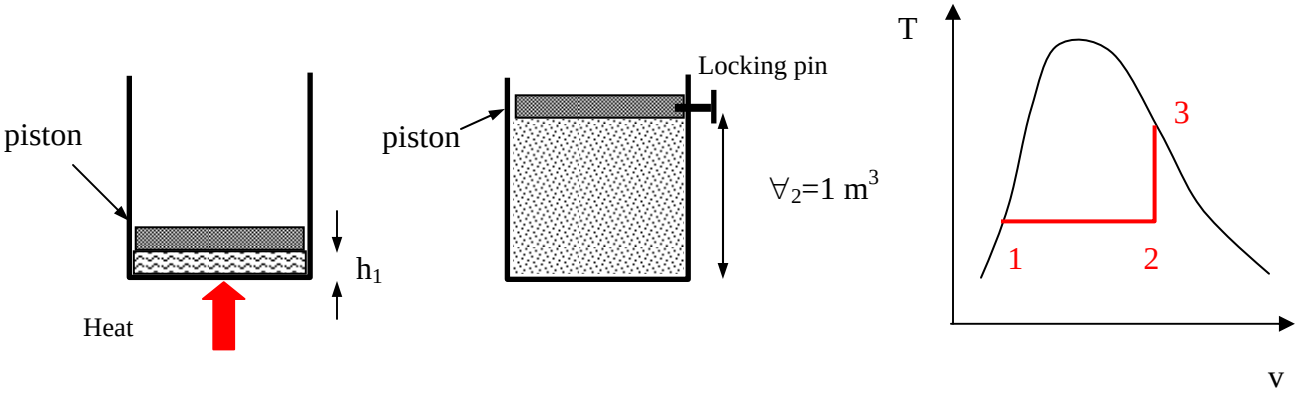
Saturated water is being heated (or cooled) in a closed piston-cylinder assembly. Initially, the cylinder contains 1 kg of liquid water (you can assume it contains 100% saturated liquid water) as shown. The piston is very light, therefore, the pressure exerted by the piston can be assumed to be close to atmospheric pressure (P=0.10 MPa).

(a) If the water height (h_1) is 0.0005215 m, what is the cross-sectional area of the piston?

(b) Heat is then added to the system until it reaches a volume of $1m^3$. What is the quality at this state (x_2)?

(c) Lock the piston by a pin and continue heat the cylinder until all liquid vaporizes into 100% saturated vapor (state 3). What is the final pressure?

(d) Draw the transition process 1-2-3 on the T-v diagram (not necessarily to scale).



(a) At $P = 0.1\,\text{MPa}, v_f = 0.001043\ (m^3/kg) = v = \frac{\forall}{m} = \frac{Ah_1}{1}, A = \frac{0.001043}{0.0005215} = 2(m^2)$

(b)

$\forall_2 = 1(m^3), v_2 = \frac{\forall_2}{m} = 1(m^3/kg) = v_f + x(v_g - v_f)$

From table A - 5 (or C - 2) $P = 0.1\,\text{MPa}, v_f = 0.001043, v_g = 1.694, x = \frac{1 - 0.001043}{1.694 - 0.001043} = 0.59$

(c) $v_2 = 1(m^3/kg) = v_3 = v_{g\,@\,\text{given pressure}}$

From table, this happens when P = 0.175 MPa (final pressure)