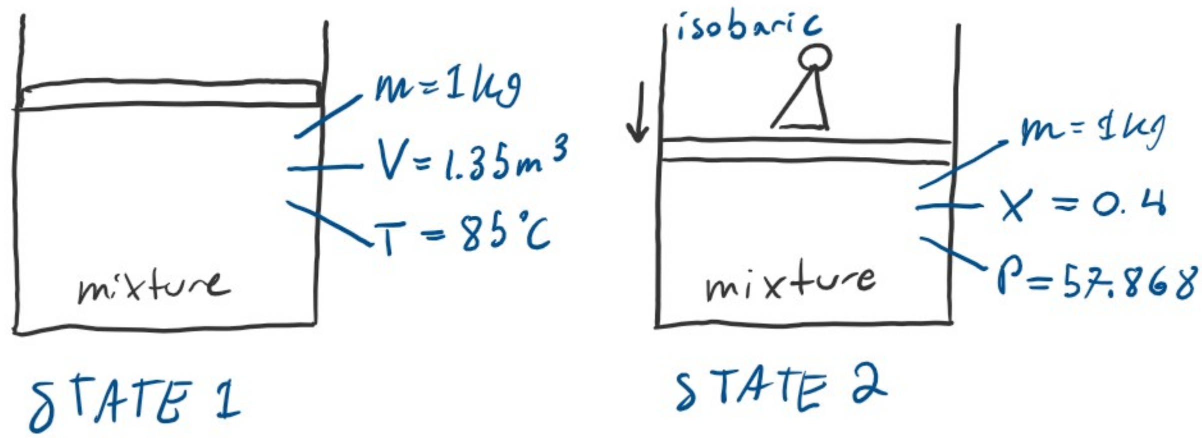
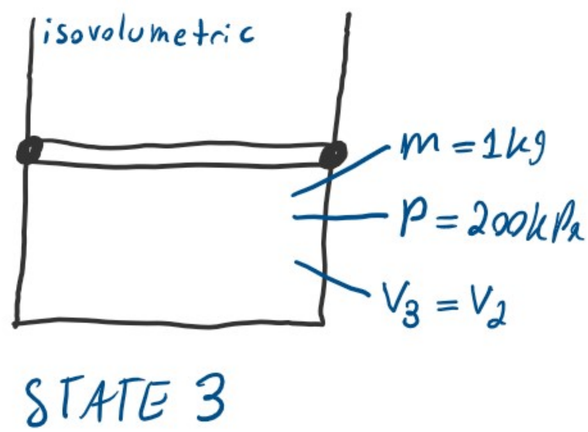
Q1

Alexander Bartella - 400308868 - 2NE3 Problem-based 1

September 23, 2022 5:32 PM





a) Assume: $v_1 = 1.35\ m^3/kg$, $T_1 = 85°C$

$v_f < v_1 < v_g$ @ T_1 $\therefore$ mixture

$P_1 = P_{sat@T_1} = 57.868\ kPa$

b) Assume: $P_2 = P_1 = 57.868\ kPa$, $X = 0.4$

* since $P_2 = P_1$ & state = mixture, $\therefore T_2 = T_1 = 85°C$

find $v_g @ P_2$ & $v_f @ P_2$

$$\frac{2.2172 - 3.2403}{75 - 50} = \frac{v_g - 3.2403}{57.868 - 50}$$

$$v_g @ P_2 = 2.9183 \ m^3/kg$$

$$\frac{0.001037 - 0.001030}{75 - 50} = \frac{v_f - 0.001030}{57.868 - 50}$$

$$v_f @ P_2 = 0.001032 \ m^3/kg$$

$$0.4 = \frac{v_2 - v_f}{v_g - v_f} = \frac{v_2 - 0.001032}{2.9183 - 0.001032}$$

$$\underline{v_2 = 1.16794 \ m^3/kg}$$

<u>state 3</u>

$v_3 = v_2 = 1.16794 \ m^3/kg$

$P_3 = 200 \ kPa$

$v_3 > v_g @ 200 \ kPa$ $\therefore$ superheated vapour interpolate for U_3

$$\frac{1.1989 - 1.0805}{2731.4 - 2654.6} = \frac{\overbrace{1.16794}^{V_3} - 1.0805}{U_3 - 2654.6}$$

