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CX	.el	CISE II	· · · · · · · · · · · · · · · · · · ·	
1.	Ra	aoult's law		
Part I –	- Raoult	t's Law		
a) Give	e the equa	tion for Raoult's law and def	fine the symbols.	
b) What	at are the i	major assumptions of Raoult	i's law?	
• • •	a)	Raoult's Law	$y_i P = X_i P_i^{SAV}$	
	•	· · · · · ·		
		$-y_i + s_i \pi$	a mole fraction of components in the vapor	
	•	- X ₁ is fl	re mole fraction of component i in the liquid	
		-Pisth	e pressure of the system	
	٠	- Pisht is	the varies pressure of pure component i	
• • •				
	b)	Major assum	$\gamma = 10$ m s. $\gamma = 1$ m s $\gamma $	
	•		- Ideal gas	
			- dec mixture	
	•			
	•		low to moderate pressure	
			-molecules are not too different in size and have the same	
	•		Chemical nature.	
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Part II – Dewpoint and Bubblepoint Calculations with Raoult's Law	•	•	•		• •	•	•	•	•		٠	•	•	٠	•	٠	•
Consider the binary system consisting of methanol (species 1) and methyl acetate (species 2). The vapor pressures for the pure species are given by	•	•	•	•	• •	•	*	•		•	•	•	•	•	•	•	•
$\ln P_1^{\rm sat} / [\rm kPa] = 16.59158 - \frac{3643.31}{T/[\rm K] - 33.424} \tag{1}$	*	٠	•	•	• •	•	•	•	•		٠	٠	•	٠	•	٠	•
$\ln P_2^{\text{sat}} / [\text{kPa}] = 14.25326 - \frac{2665.54}{T/[\text{K}] - 53.424} $ (2)	٠	٠		•	•		•	•		٠		٠	٠	٠	•	•	٠
In this problem you will generate a Pxy -diagram for the binary system based on Raoult's law.	٠	٠	•	•	•	•	•	•	•	•		٠	٠	٠	٠	•	٠
a) Based on Raoult's law, derive the equation for bubblepoint.	•	*	*	•	• •	•	•	•	•	•	•	•	٠	•	•	٠	•
b) Based on Raoult's law, derive the equation for dewpoint.	٠	٠		•	•		•	•	•	٠		٠	•		•	•	
c) Plot the <i>Pxy</i> -diagram in Python for a temperature of 45 C°. That is, plot <i>P</i> vs. x_1 (bubblepoint) and <i>P</i> vs. y_1 (dewpoint line) in the same graph.	•	•	•	•	• •	•	•	•	•	•	•	•	•	•	•	•	•
d) Raoult's law can be modified with the activity coefficient γ_i , and thus take into account liquid-phase deviations from ideal solution behavior. This produces a more broadly applicable description of VLE- behavior. The modified Raoult's law is given by:	•	•	•	•	• •	•	•	•	•	•	•	•	•	•	•	•	•
$y_i P = x_i \gamma_i P_i^{\text{sat}} \tag{3}$	٠	٠		•	• •	•	•	•	•	٠	٠	٠	٠	*	•	۰	•
For the methanol (1) and methyl acetate (2) mixture, a correction for the activity coefficients is given by	•	•	•	•	• •	•	•	•	•	•	•	•	•	•	•	•	•
$\ln \gamma_1 = A x_2^2, \ln \gamma_2 = A x_1^2, A = 2.771 - 0.00523 T[K] $ (4)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	
Daving the hubbleneist and damaging equations based on the modified Decult's law	•	٠	•	•	• •	•	•	•	•	•	•	•	٠	•	•	٠	•
between the bubblepoint and dewpoint equations based on the modified Raoult's law.	•	٠		•	•	•	•	•	٠	٠	٠	*	٠	٠	•	٠	•
 f) The modified Raoult's law provies an azeotrone for the chemical system. What does the azeotrone imply? 		•	•	•		•	•	•	•	•			•	•	•	•	٠
 a) Give the definition of the relative volutivity, our What value does our take at the exactrone and what 	•	•	•	•	•	•	•	•	•	•		•		•		•	•
g) Give the definition of the relative volativity, α_{12} , what value does α_{12} take at the absorption and what impact does this has on a separation process such as distillation?	٠	٠	•	•	•	•	•	•	•	•	٠	٠	•	•		•	
		٠	•	•	•	•		•		•			٠				
	<u>Т</u> .	٠	•	•	•	•	•	•		•			•	*			
a) for the system we have: y, P=X, P, "	. v							•									
· · · · · · · · · · · · · · · · · · ·	1 [°]	•			• •											•	
$y_a P = \chi_a P_a^2$	567	•			• •		•										
		•															
(Ising that y, + y, =), and reformulating Race	ıllis	law,	Ne	get	;	•	•	•		•	•	•	•	•	•	•	•
Using that $y_1 + y_2 = 1$, and reformulating Race	ul)'s	low,	we	geb	:	•	•	•	•	•	•	•	•	•	÷	•	•
Using that $y_1 + y_2 = 1$, and reformulating Race $x_1 P_1^{\text{set}}$	1113 x. DS	law, ei	Ne	geb		•	•	•	•	•	•	•	•	•	•	•	•
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{X_1 P_1}{P}$, $y_2 = \frac{Y_1 P_2}{P}$	1113 X <u>2 P2</u> 5 Þ	law, ei	Ne	geb	• •	•	•	•	•	•	•	•	•	•	•	•	•
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{x_1 P_1}{P}$, $y_2 = \frac{y_1}{P}$	1113 X <u>2 P2</u> 5 P	law, at	n Ne	geb	• • •	•	•	•	•	•	•	•	•	•	•	•	•
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{X_1 P_1}{P}$, $y_2 = \frac{Y_1}{P}$	1113 X <u>2 P2</u> 5 P	law, at	Ne	geb	• • •	•	•	• • • •	•	•	•	•	•	•	•	•	• • • •
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{x_1 P_1 \text{ set}}{P}$, $y_2 = \frac{y_1}{P}$	μ]}'s × <u>2 P2</u> 5 ₽	low, ct	n Ne Ne	geb	· · ·	•	•	•	•	•	•	•	•	•	•	•	• • • • •
Using that $y_1 + y_2 = 1$, and reformulating have $y_1 = \frac{X_1 P_1}{P}$, $y_2 = \frac{Y_1}{P}$, $y_2 = \frac{Y_1}{P}$	1173 X <u>2 P2</u> 5 P	low, ct	.he	get	· · ·		•		•	•	•	· · ·	•	•	•	•	• • • • •
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{x_1 P_1}{P}$, $y_2 = \frac{y_1}{P}$, $y_2 = \frac{y_1}{P}$, $y_2 = \frac{y_1}{P}$, $y_2 = 1$	x <u>2</u> P2 ⁵ P	low, <u>e1</u>	he	ged	· · ·	•	•	•	• • • • • •		•	•	•	•	•		• • • • • • •
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{x_1 P_1}{P}$, $y_2 = \frac{y_1}{P}$ $y_1 + y_2 = 1$ $\frac{x_1 P_1 + y_2}{P} + \frac{x_2 P_2 + y_2}{P}$	x <u>2 P</u> 5 P	low, at	. he	ged /.P			• • • • • •	•	• • • • • • •	• • • • • • • •	• • • • • • •	• • • • • • •	• • • • • • • •			•	• • • • • •
