**5-85** A well-insulated shell-and-tube heat exchanger is used to heat water ($c_p = 4.18$ kJ/kg·°C) in the tubes from 20 to 70°C at a rate of 4.5 kg/s. Heat is supplied by hot oil ($c_p = 2.30$ kJ/kg·°C) that enters the shell side at 170°C at a rate of 10 kg/s. Determine the rate of heat transfer in the heat exchanger and the exit temperature of oil.

5–120 A 4-L pressure cooker has an operating pressure of 175 kPa. Initially, one-half of the volume is filled with liquid and the other half with vapor. If it is desired that the pressure cooker not run out of liquid water for 75 min, determine the highest rate of heat transfer allowed.

$V = 4$ L
$(P = 175$ kPa$)$

$\dot{Q}_{in}$
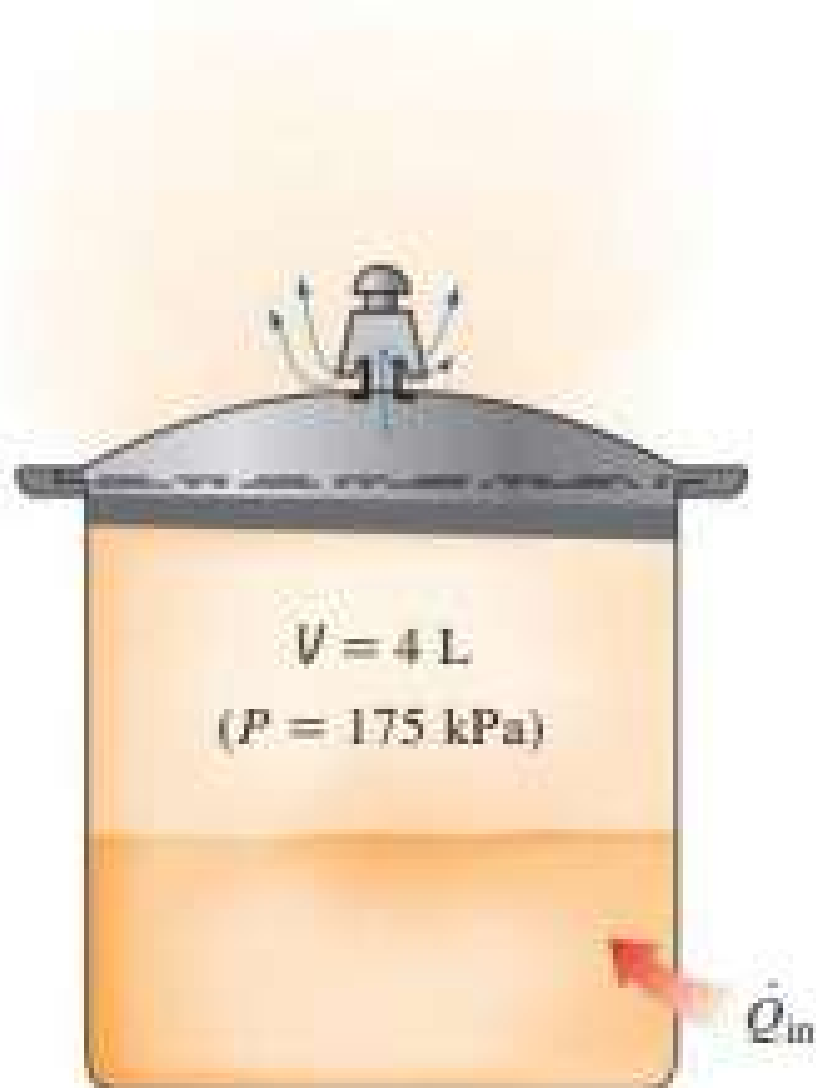
FIGURE P5–120

4–38 An insulated piston–cylinder device contains 5 L of saturated liquid water at a constant pressure of 175 kPa. Water is stirred by a paddle wheel while a current of 8 A flows for 45 min through a resistor placed in the water. If one-half of
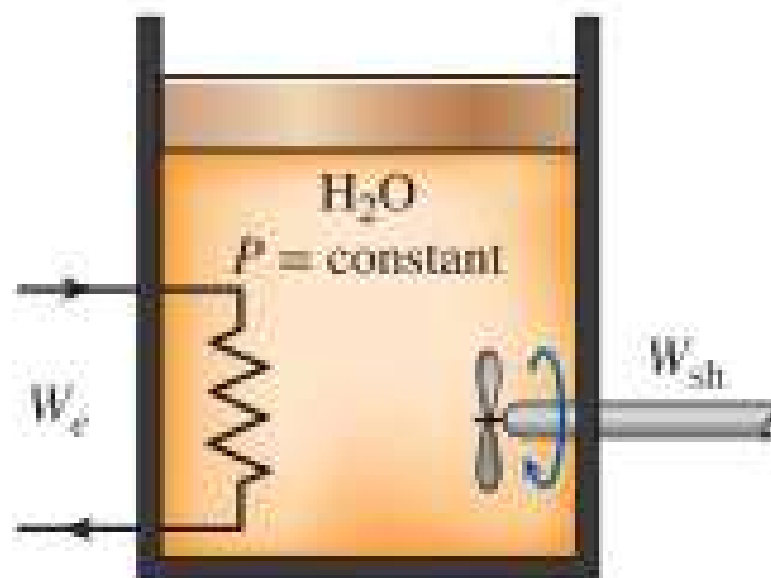
FIGURE P4–38

4–24 A piston–cylinder device contains 50 kg of water at 250 kPa and 25°C. The cross-sectional area of the piston is 0.1 m². Heat is now transferred to the water, causing part of it to evaporate and expand. When the volume reaches 0.2 m³, the piston reaches a linear spring whose spring constant is 100 kN/m. More heat is transferred to the water until the piston rises 20 cm more. Determine (*a*) the final pressure and temperature and (*b*) the work done during this process. Also, show the process on a *P-V* diagram. *Answers: (a) 450 kPa, 147.9°C, (b) 44.5 kJ*

$A = 0.1 \text{ m}^2$

H_2O

$m = 50 \text{ kg}$

Q