

SOAL 5.2

Dik. Siklus Diesel

$$r_v = 17$$

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

$$T_1 = 25 \text{ }^\circ\text{C} = 298 \text{ K}$$

$$q_m = 820 \text{ kJ/kg}$$

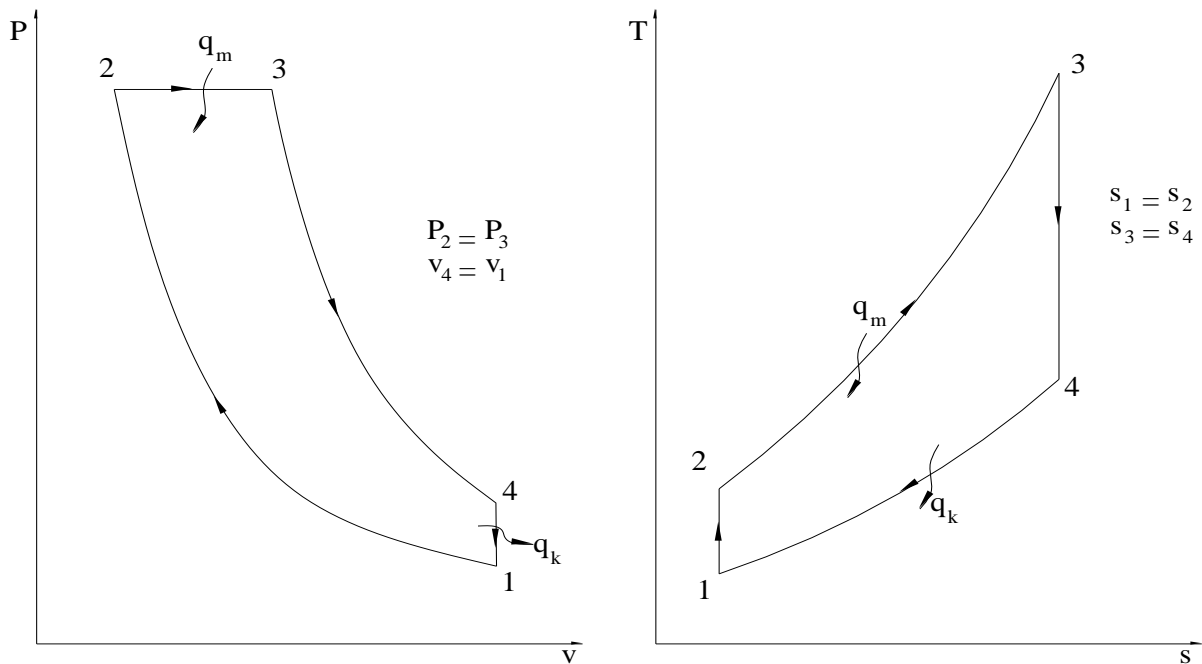
Diminta T, P, v

 η_{th}

mep

Jawab

Diagram P - v dan T - s



T, P, v pada setiap titik

Titik 1

$$v_1 = \frac{RT_1}{P_1} = \frac{0.287 \cdot 298}{100} = 0.8553 \text{ m}^3/\text{kg}$$

Titik 2

$$r_v = \frac{v_1}{v_2} \rightarrow v_2 = \frac{v_1}{r_v} = \frac{0.8553}{17} = 0.0503 \text{ m}^3/\text{kg}$$

Proses 1 - 2 Isentropik

$$\frac{T_2}{T_1} = r_v^{k-1} \rightarrow T_2 = 298 (17)^{0.4} = 925.5 \text{ K}$$

$$\frac{P_2}{P_1} = r_v^k \rightarrow P_2 = 100 (17)^{1.4} = 5279.9 \text{ kPa}$$

Titik 3

$$P_3 = P_2 = 5279.9 \text{ kPa}$$

$$q_m = C_p (T_3 - T_2)$$

$$820 = 0.7165 (T_3 - 925.5)$$

$$T_3 = \frac{820}{0.7165} + 925.5 = 2069.99 \text{ K}$$

$$v_3 = \frac{RT_3}{P_3} = \frac{0.287 \cdot 2070}{5279.9} = 0.1125 \text{ m}^3/\text{kg}$$

Titik 4

$$v_4 = v_1 = 0.8553 \text{ m}^3/\text{kg}$$

Proses 3 - 4 Isentropik

$$\frac{T_3}{T_4} = \left(\frac{v_4}{v_3} \right)^{k-1} \rightarrow T_4 = \frac{T_3}{(v_4/v_3)^{k-1}}$$

$$T_4 = \frac{2069.99}{(0.8553 / 0.113)^{0.4}} = 919.64 \text{ K}$$

$$P_4 = \frac{RT_4}{v_4} = \frac{0.287 \cdot 919.6}{0.8553} = 309 \text{ kPa}$$

$$q_k = C_v (T_4 - T_1) = 0.7165 (919.64 - 298) = 445.4 \text{ kJ/kg}$$

$$W_{\text{net}} = q_m - q_k = 820.0 - 445.4 = 375 \text{ kJ/kg}$$

* Efisiensi termal (η_{th})

$$\eta_{th} = \frac{W_{net}}{q_m} = \frac{374.6}{820.0} = 45.7 \quad \%$$

* $mep = \frac{W_{net}}{v_1 - v_2} = \frac{374.6}{0.8553 - 0.0503} = 465.36 \text{ kPa}$