ME 200 Homework 2

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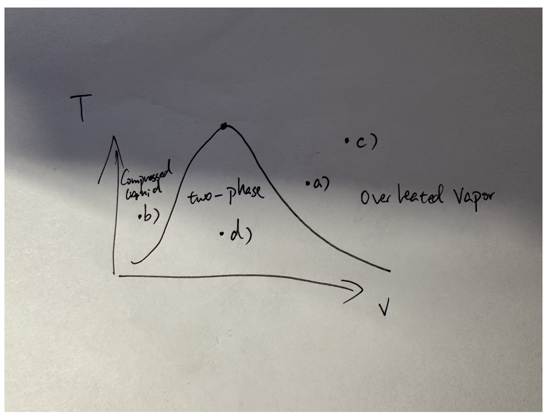
1. a) 3.613 bar
   b) $1.029 \times 10^{-3} \mathrm{m}^3/\mathrm{kg}$
   c) $b = \frac{0.03394-0.03160}{520-480} = 0.000059$, Thus $v = (485-480) \times 0.000059 + 0.03160 = 0.031893 \mathrm{m}^3/\mathrm{kg}$
   d) $v = (1-x)v_f + xv_g = 0.25 \times 1.0291 \times 10^{-3} + 0.75 \times 3.407 = 2.55551 \mathrm{m}^3/\mathrm{kg}$
   p = 0.4739 bar



2. The specific volume of CO_2 gas and liquid is given together with the quality, thus, there exists the following equation sets: (Mark specific volumes as ν)

$$\begin{cases} \frac{1}{\nu_f}V_f + \frac{1}{\nu_g}V_g & = & m \\ 0.7m & = & \frac{1}{\nu_g}V_g \\ V_g + V_f & = & 1 \end{cases}$$

plug in and solve for V_g, V_f, m gives:

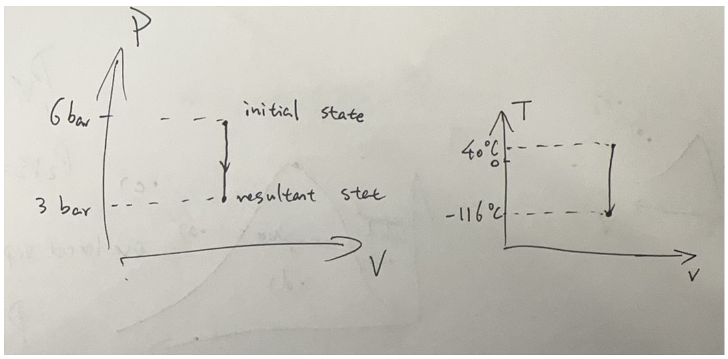
$$\begin{cases} V_f & = & 0.023422 \text{ m}^3 \\ V_g & = & 0.976578 \text{ m}^3 \\ m & = & 79.4482 \text{ kg} \end{cases}$$

$\frac{V_g}{1} = 2.34\%,\ m_v = \frac{1}{\nu_v} \times V_v = 55.6138 \text{ kg}, m_f = \frac{1}{\nu_f} \times V_f = 23.7348 \text{ kg}$
Thus, fluid mass is 23.7348 kg, vapor mass is 55.6138 kg, volume of fluid is 2.34% of the container.

3.

$$\frac{T_1}{T_2} = \frac{P_1}{P_2} = \frac{6}{3} = \frac{40 + 273}{T_2}$$

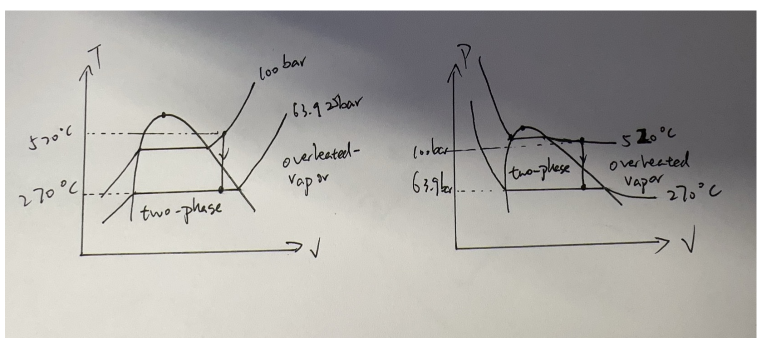
$T_2 = -116.5°C$



4.

$$\frac{T_1}{T_2} = \frac{P_1}{P_2} = \frac{520 + 173}{270 + 173} = \frac{100}{P_2}$$

Thus, $P_2 = 63.925$ bar.



5. $p_{ini} = 300 + 101 = 401$ kPa, $p_{aft} = 367 + 101 = 468$ kPa

$$\frac{T_1}{T_2} = \frac{P_1}{P_2} = \frac{401}{468} = \frac{27 + 173}{T_2}$$

$T_2 = 233.416$ K$= 60.41°$C

6. $m_{pis} = 2240$lb, $F_{g(pis)} = m_{pis} \times g = 2240$ lbf, $p_{gag} = \dfrac{F_{g(pis)}}{A} = \dfrac{2240}{2.5^2 \times \pi} =$ 114.082 lbf/ft^2 $p = p_{gag} + p_{atm} = 114.082 + 2116.22 = 2230.3$ lbf/ft^2
$v = \dfrac{nRT}{p} = \dfrac{600 \div 17.031 \times 1.987 \times 504.67}{2230.3} = \boxed{15.8399 \text{ ft}^3}$
No it is unessesary as the liquid it self is providing enough pressure on the piston which generates enough force to keep it in equalibrium state.