1. (10 points) Steam is accelerated by a nozzle steadily from a low velocity to a velocity of 250 m/s at a rate of 2 kg/s. If the temperature and pressure of the steam at the nozzle exit are 400°C and 2 MPa, determine the exit area of the nozzle.

2. (20 points) A steam turbine is designed to have a power output of 9 MW for a mass flow rate of 17 kg/s. The inlet state is 3 MPa, 450°C, and 200 m/s, and the outlet state is 0.5 MPa, saturated vapor and 80 m/s. What is the heat transfer for this turbine?

3. (30 points) In a shower, cold water at 10°C flowing at a rate of 5 kg/min is mixed with hot water at 60°C flowing at a rate of 2 kg/min. Determine the exit temperature of the mixture.

4. (40 points) An insulated 10-ft³ cylinder is used to displace a load through the motion of a piston, as shown in the diagram. The piston has negligible volume and is initially at the bottom of the cylinder. The valve to a steam line (200 psia and 700°F) is opened to raise the load, and it is closed when the piston reaches the top of the cylinder. The total work done is 50 Btu. What is the final pressure in the cylinder if the final mass is 0.5 lbm?