$R_s = R_u$

$P_1 V_1^n = P_2 V_2^n$

$T_1 = 10°C = 283.15K$

$P_1 = 120kPa$ $P_2 = 800kPa$

Question #3 [15 pts]

Argon gas is compressed in a polytropic process with $n = 1.20$ contained in a piston-cylinder device. The initial temperature and pressure are 10 °C and 120 kPa, respectively, and the final pressure is 800 kPa. Assume $R_s = 0.2081$ kJ/kg·K and average constant specific heats $c_v = 0.3122$ kJ/kg·K, Calculate:

a) the initial and final specific volume, in m^3/kg

$P_1V_1 = mR_sT_1$
$P_2V_2 = mR_sT_2$
$P_1V_1^n = P_2V_2^n$

$v_1 = \frac{R_sT_1}{P_1} = \frac{(0.2081)(283.15K)}{120kPa} = 0.4908 m^3/kg$ ✓

$v_2 = 0.100998 m^3/kg$ ✓

b) the final temperature, in K

$T_2 = \frac{P_2V_2}{R_s} = \frac{(800)(0.100998)}{0.2081} = 422.8K$ ✗

(-0.5)

b) the specific work required, in kJ/kg

$W_{1-2} = \int_1^2 P dV = \frac{P_2V_2 - P_1V_1}{1-n} = \frac{(800)(0.100998) - (120)(0.4908)}{1-1.2}$

$= -109.51 kJ/kg$

c) the change of specific internal energy, in kJ/kg

$\Delta U = \int_1^2 C_v dT = C_v(T_2 - T_1) = 0.3122(422.8 - 283.15)$

$= 43.6 kJ/kg$ a.k

d) The total specific heat transferred, in kJ/kg

$\Delta U = \delta Q - \delta W$ $\delta Q = \Delta U - \delta W = 43.6 - (-109.51)$

$= 153.11 kJ/kg$ ✗ (-1)

e) What will be the required specific work, in kJ/kg, if the compression of argon from 10 °C and 120 kPa to the final pressure of 800 kPa is done in an isothermal process?

$W_{1-2} = \int_1^2 P dv = P_1V_1 \ln\left(\frac{V_2}{V_1}\right) = (120)(0.4908)\ln\left(\frac{0.100998}{0.4908}\right)$

$= -93.11 kJ/kg$ ✗ (-1)

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