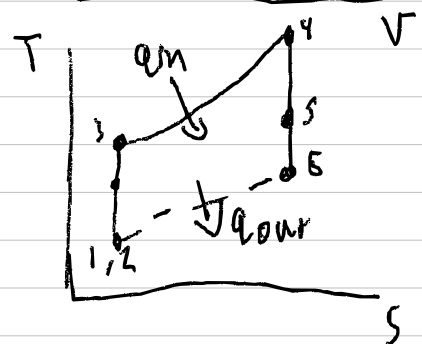
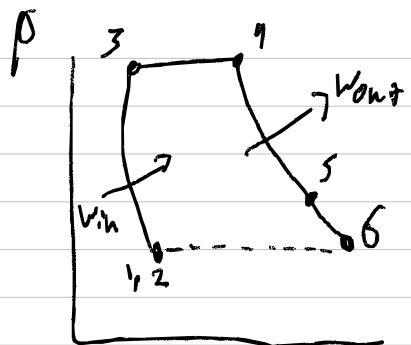


Q-135

$$\dot{m} = 20 \frac{\text{kg}}{\text{s}}$$

$$\dot{Q}_{in} = H V_f \cdot \dot{m}_f \left[\frac{\text{kJ}}{\text{s}} \right]$$

$$\dot{Q}_{in} = \dot{m}_{air} \cdot q_{in}$$



(1) 2 Isen $\rightarrow$ 3 P_{cont} $\rightarrow$ 4 Isen $\rightarrow$ 5 $\rightarrow$ 6 P_{con}

$T_1 = T^o = 280 \text{ K}$ $P_3 = 9 P_1$ $P_4 = P_3$ $P_6 = P_1$

$P_1 = 95 \text{ kPa}$

$q_{in} = \frac{H V_f \cdot \dot{m}_f}{\dot{m}_{air}}$

$\frac{T_3}{T_1} = \left(\frac{P_3}{P_1} \right)^{\frac{\gamma-1}{\gamma}}$

$q_{in} = h_4 - h_3 = c_p (T_4 - T_3)$

$W_{in} = h_3 - h_2 = c_p (T_3 - T_2)$

$W_{out} = h_4 - h_5 = c_p (T_4 - T_5)$

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

$T_5 = T_4 + T_2 - T_3$

$F = m (V_6 - V_1)$

$0 = \Delta h + \Delta \frac{V^2}{2} + \Delta \left(\frac{P}{\rho} \right)$

$c_p (T_5 - T_6) = \frac{V_6^2}{2} - \frac{V_1^2}{2}$

$V_6 = \sqrt{2 c_p (T_5 - T_6)}$

9-123

$$r_p = 3 \quad k = 1.4$$

$$T_1 = 300 \text{ K}$$

$$T_3 = 1200 \text{ K} = T$$

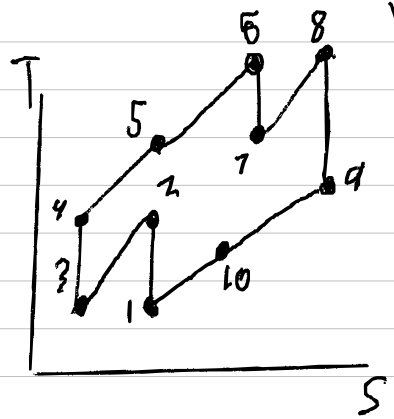
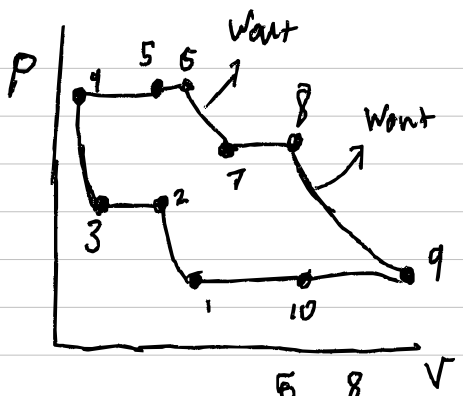
$$\frac{T_2}{T_1} = r_p^{\frac{k-1}{k}} \quad \frac{T_6}{T_5} = r_p^{\frac{k-1}{k}}$$

