ME215

#4)

\[
\begin{align*}
A & \quad B \\
V_A &= V_B \\
V_{A1} &= \frac{V_A}{M_{A1}} \\
M_{A1} &= \frac{1}{2} M_{A2} + M_{B2}
\end{align*}
\]

\[P_{A1} = 50 \text{ psi} \quad T_{A1} = 700 \text{ F} \]

Mass Conservation:

Energy Conservation:

\[U_{A1} = U_2 \]

\[U_{A1} = \frac{V_A + V_B}{M_{A1}} = \frac{2V_A}{M_{A1}} = 2U_{A1} \]

Second property:

\[C_{p1} U_{A1} = (M_{A2} + M_{B2}) U_{B2} + M_{B2} \]

\[U_{A1} = U_2 \]
If ideal gas: \( \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \)

\( T_1 = T_2 \quad \Rightarrow \quad \frac{P_2}{P_1} = \frac{V_1}{V_2} = \frac{1}{2} \)

\[ h_A \approx h_B \]

Note: \( h_A \neq \) constant with time but close!

\[ h = (P_{A1}, T_{A1}) \]

So \( h_{A1} \neq h_2 \)

b) \( S_{\text{gen}} = ? \)

Entropy balance:

\[ S_2 - S_1 = \frac{\text{Qin}}{T} + S_{\text{gen}} \]

\[ S_{\text{gen}} = M_{A1} (S_2 - S_1) \]

25 psig

697.4 F
Some Excel tools to compute thermodynamic properties:
http://www.me.ua.edu/Excel "Thermodynamics" → Thermomsi

Need to be able to compute $S_2 - S_1$ for:
- Ideal gases
- Incompressible substances

Discover the "T-dS" relationships

Consider a closed system undergoing a reversible process:

\[ Q_{1-2} + U_1 = U_2 + W_{1-2} \]

or in a differential form:
\[ dQ = dU + dW \]

For a reversible process
\[ dS = \frac{dQ}{T} \] \text{rev}

Simple compressible system
\[ \Delta W = PDV \]
So...

\[ TdS = dU + PdV \]

or

\[ TdS = dU + PdV \]

**Thermodynamic Identity**

Recall

\[ h = u + pV \]

\[ dh = d(u + pV) = du + d(pV) = du + Vdp + pdV \]

\[ du + pdV = dh - Vdp \]

So

\[ TdS = dh - Vdp \]

**Thermodynamic Identity**

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Use these to figure out how to compute \( S_2 - S_1 \) for an ideal gas

1. \[ du = \frac{C_v}{T} \text{ d}T \text{ Ideal gas} \]
2. \[ pV = RT \text{ or } p = \frac{RT}{V} \text{ Ideal gas} \]

\[ TdS = C_v \text{ d}T + \frac{RT}{V} \text{ d}V \]

\[ ds = C_v \frac{dT}{T} + R \frac{dV}{V} \]