Activity coefficient

Given the following data at 50 ^{o}C determine the activity and activity coefficients for iodoethane (I) and ethylacetate (E) at a mole fraction of $x_E = 0.0907$.

x_I	P_I (torr)	P_E (torr)
0.0000	0.0	280.4
0.0579	20.0	266.1
0.1095	52.7	252.3
0.1918	87.7	231.4
0.2353	105.4	220.8
0.3718	155.4	187.9
0.5478	213.3	144.2
0.6349	239.1	122.9
0.8253	296.9	66.6
0.9093	322.5	38.2
1.0000	353.4	0.000

Activity coefficient

Given the following data at 50 ^{o}C determine the activity and activity coefficients for iodoethane (I) and ethylacetate (E) at a mole fraction of x_E = 0.0907.

Solution: Since $x_I = 1 - x_E$ the mole fraction corresponds to the entry at x_I = 0.9093. At this mole fraction the Raoult's law ideal pressures are:

$$P_E^i = x_E P_E^* = (0.0907)(280.4) = 25.4\ Torr$$

$$P_I^i = x_I P_I^* = (0.9093)(353.4) = 321.3\ Torr$$

Using the data in the table we can calculate the activity coefficient from

$$\gamma_E = \frac{P_E}{P_E^i} = \frac{38.2}{25.4} = 1.503 \quad and \quad \gamma_I = \frac{P_I}{P_I^i} = \frac{322.5}{321.3} = 1.004$$

Activity coefficient

Given the following data at 50 ^{o}C determine the activity and activity coefficients for iodoethane (I) and ethylacetate (E) at a mole fraction of $x_E = 0.0907$.

Solution: An alternative method is to first calculate the activity and then divide by the mole fraction. The activities are:

$$a_E = \frac{P_E}{P_E^*} = \frac{38.2}{280.4} = 0.136 \; and \; a_I = \frac{P_I}{P_I^*} = \frac{322.5}{353.4} = 0.912$$

Then we divide the activity by the mole fraction to obtain the activity coefficients

$$\gamma_E = \frac{a_E}{x_E} = \frac{0.136}{0.0907} = 1.503 \quad and \quad \gamma_I = \frac{a_I}{x_I} = \frac{0.912}{0.9093} = 1.004$$

Of course either method gives us the same result.