$$U_3 = 2711.3178 \text{ kJ/kg}$$

$$U_1 = U_g x_1 + (1 - x_1) U_f$$

$$x_1 = \frac{1.35 - 0.001032}{2.8261 - 0.001032} = 0.4775$$

$$U_1 = (2487.8)(0.4775) + (1 - 0.4775)(355.96)$$

$$U_1 = 1373.91 \text{ kJ/kg}$$

$$\Delta U_{31} = 2711.3178 - 1373.91 = 1337.4 \text{ kJ/kg}$$

constant pressure ↓ ↙ constant volume

$$W_T = W_{21} + W_{32}$$

$$W_T = W_{21} + \emptyset$$

$$W_T = 57.868(1.1679 - 1.35)$$

$$W_T = -10.538 \text{ kJ/kg}$$

$$w_T = w_{21} + 0$$

$$w_T = 57.868(1.1679 - 1.35)$$

$$w_T = -10.538 \text{ kJ/kg}$$

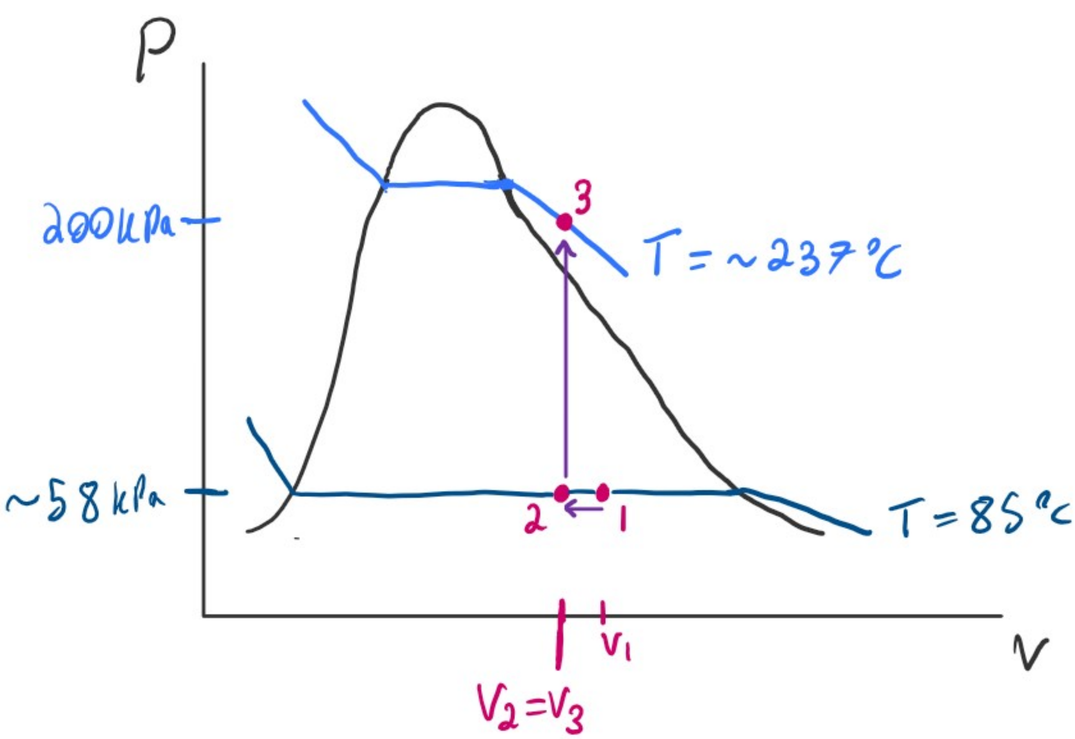
For diagram: interpolate for state 3 temperature

$$\frac{v@250°C - v@200°C}{250 - 200} = \frac{v_3 - v@200°C}{T_3 - 200°C}$$

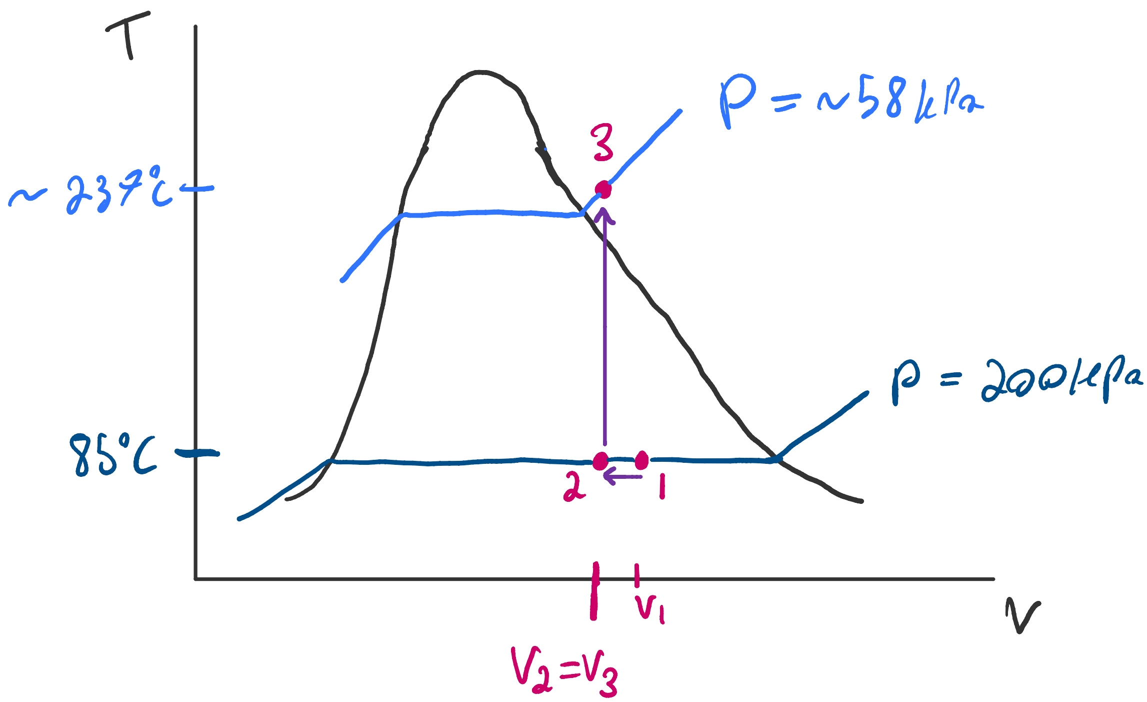
$$\frac{1.1989 - 1.0805}{250 - 200} = \frac{1.16794 - 1.0805}{T_3 - 200}$$

$$T_3 = 236.926° C$$

Diagrams




$V_2=V_3$


T
$P = \sim 58$ kPa
$\sim 237°C$
3
$P = 200$ kPa
85°C
2
1
V_1
V
$V_2=V_3$