

questions cours

ex01

(a) Eq. (2-9)

$$V_d = N_c(\pi/4)B^2S = (4 \text{ cyl})(\pi/4)(10.9 \text{ cm})^2(12.6 \text{ cm}) = \underline{4703 \text{ cm}^3 = 4.703 \text{ L}}$$

(b) Eq. (2-2)

$$\bar{U}_p = 2SN = (2 \text{ strokes/rev})(0.126 \text{ m/stroke})(2000/60 \text{ rev/sec}) = 8.40 \text{ m/sec}$$

Eq. (2-15)

$$A_p = (\pi/4)B^2N_c = (\pi/4)(0.109 \text{ m})^2(4 \text{ cyl}) = 0.0373 \text{ m}^2$$

Eq. (2-46)

$$W_b = (\text{bmep})A_p\bar{U}_p/2$$

$$88 \text{ kW} = (\text{bmep})(0.0373 \text{ m}^2)(8.40 \text{ m/sec})/2 \quad \underline{\text{bmep} = 561 \text{ kPa}}$$

or using Eq. (2-88)

$$\text{bmep} = (1000)(88)(1)/(4.703)(2000/60) = \underline{561 \text{ kPa}}$$

(c) Eq. (2-40)

$$\tau = (\text{bmep})V_d/2\pi = (561 \text{ kPa})(0.004703 \text{ m}^3)/2\pi = 0.420 \text{ kN}\cdot\text{m} = \underline{420 \text{ N}\cdot\text{m}}$$

or using Eq. (2-76)

$$\tau = (159.2)(88)/(2000/60) = \underline{420 \text{ N}\cdot\text{m}}$$

(d) for one cylinder

$$V_d = (4703 \text{ cm}^3)/4 = 1176 \text{ cm}^3$$

Eq. (2-12)

$$r_c = (V_d + V_c)/V_c = 18 = (1176 + V_c)/V_c \quad \underline{V_c = 69.2 \text{ cm}^3}$$

ex02

x

2 1

(a)(b)

using Fig. 3-2

$$\begin{array}{ll} T_1 = 100^\circ \text{ F} = 560^\circ \text{ R} & \text{given} \\ P_1 = 14.7 \text{ psia} & \text{given} \end{array}$$

Eqs. (3-4) and (3-5)

$$\begin{array}{l} T_2 = T_1(r_c)^{k-1} = (560^\circ \text{ R})(10)^{1.4-1} = 1407^\circ \text{ R} = 947^\circ \text{ F} \\ P_2 = P_1(r_c)^k = (14.7 \text{ psia})(10)^{1.4} = 369 \text{ psia} \end{array}$$

Eq. (3-12)

$$q_{in} = c_v(T_3 - T_2) = 800 \text{ BTU/lbm} = (0.216 \text{ BTU/lbm} \cdot ^\circ \text{ R})(T_3 - 1407^\circ \text{ R})$$

$$T_3 = 5110^\circ \text{ R} = 4650^\circ \text{ F}$$

at constant volume

$$P_3 = P_2(T_3/T_2) = (369 \text{ psia})(5110/1407) = 1340 \text{ psia}$$

Eqs. (3-16) and (3-17)

$$\begin{array}{l} T_4 = T_3(1/r_c)^{k-1} = (5110^\circ \text{ R})(1/10)^{1.3-1} = 2561^\circ \text{ R} = 2101^\circ \text{ F} \\ P_4 = P_3(1/r_c)^k = (1340 \text{ psia})(1/10)^{1.3} = 67.2 \text{ psia} \end{array}$$

(c)

Eq. (3-7)

$$\begin{aligned} w_{1-2} &= R(T_2 - T_1)/(1 - k) \\ &= [(0.069 \text{ BTU/lbm} \cdot ^\circ \text{ R})(1407 - 560)^\circ \text{ R}]/(1 - 1.4) = -146.1 \text{ BTU/lbm} \end{aligned}$$

Eq. (3-18)

$$\begin{aligned} w_{3-4} &= R(T_4 - T_3)/(1 - k) \\ &= [(0.069 \text{ BTU/lbm} \cdot ^\circ \text{ R})(2561 - 5110)^\circ \text{ R}]/(1 - 1.3) = +586.3 \text{ BTU/lbm} \end{aligned}$$

$$\eta_t = w_{net}/q_{in} = [(+586.3) + (-146.1)]/(800) = 0.550 = 55.0\%$$