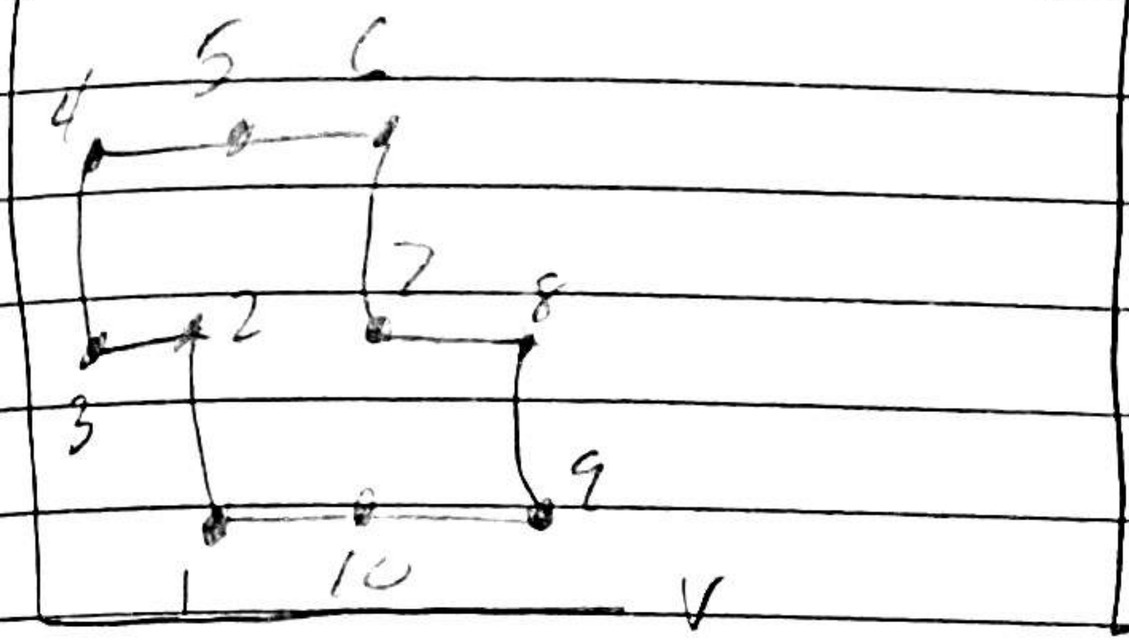
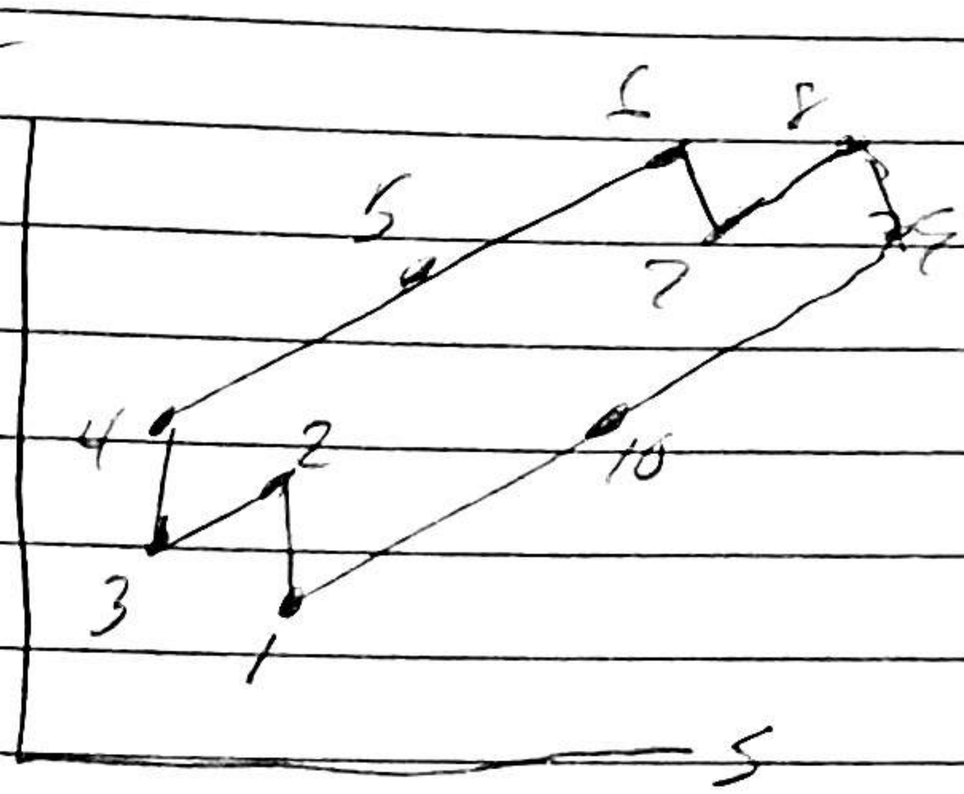
MET 350 H/W 1.5 ROY SHEPARD 123, 129, 135, 167

