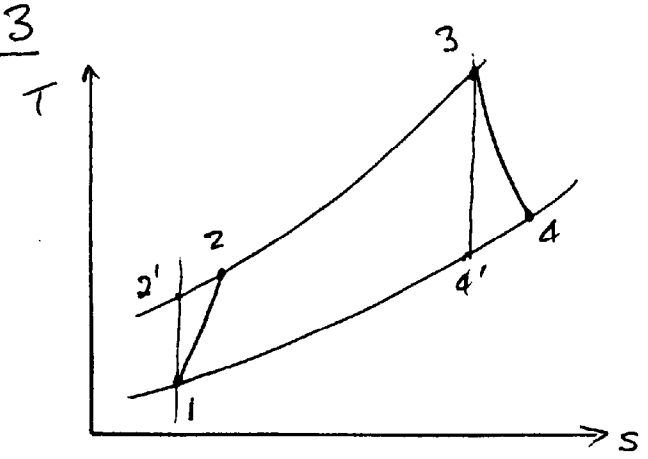
Qu.3



$T_3 = 1200\ K$

$T_1 = 290\ K$

$r_p = \frac{808}{101} = 8$

$\frac{T_{2'}}{T_1} = r_p^{\frac{\gamma-1}{\gamma}} \quad \therefore T_{2'} = 290 \times 8^{\frac{1.4-1}{1.4}} = 525.3\ K$

$\frac{T_{2'} - T_1}{T_2 - T_1} = 0.8 \quad \therefore \frac{525.3 - 290}{T_2 - 290} = 0.8$ whence $T_2 = \underline{584.2\ K}$

$\frac{T_3}{T_{4'}} = r_p^{\frac{\gamma_g - 1}{\gamma_g}} \quad \therefore T_{4'} = \frac{1200}{8^{\frac{1.3-1}{1.3}}} = 742.6\ K$

$\frac{T_3 - T_4}{T_3 - T_{4'}} = 0.84 \quad \therefore \frac{1200 - T_4}{1200 - 742.6} = 0.84$ whence $T_4 = \underline{815.8\ K}$

$$\eta_{th} = \frac{C_{pg}(T_3 - T_4) - (T_2 - T_1)C_{pa}}{C_{pg}(T_3 - T_2)} = \frac{1.15(1200 - 815.8) - (584.2 - 290)1.01}{1.15(1200 - 584.\ )}$$

i.e. $\eta_{th} = \underline{0.204}$ (or 20.4 %)

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

$$= 30\left[1.15(1200 - 815.8) - 1.01(584.2 - 290)\right]$$

$$= 4325\ kJ/s$$

or $\underline{4.325\ MW}$