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{x_1 p_1 \text{ set}}{p}$, $y_2 = \frac{y_1}{p}$ $y_1 + y_2 = 1$ $\frac{x_1 p_1 \text{ set}}{p}$, $\frac{x_2 p_2 \text{ set}}{p}$	x <u>2</u> P2 ⁵ P	low, ct		geb /.P		•	• • • • • • •		• • • • • • • •		• • • • • • • •	• • • • • • • •				• • • • • • • •	• • • • • • • •
Using that $y_1 + y_2 = 1$, and reformulating have $y_1 = \frac{x_1 P_1}{P}, y_2 = 1$ $y_1 + y_2 = 1$ $\frac{x_1 P_2 = 1}{P}, \frac{x_2 P_2 = 1}{P}$ $P = x P_2 = 1$	xz Pz ^c P	low, et	. he	geb /.P		•	• • • • • • • • •		• • • • • • • • • •								
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{x_1 P_1 \text{ set}}{P}$, $y_2 = 2$ $y_1 + y_2 = 1$ $\frac{x_1 P_1 \text{ set}}{P} + \frac{x_2 P_2 \text{ set}}{P}$ $\frac{P = x_1 P_1 \text{ set}}{P} + \frac{x_2 P_2 \text{ set}}{P}$	x <u>z</u> <u>P</u> <u>s</u> P	law, at }	ne	geb /.P	int int	•	• • • • • • • • • •	•					• • • • • • • • • •				
Using that $y_1 + y_2 = 1$, and reformulating have $y_1 = \frac{x_1 P_1}{P}, y_2 = 1$ $y_1 + y_2 = 1$ $\frac{x_1 P_1 + y_2}{P} + \frac{x_2 P_2 + x_2}{P}$ $\frac{P}{P} + \frac{x_2 P_2 + x_2}{P}$	x <u>z P</u> 2 ⁶ P	law, <u> </u>	ne	ged /.P	int				• • • • • • • • • • •								
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Using that $y_1 + y_2 = 1$, and reformulating have $y_1 = \frac{x_1 P_1^{sol}}{P}, y_2 = 2$ $y_1 + y_2 = 1$ $\frac{x_1 P_1^{sol}}{P} + \frac{x_2 P_2^{sol}}{P}$ $\frac{P = x_1 P_1^{sol} + x_2 P_2}{P}$ b) Similarly to a):	x <u>z P</u> 2 ⁶ P	law, <u> </u>	.he	ged /.P	int			• • • • • • • • • • • •									
Using that $y_1 + y_2 = 1$, and reformulating have $y_1 = \frac{X_1 P_1^{\text{sort}}}{P}, y_2 = 2$ $y_1 + y_2 = 1$ $\frac{X_1 P_1^{\text{sort}}}{P} + \frac{X_2 P_2^{\text{sort}}}{P}$ $\frac{P = X_1 P_1^{\text{sort}} + X_2 P_2}{P}$ b) Similarily to a): $X_1 = -\frac{y_1 P_1}{P_1^{\text{sort}}}, X_2 = -\frac{y_2 P_2}{P_2^{\text{sort}}}$	x <u>z Pz</u> P	law, al } B	.ve	ged /.P		•			• • • • • • • • • • • • • • •								
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{x_1 p_1^{set}}{p}$, $y_2 = \frac{y_1}{p}$ $\frac{y_1 + y_2 = 1}{p}$ $\frac{x_1 p_1^{set}}{p} + \frac{x_2 p_2^{set}}{p}$ $\frac{p = x_1 p_1^{set} + x_2 p_3}{p}$ b) Similarily to a): $x_1 = \frac{y_1 p_3}{p_1^{set}}$, $x_2 = \frac{y_1 p_3}{p_2^{set}}$	504	law, <u> </u>	. he	ged /.P	int												
Using that $y_1 + y_2 = 1$, and reformulating Read $y_1 = \frac{x_1 p_1^{set}}{p}$, $y_2 = 2$ $y_1 + y_2 = 1$ $\frac{x_1 p_1^{set}}{p} + \frac{x_2 p_2^{set}}{p}$ $\frac{p = x_1 p_1^{set} + x_2 p_2}{p}$ b) Similarily to a): $x_1 = \frac{y_1 p_1^{set}}{p_1^{set}}$, $x_2 = \frac{y_2 p_2^{set}}{p_2^{set}}$	x <u>z Pz</u> P	law, al	. Ne	ged /.P	int				• • • • • • • • • • • • • • • •								
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Using that $y_1 + y_2 = 1$, and reformulating Raa $y_1 = \frac{X_1 P_1^{5n+1}}{P}$, $y_2 = \frac{Y_1}{P}$ $\frac{Y_1 + Y_2 = 1}{Y_1 + Y_2 = 1}$ $\frac{X_1 P_1^{5n+1}}{P} + \frac{X_2 P_2^{5n+1}}{P}$ $\frac{P = X_1 P_2^{5n+1} + X_2 P_2}{P}$ b) Similarily to a): $X_1 = -\frac{y_1 P_1}{P_1^{5n+1}}$, $X_2 = -\frac{y_2 P_2}{P_2^{5n+1}}$ $X_1 + X_2 = 1$	$\frac{1}{2}$	law, al	. Ne	geb /.P	int												
Using that $y_1 + y_2 = 1$, and reformulating Race $y_1 = \frac{x_1 P_1^{soft}}{P}$, $y_2 = \frac{y_1}{P}$ $\frac{y_1 + y_2 = 1}{P}$ $\frac{x_1 P_1^{soft}}{P} + \frac{x_2 P_2^{soft}}{P}$ $\frac{P = x_1 P_1^{soft} + x_2 P_1}{P}$ b) Similarily to a): $x_1 = \frac{y_1 P_1}{P_1^{soft}}$, $x_2 = \frac{y_2 P_1}{P_2^{soft}}$ $x_1 + x_2 = 1$ $\frac{y_1 P_1 + y_2 P_2}{P} = 1$	504	law, st	. he	ged /.P	int												
Using that $y_1 + y_2 = 1$, and reformulating Real $y_1 = \frac{x_1 p_1^{set}}{p}$, $y_2 = 2$ $y_1 + y_2 = 1$ $\frac{x_1 p_1^{set}}{p} + \frac{x_2 p_2^{set}}{p}$ $\frac{p = x_1 p_2^{set} + x_2 p_1}{p}$ b) Similarily to a): $x_1 = \frac{y_1 p_1}{p_2^{set}}$, $x_2 = \frac{y_2 p_2}{p_2^{set}}$ $x_1 + x_2 = 1$ $\frac{y_1 p_1}{p_1^{set}} + \frac{y_2 p_2}{p_2^{set}} = 1$	$\frac{1}{2}$	law, s1 } B	Ne	geb /.P	int												
Using that $y_1 + y_2 = 1$, and reformulating head $y_1 = \frac{x_1 p_1^{set}}{p}, y_2 = 2$ $y_1 + y_2 = 1$ $\frac{x_1 p_1^{set}}{p}, \frac{x_2 p_2^{set}}{p}$ $\frac{p = x_1 p_1^{set}}{p}, \frac{x_2 p_2^{set}}{p}$ $\frac{p = x_1 p_1^{set}}{p}, x_2 = \frac{y_1 p_2}{p_2^{set}}$ $x_1 = \frac{y_1 p_2}{p_2^{set}}, x_2 = \frac{y_2 p_2}{p_2^{set}}$ $x_1 + x_2 = 1$ $\frac{y_1 p_2}{p_2^{set}} + \frac{y_2 p_2}{p_2^{set}} = 1$ $\frac{y_1 p_2}{p_2^{set}} + \frac{y_2 p_2}{p_2^{set}} = 1$	504	law, <u> </u>	.he	ged	int												
Using that $y_1 + y_2 = 1$, and reformulating have $y_1 = \frac{x_1 P_1 set}{P}, y_2 = 2$ $y_1 + y_2 = 1$ $\frac{x_1 P_1 set}{P}, + \frac{x_2 P_2 set}{P}$ $\frac{P = x_1 P_1 set}{P}, + \frac{x_2 P_2 set}{P}$ $\frac{P = x_1 P_1 set}{P}, + \frac{y_2 P_2 set}{P}$ $X_1 = \frac{y_1 P_1}{P_1 set}, X_2 = \frac{y_2 P_1}{P_2 set}$ $X_1 + X_2 = 1$ $\frac{y_1 P_1}{P_1 set} + \frac{y_2 P_2}{P_2 set} = 1$ $P(\frac{y_1}{P_1 set} + \frac{y_2}{P_2 set}) = 1$	$\frac{1}{2}$	law, st	. Ne	ged /.P													

