RETURN TO DR. THOMAS

HOMEWORK #~~2~~ ~~3~~ 2

2.26, 2.33E, 2.38, 2.43, 2.53, 2.70, 2.81

~~2.26~~, ~~2.31E~~, ~~2.36~~, ~~2.41~~, ~~2.50~~, ~~2.69~~, ~~2.79~~

PROB. 2.26

a) $T = 50°C$, $v = 4.16 \frac{m^3}{kg}$

FOR $T_{sat} = 50°C$, $v_f = 0.001012 \frac{m^3}{kg}$, $v_g = 12.03 \frac{m^3}{kg}$

∴ SATURATED MIXTURE

$P = P_{sat} = \underline{12.349 \text{ kPa}}$

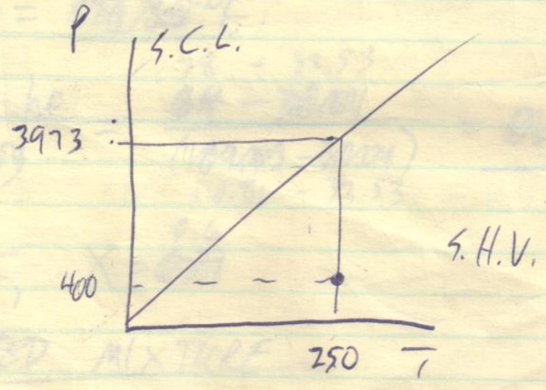
b) $P = 200$ kPa, SATURATED VAPOR

$T = T_{sat} (P_{sat} = 200 \text{ kPa}) = \underline{120.23°C}$

$\underline{v = v_g = 0.8857 \frac{m^3}{kg}}$

c) $T = 250°C$, $P = 400$ kPa

FOR $T_{sat} = 250°C$, $P_{sat} = 3.973$ MPa $= 3973$ kPa

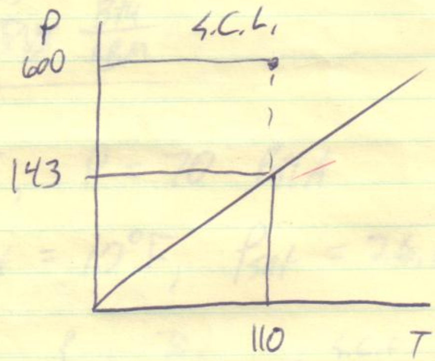


S.H.V. $\quad v = 0.5951 \frac{m^3}{kg}$

PROB. 2.26

d) $T = 110°C$, $P = 600$ kPa

FOR $T_{sat} = 110°C$, $P_{sat} = 0.14327$ MPa $= 143.27$ kPa



S.C.L $\quad v = v_f(T_{sat} = 110°C) = 0.001052 \frac{m^3}{kg}$

PROB. 2.33E R-134a

a) $P = 80$ PSIA, $h = 78$ Btu/LBM

FOR $P_{sat} = 80$ PSIA, $h_f = 32.53 \frac{Btu}{LBM}$, $h_g = 110.81 \frac{Btu}{LBM}$

∴ SATURATED MIXTURE

$T = T_{sat} = 65.93°F$

$$X = \frac{h - h_f}{h_{fg}} = \frac{78 - 32.53}{(110.81 - 32.53)} = 0.581$$

b) $T = 15°F$, $X = 0.6$

SATURATED MIXTURE

$P = P_{sat} = 29.756$ PSIA

PROB. 2.33E

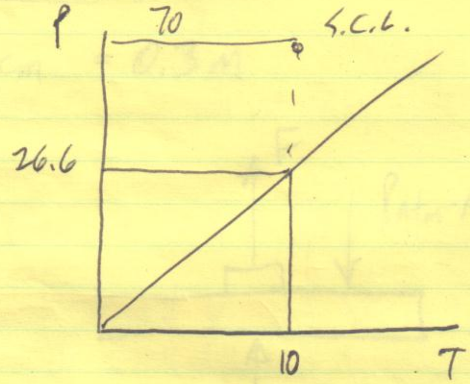
$h = h_f + x h_{fg}$

$h = (16.20) + (0.6)(87.71)$

$h = 68.83 \ \frac{Btu}{LBM}$

c) $T = 10°F, \quad P = 70$ PSIA

AT $T_{sat} = 10°F, \ P_{sat} = 26.651$ PSIA



S.C.L. X IS UNDEFINED

$h = h_f(T_{sat} = 10°F) = 14.66 \ \frac{Btu}{LBM}$

d) $P = 180$ PSIA, $h = 128.77 \ \frac{Btu}{LBM}$

FOR $P_{sat} = 180$ PSIA, $h_g = 119.91 \ \therefore$ S.H.V.

