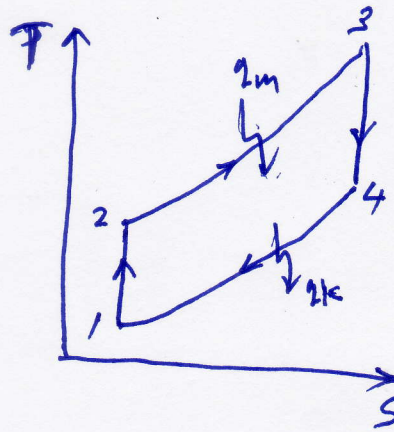
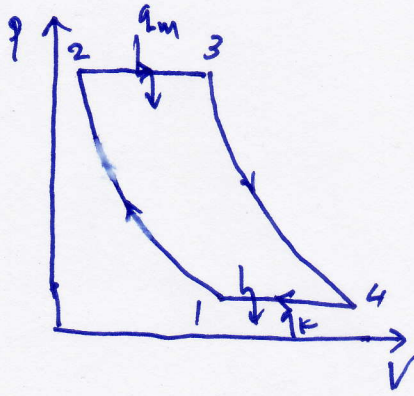


5.6



$$\text{Dik: } \gamma_p = \frac{P_2}{P_1} = \frac{P_3}{P_4} = 4,5$$

$$P_1 = 0,1 \text{ MPa} = 100 \text{ kPa}$$

$$T_1 = 30^\circ\text{C} = 303 \text{ K}$$

$$T_{\text{max}} = T_3 = 920^\circ\text{C} = 1193 \text{ K}$$

diminta: a) T, P, V setiap keadaan

b) $q_m, q_k, w_T, w_c, w_{\text{net}}$

c) η_{th}

Solusi

a)

Titik 1.

$$T_1 = 303 \text{ K}$$

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

$$v_1 = \frac{RT_1}{P_1} = 0,8696 \text{ m}^3/\text{kg}$$

1-2 isentropik

→ berlaku

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

$$0,286$$

$$\rightarrow k = \frac{5}{3}$$

Titik 2.

$$P_2 = \gamma_p P_1 = 4,5 \cdot 100 = 450 \text{ kPa}$$

$$T_2 = T_1 \cdot \gamma_p^{\frac{k-1}{k}} = 303 \cdot 4,5^{0,286} = 465,86 \text{ K}$$

$$v_2 = \frac{RT_2}{P_2} = \frac{0,287 \cdot 465,86}{450} = 0,297 \text{ m}^3/\text{kg}$$

Titik 3.

$$P_3 = P_2 = 450 \text{ kPa}$$

$$T_3 = T_{\text{max}} = 1193 \text{ K}$$

$$v_3 = \frac{RT_3}{P_3} = 0,761 \text{ m}^3/\text{kg}$$

Titik 4.

3-4 isentropik berlaku $\frac{T_3}{T_4} = r_p \left(\frac{k-1}{k}\right)$

$$P_4 = P_1 = 100 \text{ kPa}$$

$$T_4 = \frac{T_3}{r_p \left(\frac{k-1}{k}\right)} = \frac{1193}{(4,5)^{0,286}} = 775,9 \text{ K}$$

$$V_4 = \frac{RT_4}{P_4} = \frac{0,287 \cdot 775,9}{100} = 2,227 \text{ m}^3/\text{kg}.$$

$$(b) \quad w_T = C_p(T_3 - T_4) = 1,0035(1193 - 776) = 410,46 \text{ kJ/kg}$$

$$w_c = C_p(T_2 - T_1) = 1,0035(466 - 303) = 163,57 \text{ kJ/kg}$$

$$q_m = C_p(T_3 - T_2) = 1,0035(1193 - 466) = 729,54 \text{ kJ/kg}$$

$$q_k = C_p(T_4 - T_1) = 1,0035(776 - 303) = 474,66 \text{ kJ/kg}$$

$$w_{\text{net}} = q_m - q_k = 254,88 \text{ kJ/kg}$$

$$w_T - w_c = 254,88 \text{ kJ/kg}$$

$$(c) \quad \eta_{\text{th}} = \frac{w_{\text{net}}}{q_m} = 0,3493 \approx \frac{35}{100} \approx 34,93 \%$$