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V = Unit Dev point	
$\frac{1^{1}/p_{1}^{sk1}}{1^{1}} + \frac{1^{1}/p_{2}^{sk1}}{1^{1}}$	
(\mathcal{C})	
Pxy-diagram using Raolt's law	
60	
₹ 55	
0.0 0.2 0.4 0.6 0.8 1.0 x1. y1	
$\Lambda \to \nabla$	
d) tollowing the same approach as a) and b)	
Γ	
for the system we have: y, r=X, j, r,	
$y_2 P = \chi_2 \chi_2 P_2^{SPT}$	
$\cdots \cdots $	
Ising that y, + yo = 1, and reformulating Reputt's law	, we get :
	· · · · · · · · · · · · · · · · · · ·
x x P set	
$y_1 = \frac{x_1}{D} \qquad y_2 = \frac{x_2}{D}$	
$y_1 + y_2 = 1 + \cdots + y_n + y_n = 1 + \cdots + y_n + $	
$\frac{X_1 X_1 P_2}{X_2 Y_2 P_2} = 1$	· / p · · · · · · · · · · · · ·
$\frac{P = X_1 \gamma_1 P_2^{Sat} + X_2 \gamma_2 P_2^{Sat}}{2}$	Modified bubble point
Similarly I have a here a here	
cimilarity to due point:	
y,P y_P	
$\chi_1 = \frac{\chi_1 P_1 Sa^1}{\chi_1 P_1 Sa^1}$, $\chi_2 = \frac{\chi_2 P_2 Sa^1}{\chi_2 P_2 Sa^1}$	
· · · · · · · · · · · · · · · · · · ·	
$X_{i} + X_{k} = 1$	
$\frac{y_1P}{y_2P} = 1$	
$\tilde{\mathcal{W}}_{1}^{p_{0}}$	
(1) (1)	
$P\left(\frac{1}{10}\right)^{-1} + \frac{1}{10}\left(\frac{1}{10}\right)^{-1}$	

