1. (40 points) Water (1 kg) at 0.2 MPa is initially enclosed within a volume of 0.1 m$^3$, and the piston rests on the stops. The piston will move when the pressure is 1.0 MPa. A total heat transfer of 2500 kJ is added to the water. Determine the work done and the final state of the water.

2. (30 points) Two components of a steam engine are shown. The turbine is adiabatic. Determine the heat transferred in the boiler (kW). Determine the power output of the turbine (kW).

3. (10 points) A continuous copper sheet passes through a furnace at a velocity of 15 ft/s. The sheet is 6 ft × 2 in. in cross section. It is heated from a uniform temperature at the inlet of 80°F to a uniform temperature of 2060°F at the furnace outlet. The furnace is heated by electrical resistance heaters, and heat transfer from the furnace to the surroundings is negligible. How large a power supply must be provided to feed the heaters?

4. (20 points) Air at 1 atm and 20°C initially fills a bottle of 0.1 m$^3$ volume. The bottle is attached to an air line that provides air at 20°C and 50 atm, and the bottle is charged to a pressure of 50 atm. There is a heat transfer from the bottle, so the air within is held at 20°C throughout the process. Determine the heat transfer during this process.