Unit 8 - Week 6: Gaseous Mixtures and Fugacity

Assessment 6

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

Due on 2020-03-11, 23:59 IST.

1) Assume that species 1 and 2; and their mixture can be described by the equation of state: *10 points*

$P = \frac{RT}{v} - \frac{a}{\sqrt{v^3 T}}$. The constant "a" for the mixture can be appropriately described by mixing rule: $a = a_1 y_1 + a_2 y_2$ where a_1 and a_2 are constants of this equation of state for pure species 1 and 2 respectively. What is the fugacity of component "1" of the mixture, f_1 = ?

- $f_1 = \frac{RTy_2}{v} exp\left\{\frac{2}{R\sqrt{vT^3}}[a_1 + 0.5a]\right\}$
- $f_1 = \frac{RTy_1}{v} exp\left\{\frac{2}{R\sqrt{vT^3}}[a_1 + 0.5a]\right\}$
- $f_1 = \frac{RTy_2}{v} exp\left\{-\frac{2}{R\sqrt{vT^3}}[a_1 + 0.5a]\right\}$
- $f_1 = \frac{RTy_1}{v} exp\left\{-\frac{2}{R\sqrt{vT^3}}[a_1 + 0.5a]\right\}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$f_1 = \frac{RTy_1}{v} exp\left\{-\frac{2}{R\sqrt{vT^3}}[a_1 + 0.5a]\right\}$

2) Assume that pure species 1 and 2; and their mixture can be described by *10 points*

$P = \frac{RT}{v} - \frac{a}{\sqrt{v^3 T}}$. If the constants a_1 and a_2 of pure species are 800 $Jm^{1.5}K^{0.5}/mol^{1.5}$ and 500 $Jm^{1.5}K^{0.5}/mol^{1.5}$ respectively, then what is the fugacity coefficient of this vapour mixture of 1 mole of species 1 and 2 moles of species 2 occupying 6 L at 500K? Assume mixing law for "a" of the mixture as:
$a = a_1 y_1 + a_2 y_2$

- 0.689
- 0.986
- 0.869
- 0.439

No, the answer is incorrect.
Score: 0
Accepted Answers:
0.689

3) What is the fugacity (in bar) of a mixture of 70 mol.% of ethylene (1) and 30 mol.% of propylene (2) at 600K and 60bar assuming mixture and individual pure species obey van der Waals equation of state: $P = \frac{RT}{v-b} - \frac{a}{v^2}$. Use mixing rules $a = a_1 y_1^2 + 2\sqrt{a_1 a_2} y_1 y_2 + a_2 y_2^2$ and $b = b_1 y_1 + b_2 y_2$. Data: $a_1 = 453.046\times10^{-3}$ Pa (m^3/mol)^2 ; $b_1 = 0.057\times10^{-3}$ m^3/mol. ; $a_2 = 845.03\times10^{-3}$ Pa (m^3/mol)^2 ; $b_2 = 8.2485\times10^{-5}$ m^3/mol.; and z = 0.9476. *10 points*

- 6.819
- 98.016
- 56.801
- 40.439

No, the answer is incorrect.
Score: 0
Accepted Answers:
56.801

4) For a gaseous mixture obeying Redlich-Kwang equation of state, the fugacity coefficient of component "i" in the mixture is given by: *10 points*

$$\ln \phi_i = \left(\frac{b_i}{v-b}\right) - \ln\left(\frac{P(v-b)}{RT}\right) + \frac{ab_i}{b^2 RT^{\frac{3}{2}}}\left(\ln\left(\frac{v+b}{v}\right) - \left(\frac{b}{v+b}\right)\right) - \frac{2\sqrt{a_i}\sum_j y_j \sqrt{a_j}}{bRT^{3/2}} \ln\left(\frac{v+b}{v}\right)$$

Then what is the expression for the fugacity of the mixture.