(123)





(1) $P_1 = 100 kPa$

$T_1 = 290 K$

(2) $P_2 = 400 kPa$ $\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}} =$

$T_2 = 430.93 K$

(3) $P_3 = 400 kPa$ $T_3 = T_1$

$T_3 = 290 K$ $\frac{T_4}{T_3} = \left(\frac{P_4}{P_3}\right)^{\frac{k-1}{k}}$

(4) $P_4 = 1600 kPa$

$T_4 = 430.93 K$ $T_5 = T_4 + 20°C$

(5) $P_5 = 1600 kPa$ $T_6 = T_5 + \frac{q_{IN}}{C_P}$

$T_5 = 450.93$

(6) $P_6 = 1600 kPa$ $\frac{T_7}{T_6} = \left(\frac{P_7}{P_6}\right)^{\frac{k-1}{k}}$

$T_6 = 749.5 K$

(7) $P_7 = 400 kPa$

$T_7 = 544.5 K$ $T_8 = T_7 \frac{q_{IN}}{C_P}$

(8) $P_8 = 400 kPa$ $\frac{T_8}{T_8} = \left(\frac{P_8}{P_8}\right)^{\frac{k-1}{k}}$

$T_8 = 808.8 K$

(9) $P_9 = 100 kPa$ $T_{10} = T_9(T_{T5} - T_{T1})$