 $P = \frac{y_1}{\frac{y_1}{y_1 P_1 \text{ sol}}}$ e) Pxy-diagram using modified Raolt's law Dewpoint line
 Bubblepoint lin P [kPa] 09 An azestrope implies a mixture where the vapor and liquid phases have the same composition. On the graph, this is where the dev- and bulblepoint lines intersect. 9) Relative volatility: $\alpha_{12} = \frac{k_1}{k_2}$ $\Rightarrow \chi_{12} = \frac{y_{1/X_1}}{y_{2/X_2}}$ k-value: $k_i = \frac{y_i}{x_i}$ For an azertrope, $y_1 = X_1$ and $y_2 = X_2 \implies X_{12} = \frac{1}{1} =$ This means that both components are equally volatile (likely to be in the gas phase), meaning that it is impossible to separate the components from each other using distillation. Part III - Calculations with Raoult's Law 1. Use Raoult's law and calculate P and y_i for $T = 45C^{\circ}$ and $x_1 = 0.25$. Compare the result with the modified Raoult's law and provide the error in %. 2. Use Raoult's law and calculate P and x_i for $T = 45C^{\circ}$ and $y_1 = 0.60$. Compare the results with the modified Raoult's law. Hint: An iterative solution approach is needed for the modified Raoult's law. the bubble point line, and then inserting into racults law gives: 1. Calculating P from Modified: $y_1 = \frac{X_1 Y_1 P_1^{sat}}{P}$ $y_1 = \frac{X_1 Y_1}{P}$ Result:

