



$$P_1 = 100 \text{ kPa}$$

$$T_1 = 290.15 \text{ K}$$

$$V_1 = 0.833$$

$$V_1 = r \frac{T_1}{P_1}$$

$$P_3 = P_2$$

$$P_2 = 100 \text{ kPa}$$

$$P_2 = r P_1$$

$$P_2 = 400 \text{ kPa}$$

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

$$T_2 = 431.16 \text{ K}$$

$$V_2 = \frac{r T_2}{P_2} = 0.31$$

$$V_3 = \frac{r T_3}{P_3} = 0.21$$

$$T_3 = T_1$$

$$T_3 = 290.15 \text{ K}$$

$$P_4 = r P_3$$

$$P_4 = 1600 \text{ kPa}$$

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

$$T_4 = 431.08 \text{ K}$$

$$P_5 = P_4$$

$$P_5 = 1600 \text{ kPa}$$

$$T_5 = T_4 + 20$$

$$T_5 = 451.08 \text{ K}$$

$$V_5 = 0.061$$

$$P_7 = P_6 / r$$

$$P_7 = 400 \text{ kPa}$$

$$P_8 = P_9$$

$$P_9 = 100 \text{ kPa}$$

$$T_8 = T_7 + \frac{q_{in}}{C_p}$$

$$T_8 = 803.08 \text{ K}$$

$$V_8 = 0.876$$

$$q_{in} = C_p (T_6 - T_5)$$

$$q_{in} = 300$$

$$T_6 = 749.61$$

$$V_6 = 0.131$$

$$\frac{T_9}{T_8} = \left(\frac{P_9}{P_8} \right)^{\frac{\gamma-1}{\gamma}}$$

$$T_9 = 510.51$$

