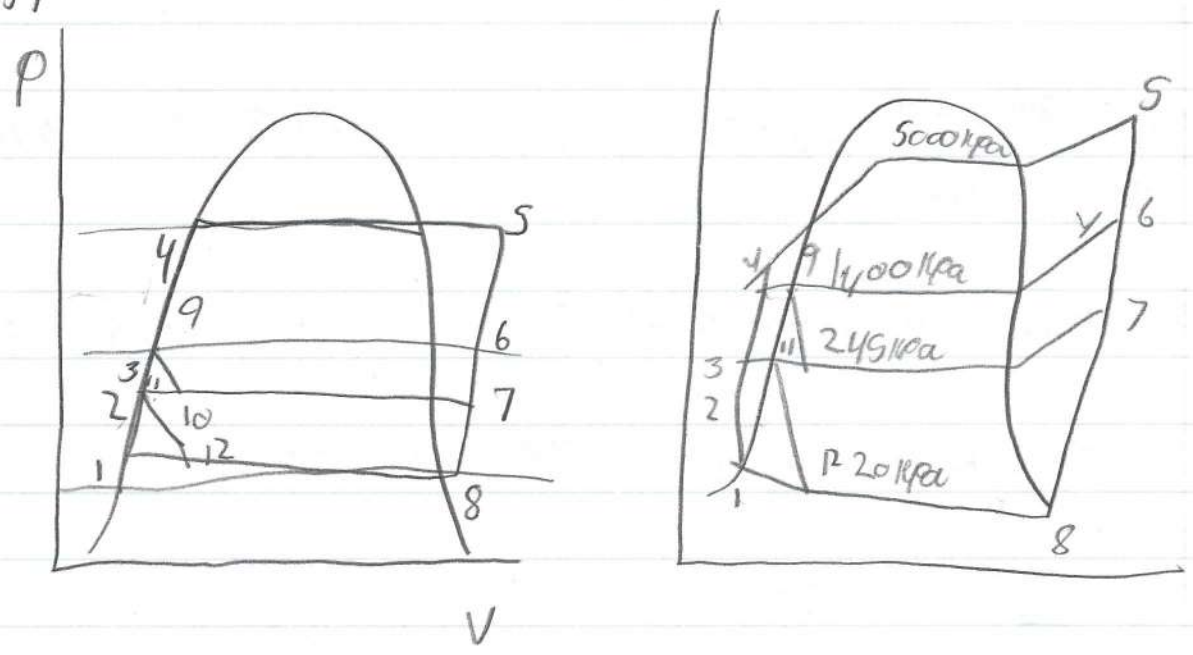
Ben Smithson Thermal applications HW 2.3

10-57



1 — 2 — 3 — 4 — 5

$T_1 =$

$P_1 = 20\text{kPa}$

$h_1 = h_{f\,20\text{kPa}} = 251\ \text{kJ/kg}$

$h_2 = v_f(P_2 - P_1)$

$P_2 = 5000$

$h_2 = 256$

$h_3 = h_{11}$

$h_{f\,245\text{kPa}} = 533$

$P_4 = 1400$

$h_4 = h_9$

$h_{f\,1400\text{kPa}} = 830$

6 — 7 — 8 — 9 — 10 — 11 — 12

$h_9 = h_4 = 830$

$h_{10} = h_9 = 830$

$h_{12} = h_{11}$ $h_{12} = 533$ 533

$$h_2 + 2h_7 + yh_{10} = h_3(y+2(h_{11})$$

$$z = \frac{(h_3 - h_2) + y(h_{11} - h_{10})}{h_7 - h_{11}} = \frac{(533 - 256.08) + 0.1440 \cdot (533 - 830)}{2918 - 533}$$

$$= 0.088103$$

$W_T = h_5 - y h_6 - z h_7 - (1 - y - z) h_8$

$W_T = 3900 - 0.1446 \cdot 3406 - 0.09802 \cdot 2918 - (1 - 0.1446 - 0.098) \cdot 2471 = 1245$

