

PeGn624 Homework # 18

- Assigned: Wednesday, March 25, 2009
- Due: Thursday, April 2, 2009 in class

1 Numerical Values

Calculate the numerical values of the matrix equations at the initial conditions for the project.

The primary variables are P_o , S_o , T . When $T < T_s$, $S_g = 0$ and T_s is used as the fourth primary variable. When $T \geq T_s$, S_g is used as the fourth primary variable.

1.1 Part (a): Initial Form, $T < T_s$

Calculate the numerical values for A_{11} , A_{12} , R_{11} , R_{12} , R_{13} , R_{14} , and R_{15} defined in Eq. 1.1. Use the initial conditions of $P_o = 500\text{psia}$ and $T_R = 100^\circ\text{F}$.

$$\begin{array}{c}
 \begin{array}{c}
 \overbrace{\begin{array}{|c|c|c|} \hline W & X & 0 & 0 & 0 & 0 \\ \hline O & X & 0 & 0 & 0 & 0 \\ \hline E & X & X & 0 & 0 & 0 \\ \hline G & 0 & 0 & 0 & 0 & 0 \\ \hline \end{array}}^{\text{A}_{11}=\text{LHS}} \times \begin{array}{|c|} \hline \delta \\ \hline \delta P_o \\ \hline \delta T \\ \hline \delta S_o \\ \hline \delta T_s \\ \hline \end{array} - \begin{array}{|c|c|c|} \hline W & X & X & 0 & 0 & 0 & 0 \\ \hline O & X & X & 0 & 0 & 0 & 0 \\ \hline E & X & X & 0 & 0 & 0 & 0 \\ \hline G & X & 0 & X & X & 0 & 0 \\ \hline \end{array} \times \begin{array}{|c|} \hline \delta \\ \hline \delta P_o \\ \hline \delta T \\ \hline \delta S_o \\ \hline \delta T_s \\ \hline \end{array} = \begin{array}{|c|c|c|} \hline W & 0 & 0 & 0 & 0 & X & X & X & 0 \\ \hline O & 0 & 0 & 0 & 0 & 0 & 0 & X & X \\ \hline E & 0 & 0 & 0 & 0 & 0 & 0 & X & X \\ \hline G & 0 & 0 & 0 & 0 & 0 & 0 & X & 0 & X & X \\ \hline \end{array} \\
 \end{array} \\
 \begin{array}{c}
 R_{11}=LHS_{P_c} \quad R_{12}=LHS_D \quad R_{13}=LHS_{\text{other}} \quad R_{14}=RHS^n \quad R_{15}=RHS^\ell \\
 \begin{array}{|c|} \hline X \\ \hline X \\ \hline X \\ \hline 0 \\ \hline \end{array} + \begin{array}{|c|} \hline X \\ \hline X \\ \hline X \\ \hline 0 \\ \hline \end{array} + \begin{array}{|c|} \hline X \\ \hline X \\ \hline X \\ \hline X \\ \hline 0 \\ \hline \end{array} + \begin{array}{|c|} \hline X \\ \hline X \\ \hline X \\ \hline 0 \\ \hline \end{array} + \begin{array}{|c|} \hline X \\ \hline \end{array} \quad (1.1)
 \end{array}
 \end{array}$$

1.2 Part (b): Revised Form, $T < T_s$

Eliminate zeros in A_{12} and adjust all terms in the appropriate rows. Calculate the numerical values for A_{31} , and R_{31} defined in Eq. 1.2. The X^* represents adjusted values based on eliminating zeros. The 0^* represents the values which have been eliminated. Use the initial conditions of $P_o = 500\text{psia}$ and $T_R = 100^\circ\text{F}$.