$$\frac{T_7}{T_6} = \left(\frac{P_7}{P_6} \right)^{\frac{\gamma-1}{\gamma}}$$

$$T_7 = 804.55$$

$$V_7 = 0.362$$

$$P_{10} = P_1$$

$$P_{10} = 100 \text{ kPa}$$

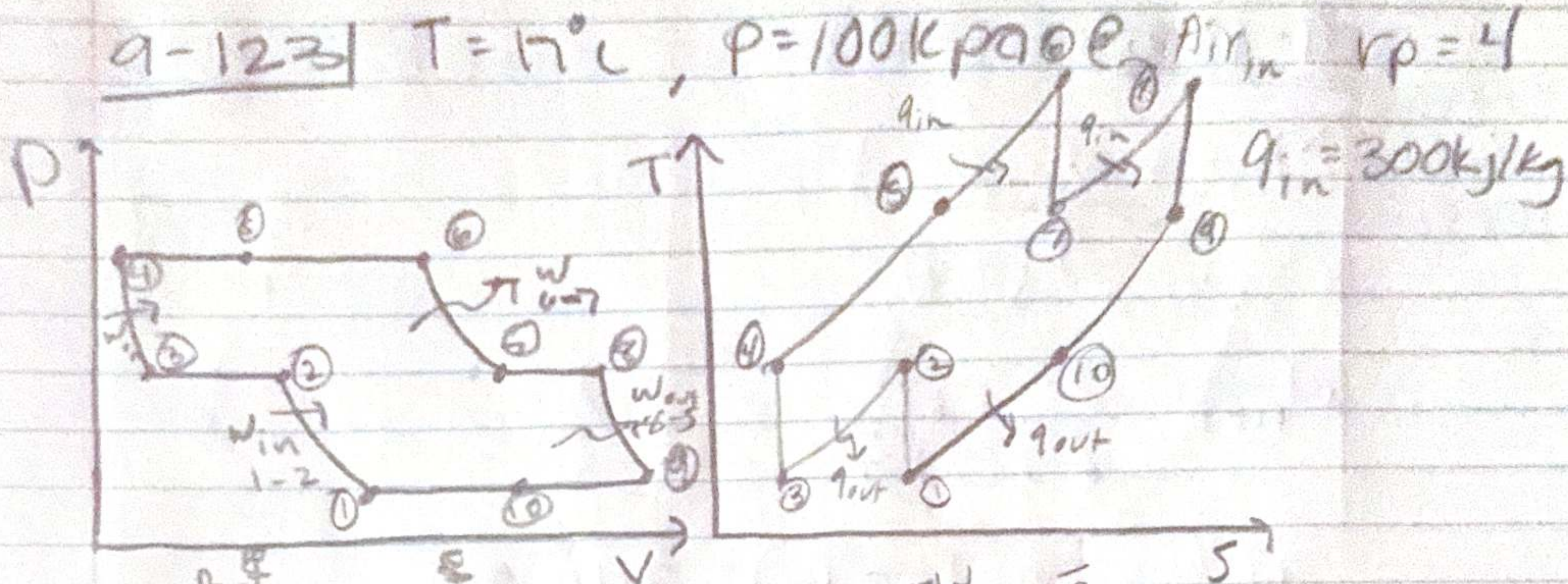
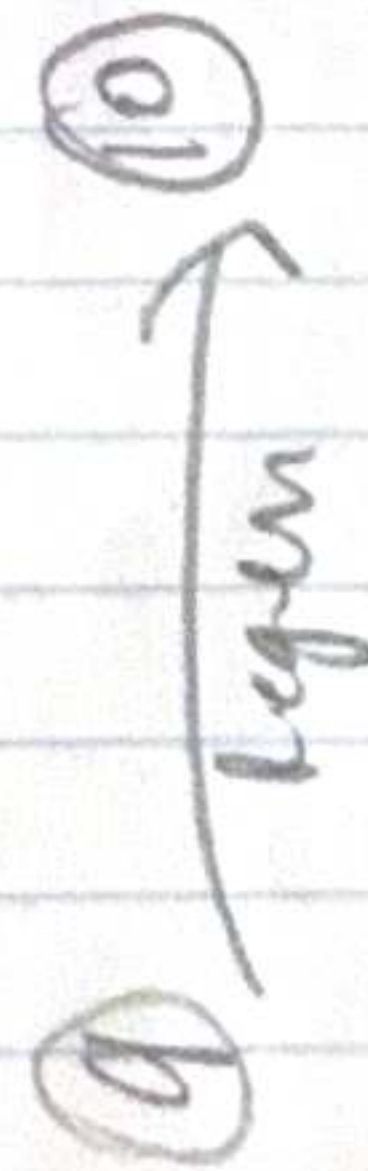
$$V_{10} = 1.494$$

$$T_{10} = 520.51 \text{ K}$$

$$P_9 = P_{10}$$

$$P_9 = 100 \text{ kPa}$$

$$T_9 = 510.51 \text{ K}$$



9-123 $T = 17^\circ \text{C}$, $P = 100 \text{ kPa}$, Air, $r_p = 4$
 $q_{in} = 300 \text{ kJ/kg}$

9-123 cont'd

$$\eta_{th} = \frac{W_{net}}{q_{in}}$$

$$W_{net} = W_{out, 6-7} + W_{out, 8-7} - W_{in, 1-2} - W_{in, 3-4}$$

$$W_{out, 6-7} = Cp(T_6 - T_7) = 246.26$$

$$W_{out, 8-7} = Cp(T_8 - T_7) = 263.86$$

$$W_{in, 1-2} = Cp(T_2 - T_1) = 141.70$$

$$W_{in, 3-4} = Cp(T_4 - T_3) = 141.62$$

$$W_{net} = 226.901$$

$$q_{in} = q_{in} + q_{in} = 300 \frac{kJ}{kg} + 300 \frac{kJ}{kg}$$

$$q_{in} = 600 kJ/kg$$

$$\eta_{th} = 0.378$$

$$P_{HIS} = 0.3048$$

$$400, 0.3048$$

$$= 274.32 \text{ m/s} \quad 20,000 \text{ ft} = 48,260 \text{ kPa} + 260.93 \text{ k}$$

