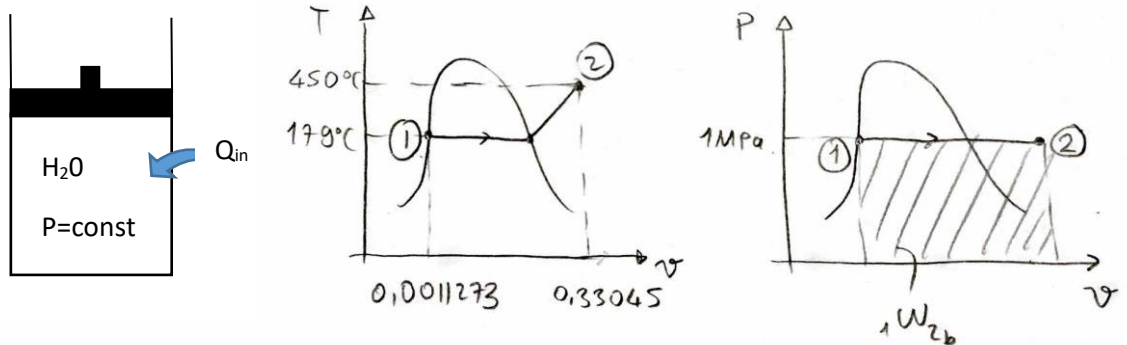


ÇANKAYA UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING
ME211 THERMODYNAMICS I

Quiz #3-solution

A piston-cylinder device which is 0.01 m^3 in volume, contains saturated liquid water at 1 MPa . Water is then heated at constant pressure until it is 450°C . Show the process on a T - v diagram with respect to saturation lines and determine (a) the mass of the steam, (b) the amount of heat transfer.



State 1

$P_1 = 1 \text{ MPa}$, Sat liquid (10 bar) $T_1 = T_{\text{sat}} = 179^\circ\text{C}$

From Table A.3

$$v_1 = v_f = 0.0011273 \text{ m}^3/\text{kg}$$

$$h_1 = h_f = 762.81 \text{ kJ/kg}$$

$$m = \frac{V_1}{v_1} = \frac{0.01}{0.0011273} = \underline{\underline{8.871 \text{ kg}}}$$

State 2

$P_2 = 1 \text{ MPa}$, $T_2 = 450^\circ\text{C}$

$$v_2 = 0.33045 \text{ m}^3/\text{kg}, \quad h_2 = 3371.3 \text{ kJ/kg}$$

1st law of thermodynamics:

$$1Q_2 - 1W_{2b} = \Delta U = m(u_2 - u_1)$$

$$\text{where } 1W_{2b} = \int_1^2 P dv = mP(v_2 - v_1)$$

$$\Rightarrow 1Q_2 = m(u_2 - u_1) + m(Pv_2 - Pv_1)$$

$$= m(u_2 + Pv_2 - u_1 - Pv_1)$$

$$= m(h_2 - h_1)$$

$$\Rightarrow 1Q_2 = 8.871 \cdot (3371.3 - 762.81) = 23.139.9 \text{ kJ}$$