

Quiz 3 Solution

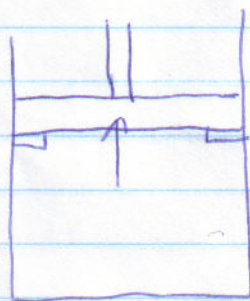
4.114 (old book) Piston/Cylinder contains 1 kg of water at 20°C with a volume of 0.1 m^3 . Initially the piston rests on stops with the top surface open to the atmosphere, and a mass so that 400 kPa will lift it. To what temperature should the water be heated to lift the piston? If it is heated to Saturated vapour, find the:

Final temperature

Volume

Work, W_2

Solution



State 1

$$T_1 = 20^\circ\text{C}$$

$$V_1 = 0.1\text{ m}^3$$

Since $m = 1\text{ kg}$

$$v_1 = \frac{V_1}{m} = 0.1 \frac{\text{m}^3}{\text{kg}}$$

State 2

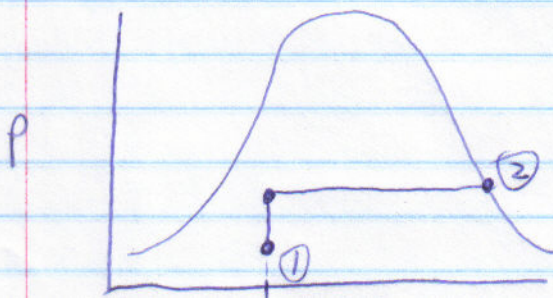
$$P = 400\text{ kPa}$$

Sat. vapour

From tables, at $P = 400\text{ kPa}$,

$$T = 143.6^\circ\text{C}$$

in the vapour dome



Heated to Vapour:

$$V_2 = V_g = 0.46246 \text{ m}^3/\text{kg} \quad (\text{Tables})$$

$$V_2 = m V_g = 0.46246 \text{ m}^3/\text{kg}$$

${}_1W_2 = P_{\text{ext}} (V_2 - V_1)$, since work is being done against a constant external pressure.

$${}_1W_2 = 400(0.4638 - 0.1) = 145 \text{ kJ}$$