Unit 13 - Week 11: Vapour - Liquid - Liquid Equilibria of Multicomponent Non-Ideal Systems

Assessment 11

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

Due on 2020-04-15, 23:59 IST.

1) Consider a case where one vapor and two liquid phases (α and β) coexisting and at equilibrium. The vapor phase is ideal whereas the liquid phase nonideal behaviour is represented by two-suffix Margules equation. Then what is corresponding phase equilibrium equation for component "a" of the binary mixture consisting of components "a" and "b". *6 points*

- $y_aP = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_aP = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$
- $y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$y_aP = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$

2) Consider a case where one vapor and two liquid phases coexisting and at equilibrium. The vapor phase nonideal behaviour is represented by van der Waals equation whereas the liquid phase nonideal behaviour is represented by two-suffix Margules equation. Then what is corresponding phase equilibrium equation for component "a" of the binary mixture consisting of components "a" and "b". *6 points*

- $y_aP = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_aP = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$
- $y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$

3) Consider a case where one vapor and two liquid phases coexisting and at equilibrium. The vapor phase is ideal whereas the liquid phase nonideal behaviour is represented by van Laar equation. Then what is corresponding phase equilibrium equation for component "a" of the binary mixture consisting of components "a" and "b". *6 points*

- $y_aP = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_aP = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$
- $y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$y_aP = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$

4) Consider a case where one vapor and two liquid phases coexisting and at equilibrium. The vapor phase nonideal behaviour represented by van der Waals equation whereas the liquid phase nonideal behaviour is represented by van Laar equation. Then what is corresponding phase equilibrium equation for component "a" of the binary mixture consisting of components "a" and "b". *6 points*

- $y_aP = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_aP = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$
- $y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$

No, the answer is incorrect.
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Accepted Answers:
$y_a\left[exp\left\{\left(b_1-\frac{a_1}{RT}\right)\frac{P}{RT}\right\}\left\{exp(\sqrt{a_1}-\sqrt{a_2})^2\cdot\frac{y_2^2P}{(RT)^2}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$

5) Consider a case where one vapor and two liquid phases coexisting and at equilibrium. The vapor phase nonideal behaviour represented by virial equation whereas the liquid phase nonideal behaviour is represented by two suffix equation. Then what is corresponding phase equilibrium equation for component "a" of the binary mixture consisting of components "a" and "b". *6 points*

- $y_aP = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_aP = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}$
- $y_a\left[exp\left\{\frac{2}{v}(y_aB_{aa}+y_bB_{ab})+\frac{3}{2v^2}(y_a^2C_{aaa}+2y_ay_bC_{aab}+y_b^2C_{abb})-lnz_{mixt}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
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$y_a\left[exp\left\{\frac{2}{v}(y_aB_{aa}+y_bB_{ab})+\frac{3}{2v^2}(y_a^2C_{aaa}+2y_ay_bC_{aab}+y_b^2C_{abb})-lnz_{mixt}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$

6) Consider a case where one vapor and two liquid phases coexisting and at equilibrium. The vapor phase nonideal behaviour represented by virial equation whereas the liquid phase nonideal behaviour is represented by van Laar equation. Then what is corresponding phase equilibrium equation for component "a" of the binary mixture consisting of components "a" and "b". *6 points*

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- $y_aP = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}$
- $y_a\left[exp\left\{\frac{2}{v}(y_aB_{aa}+y_bB_{ab})+\frac{3}{2v^2}(y_a^2C_{aaa}+2y_ay_bC_{aab}+y_b^2C_{abb})-lnz_{mixt}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A}{RT}(x_b^\alpha)^2\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A}{RT}\left(x_b^\beta\right)^2\right\}P_a^{sat}$
- $y_a\left[exp\left\{\frac{2}{v}(y_aB_{aa}+y_bB_{ab})+\frac{3}{2v^2}(y_a^2C_{aaa}+2y_ay_bC_{aab}+y_b^2C_{abb})-lnz_{mixt}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$

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$y_a\left[exp\left\{\frac{2}{v}(y_aB_{aa}+y_bB_{ab})+\frac{3}{2v^2}(y_a^2C_{aaa}+2y_ay_bC_{aab}+y_b^2C_{abb})-lnz_{mixt}\right\}\right]P = x_a^\alpha \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\alpha}{B'x_b^\alpha}\right]^2\right)}\right\}P_a^{sat} = x_a^\beta \exp\left\{\frac{A'}{\left(\left[1+\frac{A'x_a^\beta}{B'x_b^\beta}\right]^2\right)}\right\}P_a^{sat}$