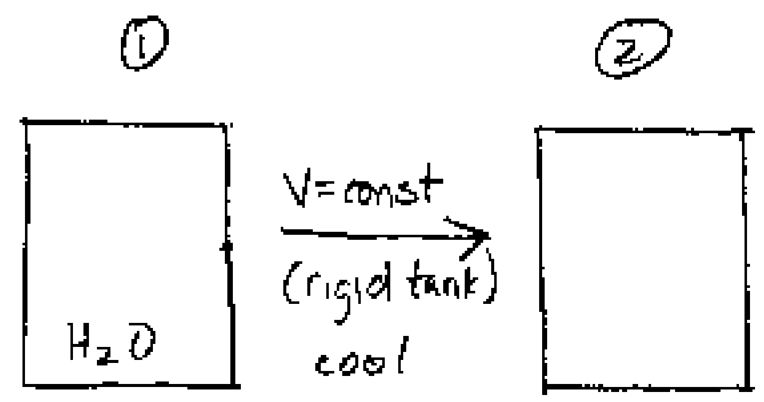
5.36



Find: T_2, ${}_1W_2$, ${}_1Q_2$

$V_2 = V_1$ & $v_2 = v_1$ rigid, closed container

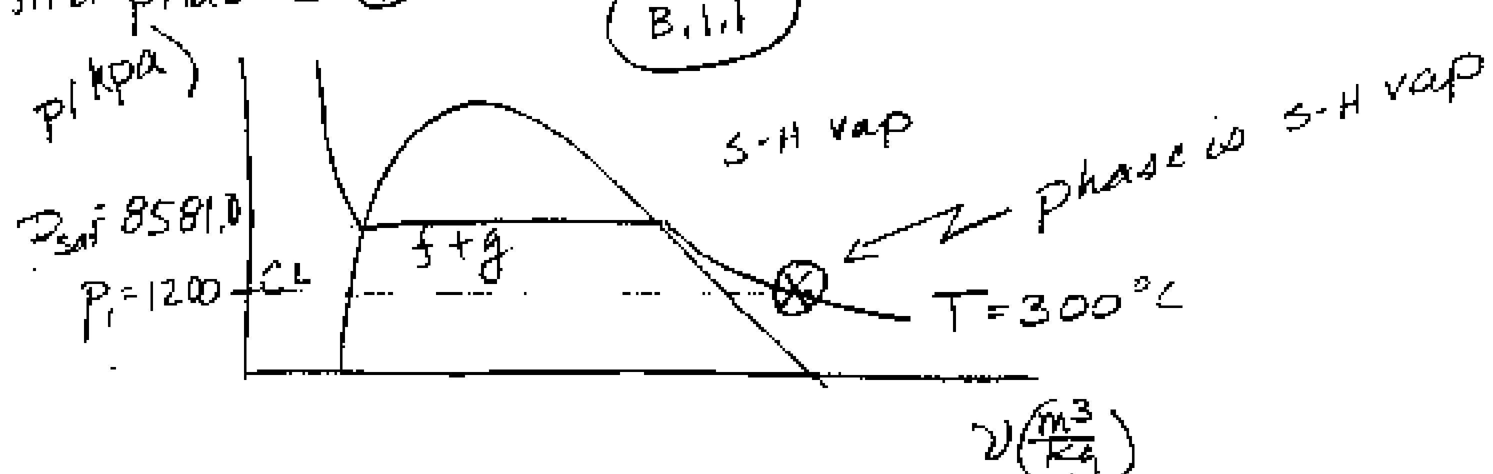
$m = 0.75$ kg

$T_1 = 300°C$

$P_1 = 1200$ kPa $P_2 = 300$ kPa

$\boxed{{}_1W_2 = 0}$ rigid tank ; $\Delta V = 0$

find phase @ ①

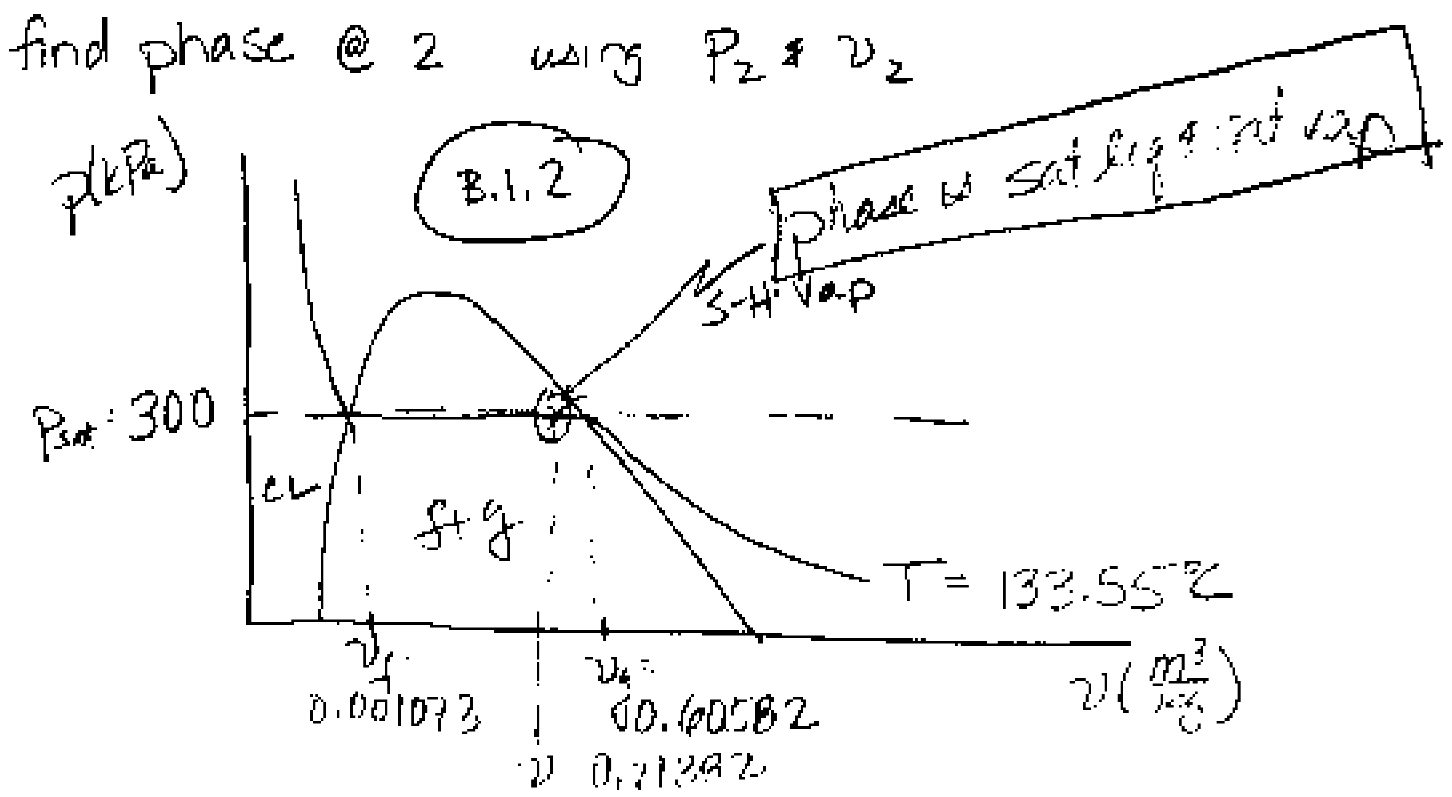


using B.1.3 @ $P_1 = 1200$ kPa, $T_1 = 300°C$

$\boxed{v_1 = 0.21382 \frac{m^3}{kg}}$ & $\boxed{u_1 = 2789.22 \frac{kJ}{kg}}$

$v_2 = v_1 = 0.21382 \frac{m^3}{kg}$ rigid (const V), closed (mass is const)

find phase @ 2 using P_2 & v_2



5.36 cont'd

$\boxed{T_2 = T_{sat}(300\text{ kPa}) = 133.55°C}$

$u_2 = u_f + x_2(u_g - u_f)$ @ 300 kPa

find x_2 using v_2

$v_2 = v_f + x_2(v_g - v_f)$ @ 300 kPa

$$x_2 = \frac{v_2 - v_f}{v_g - v_f}$$

$$= \frac{0.21382 \frac{m^3}{kg} - 0.001073 \frac{m^3}{kg}}{0.60582 \frac{m^3}{kg} - 0.001073 \frac{m^3}{kg}}$$

