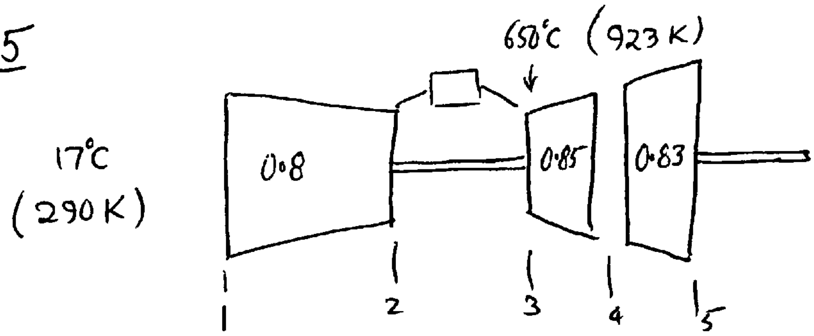
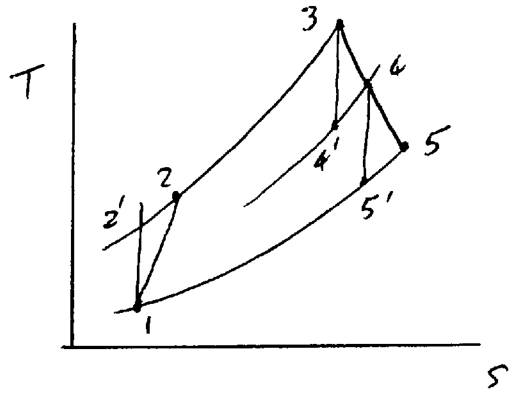
Qu.5





$$\frac{p_2}{p_1} = 8$$

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

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

Assume $\dot{W}_{HP\ Turbine} = \dot{W}_{compressor}$

$$\therefore \quad \dot{m}\, C_{pg}(T_3-T_4) = \dot{m}\, C_{pa}(T_2-T_1)$$

$$1.15\,(923-T_4) = 1.01\,(584.2-290) \quad \text{whence} \quad \underline{\underline{T_4 = 664.6\text{ K}}}$$

$$\frac{T_3-T_4}{T_3-T_{4'}} = 0.85 \qquad \frac{923-664.6}{923-T_{4'}} = 0.85 \quad \text{whence} \quad T_{4'} = \underline{619.0}\text{ K}$$

$$\frac{T_3}{T_{4'}} = r_{p_T}^{\frac{\gamma_g-1}{\gamma_g}} \quad \therefore \quad \frac{923}{619} = r_p^{\frac{1.333-1}{1.333}} \quad \text{whence} \quad r_p = 4.950$$

$$\text{i.e.} \quad \frac{p_3}{p_4} = 4.950 \quad \therefore \quad p_4 = \frac{8 \times 101}{4.950} = \underline{\underline{163.24\text{ kPa}}}$$

$$w = \frac{\dot{W}}{\dot{m}} = C_{pg}(T_4-T_5)$$

$$\frac{T_4}{T_{5'}} = \left(\frac{163.24}{101}\right)^{\frac{\gamma_g-1}{\gamma_g}} \quad \therefore \quad T_{5'} = \frac{664.6}{\left(\frac{163.24}{101}\right)^{\frac{.3}{1.3}}} = 589.5\text{ K}$$

$$\frac{T_4-T_5}{T_4-T_{5'}} = 0.83 \qquad \frac{664.6-T_5}{664.6-589.5} = 0.83 \quad \text{whence} \quad T_5 = 602.2\text{ K}$$

$$\therefore w = 1.15\,(664.6-602.2) = 71.76\text{ kJ/kg} \quad \underline{\underline{\text{or } 71.76\text{ kW/kg/s}}}$$