

Unit 3 - Week 1: Introduction of Phase Equilibria

Course outline

How does an NPTEL online course work?

Week 0: Prerequisite

Week 1: Introduction of Phase Equilibria

● Lec 1 : Introduction of Phase Equilibrium

● Lec 2 : Classical Thermodynamics of Phase Equilibria - 1

● Lec 3 : Classical Thermodynamics of Phase Equilibria – 2

○ Quiz : Assessment 1

● Lecture Notes: Week 1

○ Weekly feedback form for week 1

● Solution: Assignment 1

Week 2: Estimation of Thermodynamic Properties

Week 3: Potential Energy Functions and Intermolecular Forces

Week 4: Molecular Theory of Corresponding States

Week 5: Intermolecular Interactions and E.o.S

Week 6: Gaseous Mixtures and Fugacity

Week 7: Liquid Mixtures and Fugacity

Week 8: Models for Activity Coefficients using Excess Gibbs Energy

Week 9: Vapour - Liquid Equilibria of Multicomponent Non-Ideal Systems

Week 10: Liquid - Liquid Equilibria of Multicomponent Non-Ideal Systems

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 1

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) For the equation of state: $Z = 1 + \frac{B}{v}$, what is coefficient of volume expansion, $\alpha_p = ?$ 5 points

$\alpha_p = \frac{B+v+T(dB/dT)}{T(2v-B)}$

$\alpha_p = \frac{B+v+T(dB/dT)}{T(v+2B)}$

$\alpha_p = \frac{B+v+T(dB/dT)}{2T(v+B)}$

None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\alpha_p = \frac{B+v+T(dB/dT)}{T(v+2B)}$$

2) For the equation of state: $Z = 1 + \frac{B}{v}$, what is the coefficient of compressibility, $k_T = ?$ 5 points

$k_T = \frac{v^2}{Pv^2+BRT}$

$k_T = \frac{v^2}{Pv^2-BRT}$

$k_T = \frac{2v^2}{Pv^2+BRT}$

None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$k_T = \frac{v^2}{Pv^2+BRT}$$

3) If coefficient of volume expansion and the coefficient of compressibility are designated as α_p and k_T respectively for a fluid, then what is $(\partial P/\partial T)_v = ?$ 5 points

$\left(\frac{\partial P}{\partial T}\right)_v = \frac{\alpha_p}{2k_T} - 1$

$\left(\frac{\partial P}{\partial T}\right)_v = \frac{\alpha_p}{k_T}$

$\left(\frac{\partial P}{\partial T}\right)_v = \frac{2\alpha_p}{k_T}$

$\left(\frac{\partial P}{\partial T}\right)_v = \frac{\alpha_p}{2k_T} + 1$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\left(\frac{\partial P}{\partial T}\right)_v = \frac{\alpha_p}{k_T}$$

4) For van der Waals equation of state $P = \frac{RT}{v-b} - \frac{a}{v^2}$, what is coefficient of volume expansion α_p ? 5 points

$\alpha_p = \frac{Rv^2}{Pv^3-2av+ab}$

$\alpha_p = \frac{Rv^2}{Pv^3+av-2ab}$

$\alpha_p = \frac{2Rv^2}{Pv^3-av+ab}$

$\alpha_p = \frac{Rv^2}{Pv^3-av+2ab}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\alpha_p = \frac{Rv^2}{Pv^3-av+2ab}$$

5) For van der Waals equation of state: $P = \frac{RT}{v-b} - \frac{a}{v^2}$, what is coefficient of compressibility, $k_T = ?$ 5 points

$k_T = \frac{v^2(v-b)}{Pv^3-av+2ab}$

$k_T = \frac{v^2(v-b)}{Pv^3-2av+ab}$

$k_T = \frac{2v^2(v-b)}{Pv^3+av+2ab}$

$k_T = \frac{v^2(v-b)}{Pv^3-av+ab}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$k_T = \frac{v^2(v-b)}{Pv^3-av+2ab}$$

6) A liquid is compressed from its vapor pressure of 0.381 MPa to 1.2 MPa at T=270 K. 5 points

For saturated liquid at 270 K, $v^2=1.55 \times 10^{-3} \text{ m}^3/\text{kg}$ and $\alpha_p=2.095 \times 10^{-3} \text{ K}^{-1}$ (coefficient of volume expansion). What is the corresponding change in enthalpy? Use Maxwells relation to solve this problem.

