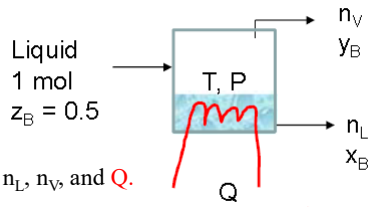
# Problem 23.2




Flash Calculation!

Given P & T, find $x_B$, $y_B$, $n_L$, $n_V$, and Q.

| | | |
|---|---|---|
| $C_6H_6(l)$ | ($T$ = 0°C, $\hat{H}$ = 0 kJ/mol) | ($T$ = 80°C, $\hat{H}$ = 10.85 kJ/mol) |
| $C_6H_6(v)$ | ($T$ = 80°C, $\hat{H}$ = 41.61 kJ/mol) | ($T$ = 120°C, $\hat{H}$ = 45.79 kJ/mol) |
| $C_7H_8(l)$ | ($T$ = 0°C, $\hat{H}$ = 0 kJ/mol) | ($T$ = 111°C, $\hat{H}$ = 18.58 kJ/mol) |
| $C_7H_8(v)$ | ($T$ = 89°C, $\hat{H}$ = 49.18 kJ/mol) | ($T$ = 111°C, $\hat{H}$ = 52.05 kJ/mol) |

Find linear correlations for $\hat{H}$

$$\hat{H} = mT + b$$

(find m & b for each species in each phase)

$$m = slope = \frac{\Delta y}{\Delta x} = \frac{\Delta \hat{H}_i}{\Delta T} = \frac{\hat{H}_{T_2} - \hat{H}_{T_1}}{T_2 - T_1}$$

$$b = \hat{H}_{T_1} - \mathrm{mT}_1$$

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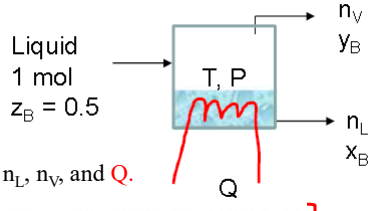


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Procedure (T&P given):
1. Use Raoult's Law to find $x_b$, $y_b$
2. Overall & species balance to find $n_V$, $n_L$
3. Energy balance $Q = \left(\sum n_i \hat{H}_i\right)_{out} - \left(\sum n_i \hat{H}_i\right)_{in}$

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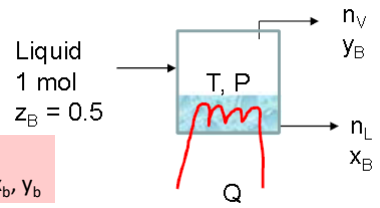


Flash Calculation!

Procedure:
1. Use Raoult's Law to find $x_b$, $y_b$

$$x_B P_B^* = y_B P_{tot}$$
$$x_T P_T^* = y_T P_{tot}$$

add

$$x_B P_B^* + (1 - x_B) P_T^* = P_{tot}$$

$$x_B (P_B^* - P_T^*) = P_{tot} - P_T^*$$

$$x_B = \frac{(P_{tot} - P_T^*)}{(P_B^* - P_T^*)} \qquad x_T = 1 - x_B$$

$$y_B = \frac{x_B P_B^*}{P_{tot}} \qquad y_T = 1 - y_B$$

2. Overall & species balance to find $n_V$, $n_L$

$$n_f = 1\ mol = n_L + n_V \qquad n_V = 1 - n_L$$

$$z_B n_f = 0.5\ mol = x_B n_L + y_B n_V$$

$$z_B n_f = 0.5\ mol = x_B n_L + y_B (1 - n_L)$$

Solve for $n_L$

$$0.5 = n_L (x_B - y_B) + y_B \qquad n_L = \frac{0.5 - y_B}{x_B - y_B}$$

3. Energy balance $Q = \left(\sum n_i \hat{H}_i\right)_{out} - \left(\sum n_i \hat{H}_i\right)_{in}$

$$Q = \left[n_V \left(y_B \hat{H}_{B,V} + y_T \hat{H}_{T,V}\right) + n_L \left(x_B \hat{H}_{B,L} + x_T \hat{H}_{T,L}\right)\right] - \left[n_F \left(z_B \hat{H}_{B,F} + z_T \hat{H}_{T,F}\right)\right]$$

$H_{vapor}$ $H_{liquid}$ $H_{feed}$(liquid)

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