$\boxed{x_2 = 0.3518}$

@ 300 kPa   B.1.2

$u_f = 561.13 \frac{kJ}{kg}$

$u_g = 2543.55 \frac{kJ}{kg}$

$$u_2 = u_f + x_2(u_g - u_f)$$

$$= 561.13 \frac{kJ}{kg} + (0.3518)(2543.55 \frac{kJ}{kg} - 561.13 \frac{kJ}{kg})$$

$\boxed{u_2 = 1258.54 \frac{kJ}{kg}}$

$${}_1Q_2 = \Delta U + {}_1W_2 \quad ({}_1W_2 \to 0)$$

$$= m(u_2 - u_1)$$

$$= (0.75\text{ kg})(1258.54 \frac{kJ}{kg} - 2789.22 \frac{kJ}{kg})$$

$\boxed{{}_1Q_2 = -1148 \text{ kJ}}$

5.114) ① → ② Find: ${}_1Q_2$

R-134a, $pV^{1.5} = const$

m = 0.5 kg
sat vap
$T_1 = -10°C$

B.5.1

$P_1 = P_{sat} = 201.7\ kPa$

$v_1 = v_g = 0.09921\ \frac{m^3}{kg}$

$u_1 = u_g = 372.27\ \frac{kJ}{kg}$

$P_2 = 500\ kPa$

$$P_1V_1^n = P_2V_2^n$$

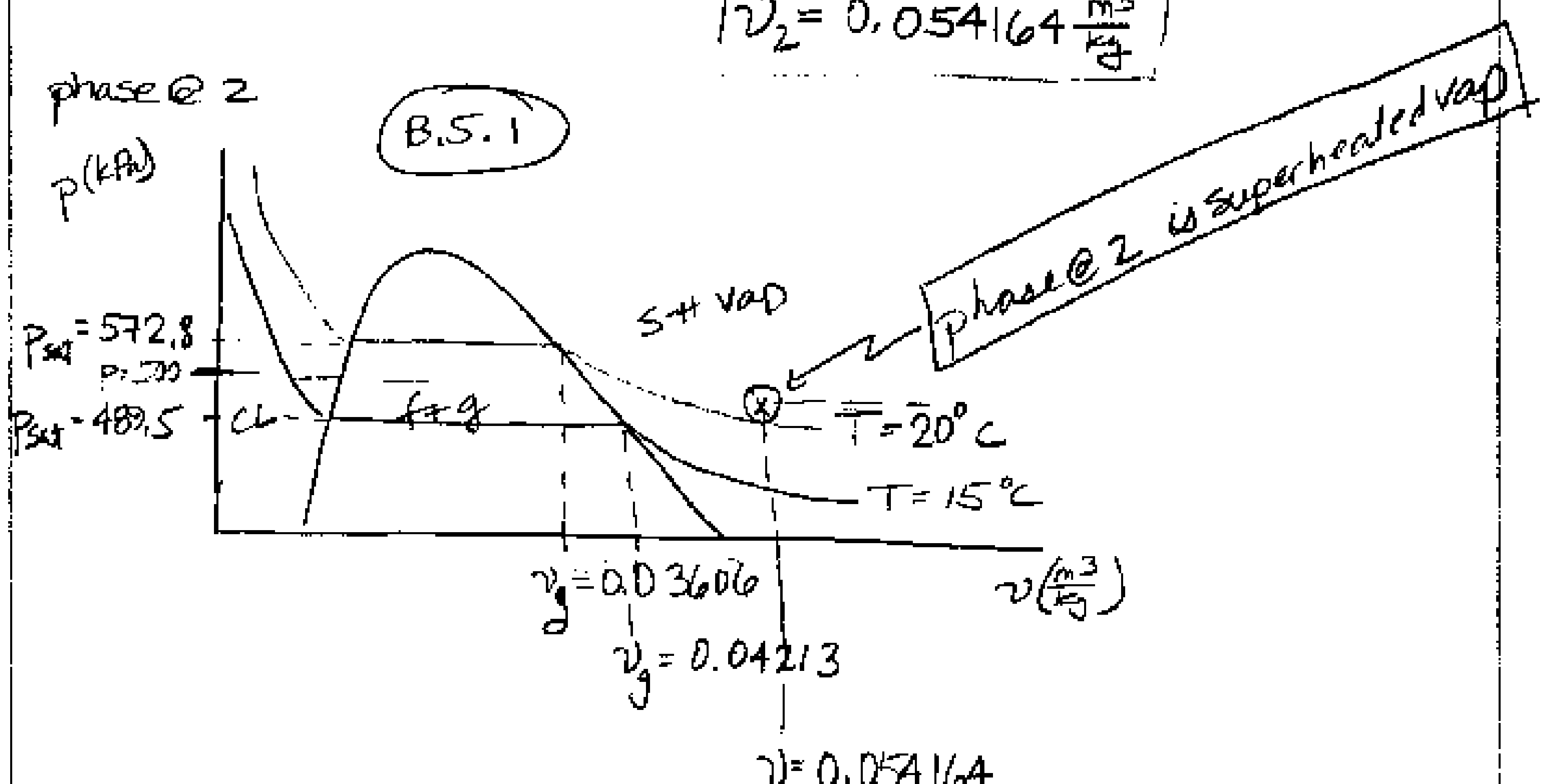
$$V_2^n = \frac{P_1V_1^n}{P_2}$$

$$V_2 = \left(\frac{P_1}{P_2}\right)^{\frac{1}{n}} V_1$$

$$v_2 = \left(\frac{P_1}{P_2}\right)^{\frac{1}{n}} v_1$$

$$v_2 = \left[\frac{(201.7\ kPa)}{(500\ kPa)}\right]^{\frac{1}{1.5}} \left(0.09921\ \frac{m^3}{kg}\right)$$

