of the compressor is 0.82.
2. Pressure drop through the heat exchanger for both the water and methane sides is negligible.
3. The compressor operates adiabatically.
4. There is no heat loss from the heat exchanger.
5. The whole process is steady-state, steady-flow (SSSF).



a. 40 points

Find T_2', h_2', s_2', and W_s', for the isentropic base case for the compressor. Each property is worth 10 points, and the work requirement is worth 10 points.

b. 40 points

Find T_2, h_2, s_2, and W_s for the actual case for the compressor. Each property is worth 10 points, and the work requirement is worth 10 points.

c. 20 points

Find the flowrate, m, of the water in kg/sec.

Use the steam tables beginning on page 664 and the methane tables beginning on page 710 of your book for all thermodynamic properties.