7.E: Mixtures and Solutions (Exercises)

Q7.1

The compression factor (Z) for O_2 at 200 K is measured to have the following values:

p (atm)	Z
1.000	0.9970
4.000	0.9880
7.000	0.9788
10.000	0.9700

Using numerical integration, calculate the fugacity constant for O_2 at 200 K from these data.

Q7.2

The normal boiling point of ethanol is 78.4 ºC. Its enthalpy of vaporization is 38.6 kJ/mol. Estimate the vapor pressure of ethanol at 24.4 ºC.

Q7.3

When 20.0 grams of an unknown nonelectrolyte compound are dissolved in 500.0 grams of benzene, the freezing point of the resulting solution is 3.77 °C. The freezing point of pure benzene is 5.444 °C and the cryoscopic constant (K_f) for benzene is 5.12 °C/m. What is the molar mass of the unknown compound?

Q7.4

Consider a mixture of two volatile liquids, A and B. The vapor pressure of pure liquid A is 324.3 Torr and that of pure liquid B is 502.3 Torr. What is the total vapor pressure over a mixture of the two liquids for which x_B = 0.675?

Q7.5

Consider the following expression for osmotic pressure

$$\pi V = \chi_B RT \tag{7.E.1}$$

where π is the osmotic pressure, V is the molar volume of the solvent, χ_B is the mole fraction of the solute, R is the gas law constant, and T is the temperature (in Kelvin).

The molar volume of a particular solvent is 0.0180 L/mol. 0.200 g of a solute (B) is dissolved in 1.00 mol of the solvent. The osmotic pressure of the solvent is then measured to be 0.640 atm at 298 K. Calculate the molar mass of the solute.

Q7.6

At 300 K, the vapor pressure of HCl(g) over a solution of HCl in $GeCl_4$ are summarized in the following table. Calculate the Henry's Law constant for HCl based on these data.

χ_{HCl}	P_{HCl} (kPa)
0.005	32.0
0.012	76.9
0.019	121.8

Q7.7

Consider the mixing of 1.00 mol of hexane (C_6H_{12}) with 1.00 mole of benzene (C_6H_6). Calculate \(\Delta H\), \(\Delta S\), and \(\Delta G\) of mixing, of the mixing occurs ideally at 298 K.

Contributors and Attributions

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