CANKAYA UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE
MECHANICAL ENGINEERING DEPARTMENT
ME 211 THERMODYNAMICS I
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CHAPTER 7 EXAMPLES
Solutions
Prof.Dr.Nevzat Onur

11) One kg of water in a piston–cylinder assembly, initially at 1.5 bar and 200 °C, cools at constant pressure with no internal irreversibilities to a final state where the water is a saturated liquid. For the water as the system, determine the work, the heat transfer, and the amounts of exergy transfer accompanying work and heat transfer, each in kJ. Let T_0= 20°C, p_0= 1 bar and ignore the effects of motion and gravity.

12) Steam undergoes a throttling process as it passes through a valve operating at steady state. Steam enters the valve at 6 MPa, 360°C and exits at 3 MPa. Determine the exit temperature and the exergy rate destruction per kg of steam flowing through the valve. Let T_0 =25°C, p_0 =100 kPa

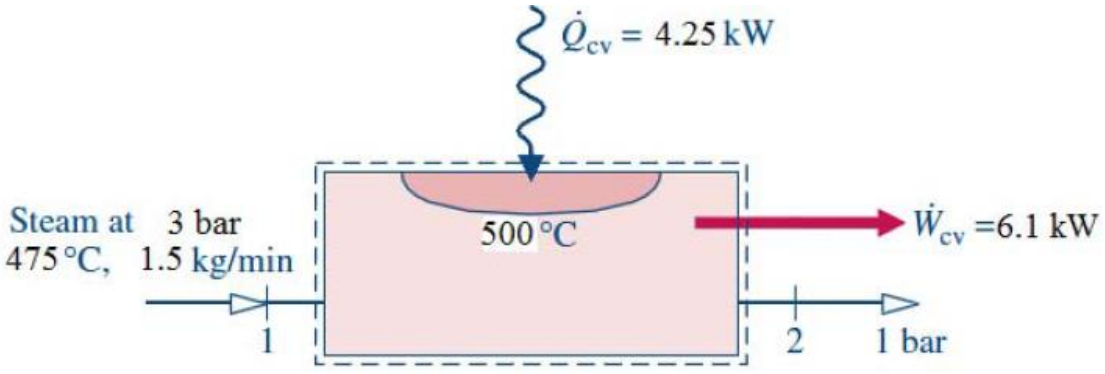
13) Figure given below shows a device to develop power using a heat transfer from a high-temperature industrial process together with a steam input. The figure provides data for steady-state operation. All surfaces are well insulated, except for the one at 500°C, across which heat transfer occurs at a rate of 4.25 kW. The device develops power at a rate of 6.1 kW. Determine, in kW,

(a) the rate of exergy enters accompanying heat transfer.

(b) the net rate of exergy carried in by the steam, $\dot{E}_{f1} - \dot{E}_{f2}$.

(c) the rate of exergy destruction within the device.

Ignore the effects of motion and gravity and let $T_0 = 293\text{K}$ $p_0 1\text{bar}$



14) Steam at 320 °C and 20 bar pressure enters an insulated turbine operating at steady state. Steam exits the turbine at 0.08 bar as saturated vapor. Ignore the effects of motion and gravity. Determine

(a) the power developed and the rate of exergy destruction, each in kJ/kg of steam flowing.

(b) the isentropic turbine efficiency.

(c) the exergetic turbine efficiency.

Let T_0 =20°C, p_0 =1 bar.