$T_9 = 540.5 K$

(10) $P_{10} = 100 kPa$

$T_{10} = 520.5 K$

$W_{IN} = C_P(T_4 - T_3 + T_2 - T_1) = 28.43 \frac{kJ}{kg}$

$q_{IN} = C_P(T_6 - T_3 + T_8 - T_7) = 60.1 \frac{kJ}{kg}$

$W_{out} = C_P(T_6 - T_7 + T_8 - T_9) = 50.3 \frac{kJ}{kg}$

$q_{out} = (P(T_{10} - T_1 + T_9 - T_3) = 515. \frac{kJ}{kg}$

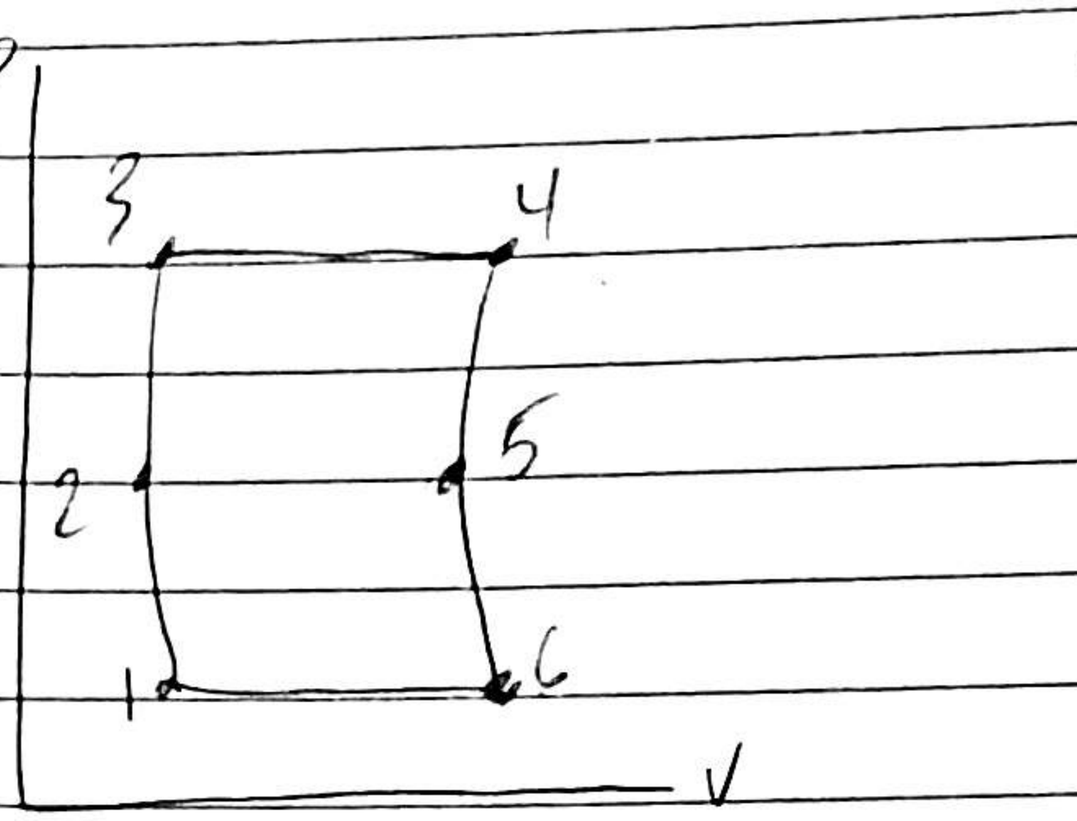
$W_{net} = 227 \frac{kJ}{kg}$

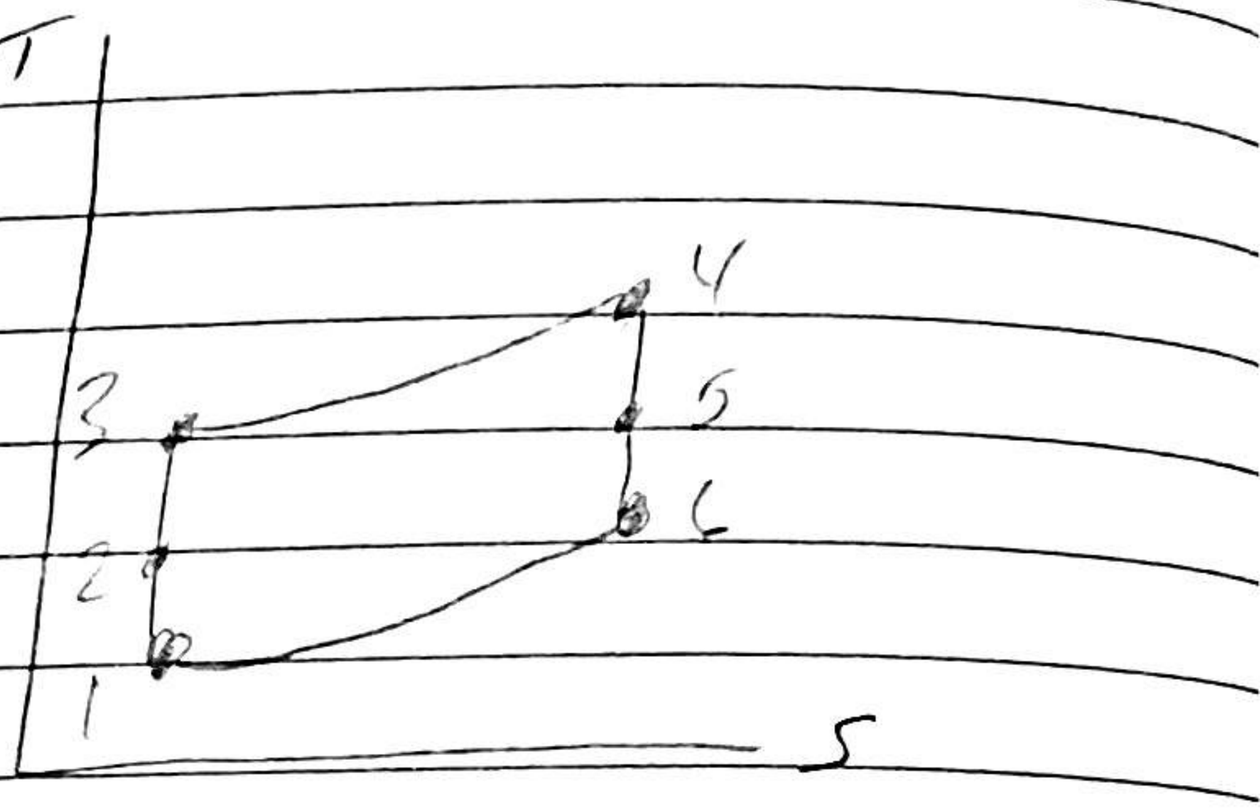
$q_{net} = 227 \frac{kJ}{kg}$

$\frac{W_{net}}{q_{IN}} = \frac{227}{C_{CU}} = 1.38$

38°C

129





(1) $V_1 = 900 \frac{ft}{s}$

$P_1 = 7 PSIA$

$T_1 = 469.7 R$

$T_2 = T_1 + \frac{V_1^2}{2c_p}$

$P_2 = P_1 \left(\frac{T_2}{T_1}\right)^{\frac{k}{k-1}}$