$$T_{Turnin} = 2400 \text{ R}$$

$$L = 1333.33 \text{ K}$$

$$q = 129$$

$$r_p = 13$$

$$V = 900 \text{ ft/s}$$

$$C_p = 1.005$$

$$C_v = 0.718$$

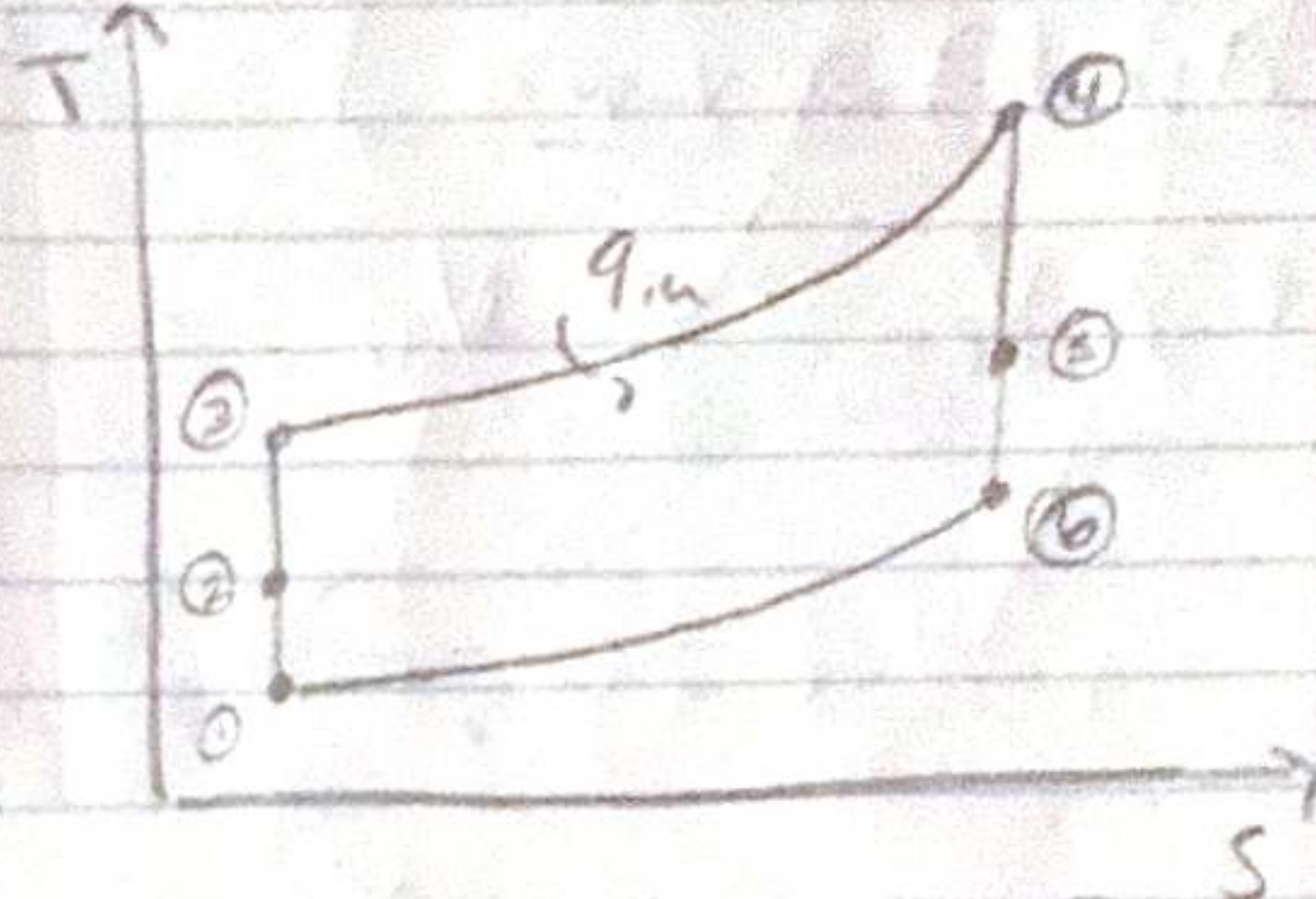
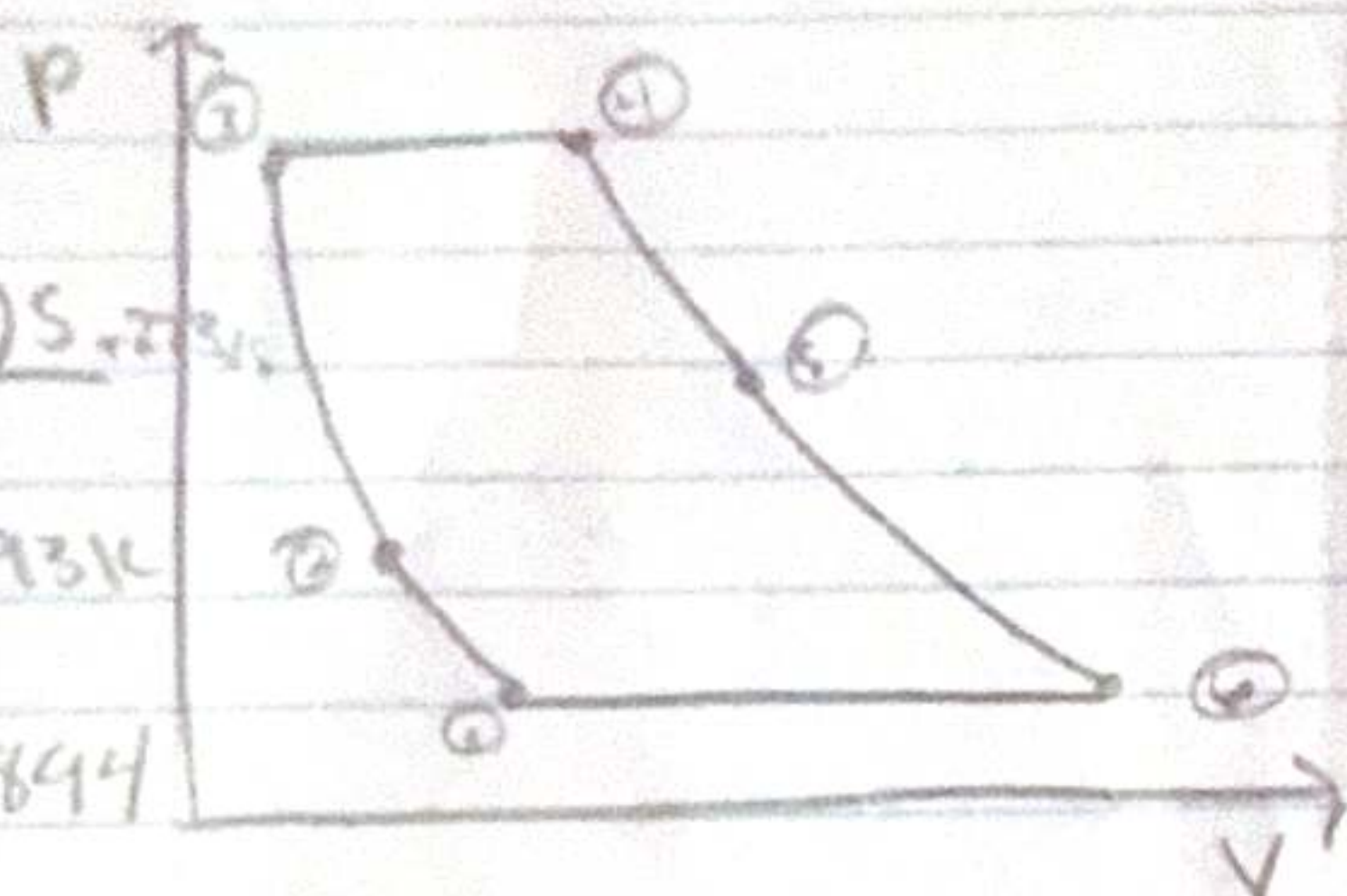
$$k = 1.4$$

