

# Unit 4 - Week 2: Estimation of Thermodynamic Properties

## Course outline

How does an NPTEL online course work?

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

Week 12: Solid - Liquid Equilibria of Non-Ideal Systems

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## Assessment 2

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

**Due on 2020-02-12, 23:59 IST.**

1) Saturated water at 327°C has vapour pressure of 8.6 MPa and fugacity of 6.7 MPa. At such conditions, liquid has a molar volume of 25 cm<sup>3</sup>/mol and the vapour has a molar volume of 40 cm<sup>3</sup>/mol. Then what is fugacity at 10 MPa? **6 points**

- 4.36 MPa  
 8.51 MPa  
 6.75 MPa  
 9.24 MPa

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
6.75 MPa

2) The van der Waals constants for n-butane (1) and n-octane (2) are given as: a<sub>1</sub> = 1.3874 Pa (m<sup>3</sup>/mol)<sup>2</sup>, b<sub>1</sub> = 0.1163×10<sup>-3</sup> m<sup>3</sup>/mol, a<sub>2</sub> = 3.7890 Pa (m<sup>3</sup>/mol)<sup>2</sup> and b<sub>2</sub> = 0.237×10<sup>-3</sup> m<sup>3</sup>/mol. What are the van der Waals constants "a" and "b" for equimolar mixture of n-butane and n-octane? **6 points**

- a = 2.4405 Pa (m<sup>3</sup>/mol)<sup>2</sup>, b = 0.1767×10<sup>-3</sup> m<sup>3</sup>/mol  
 a = 5.4315 Pa (m<sup>3</sup>/mol)<sup>2</sup>, b = 2.1837×10<sup>-6</sup> m<sup>3</sup>/mol  
 a = 7.3985 Pa (m<sup>3</sup>/mol)<sup>2</sup>, b = 5.1315×10<sup>-4</sup> m<sup>3</sup>/mol  
 a = 6.1767 Pa (m<sup>3</sup>/mol)<sup>2</sup>, b = 3.2405×10<sup>-5</sup> m<sup>3</sup>/mol

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
a = 2.4405 Pa (m<sup>3</sup>/mol)<sup>2</sup>, b = 0.1767×10<sup>-3</sup> m<sup>3</sup>/mol

3) For a gaseous mixture, the appropriate equation of state is found to  $P = \frac{RT}{v-b} - \frac{a}{v^2}$  (i.e., van der Waals equation) where constants "a" **6 points**

and "b" are given as a = 2.4405 Pa (m<sup>3</sup>/mol)<sup>2</sup> and b = 0.1767×10<sup>-3</sup> m<sup>3</sup>/mol. What is molar volume of this mixture at P = 16 bar and T = 600K?

- 6.431×10<sup>-4</sup> m<sup>3</sup>/mol  
 2.781×10<sup>-3</sup> m<sup>3</sup>/mol  
 5.634×10<sup>-6</sup> m<sup>3</sup>/mol  
 8.529×10<sup>-9</sup> m<sup>3</sup>/mol

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
2.781×10<sup>-3</sup> m<sup>3</sup>/mol

4) For a gaseous mixture, the appropriate equation of state is found to  $P = \frac{RT}{v-b} - \frac{a}{v^2}$  (i.e., van der Waals equation) where constants "a" **6 points**

and "b" are given as: a = 2.4405 Pa (m<sup>3</sup>/mol)<sup>2</sup> and b = 0.1767×10<sup>-3</sup> m<sup>3</sup>/mol. What is the compressibility of this mixture at P = 16 bar and T = 600K?

- 0.646  
 0.563  
 0.474  
 0.892

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
0.892

5) The constants for van der Waals equation  $P = \frac{RT}{v-b} - \frac{a}{v^2}$  for n-butane (1) and n-octane (2) are given as: a<sub>1</sub> = 1.3874 Pa (m<sup>3</sup>/mol)<sup>2</sup>, b<sub>1</sub> = **6 points**

0.1163×10<sup>-3</sup> m<sup>3</sup>/mol, a<sub>2</sub> = 3.7890 Pa (m<sup>3</sup>/mol)<sup>2</sup> and b<sub>2</sub> = 0.237×10<sup>-3</sup> m<sup>3</sup>/mol. For their equimolar mixture, these constants are a = 2.4405 Pa (m<sup>3</sup>/mol)<sup>2</sup> and b = 0.1767×10<sup>-3</sup> m<sup>3</sup>/mol; and the molar volume of the mixture is 2.781×10<sup>-3</sup> m<sup>3</sup>/mol. What is the fugacity of n-butane (1) at P = 16 bar and T = 600K?