•			• • • • • •	•		Part For y1 = For y1 = P = The Erro Erro	: III Raou : 0.1 60.3 modi : 0.2 73.5 errc r ir ir ir ir	Jlt's 1844 5588 ified 2822 5003 ors a n y1 n P =	: law kPa l Rad kPa = 34 : 17.	v: 4.672 879%	s la % % kPa	- 	• • • • • • •	· · · · · · · · · ·	· · ·	•	•	•	•	· · ·		· · ·	•		• • • • • • • •	• • • • • • • •	•	•		•	•	•	· · ·	•	•
•	2)	.)	ter	-b-li	ing	۰ 5	o - ↓	hct	, [.] -{	h	to		pr	e <i>ss</i> i	Иre	, P	- 	18 <i>1</i> 77	the	<u> </u>	noli	hied	 	2cov	ψs	lan	; fo	r :	eacl	n (ö)	npolv	ent	•	•
•	•	•		مرور	erp	ρισχ	(imo	dely	e	ynal.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	÷	•	•	•	•	•	•	•	•	•	•
•	•	•	•	Part	: II	I.2	:	1.000				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
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•	•	•	•	P = For	51.	089 11fi	3 k ed	Pa Raoi	·1+1	s 1	aw.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•
				x1 =	: 0.	816	9	nuot	,	5 0	an.										•							•	•					•	
•	٠			P =	62.	894	5 k	Pa				•	•		•	•		•	•	•	•		•	•		•	•		•	•	•	•	•	•	•
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2. Flash calculation using Raoult's law