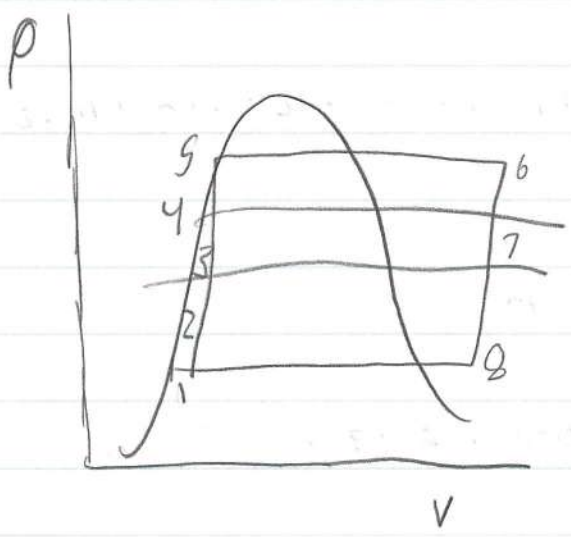
$W_{net} = 1245 - 0.00102 (5000 - 20) = 1240 - 3.75 = 93$

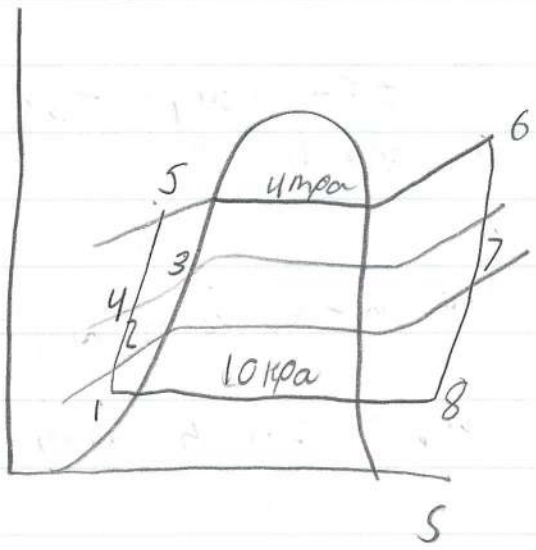
$q_{in} = m(h_5 - h_4 = 75 \cdot 3900 - 830 = 230$

