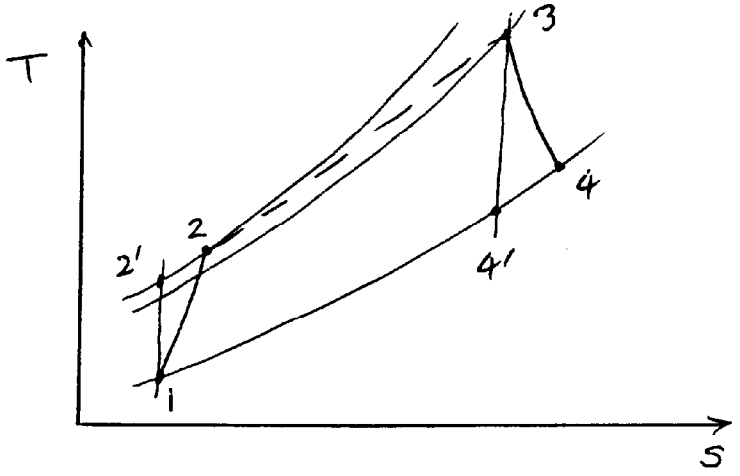
Qu.4



$$\frac{p_2}{p_1} = 4$$

$$T_1 = 17^\circ C = 290\ K$$

$$p_3 = 0.95\, p_2$$

$$\therefore \frac{p_3}{p_4} = 0.95 \times 4 = \underline{3.8}$$

$$\frac{T_{2'}}{T_1} = r_{p_c}^{\frac{\gamma-1}{\gamma}} \quad \therefore T_{2'} = 290 \times 4^{\frac{1.4-1}{1.4}} = 430.9\ K$$

$$\frac{T_{2'} - T_1}{T_2 - T_1} = 0.82 \quad \therefore \frac{430.9 - 290}{T_2 - 290} = 0.82 \quad \text{whence } \underline{T_2 = 461.9\ K}$$

$$\frac{T_3}{T_{4'}} = r_{p_T}^{\frac{\gamma_g - 1}{\gamma_g}} \quad \therefore T_{4'} = \frac{T_3}{3.8^{\frac{1.3-1}{1.3}}} = \frac{T_3}{1.361}$$

$$\frac{T_3 - T_4}{T_3 - T_{4'}} = 0.82 \quad \therefore \frac{T_3 - T_4}{T_3 - \frac{T_3}{1.361}} = 0.82$$

$$\text{or} \quad \frac{1 - \frac{T_4}{T_3}}{1 - \frac{1}{1.361}} = 0.82 \quad \text{whence } \frac{T_4}{T_3} = 0.783$$

$$(\text{or } T_4 = 0.783\, T_3)$$

$$\dot{W} = \dot{m}\left[C_{pg}(T_3 - T_4) - C_{pa}(T_2 - T_1)\right]$$

$$\therefore 40 = 0.5\left[1.15\,(T_3 - 0.783\,T_3) - 1.01\,(461.9 - 290)\right]$$

whence $\underline{\underline{T_3 = 1014\ K}}$

$$\eta_{th} = \frac{40}{\dot{m} C_{pg}(T_3 - T_2)} = \frac{40}{0.5 \times 1.15\,(1014 - 461.9)}$$

$$= 0.126$$

$$\underline{\underline{\text{or } 12.6\ \%}}$$