4.48 A small turbine, shown in Fig. P4.48, is operated at part load by throttling a 0.25-kg/s steam supply at 1.4 MPa and 250°C down to 1.1 MPa before it enters the turbine, and the exhaust is at 10 kPa. If the turbine produces 110 kW, find the exhaust temperature (and quality if saturated).

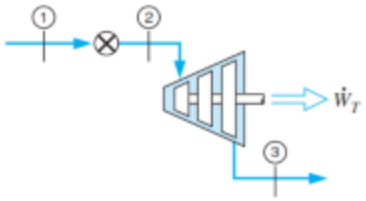


FIGURE P4.48

6.83 A condenser (heat exchanger) brings 1 kg/s water flow at 10 kPa from 300°C to saturated liquid at 10 kPa, as shown in Fig. P6.83. The cooling is done by lake water at 20°C that returns to the lake at 30°C. For an insulated condenser, find the flow rate of cooling water.

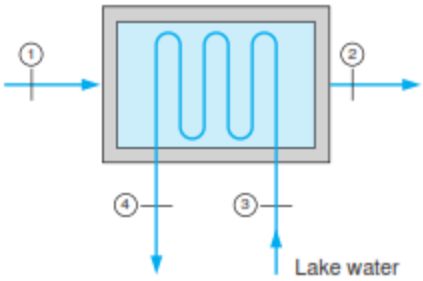


FIGURE P6.83

4.25 Superheated vapor ammonia enters an insulated nozzle at 30°C, 1000 kPa, as shown in Fig. P4.25, with a low velocity and at a rate of 0.01 kg/s. The ammonia exits at 300 kPa with a velocity of 450 m/s. Determine the temperature (or quality, if saturated) and the exit area of the nozzle.

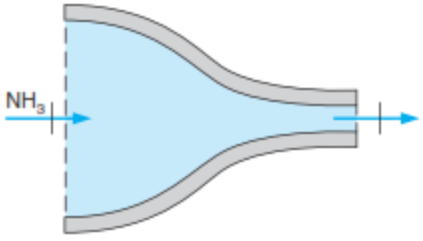


FIGURE P4.25

6.78 Two steady flows of air enter a control volume, as shown in Fig. P6.78. One is a 0.025 kg/s flow at 350 kPa, 150°C, state 1, and the other enters at 450 kPa, 15°C, state 2. A single flow exits at 100 kPa, −40°C, state 3. The control volume ejects 1 kW heat to the surroundings and produces 4 kW of power output. Neglect kinetic energies and determine the mass flow rate at state 2.

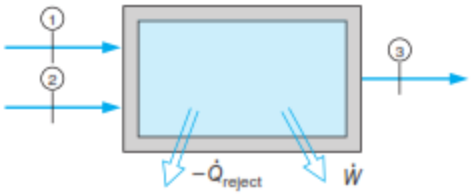
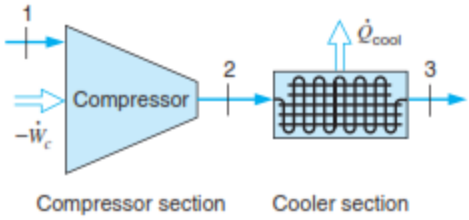


FIGURE P6.78

4.54 A factory generates compressed air from 100 kPa, 17°C by compression to 1000 kPa, 600 K, after which it cools in a constant pressure cooler to 300 K, (see Fig. P4.54). Find the specific compressor work and the specific heat transfer in the cooler.



6.71 Consider a water pump that receives liquid water at 15°C, 100 kPa and delivers it to a same-diameter short pipe having a nozzle with an exit diameter of 1 cm (0.01 m) to the atmosphere at 100 kPa (see Fig. P6.71). Neglect the kinetic energy in the pipes and assume constant u for the water. Find the exit velocity and the mass flow rate if the pump draws 1 kW of power.

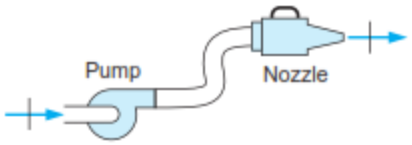


FIGURE P6.71

4.68 Saturated liquid nitrogen at 600 kPa enters a boiler at a rate of 0.008 kg/s and exits as saturated vapor (see Fig. P4.68). It then flows into a superheater also at 600 kPa, where it exits at 600 kPa, 280 K. Find the rate of heat transfer in the boiler and the superheater.

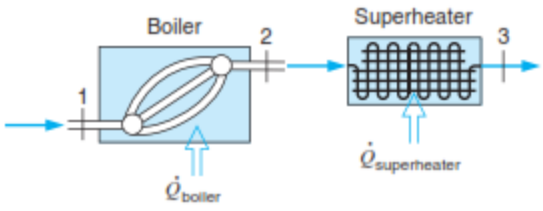


FIGURE P4.68