$\eta = \frac{W_{net}}{q_{in}} = 40\%$

Ben Smithson Thermal applications hw 2.3

10-69





1 ⌒ 2 ⌒ 3 ⌒ 4 ⌒ 5 ⌒ 6 ⌒ 7 ⌒ 8 ⌒

$h_1 = h_f$ $= 191.81$ kJ/kg

$V_1 = V_f =$ $0.0010 m^3/kg$

$P_2 = 1.2 mpa$

$m_2 = m_4$

$m_3 =$

$m_3 = m_1$

$= \frac{1}{4} m_4$

$= \frac{1}{4} 55$

$= 13.75 kg$

$m_4 = 55$

$h_4 = 41.193 +$

$13.73 \cdot 7.3$

55

$= 344.34$

$V_4 = V_f$

$= 0.0013$

$h_5 = h_4$

$+ w_{p,in}$

$= 347.23$

$s_6 = s_7$ $h_7 =$ 3080.3

$h_8 =$

$h_f + x_8 h_{fg}$

$= 191.81$

$= 2246$

$h_2 = h_1 +$

$w_{p,in}$

$= 193.01$ kg

$w_{out} = m_6(h_6 - h_7) + m_8(h_7 - h_8)$

$= 55\ (3446 - 308104) + (0.75 \cdot 55)(3081.4 - 2246.8)$

$= 54\ 478\ kw$

$w_{p.m} = m_1 w_{p1} m + m_4 w_{p2} m$

$w_{p1.m} = (0.75 \cdot 55 kg/s \cdot 1.20) + 55 kg/s \cdot 2.89) =$

$20\ 805\ kw$

$w_{net} = w_t - w_p = 54\ 478 - 20\ 805 = 54\ 269.75 kw$

$q_{in} = m_5(h_6 - h_5 = 55(3446 - 342.2) =$

$170\ 432.35 = w_{net} + q_{in}$

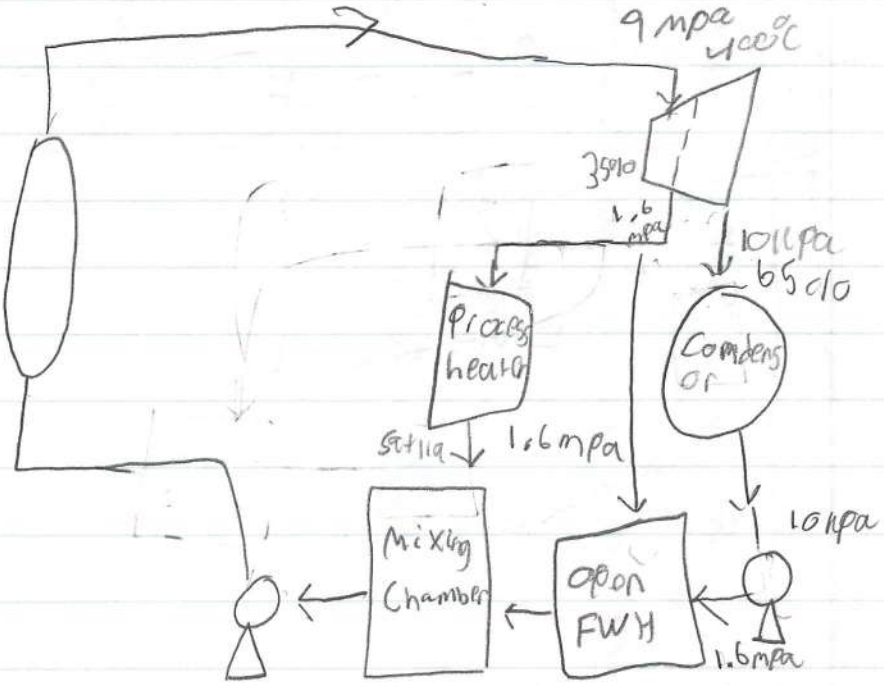
q_{in}

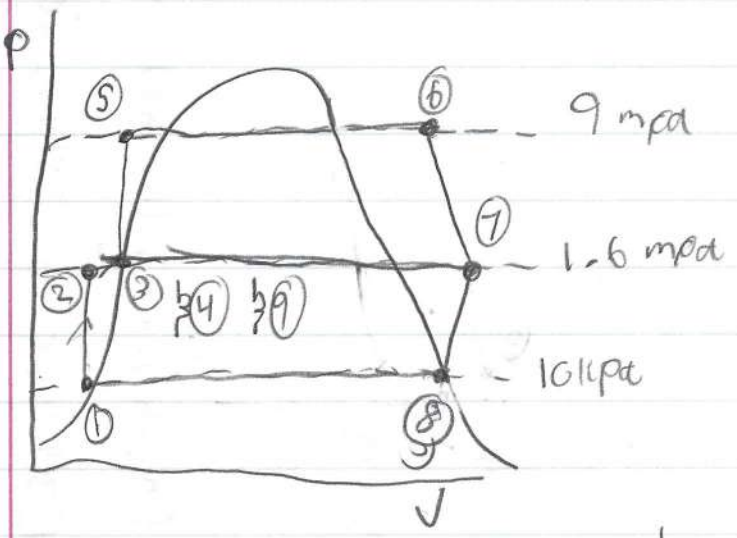
$$\frac{54269.75 + 31392.2}{170432.3} = 50.26\%$$

