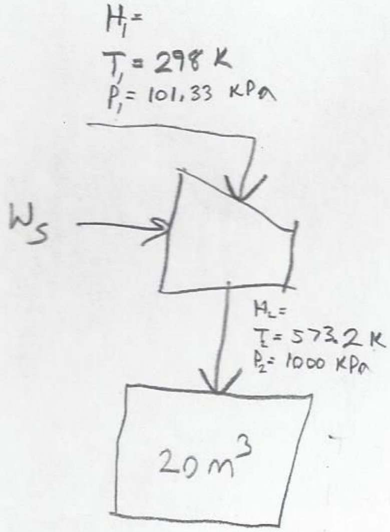
HW 5

(1)




$C_p = 7/2 R$

Adiabatic, ideal gas, isentropic

$W_s = ?$

$\dot{W}_s = \dot{m}\Delta\hat{H}$

$\hat{W}_s = \Delta\hat{H}$

$PV = nRT$

$(1000\times10^3)(20) = n(8.314)(573.2)$

$n = 4.2\times10^3$ moles

$W_{s,\,isentropic} = (\Delta H)_s$

$$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{R/C_p}$$

$$\frac{T_2}{298} = \left(\frac{1000}{101.33}\right)^{\cancel{R}/7/2\cancel{R}}$$

$T_2 = 573.2$ K

$dU = \cancel{dQ}^{\,0} + dw$

$dU = -pdV$

$H = U + PV$

$\frac{RT}{P}dP$

$dH = dU + d(PV)$

$dH = -\cancel{pdV} + \cancel{pdV} + VdP$

$d\tilde{H} = \tilde{C}_p\,dT$

$\Delta H = 20\ m^3\,(1000\ kPa - 101.33\ kPa) \times \frac{1000\ J}{1\ kPa \cdot m}$

$\Delta\tilde{H} = 7/2\left(8.314\ \frac{J}{mol\cdot K}\right)(573.2\ k - 298\ k)$

$\Delta H = 1.8\times10^7$ J

$RT \ln \frac{P_2}{P_1}$

$= 8008$ J/mol

$$\boxed{W_s = 1.8\times10^7\ J}$$