1. Water is the working fluid in a Rankine cycle. Superheated vapor enters the turbine at 8 MPa, 560°C with a mass flow rate of 7.8 kg/s and exits at 8 kPa. Saturated liquid enters the pump at 8 kPa. The isentropic turbine efficiency is 88%, and the isentropic pump efficiency is 82%. Cooling water enters the condenser at 18°C and exits at 36°C with no significant change in pressure. Determine a) the net power developed, in kW, b) the thermal efficiency, and c) the mass flow rate of cooling water, in kg/s.

2. Water is the working fluid in an ideal regenerative Rankine cycle. Superheated vapor enters the turbine at 10 MPa, 480°C, and the condenser pressure is 6 kPa. Steam expands through the first-stage turbine to 0.7 MPa where some of the steam is extracted and diverted to an open feedwater heater operating at 0.7 MPa. The remaining steam expands through the second-stage turbine to the condenser pressure of 6 kPa. Saturated liquid exits the feedwater heater at 0.7 MPa. Determine for the cycle, a) the heat addition, in kJ per kg of steam entering the first-stage turbine, b) the thermal efficiency, and c) the heat transfer from the working fluid passing through the condenser to the cooling water, in kJ per kg of steam entering the first-stage turbine.

3. Refrigerant 134a is the working fluid in a vapor-compression heat pump that provides 35 kW to heat a dwelling on a day when the outside temperature is below freezing. Saturated vapor enters the compressor at 1.6 bar, and saturated liquid exits the condenser, which operates at 8 bar. Determine for isentropic compression, a) the refrigerant mass flow rate, in kg/s, b) the compressor power, in kW, and c) the coefficient of performance.