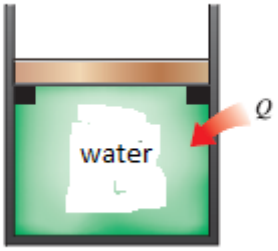
ÇANKAYA UNIVERSITY
MECHANICAL ENGINEERING DEPARTMENT
ME 211 THERMODYNAMICS I
FALL 2016

HW # 3

Q-1 A piston-cylinder system with a volume of 10 liters contains saturated water at 500 kPa with a specific volume of 0.05m^3/kg.

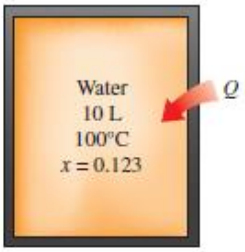
a) Find the total mass of water in the system.
b) Find the quality of the state.
c) Find the mass of vapor.

Q-2 Water of mass 1 kg at 0.2 MPa is initially enclosed within a volume of 0.10 m^3, and the piston rests on the stops. The piston will move when the pressure is 1 MPa. A total heat transfer of 2500 kJ is added to water. Determine the work done and the final volume.

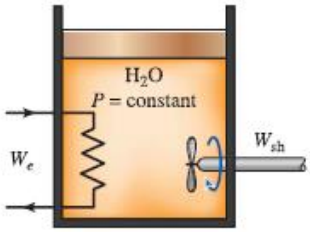


Hint: This a multistep problem.

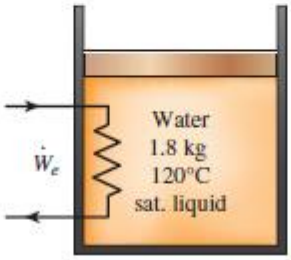
Q-3 A rigid 10-L vessel initially contains a mixture of liquid water and vapor at 100 ºC with 0.123 (12.3 %) quality. The mixture is then heated until its temperature is 150 ºC. Calculate the heat transfer required for this process.



Q-4 An insulated piston-cylinder contains 5L 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 water. If one half of the liquid is evaporated during this constant pressure process and paddle Wheel work is 400 kJ, determine the voltage of the source. Also show the process on P-v diagram with respect to saturation lines.



Q-5 An insulated piston-cylinder device initially contains 1.8 kg of saturated liquid water at 120 ^{o}C. Now an electric resistor placed in the tank is turned on for 10 min until the tank contains saturated vapor and the volume quadruples. Determine a) the volume of the tank, b) the final temperature and c) the electrical power rating of the resistor.



Q-6 Calculate the specific volume of propane at pressure of 7 MPa and a temperature of 150 ^{o} C using real gas assumption (Z) and compare the results with specific volume given by the ideal gas equation of state.

Q-7 Air at 20^{o} C and 100 kPa is compressed in an insulated cylinder from 400 cm^3. For a compression ratio of 8 to 1 ($\frac{\forall_2}{\forall_1} = 8$), find the required work. Assume constant specific heats and quasi-equilibrium process.

Hint: Use Polytropic process equation to calculate T_2 . Take n=k=1.4 and $c_v = 0.717\,\text{kJ/kg.K}$ for air.