$\Delta H = 0.9716 \text{ kJ/kg}$

$\Delta H = 0.4553 \text{ kJ/kg}$

$\Delta H = 0.5514 \text{ kJ/kg}$

$\Delta H = 0.7241 \text{ kJ/kg}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\Delta H = 0.5514 \text{ kJ/kg}$$

7) A liquid is compressed from its vapor pressure of 0.381 MPa to 1.2 MPa at T=270 K. 5 points

For saturated liquid at 270 K, $v^2=1.55 \times 10^{-3} \text{ m}^3/\text{kg}$ and $\alpha_p=2.095 \times 10^{-3} \text{ K}^{-1}$ (coefficient of volume expansion). What is the corresponding change in entropy? Use Maxwells relation to solve this problem.

$\Delta S = -1.59 \times 10^{-5} \text{ kJ/kg-K}$

$\Delta S = -2.66 \times 10^{-3} \text{ kJ/kg-K}$

$\Delta S = -3.09 \times 10^{-4} \text{ kJ/kg-K}$

$\Delta S = -1.26 \times 10^{-3} \text{ kJ/kg-K}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\Delta S = -2.66 \times 10^{-3} \text{ kJ/kg-K}$$

8) For van der Waals equation of state: $P = \frac{nRT}{V-bn} - \frac{an^2}{V^2}$, What is $\Delta S = ?$ 5 points

$\Delta S = nR \ln \left[\frac{V_2-bn}{V_1-bn} \right]$

$\Delta S = 2nR \ln \left[\frac{V_2-bn}{V_1+bn} \right]$

$\Delta S = nR \ln \left[\frac{V_2+bn}{V_1-bn} \right]$

$\Delta S = \frac{1}{2} nR \ln \left[\frac{V_2-bn}{V_1-bn} \right]$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\Delta S = nR \ln \left[\frac{V_2-bn}{V_1-bn} \right]$$

9) For van der Waals equation of state: $P = \frac{nRT}{V-bn} - \frac{an^2}{V^2}$, What is $\left(\frac{\partial U}{\partial V}\right)_T = ?$ 5 points

$\left(\frac{\partial U}{\partial V}\right)_T = \frac{an^2}{V^2} + 1$

$\left(\frac{\partial U}{\partial V}\right)_T = \frac{2an^2}{V^2}$

$\left(\frac{\partial U}{\partial V}\right)_T = \frac{an^2}{V^2} - 1$

$\left(\frac{\partial U}{\partial V}\right)_T = \frac{an^2}{V^2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\left(\frac{\partial U}{\partial V}\right)_T = \frac{an^2}{V^2}$$

10) For van der Waals equation of state: $P = \frac{nRT}{V-bn} - \frac{an^2}{V^2}$, What is $\left(\frac{\partial S}{\partial P}\right)_T = ?$ 5 points

$\left(\frac{\partial S}{\partial P}\right)_T = \frac{nRV^3}{PV^3+an^2V-2abn^3}$

$\left(\frac{\partial S}{\partial P}\right)_T = \frac{-nRV^3}{PV^3-2an^2V+abn^3}$

$\left(\frac{\partial S}{\partial P}\right)_T = \frac{-nRV^3}{PV^3-an^2V+2abn^3}$

$\left(\frac{\partial S}{\partial P}\right)_T = \frac{-2nRV^3}{PV^3-an^2V+2abn^3}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\left(\frac{\partial S}{\partial P}\right)_T = \frac{-nRV^3}{PV^3-an^2V+2abn^3}$$