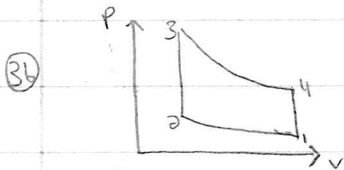


HW 1.3

33. It's the way the Combustion occurs in the engines:

Fuel-Injected - fuel's mixed w/air, Compressed by pistons & ignited by the spark plug.

Diesel - Air is Compressed first, then Fuel is injected & ignited,



$$r = \frac{V_1}{V_2}$$

$$r = \frac{V_1}{V_2} = 17.20$$

$$\boxed{r = 17.20}$$

$$T_2 = T_1 \left(\frac{V_1}{V_2} \right)^{\gamma-1}$$

$$= 565 R (17.20)^{0.4}$$

$$\boxed{T_2 = 1430.7 R}$$

$$T_4 = T_3 \left(\frac{V_3}{V_4} \right)^{\gamma-1} \Rightarrow T_4 = T_3 \left(\frac{1}{r} \right)^{\gamma-1}$$

$$T_4 = (2860 R) \left(\frac{1}{17.20} \right)^{0.4}$$

$$\boxed{T_4 = 1129.4 R}$$

$$W_{net} = (2.171 \text{ Btu/lbm} \cdot R) (2860 - 1129.4) R - (2.171 \text{ Btu/lbm} \cdot R) (1430.7 - 565) R$$

$$\boxed{W_{net} = 147.9 \text{ Btu/lbm}}$$

$$V_1 = \frac{RT_1}{P_1} = \frac{(2.3704 \text{ psia} \cdot \text{ft}^3/\text{lbm} \cdot R) (565 R)}{14 \text{ psia}}$$

$$\boxed{V_1 = 14.95 \text{ ft}^3/\text{lbm}}$$

$$m = N_{cyl} \frac{m_{B^3S/4}}{V_1} = (6) \frac{\pi (3.5/12)^3 (3.9/12)/4}{14.95}$$

$$\boxed{m = 0.008716 \text{ lbm}}$$

$$W_{net} = m w_{net}$$

$$= (0.008716) (147.9)$$

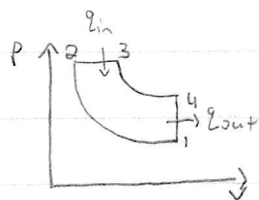
$$\boxed{W_{net} = 1.289 \text{ Btu/cycle}}$$

$$\dot{W}_{net} = \frac{W_{net} \dot{n}}{N_{rev}}$$

$$\dot{W}_{net} = \frac{(1.289) (2500)}{2} \left(\frac{1}{2.7068} \right)$$

$$\boxed{\dot{W}_{net} = 38 \text{ hp}}$$

(1b)



$$u_1 = 214.1 \text{ kJ/kg}$$

$$a) T_1 = 300 \text{ K} \Rightarrow v_{r1} = 621.2$$

$$v_{r2} = \frac{v_2}{v_1} v_{r1} \Rightarrow \frac{1}{r} v_{r1}$$

$$= \frac{1}{16} (621.2)$$

$$\underline{v_{r2} = 38.83} \Rightarrow T_2 = 862.4 \text{ K}$$

$$h_2 = 890.9 \text{ kJ/kg}$$

$$T_3 = 2T_2$$

$$= 2(862.4 \text{ K})$$

$$h_3 = 1912.6 \text{ kJ/kg}$$

$$\boxed{T_3 = 1724.8 \text{ K}} \Rightarrow v_{r3} = 4.546$$

$$b) v_{r4} = \frac{r}{2} v_{r3}$$

$$= \frac{16}{2} (4.546)$$

$$\underline{v_{r4} = 36.37} \Rightarrow u_4 = 659.7 \text{ kJ/kg}$$

$$q_{out} = u_4 - u_1$$

$$= 659.7 - 214.07 = 445.63 \text{ kJ/kg}$$

$$\eta_{th} = 1 - \frac{q_{out}}{q_{in}}$$

$$= 1 - \frac{445.63}{1019.7}$$

$$\boxed{\eta_{th} = 56.3\%}$$

$$c) w_{net,out} = q_{in} - q_{out}$$

$$= 1019.7 - 445.63$$

$$w_{net,out} = 574.07 \text{ kJ/kg}$$

$$v_1 = \frac{RT_1}{P_1} = \frac{(0.287)(300)}{95}$$

$$v_1 = 0.906 \text{ m}^3/\text{kg} \quad (v_{max})$$

$$MEP = \frac{w_{net,out}}{v_1(1 - 1/r)} = \frac{574.07}{0.906(1 - 1/16)}$$

$$\boxed{MEP = 675.9 \text{ kPa}}$$