Let F denote the moles of feed sent into a separator where a flash process takes place. A liquid at a pressure equal to or greater than its bubblepoint pressure flashes or partially evaporates when the pressure is reduced below its bubblepoint pressure. Let L denote the moles of liquid and V the moles of vapor resulting from the flash process.





Consider a non-reacting system with the following overall mole balance

$$F = V + L = 1$$

The material balance is



. .. .



The saturation pressure of the pure components can be computed from

$$P_i^{\text{sat}} = P_c \times 10^{[7/3(1+\omega)(1-1/T_r)]}$$
(5)

The system is at constant temperature of 60°C. The compressed liquid is brought to a pressure of 0.1 MPa where the flash process takes place. What are the liquid and vapor compositions after the flash separation? Furthermore, what is the vapor-over-feed ratio, VOF=V/F?

We will use a nested function which allows us to share variables with the parent function. The parent function will call *fsolve* to solve the non-linear, or iteration, problem. A guess VOF=0.5 is provided to *fsolve* to initiate the iteration process. See the following incomplete code.

We need to complete the nested function *calcobj* in the above Python code.

In the incomplete Python, determine obj which fsolve must minimize (i.e. obj should approach zero) at convergence.

The correct implementation should result in VOF=0.28, $x_1 = 0.37$ and $y_1 = 0.81$.

Increase the flash-pressure from 0.1 MPa to 0.2 MPa. Run the Python code and analyze the results.

Increase the flash-pressure to 0.25 MPa, run the Python code and analyze the results.

Explain why your results are not reasonable.

(1)

(2)