$$\boxed{v_2 = 0.054164\ \frac{m^3}{kg}}$$



5.114 cont'd

using table B.5.2 @ 500 kPa, must interpolate

	T (°C)	$v\ (\frac{m^3}{kg})$	$u\ (\frac{kJ}{kg})$
①	70	0.05247	433.06
②	80	0.05435	441.77
ⓜ	Tm	0.054164	um

$$u_m = u_1 + \frac{(u_2 - u_1)}{(v_2 - v_1)}(v_m - v_1)$$

$$= 433.06 + \frac{(441.77 - 433.06)}{(0.05435 - 0.05247)}(0.054164 - 0.05247)$$

$$u_m = \boxed{440.91\ \frac{kJ}{kg} = u_2}$$

$${}_1Q_2 = \Delta U + {}_1W_2$$

for process where $pV^n = const$

$${}_1W_2 = \frac{P_2V_2 - P_1V_1}{1-n} = \frac{m(P_2v_2 - P_1v_1)}{1-n}$$

$${}_1W_2 = \frac{(0.5\,kg)\left[(500\,kPa)(0.054164\,\frac{m^3}{kg}) - (201.7\,kPa)(0.09921\,\frac{m^3}{kg})\right]}{1 - 1.5} \cdot \frac{1\,kJ}{10^3\,Nm} \cdot \frac{10^3\,\frac{N}{m^2}}{1\,kPa}$$

$$\boxed{{}_1W_2 = -7.07\ kJ}$$

$${}_1Q_2 = m(u_2 - u_1) + {}_1W_2$$

$$= (0.5\,kg)\left[440.91\,\frac{kJ}{kg} - 372.27\,\frac{kJ}{kg}\right] + (-7.07\ kJ)$$

$$\boxed{{}_1Q_2 = 27.25\ kJ}$$

Note, interpolating, $\boxed{T_2 = 79.01°C}$