(2) $V_2 = 0 ft/s$

$P_2 = 11.2 PSIA$

$T_2 = 537.4 R$

$P_3 = 13 P_2$

$T_3 = T_2 \left(\frac{P_3}{P_2}\right)^{\frac{1.4}{1.4}}$

(3) $V_3 = 0 ft/s$

$P_3 = 145.6 PSIA$

$T_3 = 1118.7 R$

$T_4 - T_5 = T_3 - T_2$

$P_6 = P_4 \left(\frac{T_5}{T_4}\right)^{\frac{1.4}{1.4}}$

$T_6 = T_5 \left(\frac{P_6}{P_5}\right)^{\frac{1.4}{1.4}}$

$c_p (T_6 - T_5) \frac{V_6^2}{2} = 0$

(4) $V_4 = 0 ft/s$

$P_4 = 145.6 PSIA$

$T_4 = 2400 R$

(5) $V_5 = 0 ft/s$

$P_5 = 56.2 PSIA$

$T_5 = 1814 R$

(6) $V_6 = 3121 ft/s$

$P_6 = 7 PSIA$

$T_6 = 1008.6 R$

(a) 56.2 PSIA

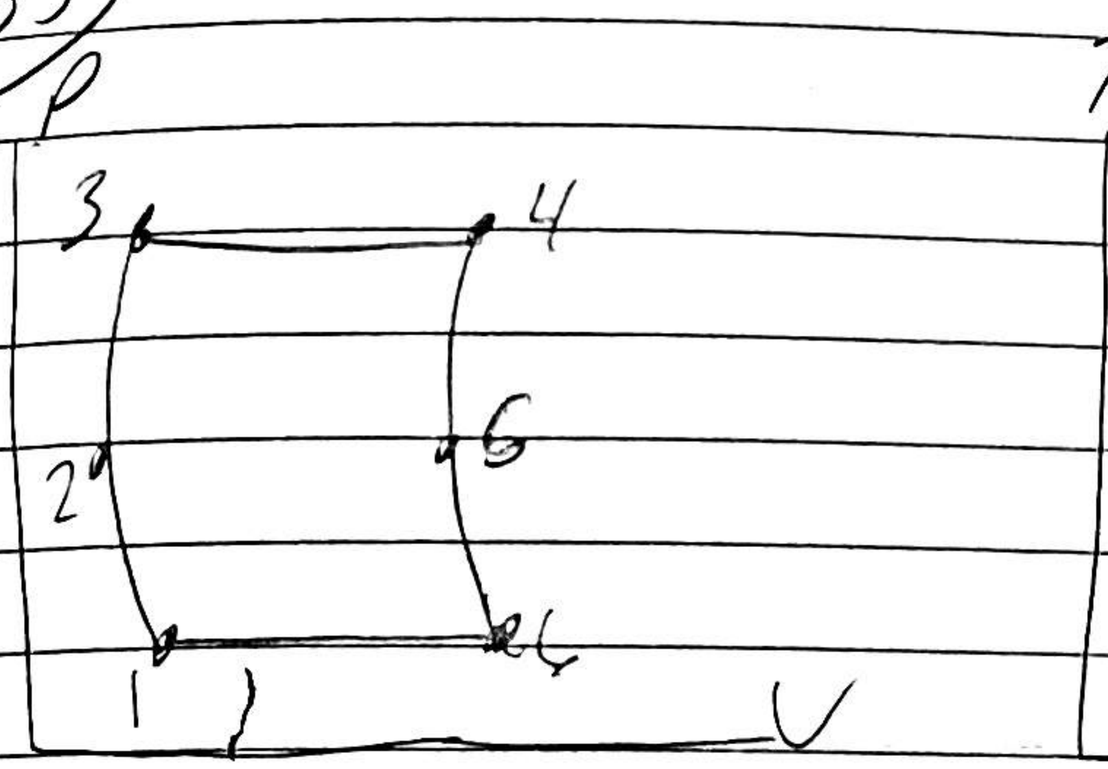
(b) = 3121 ft/s

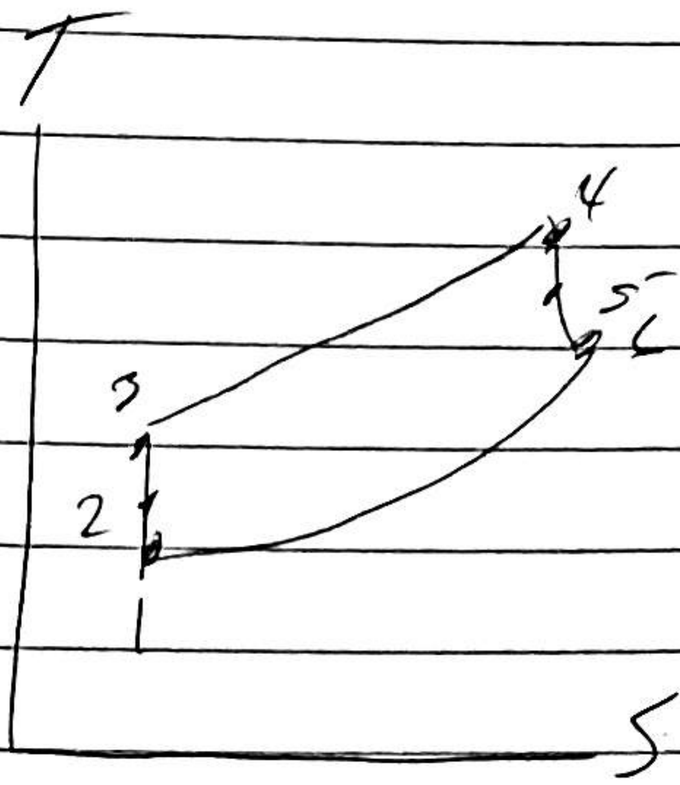
(c) $= \frac{(V_6 - V_1) V_1}{c_p (T_4 - T_3)}$

