Assignment 11

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

Due on 2016-10-16, 23:59 IST.

1) For Distillation - Column design, we need k factors \( k = y/x \). A liquid mixture at \( 10^0 \) C contains 30 mol % n-hexane and 70 mol % benzene. Calculate the \( k \) factors of n-hexane and benzene in this mixture. Assume that the pressure is sufficiently low to neglect gas-phase correction and Poynting factors. At \( 10^0 \) C, pure-component vapor pressures are 0.333 bar for n-hexane and 0.266 bar for benzene. The volume fractions of n-hexane is 0.309 and benzene is 0.691.

At \( 25^0 \) C, the molar volumes and solubility parameters are:

\[
\begin{align*}
\text{n-hexane} & : \nu = 141 \text{ cm}^3 \text{ mol}^{-1} \quad \delta = 3 \text{ J cm}^{-3/2} \\
\text{Benzene} & : \nu = 14.9 \text{ cm}^3 \text{ mol}^{-1} \quad \delta = 18.8 \text{ J cm}^{-3/2} \\
\end{align*}
\]

- \( k_{n-hexane} = 1.41 \) \( k_{Benzene} = 0.82 \)
- \( k_{n-hexane} = 1.81 \) \( k_{Benzene} = 2.82 \)
- \( k_{n-hexane} = 2.41 \) \( k_{Benzene} = 4.82 \)
- \( k_{n-hexane} = 2.41 \) \( k_{Benzene} = 1.66 \)

No, the answer is incorrect.
Score: 0

Accepted Answers:
- \( k_{n-hexane} = 1.41 \)
- \( k_{Benzene} = 0.82 \)

2) At \( 25^0 \) C and the vapor pressure of liquid is \( 2.0 \times 10^3 \) torr, the molar volume is \( 14.76 \text{ cm}^3 \text{ mol}^{-1} \), and its activity is defined to be unity. Assuming log \( Y \) point to be incompressible (and to remain a liquid), determine the fugacity and 1 kbar at 25 \( ^{0} \) C.

\[
\begin{align*}
\text{At} & : 1.6 \times 10^4 \text{ bar} \\
\text{At} & : 4.8 \times 10^4 \text{ bar} \\
\text{At} & : 1.6 \times 10^5 \text{ bar} \\
\text{At} & : 4.8 \times 10^5 \text{ bar} \\
\end{align*}
\]

No, the answer is incorrect.
Score: 0

Accepted Answers:
- \( 4.8 \times 10^4 \) bar

3) A binary liquid mixture contains nonpolar components 1 and 2. The mixture is to be separated by ordinary distillation. To determine if this is feasible, it is necessary to know whether the mixture has an azeotrope. At \( 30^0 \) C, the pure component vapor pressures are \( P_1 = 5.33 \) kPa and \( P_2 = 80 \) kPa. The pure - component molar volumes are both \( 190 \text{ cm}^3 \text{ mol}^{-1} \) and the solubility parameters are \( \delta_1 = 14.3 \) and \( \delta_2 = 17.4 \text{ (J cm}^{3/2}) \). At 300 K, what would be the composition of the azeotrope?

No, the answer is incorrect.
Score: 0

Accepted Answers:
- \( x_1 = 0.578 \)
- \( x_1 = 0.171 \)
- \( x_1 = 0.996 \)
- \( x_1 = 0.402 \)

4) At \( 25^0 \) C, a binary liquid mixture contains nonpolar components 1 and 2. Data for the dilute regions of this mixture indicate that \( \gamma_1 \) = 9.3 and \( \gamma_2 \) = 4.7. At \( 25^0 \) C, the correct range for the instability would be ? (Use the three-suffix two-constant Margules equation)

\[
\begin{align*}
0.382 < x_1 < 0.621 \\
0.112 < x_1 < 0.211 \\
0.382 < x_1 < 0.796 \\
0.392 < x_2 < 0.995 \\
\end{align*}
\]

No, the answer is incorrect.
Score: 0

Accepted Answers:
- \( 0.262 < x_1 < 0.621 \)

5) At \( 380 \) K, an equimolar liquid mixture of A and B has a total pressure of \( 5.887 \) bar. Fluids A and B are simple nonpolar liquids having similar molar volumes. Pure-component vapor pressures (in bar) are \( P_1^\text{v} = 0.426 \) and \( P_2^\text{v} = 0.453 \). If the equimolar mixture is cooled, why is it impossible to have a local pressure equal to the ideal liquid phase results? Give an estimate of the upper critical solution temperature where partial miscibility begins. (Since the two fluids are similar in size, simple and nonpolar, assume that \( \gamma_7 \)'s are given by two-suffix Margules equations).

\[
\begin{align*}
T_1 = 582 \text{ K} \\
T_2 = 282 \text{ K} \\
T_1 = 458 \text{ K} \\
T_2 = 1143 \text{ K} \\
\end{align*}
\]

No, the answer is incorrect.
Score: 0

Accepted Answers:
- \( T = 282 \text{ K} \)

6) For an extraction separation of hexane and hexene, which of the following should be the characteristic of the solvent?  

- Strongly hydrogen-bonded liquids (e.g. water and most alcohols) would be poor solvents. 
- Strongly hydrogen-bonded liquids would be good solvents. 
- A weak Lewis acid would be a good solvent. 
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
- Strongly hydrogen-bonded liquids (e.g. water and most alcohols) would be poor solvents.