$$\begin{array}{c}
 \overbrace{\begin{array}{l|llll|llll|llll}
 & & & & & A_{31} & & & \\
 \hline
 W: & X^* & X^* & 0^* & 0 & X^* & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 O: & X^* & X^* & 0^* & 0 & X^* & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 E: & X & X & X & 0 & X & X & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 G: & X & 0 & X & X & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
 \end{array}}^{\delta} & \times & \overbrace{\begin{array}{l|ll}
 R_{31} & X^* \\
 \hline
 \delta P_o & X^* \\
 \delta T & X^* \\
 \delta S_o & X \\
 \delta T_s & X
 \end{array}}^{\delta} & = & \overbrace{\begin{array}{l|ll}
 & X^* \\
 \hline
 \delta P_o & X^* \\
 \delta T & X^* \\
 \delta S_o & X \\
 \delta T_s & X
 \end{array}}^{\delta} & (1.2) \\
 \hline
 W: & X^* & 0 & 0 & 0 & X^* & X^* & 0^* & 0 & X^* & 0 & 0 & 0 & 0 \\
 O: & X^* & 0 & 0 & 0 & X^* & X^* & 0^* & 0 & X^* & 0 & 0 & 0 & 0 \\
 E: & X & X & 0 & 0 & X & X & X & 0 & X & X & 0 & 0 & 0 \\
 G: & 0 & 0 & 0 & 0 & X & 0 & X & X & 0 & 0 & 0 & 0 & 0
 \end{array}}^{\delta} & \times & \overbrace{\begin{array}{l|ll}
 & X^* \\
 \hline
 \delta P_o & X^* \\
 \delta T & X^* \\
 \delta S_o & X \\
 \delta T_s & X
 \end{array}}^{\delta} & = & \overbrace{\begin{array}{l|ll}
 & X^* \\
 \hline
 \delta P_o & X^* \\
 \delta T & X^* \\
 \delta S_o & X \\
 \delta T_s & X
 \end{array}}^{\delta} & (1.2) \\
 \hline
 W: & 0 & 0 & 0 & 0 & X^* & 0 & 0 & 0 & X^* & X^* & 0^* & 0 & 0 \\
 O: & 0 & 0 & 0 & 0 & X^* & 0 & 0 & 0 & X^* & X^* & 0^* & 0 & 0 \\
 E: & 0 & 0 & 0 & 0 & X & X & 0 & 0 & X & X & X & 0 & 0 \\
 G: & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & X & 0 & X & X & 0
 \end{array}}^{\delta} & \times & \overbrace{\begin{array}{l|ll}
 & X^* \\
 \hline
 \delta P_o & X^* \\
 \delta T & X^* \\
 \delta S_o & X \\
 \delta T_s & X
 \end{array}}^{\delta} & = & \overbrace{\begin{array}{l|ll}
 & X^* \\
 \hline
 \delta P_o & X^* \\
 \delta T & X^* \\
 \delta S_o & X \\
 \delta T_s & X
 \end{array}}^{\delta} & (1.2)
 \end{array}$$

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1.3 Part (c): Extract Temperature and Pressure, $T < T_s$

Extract the pressure and temperatures from A_{41} . Calculate the numerical values for A_{41} , and R_{41} defined in Eq. 1.3. Use the initial conditions of $P_o = 500\text{psia}$ and $T_R = 100^\circ\text{F}$.

$$\begin{array}{c}
 \overbrace{\begin{array}{l|ll|ll}
 & & A_{41} & & \\
 \hline
 X & X & X & 0 & 0 & 0 \\
 X & X & X & 0 & 0 & 0
 \end{array}}^{\delta} & \times & \overbrace{\begin{array}{l|ll}
 R_{41} & X \\
 \hline
 \delta P_o & X \\
 \delta T & X
 \end{array}}^{\delta} & = & \overbrace{\begin{array}{l|ll}
 & X \\
 \hline
 \delta P_o & X \\
 \delta T & X
 \end{array}}^{\delta} & (1.3) \\
 \hline
 X & 0 & X & X & X & 0 \\
 X & 0 & X & X & X & 0 \\
 \hline
 0 & 0 & X & 0 & X & X \\
 0 & 0 & X & 0 & X & X
 \end{array}}^{\delta} & \times & \overbrace{\begin{array}{l|ll}
 & X \\
 \hline
 \delta P_o & X \\
 \delta T & X
 \end{array}}^{\delta} & = & \overbrace{\begin{array}{l|ll}
 & X \\
 \hline
 \delta P_o & X \\
 \delta T & X
 \end{array}}^{\delta} & (1.3)$$

1.4 Part (d): Initial Form, $T \geq T_s$

Calculate the numerical values for A_{11} , A_{12} , R_{11} , R_{12} , R_{13} , R_{14} , and R_{15} defined in Eq. 1.4. Use the conditions of $P_o = 500\text{psia}$ and $T = 500^\circ F$.