$$T_2 = T_1 r_p^{\frac{k-1}{k}}$$

$$T_2 = (300)(3)^{\frac{1.4-1}{1.4}} = 410.6 \text{ K}$$

$$\frac{T_4}{T_3} = r_p^{\frac{k-1}{k}} \rightarrow T_4 = T_3 r_p^{\frac{k-1}{k}} = 300(3)^{\frac{1.4-1}{1.4}}$$

$$T_4 = 410.6 \text{ K}$$



2 stages $W_c = 2 c_p (T_2 - T_1)$

$$W_c = 2 c_p (410.6 - 300)$$

$$W_c = 221.2 c_p$$

$$T_6 = \frac{1200}{(3)^{\frac{1.4-1}{1}}} = 876.7 \text{ K}$$

$$T_8 = \frac{1200}{3^{\frac{1.4-1}{1}}} = 876.7 \text{ K}$$

$$W_t = c_p ((T_5 - T_6) + (T_7 - T_8)) = c_p ((323.3) + (300))$$

$$W_t = c_p (646.6) = 646.6 c_p$$

$$BWR = \frac{W_c}{W_t} = \frac{221.2 c_p}{646.6 c_p} = \boxed{0.342}$$

$$Q_{in} = c_p ((T_5 - T_4) + (T_7 - T_6))$$

$$Q_{in} = c_p ((1200 - 410.6) + (1200 - 876.7))$$

$$Q_{in} = 1112.7 c_p$$

$$W_{net} = 646.6 c_p - 221.2 c_p = 419.4 c_p$$

$$h = \frac{419.4 c_p}{1112.7 c_p} = 0.38 \cdot 100 = \boxed{38\%}$$

Q-129

Propulsive power is the rate of work done by a propulsion system. It relates to thrust by showing how much force is pushing the aircraft

9-167

$$r = 11 \quad n = 1.3$$

$$p_1 = 100 \text{ kPa}$$

$$T_1 = 37^\circ\text{C} + 273 = 310 \text{ K}$$

$$p_3 = 8000 \text{ kPa}$$

$$R = 0.287$$

$$c_v = 0.821$$

$$T_2 = T_1 r^{n-1}$$

$$T_2 = 310 (11)^{1.3-1} = 636.47 \text{ K}$$

$$p_2 = p_1 r^n = 100 (11)^{1.3} = 2258.5 \text{ kPa}$$

$$T_3 = T_2 \frac{p_3}{p_2} = 636.47 \left(\frac{8000}{2258.5} \right)$$

$$T_3 = 2249.3 \text{ K}$$

$$T_4 = \frac{T_3}{r^{n-1}} = \frac{2249.3}{11^{1.3-1}} = 1095.5 \text{ K}$$

$$q_{in} = c_v (T_3 - T_2) = 0.821 (2249.3 - 636.47)$$

$$q_{in} = 1322.52$$

$$q_{out} = c_v (T_4 - T_1) = 0.821 (1095.5 - 310)$$

$$q_{out} = 644.9$$

$$W_{net} = q_{in} - q_{out} = 1322.52 - 644.9$$

$$W_{net} = 677.62 \frac{\text{kJ}}{\text{kg}}$$

$$\eta = \frac{W_{net}}{q_{in}} = \frac{677.62}{1322.52} = 0.51100 = 51\%$$

$$p_1 V_1 = m R T_1$$

$$V = 1.6 \text{ L} = 0.0016 \text{ m}^3$$

$$V_1 = \frac{r}{r-1} V = \frac{11}{11-1} (0.0016) = 0.00176$$

$$m = \frac{p_1 V_1}{R T_1} = \frac{(100)(0.00176)}{(0.287)(310)} = 0.002 \text{ kg}$$

$$W_{cyc.} = m W_{net}$$

$$W_{cyc.} = (0.002)(677.62) = 1.4 \text{ kJ}$$

$$MEP = \frac{W_{cyc.}}{V} = \frac{1.4}{0.0016} = 875 \text{ kPa}$$

$$\dot{W} = 50 \text{ kW}$$

$$N = \frac{\dot{W}}{W_{cyc.}} = \frac{50}{1.4} = 35.7 \text{ rev/s}$$