species by	i. The	composition in each phase is constrained by $\sum_i x_i = 1$ and $\sum_i y_i = 1$. The K-factor is given																	
.,		$K_i = y_i / x_i \tag{3}$	•		•	•	•	•	•	•	•	•	•	•		•	•	•	•
In terms	s of Rad	bult's law, $y_i P = x_i P_i^{\rm sat}$, the K-factor can be written as	•	٠	٠	٠	٠	٠	٠	٠	٠	•	•	•	•	•		•	٠
		$K_i = P_i^{\rm sat} / P \tag{4}$	•				·	•		•		•	٠	٠			•	•	•
We will Python	perform with the	m a flash calculation based on Raoult's law in this exercise. The calculation will be done using e SciPy library and its function <i>fsolve</i> .	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Let's co $z_2 = 0.$	onsider a	a binary mixture of pentane (comp.1) and heptane (comp.2). The overall composition is z_1 = critical properties and acentric factor of the components are:		٠	•	٠	٠	٠	٠		•	•		٠	٠	•		•	•
•	•	Rearranging (1) gives: $L = F - V = 1 - V$ (VOF	bern		, ()	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•			العين	V./	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	Combining with (2) to eliminate L:	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•
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٠	٠	$\mathcal{Z}_{i} = X_{i} ((-V) + y_{i})$	٠		•	٠	•	٠	•	•	•	•				٠	٠	•	٠
٠	٠	$\mathcal{Z}_{i} = X_{i} + (y_{i} - X_{i}) \vee (b)$	۰		٠	٠	•	٠	•	٠	•	•	٠	٠		•	٠	٠	•
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•																			
•	٠	Flimingding X: with the K-fector: K:= # =>>	Χ:=	y:			•	•	•	•	•	•	•	•	•	•	٠		
•	•	Eliminating X_i with the K-fector: $K_i = \frac{y_i}{x_i} \Rightarrow x_i$	χ; ⁻	yi Ki		•	•	•	•	•	0	•	•	•	•	•	•	•	
•	•	Eliminating X: with the K-fector: $K_i = \frac{y_i}{x_i} \Rightarrow x_i$ Using Rooutts law: $y_i P = x_i P_i^{sot} \Rightarrow \frac{y_i}{x_i} = \frac{P_i^{sot}}{P_i} = k$	X;;⁼ <;:	柴 (4)		e Ce	an C	alcul	late	Ki	Keji		(5)	QS .	bhe f)re.55(ure i's	knov	VИ
•	•	Eliminating X. with the K-fector: $K_i = \frac{y_i}{x_i} \Rightarrow x$ Using Robult's law: $y_i P = x_i P_i^{sat} \Rightarrow \frac{y_i}{x_i} = \frac{P_i^{sat}}{P} = k$	Xi= ⟨i	光 (4)	, .₩	e C	an C	alcul	late	Ki	usi	ng ((5)	Qs ·	bhe f)+C.56(une i's	knov	vn
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• • • • • • • • • • • • • • •		Ediminating X: with the K-fector: $K_i = \frac{y_i}{x_i} \Rightarrow N$ Using Rooutt's law: $y_i P = x_i P_i^{sort} \Rightarrow \frac{y_i}{x_i} = \frac{P_i^{sort}}{P} = k$ Inserting the K-factor into (6) eliminates X: $Z_i = \frac{y_i}{K_i} + (y_i - \frac{1}{K_i})V$ $K_i Z_i = y_i (1 + K_i V - V)$ $y_i = \frac{K_i Z_i}{1 + (K_i - 1)V}$ (7) Finally, using that $\sum y_i = 1 \Rightarrow \sum y_i - 1 = 0$ $Oloj = \frac{K_i Z_i}{1 + (K_i - 1)V} + \frac{K_z Z_z}{1 + (K_z - 1)V} - 1 = 0$ (8)	x;⁼ <;), {	光 (4)	, W	e. Co	ân C	alcul beco	ete			· · · · · · · · · · · · · · · · · · ·			bhe f	· • • • • • •	ure is		· · · · · · · · · · · · · · · · · · ·

Implementing (8) and (5) into the calcobj solves the problem. Flash results at T[K] = 333.15, p = 0.1 Comp. 1 = pentane, Comp. 2 = heptane These seem reasonable VOF = 0.2825149114915437 Composition in liquid: x1 = 0.3771705160004604, x2 = 0.6228294839995375 Composition in vapour: y1 = 0.8119422006207822, y2 = 0.1880577993792229 Flash results at T[K] 333.15. 10F & Almost all of the feed is unporized => We are close to the daw-point line Comp. 1 = pentane, Comp. 2 = heptane VOF = 0.999999999999957 Composition in liquid: x1 = 0.4645287752158828, x2 = 3.3119045636792346 Composition in vapour: y1 = 0.500000000000001, y2 = 0.499999999999878 Flash results at T[K] = 333.15, p = 0.25 Comp. 1 = pentane, Comp. 2 = heptane VOF = 4.168076039642018 Composition in liquid: x1 = 1.1876404459783716, x2 = -0.18764044597837162 Composition in vapour: y1 = 1.0226625426392015, y2 = -0.022662542639201536 Here VOF>1 => We are producing more vapor than the feed into the system, which is impossible We also have X1, y1 >1 and X2, y2 <0 which is not possible Looking at the result from p=0,2, we are outside the two-phase region, Which means that phase separation is impossible, and most of the equations used in the calculations are wrong, which is the reason for the error.