X IS UNDEFINED

$T = 160°F$

PROB. 2.33E

e) $T = 110°F, \; x = 1.0$

SATURATED VAPOR

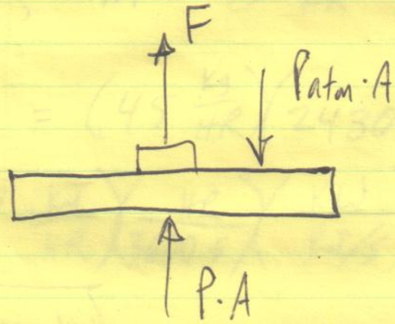
$P = P_{sat} = 161.04$ PSIA

$h = h_g = 115.96 \; \frac{Btu}{LBM}$

PROB. 2.38

$D = 30 \text{ cm} = 0.3 \text{ m}$

FBD



$m = 8 \text{ Kg}$

$T = 20°C$

$F + PA - P_{atm} \cdot A = 0$

$F = A(P_{atm} - P)$

$F = \frac{\pi}{4} D^2 (P_{atm} - P)$

$P = P_{sat}(T_{sat} = 20°C) = 2.339 \text{ KPa}$

$P_{atm} = 101 \text{ KPa}$

PROB. 2.~~36~~ 38

$$F = \frac{\pi}{4}(0.3\,m)^2 (101 - 2.339\ kPa)\left(\frac{1000\ \frac{N}{m^2}}{kPa}\right) = 6974\ N$$

THE WEIGHT OF THE FOOD IS

$$W = mg = (8\ kg)(9.8\ \frac{m}{s^2}) = 78.4\ N$$

PAN WILL BE LIFTED UP.

PROB. 2 (~~40~~) (43)

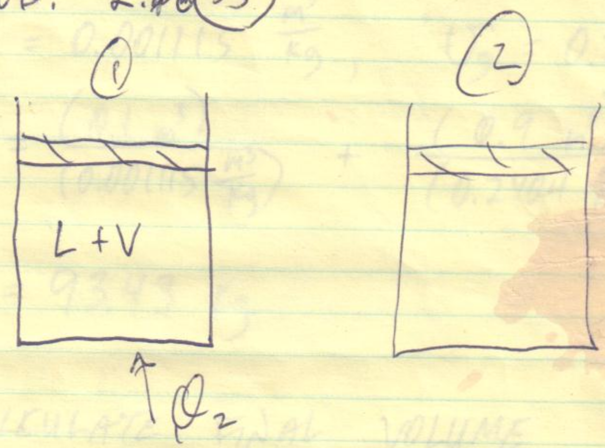
$T_{sat} = 30°C$, $\dot{m} = 45\ \frac{kg}{HR}$

$$\dot{Q} = \dot{m}\,h_{fg} = (45\ \frac{kg}{HR})(2430.5\ \frac{kJ}{kg}) = 1.09 \times 10^5\ \frac{kJ}{HR}$$

$$\dot{Q} = (1.09 \times 10^5\ \frac{kJ}{HR})(\frac{HR}{3600\ s})(\frac{kW}{kJ/s})$$

$$\boxed{\dot{Q} = 30.38\ kW}$$

PROB. 2.53



STATE 1:

$V_f = 0.1\ m^3, \quad V_g = 0.9\ m^3$

$P_1 = 800\ kPa$

STATE 2:

$P_2 = P_1 = 800\ kPa$

$T_2 = 350°C$

a) FIND T_1

$T_1 = T_{sat}(P_{sat} = 800\ kPa) = 170.43°C$

b) FIND TOTAL MASS OF H_2O

$v = \frac{V}{m}, \quad m = \frac{V}{v}$

$m_T = m_f + m_g$

$m_T = \frac{V_f}{v_f} + \frac{V_g}{v_g}$

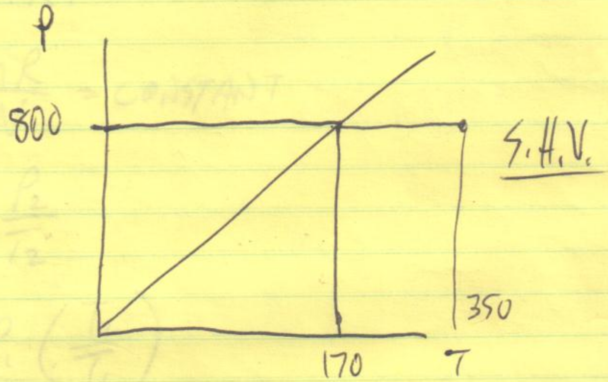
PROB. 2.53

$v_f = 0.001115 \frac{m^3}{Kg}, \quad v_g = 0.2404 \frac{m^3}{Kg}$

$$M_T = \frac{(0.1\ m^3)}{(0.001115 \frac{m^3}{Kg})} + \frac{(0.9\ m^3)}{(0.2404 \frac{m^3}{Kg})}$$