$= \frac{(3121 - 900) \cdot 900}{0.24 (2400 - 1118) \cdot 25037}$

$= .255 = 25.5\%$

13.5





① $P_1 = 95 kPa$

$T_1 = 280 K$

$h_1 = 280.13 \frac{kJ}{kg}$

$P_{r1} = 1.386$

② $T_2 = T_1 \, r_c^{k-1}$

$T_2 = 521 K$

③ $P_3 = 834.8 kPa$

$T_3 = 521 K$

$h_3 = 526.42 \frac{kJ}{kg}$

$P_{r3} = 9.8$

$P_{r3} = P_1 \left(\frac{T_2}{T_1}\right)^{\frac{1.4}{.4}}$

$Q_{IN} = \frac{1}{2} 4270$

$Q_{IN} = 2135 kW$

④ $T_4 = 1464.3 K$

$h_4 = 1592 \frac{kJ}{kg}$

$P_{r4} = 543.9$

$1067.5 = h_4 - 526.4$

⑤ $h_5 = 1347.6 \frac{kJ}{kg}$

$P_{r5} = 60.4$

$h_4 - h_5 = h_3 - h_2$

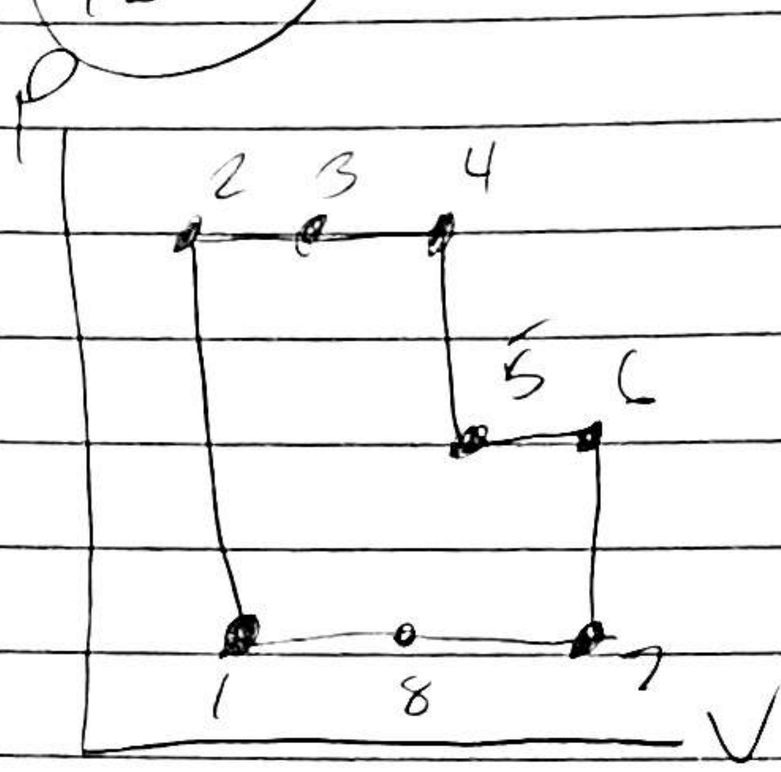
