

First midterm exam of Chem 336

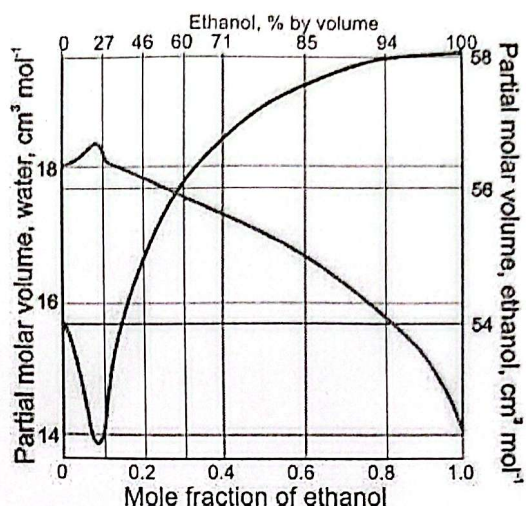
Date: 26/02/2025 - Allowed time: 90 minutes

Answer all the following questions and be sure to give at least 3 significant figures for any numerical answer and the appropriate unit.

1.

The variation of partial molar volumes of ethanol and water, as function of ethanol mole fraction, is shown in the figure.

- a) Calculate the percentage by mass of a mixture with $x = 0.50$.
- b) Calculate the percentage by volume of a mixture with $x = 0.50$.
- c) Calculate the total volume of a mixture of 2.00 mol ethanol and 2.00 mol of water.



2. At 20 °C, the density of a 91.1 per cent by mass ethanol–water solution is 880 kg m^{-3} . Given that the partial molar volume of water in the solution is $15.7 \text{ cm}^3 \text{ mol}^{-1}$, calculate the partial molar volume of the ethanol.
3. The total volume (in cm^3) of a liquid solution of A in B is expressed as function of the number of moles of A (n) by the following equation:

$$V_T = 23 + 2.32 n + 0.67 n^2$$
 Given that the number of moles of A and B are 1.23 mol and 3.73 mol respectively, what are the partial molar volumes of A and B?
4. Consider a container of volume 6.0 dm^3 that is divided into two compartments of equal sizes. In one compartment there is nitrogen at 5.0 atm and 25°C; in the other compartment there is oxygen at 2.5 atm and 25°C. Calculate the entropy and Gibbs energy of mixing when the partition is removed. Assume that the gases are perfect.
5. The chemical potential of a formaldehyde/acetone mixture at 25 °C is given by the following equation:

$$\mu_{\text{Aceto}} / (\text{cm}^3 \text{ mol}^{-1}) = 6.218 + 5.146 n$$
 where n is the number of moles of acetone. Given that the number of moles of acetone and formaldehyde are 1.23 mol and 3.73 mol respectively, calculate the chemical potential of acetone using the Gibbs-Duheim equation.
6. What is the chemical potential of ethanol at 30 °C in ethanol/ acetic acid mixture containing 0.25 mole of ethanol and 0.49 mole of acetic acid. Given that the Gibbs enthalpy of mixture is expressed as below:

$$G_T = 2.25 + 0.28 n + 0.18 n^2$$
 , where n is the number of moles of ethanol.