$$P = 0.2870$$

$$k = \frac{(F-32)S}{9}$$

$$L = 260.93 \text{ K}$$

$$1 \text{ psi} = 6.894$$



$$1 \times 6.894 = 48.26$$

$$P_1 = 48.26 \text{ kPa}$$

$$T_1 = 260.93 \text{ K}$$

$$V_1 = 1.55$$

$$V_1 = 274.32 \text{ m/s}$$

$$P_3 = 13 P_2$$

$$P_3 = 1003.08$$

$$T_3 = 619.76 \text{ K}$$

$$V_3 = 0.177$$

$$P_4 = 1003.08$$

$$T_4 = 1333.33 \text{ K}$$

$$V_4 = 0.381$$

$$V_5 = 0 \text{ m/s}$$

$$P_6 = 48.26$$

$$T_6 = 779.76$$

$$V_6 = 4.6$$

$$V_1 = \frac{RT_1}{P_1}$$

$$= \frac{(0.2870)(260.93)}{(48.26)}$$

$$P_2 = 77.16 \text{ kPa}$$

$$T_2 = 298.37$$

$$V_2 = 1.109$$

$$V_2 = 0 \text{ m/s}$$

$$V = \frac{RT}{P}$$

$$\frac{V_1^2}{2} + h_1 = (P(T_2 - T_1))$$

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

$$T_2 = 260.93 + \frac{(274.32)^2}{2(1.005)}$$

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

$$P_2 = P_1 \left(\frac{T_2}{T_1}\right)^{\frac{k}{k-1}} = (48.26) \left(\frac{298.37}{260.93}\right)^{3.5}$$

$$V_5 = \frac{RT_5}{P_5}$$

$$\frac{T_3}{T_2} = \left(\frac{P_3}{P_2}\right)^{\frac{k-1}{k}}$$

$$T_3 = T_2 \left(\frac{P_3}{P_2}\right)^{\frac{k-1}{k}}$$

$$T_3 = (298.37) \left(\frac{1003.08}{77.16}\right)^{0.285}$$

$$V_3 = \frac{RT_3}{P_3}$$

$$V_4 = \frac{RT_4}{P_4}$$

$$V_6 = \frac{RT_6}{P_6}$$

$$T_5 = T_4 - (T_3 - T_2)$$

$$= 1333.33 - (619.76 - 298.37)$$

$$T_5 = 1012.03$$

$$P_5 = 382.14$$

$$V_5 = 0.76$$

$$V_5 = 0 \text{ m/s}$$

$$\frac{T_6}{T_5} = \left(\frac{P_6}{P_5}\right)^{\frac{k-1}{k}}$$

9-129 cont'd

a) 77.1 kPa

b) $V_{\text{exhaust}} = V_6$
Gases

$$\frac{V_5^2}{2} + h_5 = \frac{V_6^2}{2} + h_6$$

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

$$V_6 = \sqrt{C_p(T_5 - T_6)}$$

$$V_6 = \sqrt{1.005(1012.02 - 779.76)}$$

$V_6 = 15.27 \text{ m/s}$

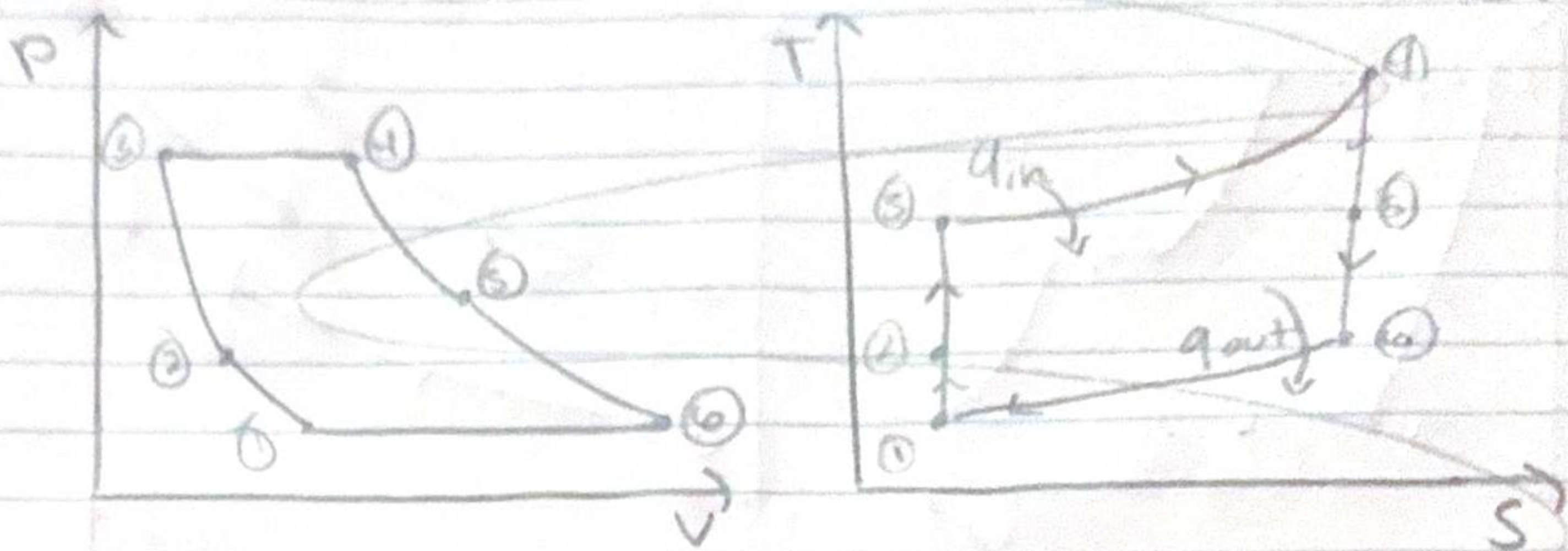
c) $\eta_p = \frac{\dot{W}_p}{\dot{Q}_{in}}$