- $f_{mixture} = \left(\frac{RT}{v+b}\right) exp\left\{\left(\frac{b}{v+b}\right) - \frac{a}{RT^{\frac{3}{2}}(v+b)} - \frac{a}{bRT^{3/2}} ln\left(\frac{v}{v+b}\right)\right\}$
- $f_{mixture} = \left(\frac{RT}{v-b}\right) exp\left\{\left(\frac{b}{v-b}\right) - \frac{a}{RT^{\frac{3}{2}}(v+b)} + \frac{a}{bRT^{3/2}} \ln\left(\frac{v}{v+b}\right)\right\}$
- $f_{mixture} = \left(\frac{RT}{v-b}\right) exp\left\{\left(\frac{b}{v-b}\right) + \frac{a}{RT^{\frac{3}{2}}(v+b)} + \frac{a}{bRT^{\frac{3}{2}}} \ln\left(\frac{v}{v+b}\right)\right\}$
- $f_{mixture} = \left(\frac{RT}{v-b}\right) exp\left\{\left(\frac{b}{v+b}\right) - \frac{a}{RT^{\frac{3}{2}}(v+b)} - \frac{a}{bRT^{3/2}} \ln\left(\frac{v}{v+b}\right)\right\}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$f_{mixture} = \left(\frac{RT}{v-b}\right) exp\left\{\left(\frac{b}{v-b}\right) - \frac{a}{RT^{\frac{3}{2}}(v+b)} + \frac{a}{bRT^{3/2}} \ln\left(\frac{v}{v+b}\right)\right\}$

5) Using the virial equation of state, calculate the fugacity (in bar) of a mixture of ethylene (1) and propylene (2) in a mixture of 70 % (by mol.) of ethylene and 30 % (by mol.) of propylene at 600K and 5 bar. Data: $B_{11} = -1.4789\times10^{-5}$ m^3/mol. ; $B_{22} = -5.9819\times10^{-5}$ m^3/mol. ; $B_{12} = -3.1078\times10^{-5}$ m^3/mol. Use mixing rules $B_{mixt} = B_{11} y_1^2 + 2y_1 y_2 B_{12} + B_{22} y_2^2$. *10 points*

- 6.495
- 1.492
- 4.987
- 0.968

No, the answer is incorrect.
Score: 0
Accepted Answers:
4.987

6) Assume a gaseous mixture and individual pure species 1 and 2 obey Berthelot equation of state *10 points*

$P = \frac{RT}{v-b} - \frac{a}{Tv^2}$ where a and b are constant of mixture. If constants of pure species a_1, b_1, a_2, b_2 are known, then what is fugacity of the mixture provided that the mixing rules used are: $a = a_1 y_1^2 + 2\sqrt{a_1 a_2} y_1 y_2 + a_2 y_2^2$ and $b = b_1 y_1 + b_2 y_2$.

- $\ln(f_{mixture}) = ln\left(\frac{v}{v-b}\right) + \left(\frac{b}{v-b}\right) - \frac{2a}{vRT^2} + \ln\left(\frac{RT}{v}\right)$
- $\ln(f_{mixture}) = ln\left(\frac{v}{v+b}\right) + \left(\frac{b}{v-b}\right) - \frac{2a}{vRT^2} - \ln\left(\frac{RT}{v}\right)$
- $\ln(f_{mixture}) = ln\left(\frac{v}{v-b}\right) + \left(\frac{b}{v+b}\right) + \frac{2a}{vRT^2} + \ln\left(\frac{RT}{v}\right)$
- $\ln(f_{mixture}) = ln\left(\frac{v}{v-b}\right) + \left(\frac{b}{v-b}\right) + \frac{2a}{vRT^2} - \ln\left(\frac{RT}{v}\right)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\ln(f_{mixture}) = ln\left(\frac{v}{v-b}\right) + \left(\frac{b}{v-b}\right) - \frac{2a}{vRT^2} + \ln\left(\frac{RT}{v}\right)$