Assignment 3

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

Symbols have usual meaning unless stated otherwise.
Useful Data: \( R = 8.314 \text{ J/(mol.K)} \)

Questions 1 to 4 are based on the following information:

The Flory-Huggins interaction parameter for a polymer-solvent system is given by:

\[ \chi = 0.2 + 125/T \]

where \( T \) is in K. The number of segments per polymer chain is 300.
Assume the Flory-Huggins equation to apply.

1) The critical composition \( (\phi_{2c}) \), rounded to four decimal places, is __________.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Initializer: Range) 0.0540, 0.0550

2) At \( T = 312.5 \text{ K} \), the volume fractions of the polymer corresponding to the spinodal points are

- 0.012 and 0.174
- 0.018 and 0.151
- 0.026 and 0.135
- 0.031 and 0.112

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.018 and 0.151

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interaction parameter \( (\chi_s) \) at the same temperature, rounded to two decimal places, is ________.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.61, 0.63

4) The upper critical solution temperature is

- 283.80 K
- 304.80 K
- 326.80 K
- 347.80 K

No, the answer is incorrect.
Score: 0
Accepted Answers: 347.80 K

Questions 5 and 6 are based on the following information:

A miscible polymer blend is prepared by mixing \( 10^{-3} \) mol of a polymer having 400 segments per chain with \( 4 \times 10^{-3} \) mol of another polymer having 200 segments per chain at 75°C. The Flory-Huggins polymer-polymer interaction parameter is given by

\[
\chi = 0.1 - \frac{40}{T} \quad \text{(where } T \text{ is in K)}
\]

5) The Gibbs free energy change of mixing, up to one decimal place, is ________ J/mol.

- \(-19.37\) J/mol
- \(-15.57\) J/mol
- \(-11.77\) J/mol
- \(-07.37\) J/mol

No, the answer is incorrect.
Score: 0
Accepted Answers: \(-19.37\) J/mol

6) The critical temperature, rounded to the nearest integer, is ________ K.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 429, 434

7) A miscible polymer blend with \( \phi_2^0 = 0.5 \) is slowly heated to a temperature where phase separation occurs into two phases (\( \alpha \) and \( \beta \) phases). The volume fractions of the second polymer in the \( \alpha \) and \( \beta \) phases are \( \phi_{2\alpha} = 0.35 \) and \( \phi_{2\beta} = 0.75 \) respectively. The volume fraction of the \( \alpha \) phase, up to three decimal places, is ________.
8) In a conformationally symmetric A–B di-block copolymer showing microphase separation, the sequence of microstructures formed (at $\chi = 50$) with increasing volume fraction of the A-block ($f_A$) from a small value to a value of $f_A = 0.5$ is:

- BCC Spheres → HCP Cylinders → Bicontinuous Gyroid → Lamellae
- BCC Spheres → Bicontinuous Gyroid → HCP Cylinders → Lamellae
- HCP Cylinders → BCC Spheres → Bicontinuous Gyroid → Lamellae
- HCP Cylinders → Bicontinuous Gyroid → BCC Spheres → Lamellae

No, the answer is incorrect.
Score: 0
Accepted Answers:
BCC Spheres → HCP Cylinders → Bicontinuous Gyroid → Lamellae

9) Consider a capillary osmometer containing a dilute polymer solution on one side and the pure solvent on the other side of a semi-permeable membrane. The volume fraction of the polymer in the solution is 0.01 and the number of segments per polymer chain is 1000. The molar volume of the solvent is 100 cm$^3$/mol. The osmotic pressure of the solution measured at 300 K is 300 Pa. Assuming Flory-Huggins theory to apply, the value of the Flory-Huggins interaction parameter, rounded to two decimal places, is __________.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.47, 0.49

10) Which of the following methods is appropriate for measuring number-average molar mass of polymer samples having molar mass in the range $10^5 - 10^6$ g/mol:

- Vapour pressure osmometry
- End group analysis
- Cryoscopy
- Membrane osmometry

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

Questions 11 and 12 are based on the following information:

A polystyrene (PS) sample was dissolved in benzene to obtain two dilute solutions of different known concentrations. Measurement of osmotic head (height difference in the two columns of the osmometer) for these solutions at 30°C with a static equilibrium osmometer produced the following data (take the densities of benzene and PS at 30°C to be 0.868 g/cm$^3$ and 1 g/cm$^3$ respectively):

<table>
<thead>
<tr>
<th>Concentration, C (g dm$^{-3}$)</th>
<th>Osmotic head, h (cm of benzene)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.60</td>
<td>0.140</td>
</tr>
</tbody>
</table>
Assume that the solution is dilute enough so that the terms containing the third virial coefficient and above can be neglected. Take the acceleration due to gravity, $g=9.81\ \text{m/s}^2$.

1. The number-average molar mass of the polystyrene sample is

- 1127 kg/mol
- 1551 kg/mol
- 1983 kg/mol
- 2412 kg/mol

No, the answer is incorrect.
Score: 0
Accepted Answers:
1983 kg/mol

2. The second virial coefficient ($A_2$) is

- $3 \times 10^{-4}\ \text{mol.m}^3/\text{kg}^2$
- $5 \times 10^{-4}\ \text{mol.m}^3/\text{kg}^2$
- $7 \times 10^{-4}\ \text{mol.m}^3/\text{kg}^2$
- $9 \times 10^{-4}\ \text{mol.m}^3/\text{kg}^2$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$5 \times 10^{-4}\ \text{mol.m}^3/\text{kg}^2$