- 11.547 bar  
 7.677 bar  
 4.246 bar  
 9.782 bar

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
7.677 bar

6) The constants for van der Waals equation  $P = \frac{RT}{v-b} - \frac{a}{v^2}$  for n-butane (1) and n-octane (2) are given as: a<sub>1</sub> = 1.3874 Pa (m<sup>3</sup>/mol)<sup>2</sup>, b<sub>1</sub> = **6 points**

0.1163×10<sup>-3</sup> m<sup>3</sup>/mol, a<sub>2</sub> = 3.7890 Pa (m<sup>3</sup>/mol)<sup>2</sup> and b<sub>2</sub> = 0.237×10<sup>-3</sup> m<sup>3</sup>/mol. For their equimolar mixture, these constants are a = 2.4405 Pa (m<sup>3</sup>/mol)<sup>2</sup> and b = 0.1767×10<sup>-3</sup> m<sup>3</sup>/mol; and the molar volume of the mixture is 2.781×10<sup>-3</sup> m<sup>3</sup>/mol. What is the fugacity of n-octane (2) at P = 16 bar and T = 600K?

- 3.986 bar  
 7.624 bar  
 9.564 bar  
 6.763 bar

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
6.763 bar

7) The constants for van der Waals equation  $P = \frac{RT}{v-b} - \frac{a}{v^2}$  for n-butane (1) and n-octane (2) are given as: a<sub>1</sub> = 1.3874 Pa (m<sup>3</sup>/mol)<sup>2</sup>, b<sub>1</sub> = **6 points**

0.1163×10<sup>-3</sup> m<sup>3</sup>/mol, a<sub>2</sub> = 3.7890 Pa (m<sup>3</sup>/mol)<sup>2</sup> and b<sub>2</sub> = 0.237×10<sup>-3</sup> m<sup>3</sup>/mol. For their equimolar mixture, these constants are a = 2.4405 Pa (m<sup>3</sup>/mol)<sup>2</sup> and b = 0.1767×10<sup>-3</sup> m<sup>3</sup>/mol; and the molar volume of the mixture is 2.781×10<sup>-3</sup> m<sup>3</sup>/mol. What is the fugacity of the mixture at P = 16 bar and T = 600K?

- 14.409 bar  
 12.354 bar  
 10.526 bar  
 8.648 bar

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
14.409 bar

8) A gas mixture composing of 20% A, 35% B and 45% C on mole% basis, the fugacity co-efficient of these are 0.7, 0.6, and 0.9 respectively. What is the fugacity of the mixture at T = 398K and P = 6.08 MPa? **6 points**

- 4.52 MPa  
 6.62 MPa  
 7.96 MPa  
 2.42 MPa

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
4.52 MPa

9) Calculate fugacity of water vapour at 320°C and 70 bar using Redlich-Kwong equation of state with constants a = 14.27 Pa K<sup>1/2</sup> m<sup>6</sup>/mol<sup>2</sup> and b = **6 points**

2.11×10<sup>-5</sup> m<sup>3</sup>/mol.

- 88.45 bar  
 47.82 bar  
 60.46 bar  
 70.31 bar

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
60.46 bar

10) Calculate fugacity of compressed liquid water at 320°C and 170 bar using Redlich-Kwong equation of state with constants a = 14.27 Pa K<sup>1/2</sup> **6 points**

m<sup>6</sup>/mol<sup>2</sup> and b = 2.11×10<sup>-5</sup> m<sup>3</sup>/mol.

- 84.68 bar  
 101.29 bar  
 132.51 bar  
 74.37 bar

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
101.29 bar