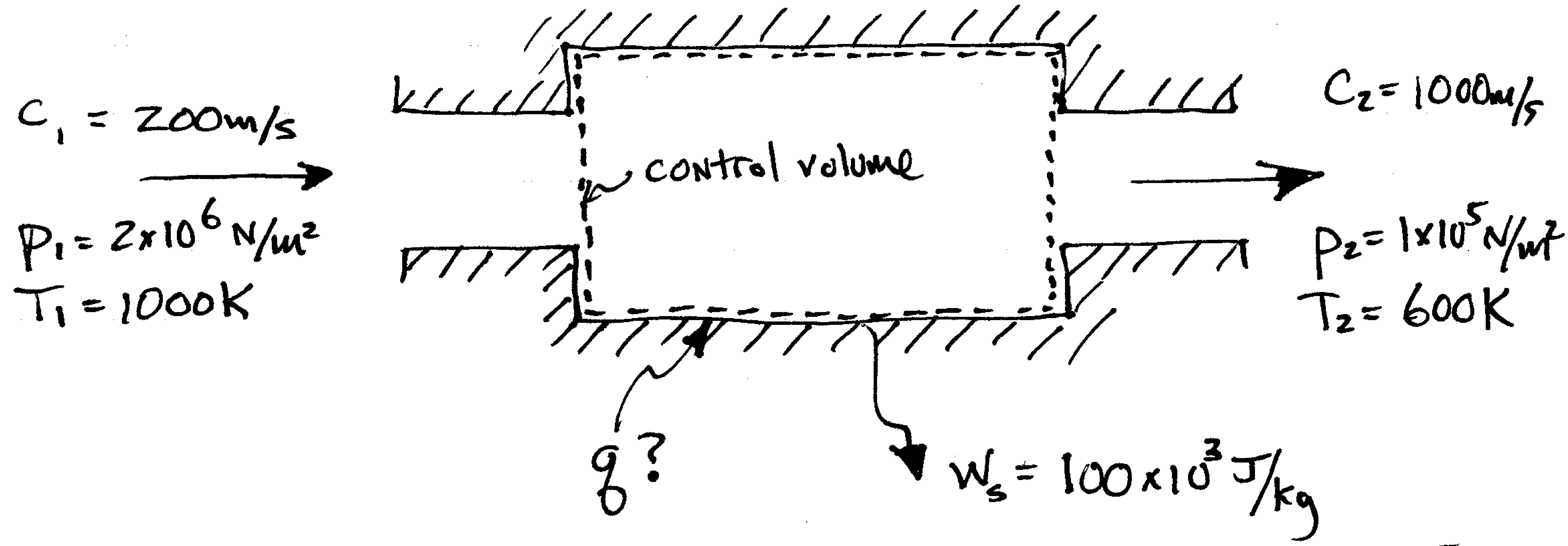
T8 SOLUTIONS BY WAITZ



$R = 287$ J/kgK , $C_p = 1003.5$ J/kgK , $C_v = 716.5$ J/kgK

a) QUANTITIES SAME AT INLET & OUTLET?

THERMODYNAMIC STATE DIFFERENT

KINETIC ENERGY DIFFERENT (WILL NEGLECT POTENTIAL ENERGY)

∴ ONLY QUANTITIES THAT ARE THE SAME → $\dot{m}_1 = \dot{m}_2$

b) CHANGE IN STAGNATION ENTHALPY INLET TO OUTLET

$$h_{T_1} = C_p T_1 + \frac{C_1^2}{2} \qquad h_{T_2} = C_p T_2 + \frac{C_2^2}{2}$$

$$= (1003.5)(1000) + \frac{(200)^2}{2} \qquad = (1003.5)(600) + \frac{1000^2}{2}$$

$$= 1.02 \text{ MJ/kg} \qquad = 1.10 \text{ MJ/kg}$$

$$\Delta h_T = 78.6 \text{ kJ/kg}$$

c) RATE OF HEAT TRANSFER

$$q - w_s = h_{T_2} - h_{T_1}$$

$$q = 78.6 \ kJ/kg + 100 \ kJ/kg$$

$$q = 178.6 \ kJ/kg$$

d) NO HEAT TRANSFER, P_2 SAME $(= 1\times10^5 N/m^2)$
WHAT ARE C_2 & T_2 ?

$$\cancel{q}^{0} - w_s = \Delta h_T \quad \therefore \Delta h_T = -100 \ kJ/kg$$

$$h_{T_1} = 1.02 \ MJ/kg \qquad \text{so} \quad h_{T_2} = 0.92 \ MJ/kg$$

$$= \left[C_p T_2 + \frac{C_2^2}{2} \right]$$

ALSO IF QUASI-STATIC

$$\frac{P_2}{P_1} = \left(\frac{T_2}{T_1}\right)^{\gamma/\gamma-1} \quad \therefore \left[T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}} \right]$$

SO $\boxed{T_2 = 425 K}$

AND

$$0.92 \ MJ/kg = 1003.5 \ J/kg\,K \cdot 425 + \frac{C_2^2}{2}$$

SO $\boxed{C_2 = 993.6 \ m/s}$