Quiz #1 Soln.

1) a. $P = 2\ MPa$
$T = 220°C$

Table A.6 → @ 2 MPa, $T_{sat} = 212.38°C$

$T > T_{sat}$ ∴ **superheated vapor**

b. $P = 300\ kPa$
$T = 127°C$

Table A.6 → @ 0.3 MPa, $T_{sat} = 133.52°C$

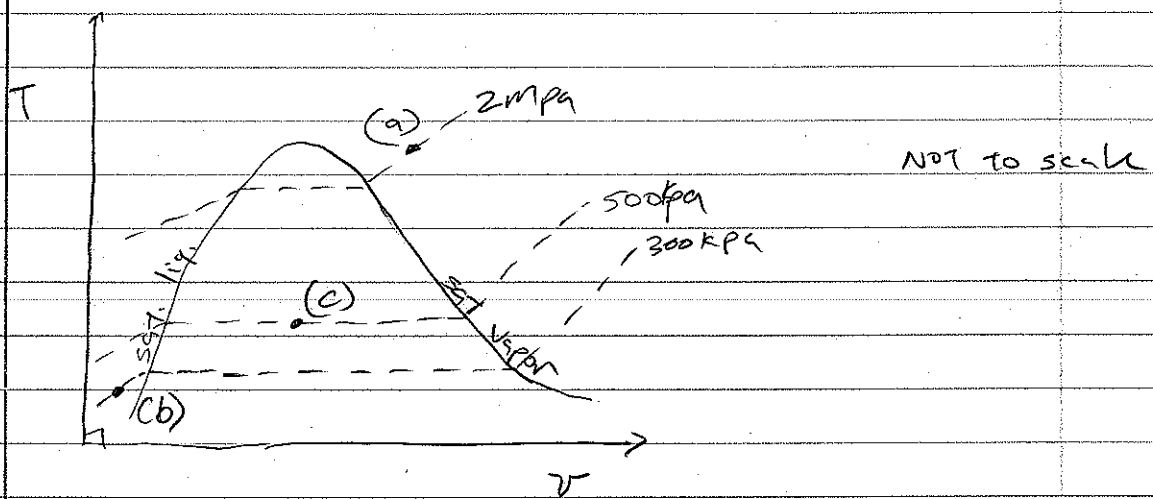
$T < T_{sat}$ ∴ **compressed liquid**

c. $v = .12 m^3 / 8 kg = .025 m^3/kg$

Table A.5 → @ 500 kPa $v_f = .001093\ m^3/kg$
$v_g = .37483\ m^3/kg$

$v_f < v < v_g$

mixture of sat L-V



2. $V = 230 m^3$, $X = .75$

a) @ 120°C → $v_f = 0.001060\ m^3/kg$

$v_g = 0.89133\ m^3/kg$

$v = v_f + X\, v_{fg}$

$= .001060 + 0.75(.89133 - .001060)$

$= .66876\ m^3/kg$

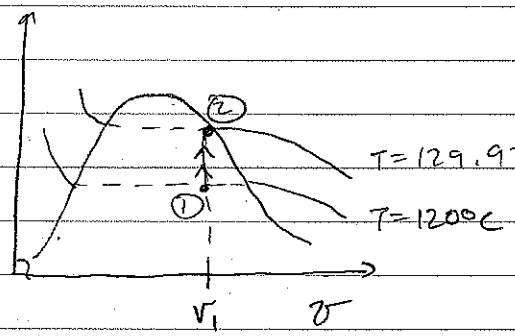
$m = V/v = 230 m^3 / .66876 m^3/kg = \boxed{344\ kg = m}$

b) $T_2 = T_g$, when $v_1 = v_g$

$v_1 = .66876\ m^3/kg = v_g$ @ ≈ $T = 129°C$

extrapolate from Table A.4 → $\boxed{T = 129.97°C}$ $\boxed{P = 270.03\ kPa}$

c)



d) $Q_{1\to2} = u_2 - u_1$

$u_1 = u_f + X\, u_{fg}$ @ 120°C $= 503.60 + 0.75(2025.3)$

$= 2022.58\ kJ/kg$

$u_2 = u_g$ @ $v_g = v_1$

$u_2 = 2539.47\ kJ/kg$ (extrapolated from Table A.4)

$Q_{1\to2} = 2539.47 - 2022.58 = \boxed{516.89\ kJ/kg}$

$H = 516.89 \frac{kJ}{kg} \cdot 344\ kg = \boxed{177.8\ MJ}$

3) $P_1 = 350\,kPa$ $\quad P_2 = 375\,kPa$

$T_1 = 15 + 273 = 288\,K$ $\quad T_2 = ?$

Rigid tank → $V = const$, $m = const$ (8)

$R = const$

(6) $\frac{P}{T} = \frac{mR}{V} = const$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\qquad T_2 = \frac{T_1 P_2}{P_1} = \frac{288\,K\,(375\,kPa)}{350\,kPa}$

$T_2 = 308.6\,K \approx \boxed{35.6\,^\circ C}$ (4)

4) $m_1 = 7\,kg$ $\quad m_2 = 3.5\,kg$ (4)

$P_1 = 500\,kPa$ $\quad P_2 = 150\,kPa$

$T_1 = 30 + 273 = 303\,K$ $\quad T_2 = ?$

Rigid tank → $V = const$

$R = const$

$PV = mRT \rightarrow \frac{mT}{P} = \frac{V}{R} = const$

(4)

$\frac{m_1 T_1}{P_1} = \frac{m_2 T_2}{P_2} \Rightarrow \frac{m_1 T_1 P_2}{m_2 P_1} = T_2$

(8)

$= \frac{7\,kg\,(303\,K)\,150\,kPa}{3.5\,kg\,(500\,kPa)}$ (4)

$= 181.8\,K = \boxed{-91.2\,^\circ C}$