$q = 135$ | $r_p = 9$ | $\dot{m}_{air} = 20$ | $\dot{m}_{fuel} = 0.5$ | $C_p = 1.005$

$C_v = .718$

$R = .287$

$k = 1.4$



① Isent ② Isent ③ P const ④ Isent ⑤ Isent ⑥

$P_1 = 95 \text{ kPa}$ $P_2 = 855$ $P_3 = 7695$ $P_4 =$ $P_5 =$ $P_6 = 95 \text{ kPa}$
 $T_1 = 7^\circ\text{C} \rightarrow$ $T_2 = 524.0 \text{ K}$ $T_3 = 1459$ $T_4 =$ $T_5 =$ $T_6 =$
 $= 280.15 \text{ K}$ $-$ $P_3 = 9P_2$

Table A-17

$h_1 = 280.13$ $h_2 = 525.3$ $h_3 = 1593$ $h_4 =$ $h_5 =$ $h_6 =$
 $P_{r1} = 1.0889$ $P_{r2} = 9.8$ $P_{r3} = 551$ $P_{r4} =$ $P_{r5} =$ $P_{r6} =$
 $\uparrow$ interpolate

$\frac{P_2}{P_1} = \frac{P_{r2}}{P_{r1}}$

$P_{r2} = P_{r1} \left(\frac{P_2}{P_1} \right)$
 $= 9.8$

$q_{in} = h_3 - h_2$
 $1067.5 = h_3 - 525.3$
 $h_3 = 1593$

★ Confusion when looking for Variable

$r_p = \frac{P_2}{P_1}$

$q_{in} = C_p(T_3 - T_2)$

$T_3 = \frac{q_{in}}{C_p} + T_2$

At Stage 4! Started to

$\dot{Q}_{in} = \dot{m} h + V$

$\dot{Q}_{in} = 0.5(42,700)$
 $= 21350 \text{ kW}$

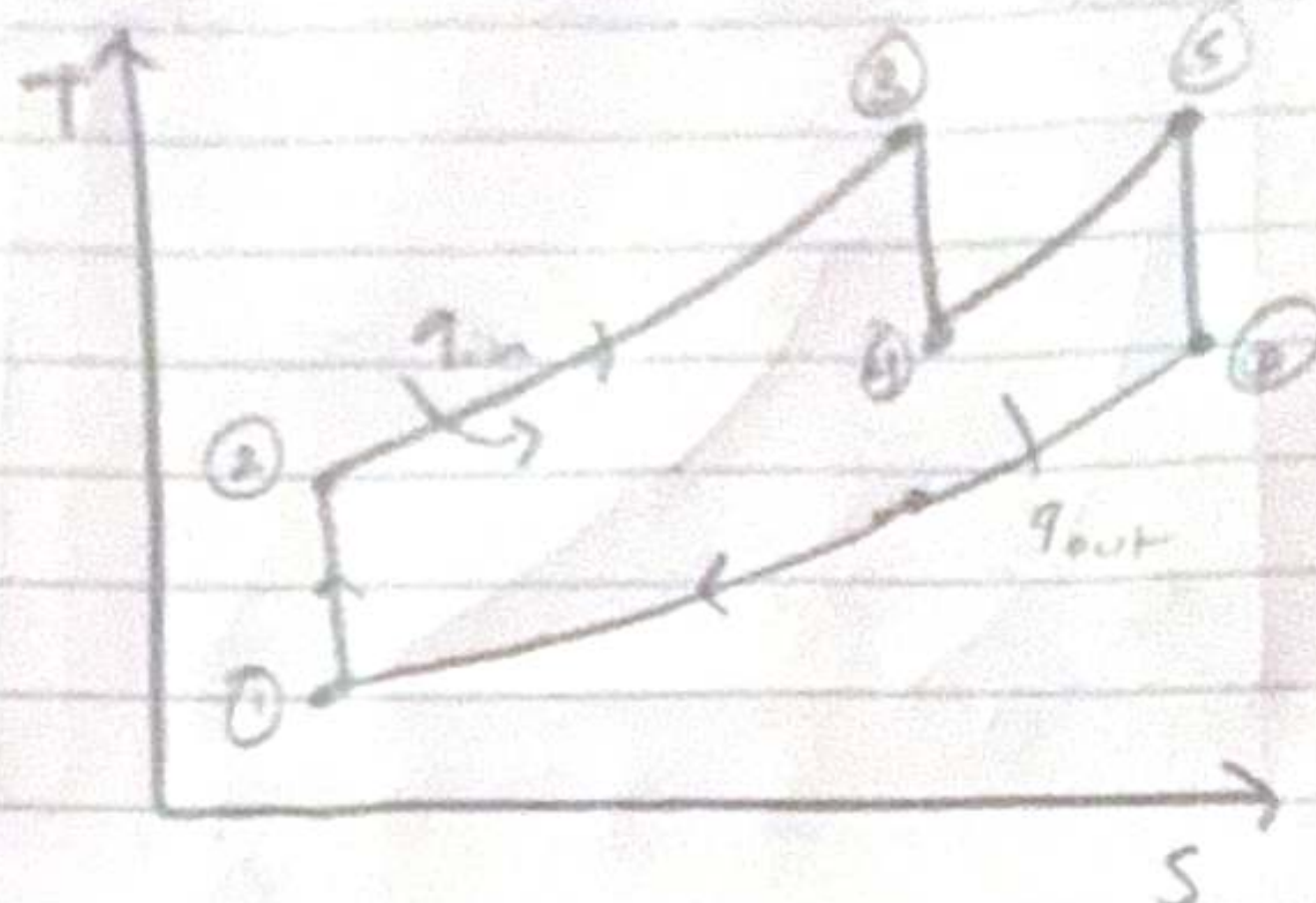
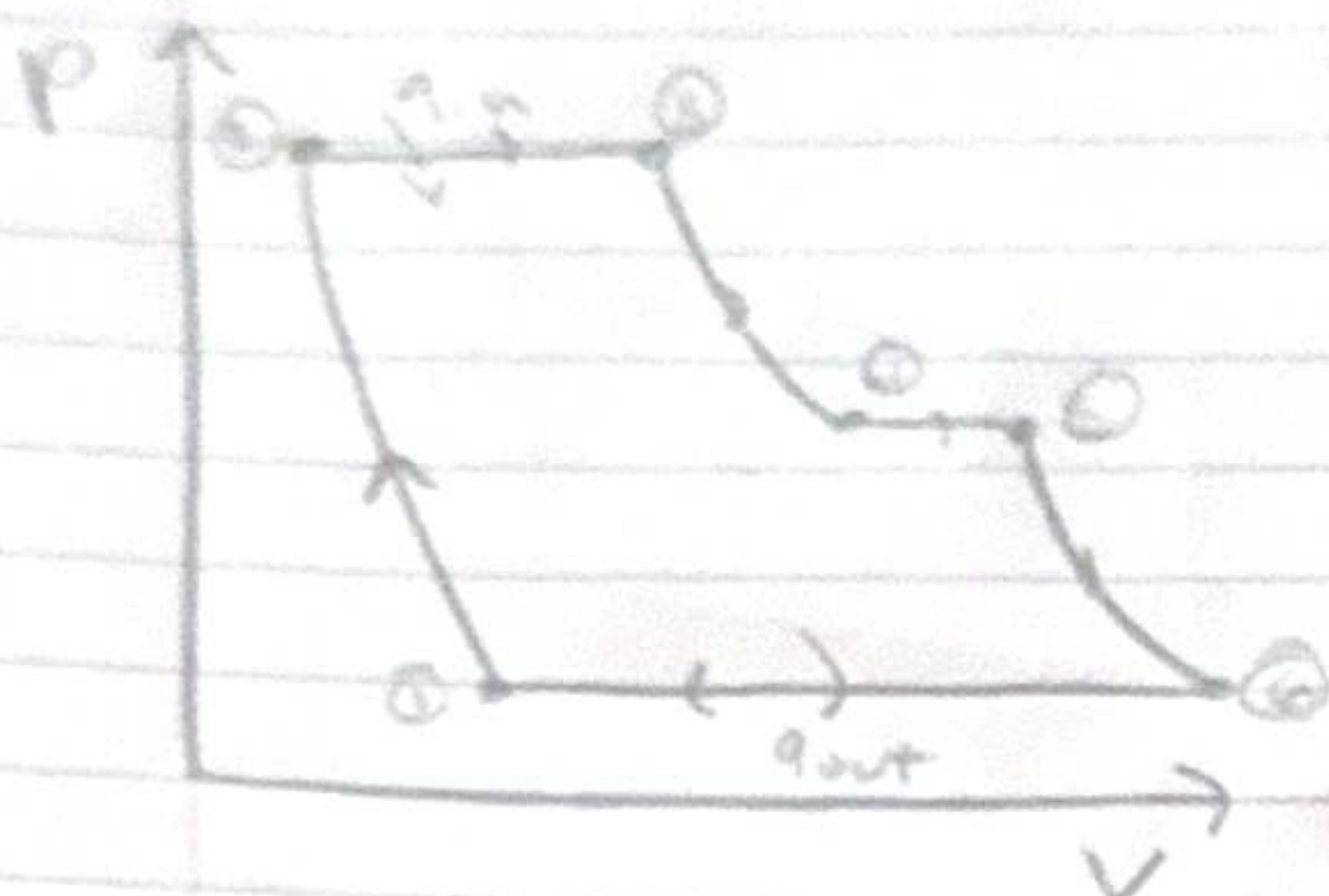
$q = \frac{P_2}{95}$