⑥ $T_6 = 850.4 K$

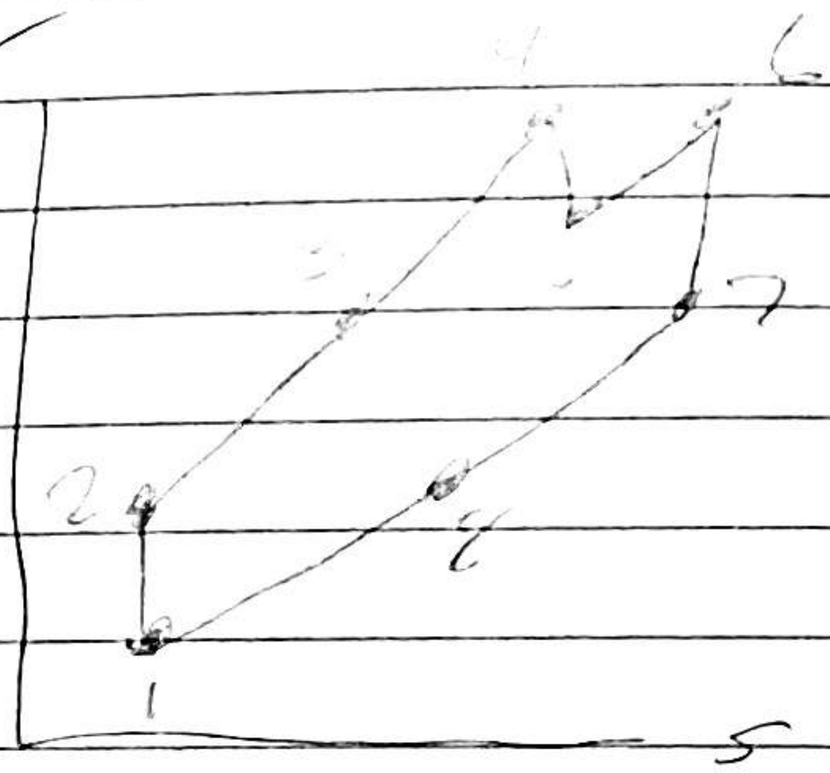
$h_6 = 877.6 \frac{kJ}{kg}$

$V_{ea} = \sqrt{2(h_5 - h_6)100} = 969.6 \frac{m}{s}$

$F = ma \quad 20(969.6) = 19380 N$

167





$$q_{in} = h_3 - h_7 = C_p (T_3 - T_7) = C_p (T_3 \left(1 - VP^{\frac{(1-K)}{2K}}\right)$$

$$q_{out} = h_6 - h_1 = C_p (T_6 - T_1) = C_p T_1 \left(VP^{\frac{(K-1)}{2K}} - 1\right)$$

$$\eta_{th} = 1 - \frac{q_{out}}{q_{in}} = 1 - \frac{C_p T_1 \left(VP^{\frac{(K-1)}{2K}} - 1\right)}{C_p T_3 \left(1 - VP^{\frac{1-K}{2K}}\right)}$$

The efficiency is higher than standard because of the two stages and imperfect expansion process.