4.50 Steam enters the first-stage turbine shown in Fig. P4.50 at 40 bar and 500°C with a volumetric flow rate of 90 m³/min. Steam exits the turbine at 20 bar and 400°C. The steam is then reheated at constant pressure to 500°C before entering the second-stage turbine. Steam leaves the second stage as saturated vapor at 0.6 bar. For operation at steady state, and ignoring stray heat transfer and kinetic and potential energy effects, determine the

(a) mass flow rate of the steam, in kg/h.
(b) total power produced by the two stages of the turbine, in kW.
(c) rate of heat transfer to the steam flowing through the reheater, in kW.
Steady-state operating data for a simple steam power plant are provided in Fig. P4.102. Stray heat transfer and kinetic and potential energy effects can be ignored. Determine the (a) thermal efficiency and (b) the mass flow rate of the cooling water, in kg per kg of steam flowing.

\[ \dot{Q}_{in}/m = 3400 \text{ kJ/kg} \]

\( p_1 = 4 \text{ MPa} \)
\( T_1 = 600^\circ\text{C} \)

\( p_2 = 0.2 \text{ bar, saturated vapor} \)

Cooling water in at \( T_5 = 15^\circ\text{C} \)
Cooling water out at \( T_6 = 35^\circ\text{C} \)

\[ \text{Power in} = 4 \text{ kJ/kg} \]