$M_T = 93.43\ Kg$

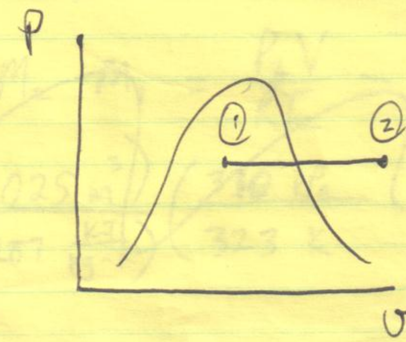
c) CALCULATE FINAL VOLUME



$v_2(800\ KPa, 350°C) = 0.3544 \frac{m^3}{Kg}$

$V_2 = m v_2 = (93.43\ Kg)(0.3544 \frac{m^3}{Kg})$

$V_2 = 33.11\ m^3$



PROB. 2.70

$V = 0.025\ m^3$

$T_1 = 25^\circ C$, $P_1 = 210\ kPa$ (GAGE)

$T_2 = 50^\circ C$, $P_{atm} = 100\ kPa$

FIND P_2

$PV = mRT$

$$\frac{P}{T} = \frac{mR}{V} = \text{CONSTANT}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$P_2 = P_1 \left(\frac{T_2}{T_1}\right)$$

$$P_2 = (210 + 100\ kPa)\left(\frac{50 + 273\ K}{25 + 273\ K}\right)$$

$P_2 = 336\ kPa$

$\Delta P = P_2 - P_1 = 336 - 310 = \underline{26\ kPa}$

~~AIR TO BE BLED OFF IS~~

$$\Delta m = m_2 - m_1 = \frac{P_2 V}{RT_2} - \frac{P_1 V}{RT_1} = \frac{V}{R}\left(\frac{P_2}{T_2} - \frac{P_1}{T_1}\right)$$

$$\Delta m = \frac{(0.025\ m^3)}{(0.287\ \frac{kJ}{kg\text{-}K})}\left(\frac{310\ kPa}{323\ K} - \frac{310\ kPa}{298\ K}\right)$$

PROB. 2.70

AIR TO BE BLED OFF:

MASS OF AIR IN TIRE FOR $P_1 = 210$ KPa gage, $T_1 = 25°C$

− MASS OF AIR FOR $P_2 = 210$ KPa gage, $T_2 = 50°C$

$$\Delta m = m_1 - m_2 = \frac{P_1 V}{R T_1} - \frac{P_2 V}{R T_2}$$

SINCE $P_1 = P_2 = P$

$$\Delta m = \frac{PV}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\Delta m = \frac{(210 + 100 \text{ KPa})(0.025 \text{ m}^3)}{\left(0.287 \frac{\text{KJ}}{\text{Kg-K}}\right)} \cdot \left(\frac{1}{298\text{K}} - \frac{1}{323\text{K}}\right)$$

$$\Delta m = 0.00701 \text{ Kg}$$

PROB. 2.81

R-134a

$P = 1.4\ MPa\ ,\quad T = 140°C$

a) IDEAL GAS RELATION

$Pv = RT$

$$v = \frac{RT}{P} = \frac{(0.08149\ \frac{kJ}{kg\text{-}K})(140 + 273\,K)}{(1400\ kPa)} = 0.02404\ \frac{m^3}{kg}$$

b) COMPRESSIBILITY CHART

$P_{cr} = 4.067\ MPa$

$T_{cr} = 374.3\ K$

$$P_r = \frac{P}{P_{cr}} = \frac{1.4}{4.067} = 0.344$$

$$T_r = \frac{T}{T_{cr}} = \frac{(140 + 273\ K)}{374.3\ K} = 1.10$$

$Z = 0.91$

$$v_A = Z \cdot v_{p.g.} = 0.91\left(0.02404\ \frac{m^3}{kg}\right) = 0.02188\ \frac{m^3}{kg}$$

c) TABLES

$v = 0.02189\ \frac{m^3}{kg}$