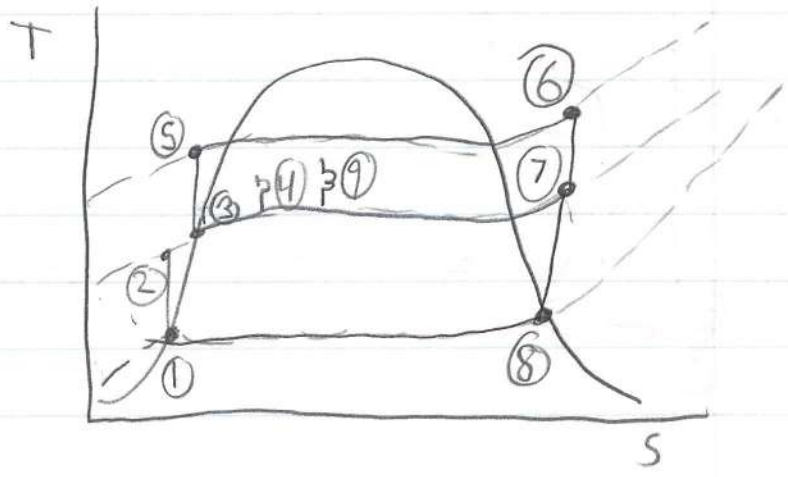
Ben Smithson

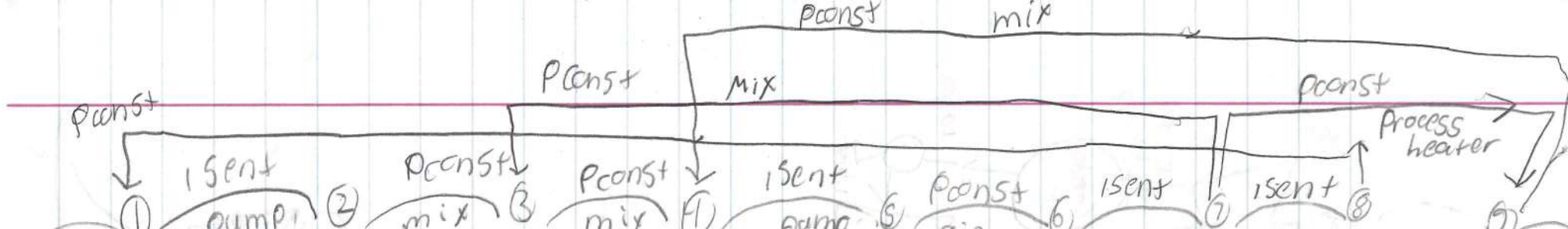
Vapor Thermal applications HW 2.3

10-77









$P_1 = 10\ kPa$

$x_1 = 0$

Sat H_2O tables read

h_1

v_1

s_1 ✓

$P_2 = 1.6 mpa$ ✓

h_2

$P_3 = 1.6\ mpa$

$x_3 = 0$ ✓

$P_4 = 1.6\ mpa$

$x_4 = 0$

Sat tables

h_4

v_4 ✓

$P_5 = 9\ mpa$ ✓

h_5

$P_6 = 9 mpa$

$T_6 = 400°C$

Super tables

$P_7 = 1.6 mpa$

$s_7 = 5.6$

$s_7 = s_{g7}$

$s_7 = s_{f7} + x_7 s_{fg7}$

$h_7 = h_{f7} + x_7 h_{fg7}$ ✓

$P_8 =$ Same as 7 ✓

$P_9 = 1.6$ $x_9 = 0$ ✓

Find which table

$w_p = h_2 - h_1 =$

$= v_1 (P_2 - P_1)$

$h_2 = v_1 (P_2 - P_1) + h_1$

$w_{net} = m_T (h_6 - h_7) + m_{1-4} (h_7 - h_8) - m_{1-4} (h_2 - h_1) - m_4 (h_5 - h_4)$

$m_T [389.36 + 0.69 \cdot 739.174 - 0.69 \cdot 1.606 - 8.57] =$ 29.06 kg/s