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

Overthink whether this cycle has 4 or 6 Stages ★

$q_{in} = \frac{21350}{20} \rightarrow 1067.5$

$$9-107 \quad r_c = \frac{P_2}{P_1}$$



① Isentropic ② P const ③ Isentropic ④ P const ⑤ Isentropic ⑥

P const

$$\begin{array}{llllll} P_1 = P_6 & P_2 = P_3 & P_3 = P_2 & P_4 = P_5 & P_5 = P_4 & P_6 = P_1 \\ T_1 = & T_2 = & T_3 = & T_4 = & T_5 = & T_6 = \\ V_1 = & V_2 = & V_3 = & V_4 = & V_5 = & V_6 = \end{array}$$

$$\frac{P_2}{P_1} = \frac{P_4}{P_3} \quad T_2 = T_1 \left(\frac{P_2}{P_1} \right)^{\frac{k-1}{k}} \quad T_4 = T_3 \left(\frac{P_4}{P_3} \right)^{\frac{k-1}{k}} \quad T_6 = T_5 \left(\frac{P_6}{P_5} \right)^{\frac{k-1}{k}}$$

$$V_1 = \frac{RT_1}{P_1}$$

$$V_2 = \frac{RT_2}{P_2} \quad T_3 = \quad V_4 = \frac{RT_4}{P_4}$$

$$V_6 = \frac{RT_6}{P_6}$$

$$\eta_{th} = \frac{W_{net}}{q_{in}}$$

$$V_3 = \frac{RT_3}{P_3}$$

$$T_5 = T_4 \left(\frac{P_5}{P_4} \right)^{\frac{k-1}{k}}$$

$$q_{in} = C_p (T_3 - T_2)$$

$$V_5 = \frac{RT_5}{P_5}$$

$$T_3 = \frac{q_{in}}{C_p} + T_2$$

* Not sure on what solving for?

$$q_{out} = C_p (T_6 - T_1)$$

$$\eta_{th} = 1 - \frac{T_6 - T_1}{T_3 - T_2}$$