$$\begin{array}{c}
 \begin{array}{c}
 \overbrace{\begin{array}{|c|c|c|} \hline W & X & 0 & 0 & 0 & 0 \\ \hline O & X & 0 & 0 & 0 & 0 \\ \hline E & X & X & 0 & 0 & 0 \\ \hline G & 0 & 0 & 0 & 0 & 0 \\ \hline \end{array}}^{\text{A}_{11}=\text{LHS}} \times \begin{array}{|c|} \hline \delta \\ \hline \delta P_o \\ \hline \delta T \\ \hline \delta S_o \\ \hline \delta S_g \\ \hline \end{array} - \begin{array}{|c|c|c|} \hline W & X & X & X & X \\ \hline O & X & X & X & 0 \\ \hline E & X & X & X & X \\ \hline G & X & X & X & X \\ \hline \end{array} \times \begin{array}{|c|c|c|} \hline W & 0 & 0 & 0 & 0 \\ \hline O & 0 & 0 & 0 & 0 \\ \hline E & 0 & 0 & 0 & 0 \\ \hline G & 0 & 0 & 0 & 0 \\ \hline \end{array} \times \begin{array}{|c|} \hline \delta \\ \hline \delta P_o \\ \hline \delta T \\ \hline \delta S_o \\ \hline \delta S_g \\ \hline \end{array} = \begin{array}{|c|c|c|} \hline W & 0 & 0 & 0 & 0 \\ \hline O & 0 & 0 & 0 & 0 \\ \hline E & 0 & 0 & 0 & 0 \\ \hline G & 0 & 0 & 0 & 0 \\ \hline \end{array} \times \begin{array}{|c|} \hline \delta \\ \hline \delta P_o \\ \hline \delta T \\ \hline \delta S_o \\ \hline \delta S_g \\ \hline \end{array} \\
 \end{array} \\
 \begin{array}{c}
 R_{11}=LHS_{P_c} \quad R_{12}=LHS_D \quad R_{13}=LHS_{\text{other}} \quad R_{14}=RHS^n \quad R_{15}=RHS^\ell \\
 \begin{array}{c}
 \begin{array}{|c|} \hline X \\ \hline X \\ \hline X \\ \hline 0 \\ \hline \end{array} + \begin{array}{|c|} \hline X \\ \hline X \\ \hline X \\ \hline 0 \\ \hline \end{array} + \begin{array}{|c|} \hline X \\ \hline X \\ \hline X \\ \hline X \\ \hline 0 \\ \hline \end{array} + \begin{array}{|c|} \hline X \\ \hline X \\ \hline X \\ \hline 0 \\ \hline \end{array} + \begin{array}{|c|} \hline X \\ \hline \end{array} \\
 \end{array} \\
 \end{array}
 \end{array}
 \end{array}
 \quad (1.4)$$

1.5 Part (e): Revised Form, $T \geq T_s$

Eliminate zeros in A_{12} and adjust all terms in the appropriate rows. Calculate the numerical values for A_{31} , and R_{31} defined in Eq. 1.5. The X^* represents adjusted values based on eliminating zeros. The 0^* represents the values which have been eliminated. Use the conditions of $P_o = 500\text{psia}$ and $T = 500^\circ\text{F}$.

$$\begin{array}{c}
 \overbrace{\begin{array}{l|llll|llll|llll}
 & & & & & A_{31} & & & \\
 \hline
 W: & X^* & X^* & 0^* & 0^* & X^* & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 O: & X^* & X^* & 0^* & 0 & X^* & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 E: & X^* & X^* & X^* & 0^* & X^* & X^* & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 G: & X & X & X & X & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
 \end{array}}^{\delta} \times \begin{array}{l|llll}
 \delta & \delta P_o & \delta T & \delta S_o & \delta S_g
 \end{array} = \begin{array}{l|llll}
 R_{31} & X^* & X^* & X^* & X
 \end{array} \\
 \hline
 W: & X^* & 0 & 0 & 0 & X^* & X^* & 0^* & 0^* & X^* & 0 & 0 & 0 & 0 \\
 O: & X^* & 0 & 0 & 0 & X^* & X^* & 0^* & 0 & X^* & 0 & 0 & 0 & 0 \\
 E: & X^* & X^* & 0 & 0 & X^* & X^* & X^* & 0^* & X^* & X^* & 0 & 0 \\
 G: & 0 & 0 & 0 & 0 & X & X & X & X & 0 & 0 & 0 & 0 & 0
 \end{array} \\
 \hline
 W: & 0 & 0 & 0 & 0 & X^* & 0 & 0 & 0 & X^* & X^* & 0^* & 0^* & \\
 O: & 0 & 0 & 0 & 0 & X^* & 0 & 0 & 0 & X^* & X^* & 0^* & 0 \\
 E: & 0 & 0 & 0 & 0 & X^* & X^* & 0 & 0 & X^* & X^* & X^* & 0^* \\
 G: & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & X & X & X & X & X
 \end{array}
 \end{array} \quad (1.5)$$

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1.6 Part (f): Extract Temperature and Pressure, $T \geq T_s$

Extract the pressure and temperatures from A_{41} . Calculate the numerical values for A_{41} , and R_{41} defined in Eq. 1.3. Use the conditions of $P_o = 500\text{psia}$ and $T = 500^\circ\text{F}$.